Joint United Nations Development Programme World Bank

ESMAP

Energy Sector Management Assistance Programme

Mozambique

Sample Survey of Low Voltage Electricity Customers

Report No. 195/97

June 1997

JOINT UNDP / WORLD BANK
ENERGY SECTOR MANAGEMENT ASSISTANCE PROGRAMME (ESMAP)

PURPOSE

The Joint UNDP/World Bank Energy Sector Management Assistance Programme (ESMAP) is a special global technical assistance program run by the World Bank's Industry and Energy Department. ESMAP provides advice to governments on sustainable energy development. Established with the support of UNDP and 15 bilateral official donors in 1983, it focuses on policy and institutional reforms designed to promote increased private investment in energy and supply and end-use energy efficiency; natural gas development; and renewable, rural, and household energy.

GOVERNANCE AND OPERATIONS

ESMAP is governed by a Consultative Group (ESMAP CG), composed of representatives of the UNDP and World Bank, the governments and other institutions providing financial support, and the recipients of ESMAP's assistance. The ESMAP CG is chaired by the World Bank's Vice President, Finance and Private Sector Development, and advised by a Technical Advisory Group (TAG) of independent energy experts that reviews the Programme's strategic agenda, its work program, and other issues. ESMAP is staffed by a cadre of engineers, energy planners, and economists from the Industry and Energy Department of the World Bank. The Director of this Department is also the Manager of ESMAP, responsible for administering the Programme.

FUNDING

ESMAP is a cooperative effort supported by the World Bank, UNDP and other United Nations agencies, the European Community, Organization of American States (OAS), Latin American Energy Organization (OLADE), and public and private donors from countries including Australia, Belgium, Canada, Denmark, Germany, Finland, France, Iceland, Ireland, Italy, Japan, the Netherlands, New Zealand, Norway, Portugal, Sweden, Switzerland, the United Kingdom, and the United States.

FURTHER INFORMATION

An up-to-date listing of completed ESMAP projects is appended to this report. For further information or copies of completed ESMAP reports, contact:

ESMAP
c/o Industry and Energy Department
The World Bank
1818 H Street, N.W.
Washington, D.C. 20433
U.S.A.

MOZAMBIQUE

SAMPLE SURVEY OF LOW VOLTAGE ELECTRICITY CUSTOMERS

June 1997

ABBREVIATIONS

DNE	National Directorate for Energy
EDM	Electricidade de Mozambique
ESMAP	Energy Sector Management Assistance Program
GWh	gigawatt hour
kVA	kilovolt ampere
kW	kilowatt
kWh	kilowatt hour
LV	low voltage
MT	Metical (Rate of exchange as of January 1996: 11,000 MT/US$)

TABLE OF CONTENTS

EXECUTIVE SUMMARY

1. This study was carried out by the World Bank and ESMAP, in close cooperation with the Ministry of Mineral Resources and Energy and DNE, to gain insight into the situation of EDM's LV-customers of the "domestic" and "general" tariff type. In particular, since EDM plans to raise average tariffs to 9.5 UScents/kWh by 1999, there have been concerns about the potential response of this customer group to the scheduled rate increases. A survey conducted in early 1996 was intended to shed light on this issue. The findings of this study are based on the survey, covering a sample of 912 LV-customers randomly selected from the population of customers served through EDM's southern, central and northern grid, and from electricity users supplied in two isolated areas (not connected to any of the major grids).

Domestic Grid-Connected Customers

2. The survey found that almost one in two domestic customers interviewed (i.e., the head of a household/family) is a civil servant, and one in five is self-employed. Both groups account for 70% of EDM's clients subjected to domestic tariffs. Almost 43% of the households visited have a monthly income of less than MT 0.5 million, 42% earn between MT 0.5 and MT 1.5 million, and the top 15% earn more than MT 1.5 million a month.

3. Households owning a telephone and renting a house/apartment on average spend 580,000 MT/month, not including expenditures on food and transport. Average monthly expenditures are highest in Chimoio (MT 955,000) and lowest in Nampula (MT 280,000), and they increase with income, from MT 328,000 (low-income households) to MT 1,400,000 (high-income households). However, since not all households questioned have a telephone or pay a monthly rent, and because expenditures on food and other items are not included, the above estimates, while being an indicator of relative differences across households or regions, do not permit inferences about expenditure levels or ratios.

4. The households interviewed on average consume 227 kWh a month. Average consumption varies between 156 kWh/month (low income) and 492 kWh/month (high income). Also, expenditures on electricity rise with income, from 118,000 MT/month (low income) to 294,000 MT/month (highest income), with a mean of 168,000 MT/month. On the other hand, the share of household expenditures recorded by the survey and accounted for by electricity is inversely related to the level of income, i.e., decreases from 35% (low income) to 21% (high income), with a mean of 29%.[1]

---

[1] As is explained above, these estimates tend to inflate the significance of expenditures on electricity and, therefore, should only be seen as a proxy for relative differences.

5. All households interviewed use electricity for lighting, and nine out of ten have a radio. About 65% own a TV-set and a freezer, and 43% said that they use electricity for cooking. Eight out of ten respondents have an electric iron, and almost 50% use a fan. Air conditioning (on average 20%) shows the largest spread in end use: Only 10% of the low-income customers have an air conditioner, compared to 44% of the high-income households. Other appliances play a minor role.[2]

6. The survey found that even though woodfuel still is the dominant source of cooking energy (mainly among the lowest income households), electric cooking plays a considerable part. About 39% of the households interviewed use charcoal in tandem with fuelwood, while 34% cook mainly with electricity. LPG is used by 13.6% , 7.6% use LPG in tandem with electricity, and 3% use it in combination with fuelwood and charcoal.[3] Electric cooking is most common among higher income households. The higher the income, however, the greater is the tendency to switch from electricity to LPG or to use LPG *in addition* to electricity.

7. Electric cooking and air conditioning have a marked impact on the level of electricity consumption. When electric stoves are used, monthly household consumption is 323 kWh, compared to 163 kWh consumed by households that do not cook with electricity. Households using an air conditioner consume 421 kWh/month, while those without air conditioning use 183 kWh/month. Thus, the amount of electricity used by households equipped with air conditioners is almost twice as high than that of the average domestic customer (227 kWh/month).

8. Almost one third of the domestic customers reported that they experienced disruptions in supply more than twice a week, and 40% said the disruptions were normally longer than two hours. Most complaints came from low-income households. The supply to 36% of the low-income households was disrupted more than twice a week (compared to 29% of the high-income households), and 47% of the low-income customers told the duration of outages was longer than two hours (compared to 30% of the high-income households).

9. The share of customers affected by power outages is much higher in the northern and central region than along the southern grid. This is a plausible finding since the transmission and distribution systems in the central and northern part of the country are in a comparatively poor shape. Almost 44% of the northern and 38.4% of the central system customers said the disruptions occurred more than twice a week, while only 28% of the southern customers made this complaint. In the same vein, the share of customers hit by disruptions with a length of more than two hours is 63.7% in the north and 47.2% in the central region, compared to 33.1% in the south. Overall, the duration of outages seems to be a greater concern than the frequency of disruptions.

---

[2] Typically, high-end appliances such computers, micro waves, vacuum cleaners, hair dryers and toasters are used by customers falling into the highest income category.

[3] Currently, LPG is not being distributed in the northern region.

10. Nevertheless, 55.5% of the domestic customers said the reliability of service did improve, and only 15.5% felt that the situation got worse. The share of customers saying the supply became less reliable is lowest in the southern system (12.8%) and highest in the northern system (24%). Along the northern grid, though, almost 65% of the respondents stated that the quality of service got better (compared to 56% in the south and 42% in the central system).

11. The share of customers who regard EDM's service as "good" is highest among low-income households (24%) and lowest among the most affluent ones (16%). This suggests that badly serviced customers, which tend to have a low income, are more satisfied with EDM (or, for that matter, with having access to electricity) than the better served higher-income households. In the northern system, which has the largest share of customers saying the reliability of supply had improved, EDM's ratings are worst. Almost one out of three northern customers stated that EDM provides a "bad" service, and only one in five said the service is "good". Hence, northern customers, while appreciating the recent improvements in reliability, are still less satisfied with EDM's performance than households connected to the southern or central grid.

12. About 15% of the customers questioned expressed the view that they would cease using electricity if tariffs continued to rise. The share of customers saying they would switch away from electricity varies from 9.1% in the southern system to formidable 36.3% in the northern system. The customers' response, however, does not indicate that the willingness to accept higher tariffs increases with income.

13. Almost 40% of the customers said they would substitute kerosene for electricity if the latter were no longer affordable; 52% would replace electricity mainly with kerosene or with kerosene in combination with charcoal. And while kerosene scores best among the poorest households (straight kerosene is preferred by 42.1%, and kerosene in tandem with charcoal by 56%), one out of three customers with the highest income favors LPG and 53.6% of them would opt either for straight LPG or for LPG in combination with charcoal. Only the poorest households do not consider LPG as an alternative to electricity. Except for the isolated areas, almost no household would switch back to fuelwood, and only one in ten respondents would use charcoal in lieu of electricity.[4]

General Grid-connected Customers

14. Customers subject to "general" tariffs constitute a rather heterogeneous group, notably those with a monthly turnover in excess of MT 10 million (about 45%). Most of the businesses run by general customers can be classified as "services", mainly retailing; only a small number of workshops and manufacturing activities were encountered. Regional differences (between customers in the southern system and those operating in

[4] It should be noted that the questionnaire did not explicitly ask for the end uses in which households would displace electricity. The customers only stated which fuel they would use in lieu of electricity if electricity were too expensive, without regard to a particular end use.

other parts of the country) seem less pronounced than in the case of domestic electricity users.

15. In terms of monthly expenditures, the low-turnover and high-turnover customers differ by a factor of ten. Average monthly electricity bills vary between MT 400,000 and MT 1,500,000. As a rule, general customers reported that the quality of service provided by EDM was not quite as bad as that described by domestic customers. However, they seemed less satisfied with EDM's performance than their domestic counterparts. Yet only 6.2% said they would quit using electricity if tariffs continued to rise.

Isolated Areas

16. With 72.2%, the share of electricity users accounted for by civil servants is disproportionately high in isolated areas. Monthly expenditures (net of food etc.), on the other hand, are significantly lower than among the grid-connected customers (MT 200,000 vs. MT 580,000). Electric cooking and other high-end uses are uncommon. About 83% of the households interviewed cook with woodfuel, and only 2.4% have an electric stove.

17. Judged by the response of the households questioned, the quality of service in isolated areas leaves as much to be desired as does the service standard experienced by grid-connected customers. However, only 2.4% of the isolated electricity users said that the reliability of supply had declined, and no more than 2.4% gave a bad rating for the utility's performance. If electricity became too expensive, 22% would resort to other forms of energy, and 44.5% of them would choose kerosene as a substitute.

Conclusions

18. In conclusion, most domestic customers interviewed seem to be well off by Mozambiquen standards, and they clearly do not want to miss electricity, even when the quality of service is relatively poor.[5] Higher rates would reduce demand (as is the case with every ordinary good), but the rate increases sought for by EDM are unlikely to crowd out a large number of this customer group. Still, 15% of the customers questioned said they would discontinue purchasing electricity if it became too expensive (without stating what the threshold of affordability would be). However, the strong preference given to kerosene and LPG as potential substitutes for electricity and the low propensity to switch back to traditional sources of energy such as charcoal or fuelwood suggest that most households connected to the grid are more concerned about fuel and service quality than about costs.[6] It

---

[5] It should be kept in mind in this connection that only 5% of the total population have access to electricity.

[6] Since the survey did not collect data on the relative costs of fuels and appliances, it is assumed that income-based preferences revealed by purchases are indicative of cost differentials: Currently, low-income households use mainly woodfuel (rather than kerosene or LPG) in addition to electricity. Therefore, woodfuel can be deemed to be more "affordable" than the higher-quality substitutes kerosene and LPG.

can therefore be assumed that in general the willingness to pay for electricity is much higher than the rates currently charged by EDM. This study expects that if EDM implements the planned increases in rates, most households will continue to buy electricity, but in smaller quantities.

19. Tariff increases will be least acceptable for poor households, notably those in the northern system (and in isolated areas) where income is lowest. The northern system has the highest share of new customers; it suffers from the highest rate of non-technical losses, and it has the largest proportion of customers saying they would cease to use electricity if tariffs continued to rise. In addition, the quality of service has been much worse than in the rest of the country, and most households with access to electricity still use woodfuel for cooking (87%). In short, northern system customers face tighter budget constraints and their attachment to electricity is not as deep as in other parts of the country. Hence, the probability that domestic customers drop out of the electricity market and resort to alternative fuels is much higher in the northern region than along the southern and central network. Similar arguments apply to the domestic electricity users in isolated areas.

20. Finally, the situation in the northern system is likely to foreshadow the problems that EDM will meet in the wake of its ambitious electrification program aiming at about 5000 new connections a year. Therefore, the response of the northern customers to the scheduled tariff increases and other measures (enforcement of revenue collection, introduction of prepaid meters) should be closely monitored so that lessons can be dawn for EDM's grid extension policy.

1. INTRODUCTION

1.1 This study was prepared by the World Bank and ESMAP, in close cooperation with the Ministry of Mineral Resources and Energy and DNE, to apprehend the situation of EDM's small LV-customers (≤ 19.8 kVA).[7] Although small LV-electricity users account for about 50% of EDM's sales, the profile of this customer group is fuzzy. In particular, since higher electricity tariffs sought for by EDM may have a serious financial impact on LV-customers, policy makers and EDM are concerned about the potential response of this group to changes in the tariff regime.[8]

1.2 To gain insight into the situation of EDM's LV-customers, the World Bank, ESMAP and DNE conducted a survey of electricity users subsumed under the "domestic" and "general" tariff category ("tarifa domestica" and "tarifa geral"). DNE crafted the questionnaire (see Appendix 5) and carried out the field work in February-March 1996, based on a stratified sample of 912 customers. The sample was randomly selected without replacement and covers EDM's southern, central and northern system as well as two isolated areas not connected to one of the main grids. Its design is described in Appendix 1. A brief overview of the analytical underpinnings is given in Appendix 3. The main results are summarized in Appendix 2. Appendix 4 presents the program used to analyze the data obtained during the field work.

1.3 Since the survey was the first attempt[9] to collect detailed information on LV-customers, no recourse could be made to past experience or reliable a-priori knowledge of the group's socio-economic characteristics. This led to shortcomings in the design of the questionnaire. Some questions were redundant, others were incomplete or not to the point, and several questions that have not been asked left informational gaps. Nevertheless, the survey provides a reasonably comprehensive picture of the socio-economic situation and the attitudes of the customer groups under investigation. Moreover, the experience made and the data base collected lay the groundwork for additional surveys that EDM or the Ministry may want to conduct in the future.

1.4 The findings of the survey were discussed with DNE and other interested parties in Mozambique in March 1997. The suggestions received during these discussions as well as comments made by Bank staff have been incorporated in the final version of this study.

---

[7] The few LV-customers with a contracted capacity in excess of 19.8 kVA (< 1% of all LV-customers), mainly industrial and semi-industrial users, have been excluded from the sampling frame.

[8] The target level called for is 9.5 UScents/kWh (system average in prices of 1995). For comparison, when the survey was conducted, the LV-customers interviewed on average paid 6.7 UScents/kWh.

[9] Household surveys conducted in the past (e.g. the one undertaken by Behrens in 1989) were of little help in this connection because their focus and their sampling procedure do not match the approach chosen by this study.

2. DOMESTIC CUSTOMERS

Total System[10]

2.1 About 85% of the households interviewed have a monthly income of MT 1.5 million or less; 42.5% fall below the MT 0.5 million line, while 15% earn more than MT 1.5 million.[11] Telephone- and car ownership are a good indicators of income: 71% (42%) of the highest income class have a telephone (car), compared with 18% (9.7%) of the lowest-income households.

2.2 Almost one in two family heads is a civil servant, and one in five is self-employed. Together, civil servants and self-employed earners account for 70% of EDM's domestic-tariff customers. Their share increases with income. On the other hand, workers make up 16% of the family heads, and their share decreases from 20% for low-income households to 3% for high-income households. One in ten families among the low-income group is headed by a retiree.

2.3 Typically, a household consists of six to seven persons occupying four to five rooms. Almost 60% of the customers visited live in their own home (apartment). Home ownership is most common in Quelimane (77%), while Beira has the highest share of tenants (83%). About 50% of the lowest-income households cook and wash outdoors. By contrast, 90% of the highest-income households live in places with indoor facilities for cooking and washing. In-house cooking and washing is most frequent in Beira (95%) and least likely in Nampula (<35%). On average, 90% of the houses visited have brick walls, but only 60% are covered with tiles. Whereas almost all customers interviewed in Beira live in houses made of bricks and roofed with tiles, every second house in Nampula uses inferior material.

2.3 Since the survey was not designed to obtain detailed household budget data[12], the information on expenditures is incomplete. EDM's customers were asked to estimate their expenditures on electricity, water, other energy, telephone, housing and loans. Expenditure ranges were stated for food and transport. The data suggest that households

---

[10] Unless stated otherwise, the total system covers customers connected to one of the major grids, i.e., customers served in isolated areas are not included. The findings pertaining to isolated areas covered by the survey (Pemba and Inhambane) are discussed in Section 2.5.

[11] When the survey was conducted, the official rate of exchange was about 11,000 MT/US$. Hence, high income households earned more than 137 US$/month, while low income households had less than 46 US$/month. Note also that the survey was designed to tabulate customers into four income groups: < 500,000 MT; 500,000-1,500,000 MT; 1,500,000-3,000,000 MT; and >3,000,000 MT. Except for Maputo (Southern System), however, there were virtually no customers falling into the highest group. Therefore, in a systemwide context, the two highest income groups are lumped together.

[12] The reason for this is that it was thought households would either be incapable of giving reliable estimates of their income and expenditures or would be inclined to not tell the truth.

owning a telephone and renting a house/apartment on average spend 580,000 MT/month, not including expenditures on food and transport. The figure is highest in Chimoio (MT 955,000) and lowest in Nampula (MT 280,000), and it increases with income, from MT 328,000 (average of low-income households) to MT 1,400,000 (average of high-income households). However, since not all households have a telephone or pay a monthly rent, and because expenditures on food and other items are excluded, the above estimates are only a rough indicator of relative spending patterns. Inferences regarding the level of expenditures would be misleading.

2.4 While all households interviewed are electrified, they use different fuels in addition to electricity.[13] About 39% of the respondents said they use charcoal, 14.3% use LPG, 14% use charcoal in combination with LPG, and 11% use charcoal in combination with fuelwood. Kerosene plays only a marginal role. Also, as income rises, households switch away from charcoal in favor of LPG. Of the low income households, 46% rely on charcoal as a second fuel, but only 7.4% on LPG. On the other hand, the proportion of high income households using charcoal is 25%, while 31.5% use LPG in addition to electricity.

2.5 The households interviewed on average consume 227 kWh a month. Income-dependent consumption varies between 156 kWh/month (low income) and 492 kWh/month (high income).[14] Overall, the respondents said they spend 168,000 MT/month on electricity. Expenditures on electricity rise with income, from 118,000 MT/month (low income) to 294,000 MT/month (highest income). On the other hand, the share of monthly household expenditures accounted for by electricity decreases from 35% (low income) to 21% (high income), with a mean of 29%.[15] Moreover, average tariff payments are lowest for the top-15% (598 MT/kWh) and highest for the middle-income group (768 MT/kWh).[16] If lumped together, domestic customers on average pay 740 MT/kWh (about 6.7 UScents/kWh).

2.6 Put into a regional perspective, customers in Chimoio (336 kWh/month) and Maputo (243 kWh/month) consume more than the sample average, while those in Nampula (169 kWh/month) and Quelimane (79 kWh) use less. Beira's consumption is roughly on par with the country mean. Accordingly, the central region's customers pay an average tariff (647 MT/kWh), which is below the country mean, while northern customers pay more (747 MT/kWh), as do those in Maputo (755 MT/kWh). Both in Maputo and in the central region,

---

[13] Two questions were asked regarding the use of energy other than electricity: One referred to fuels used in addition to electricity; the other dealt with energy used for cooking (see Table 2.1). The answers proved by and large consistent.

[14] n most cases, consumption figures are computed as a monthly average over the period August 1995-January 1996.

[15] It should be kept in mind that since the proxy used for expenditures tends to underestimate household spending, it leads to an overestimation of the share of expenditures attributable to electricity.

[16] Since the tariff system does not discriminate against low-income, small-volume customers, the reason why they pay a higher average rate than the more affluent households is that their load factor is lower.

the share of household "expenditures" (proxy) accounted for by electricity is about 28%. By contrast, in the northern system the share is 38%.

2.7 All households interviewed use electricity for lighting, and nine out of ten have a home radio. About 65% have a TV-set and a freezer, and 43% said that they use electricity for cooking. Other end uses, mainly of high-income households, are air conditioning (20%) and water heating (7.2%). What comes as a little surprise is that even 51% of the low-income households watch television, compared to 82.4% of the high-income households. Air conditioning shows the largest spread in end use: While only 10% of the low-income customers own and operate an air conditioner, this appliance is used by 44% of the high-income households.

2.8 Eight out of ten respondents have an electric iron, and almost 50% possess a fan. Other appliances, which are owned in large part by the highest-income households, play a minor role. For instance, only 3.3% of the household interviewed own a personal computer, and 1% has a micro wave. Among the high-income households, there is a considerable proportion of customers using hair dryers (35.5%), toasters (20%), and vacuum cleaners (16%).

2.9 It can be expected that electric cooking and air conditioning have a marked effect on the level of electricity consumption. As regards cooking, the survey was therefore designed to obtain detailed information on the type of stove/fuel used by the households interviewed. The main results are shown in Table 2.1.

Table 2.1: Stoves/Fuel Used for Cooking by Income Group (%)[1)]

Income Group:	Low	Middle	High	Total
Fuelwood (FW) + Charcoal (CH)	53.3 +/- 0.88	31.8 +/- 1.18	24.3 +/- 1.77	39.2 +/- 0.68
Electricity	22.3 +/- 1.04	42.2 +/- 1.15	40.8 +/- 1.96	33.9 +/- 0.66
LPG	12.7 +/- 0.53	13.0 +/- 0.50	17.4 +/- 1.21	13.6 +/- 0.35
Electricity + LPG	3.7 +/- 0.26	6.9 +/- 0.44	16.0 +/- 0.84	7.6 +/- 0.34
FW+CH+LPG	5.1 +/- 0.77	3.1 +/- 0.40	0	3.0 +/- 0.25

1) Proportions of households, stated with 95%-confidence interval

2.10 The survey found that even though woodfuel still is the dominant source of cooking energy, electric cooking is widespread, particularly among medium- and high income households. It can be stated with 95% confidence[17] that between 38.5 and 39.9% of the households interviewed cook with charcoal in tandem with fuelwood[18], and that between 33.2 and 34.6% use an electric stove. LPG is used by 13.6% (+/- 0.4 percentage points);

---

17 For technical details, see Appendix 3.

18 The share of households that are connected to the grid and use only fuelwood or charcoal is 0.3% and 0.5%, respectively. In isolated areas, however, one out of ten households cooks with fuelwood and 75% use charcoal only, or charcoal in combination with fuelwood.

7.6% (+/- 0.4 percentage points) use LPG in tandem with electricity, and 3% (+/- 2.5 percentage points) use it in combination with fuelwood and charcoal.[19]

2.11 Electric cooking is much more common among higher-income households than among their low-income counterparts. The higher the income, however, the greater is the tendency to switch from electricity to LPG (or to use LPG in addition to electricity). As is shown in Table 2.1, the proportion of households cooking with LPG and electricity increases from 3.7% (low income) to 16% (high income). Over the same income range, the share of LPG-users rises from 12.7% to 16%. On the other hand, the proportion of households that exclusively use electric stoves reaches 42.2% at the middle income level (compared with 22.3% at the low income levels), yet tapers off in the vicinity of 41% among the high income group.

2.12 In addition, there are marked regional differences[20]: In the northern system, 87% of the households interviewed use woodfuel for cooking, and only 6.2% use electricity. By contrast, in the central region only 50% of the households cook with charcoal/fuelwood, while electricity is used by 36%. LPG plays no role in the northern system, and it is used by meager 5.2% in the central system. The most advanced cooking habits are those observed in the southern region. Almost 40% of the southern customers questioned cook with electricity, 28% either use straight LPG or LPG in tandem with electricity, and only 27% rely on charcoal/fuelwood.

2.13 Also, the survey provides compelling evidence that cooking with electric stoves significantly raises the level of electricity consumption. When electric stoves are used, monthly household consumption is 323 kWh, compared to 163 kWh consumed by households that do not cook with electricity (note that 227 kWh/month are used on average). Air conditioning has an even stronger impact on the consumption level. Households using an air conditioner consume 421 kWh/month, while in the absence of air conditioning consumption is 183 kWh/month. Thus, the amount of electricity used by households equipped with air conditioners is almost twice as high than that of the average domestic customer.[21]

2.14 Most of the households interviewed (76%) use electricity for more than five years. The largest share of old customers is among the high income class (80%), while the proportion of customers served for less than 5 years is highest among low- and medium income households (25.6%, compared to 19.5% in the case of high income customers). Only 4.3% of all domestic customers use electricity for less than one year, and almost one

---

[19] It should also be noted that the proportion of households that reported to use electricity for cooking (43.6%)is roughly equal to the share of households that use electric stoves only or LPG stoves in combination with electric stoves (41.5%).

[20] For details, see the sections dealing with the different regions.

[21] Another important impact of electric cooking and air conditioning is that it contributes to, and most likely increases, the system peak. The data collected by the survey, however, tell nothing about the magnitude of this effect.

of two new customers fall into the low income category. The share of new customers is largest in the northern system (10%).[22] At any rate, the figures indicate that during the recent years EDM succeeded in connecting a significant number of additional domestic customers and that most of them are lower-income households.

2.15 Notwithstanding the efforts EDM made to contract new customers, the quality of its service remained unsatisfactory. Almost one third of the customers interviewed complained that they experienced disruptions in supply more than twice a week, and 40% said the disruptions were normally longer than two hours. Most complaints came from low-income customers. The supply to 36% of the low-income households was disrupted more than twice a week (compared to 29% of the high-income households making the same complaint), and 47% of the low-income customers told the duration of outages was longer than two hours (compared to 30% of the high-income households telling the same story).

2.16 The share of customers affected by power outages is much higher in the northern and central region than along the southern grid (see Table 2.2).[23] Almost 44% of the northern customers and 38.4% of the customers supplied by the central system said the disruptions occurred more than twice a week. In the same vein, the share of customers hit by disruptions that usually last more than two hours is 63.7% in the north and 47.2% in the central region, compared to 33.1% in the south. Generally speaking, customers consider long outages more annoying than frequent ones.

Table 2.2: Power Outages (%)[1)]

	Frequency of Disruptions		Duration of Disrupt.
	once a week	more than twice a week	longer than two hours
Total System	22.8	31.9	39.7
South	20.3	28.1	33.1
Center	21.4	38.4	47.2
North	34.8	43.8	63.7

1) Percentage share of customers affected

2.17 Nevertheless, 55% of the customers questioned said the reliability of service did improve, while only 15.5% felt that the situation got worse. The share of households saying that the quality of service deteriorated was 20% for the low-income group, 14% for the middle income group, and 16.6% among the customers with the highest income.[24]

2.18 In the northern system, customers were most divided over the trend in reliability. Almost 65% of the respondents believed that the quality of service got better, while 24% said it declined (see Table 2.3). The share of customers saying that the reliability

---

[22] The proportion of new customers is 16.7% in Quelimane and 7.4% in Nampula.

[23] The frequency of disruptions seems to be lowest in isolated areas (not considered in Table 2.2). Only 24.4% of the customers served in isolated areas said they had more than two outages a week.

[24] The section dealing with the southern system (2.2) provides a more detailed and, thus, more illuminating analysis of the customer's view of the reliability of service.

of supply deteriorated is lowest in the southern system (12.8%), while the proportion of customers stating that it improved is lowest in the central system (42.4%).

2.19 It comes as a surprise that the share of customers who regard EDM's service as "good" is highest among low-income households (24%) and lowest among the most affluent ones (16%). This suggests that badly serviced customers, which tend to have a low income, are more satisfied with EDM (or, for that matter, with having access to electricity) than the better served high-income customers. It is also worth mentioning that in the northern system, where the share of customers saying that the reliability of supply had improved is largest, EDM's ratings are worst. Almost one out of three northern customers stated that EDM provides a "bad" service, and only one in five said the service is "good". These seemingly contradictory opinions can be explained by the fact that even though the northern system's quality of service has improved, it does not live up to the higher standards prevailing in the other regions.

Table 2.3: Reliability and Service Assessment (%)[1)]

	Reliability		EDM Service	
	better	worse	good	bad
Total System	55.5	15.5	20.8	22.8
South	55.7	12.8	20.1	22.4
Center	42.4	20.4	26.2	13.9
North	64.8	23.8	19.1	31.6

1) Percentage share of customers

2.20 A key motive behind the survey is the concern of EDM and policy makers that many domestic customers might not be able, or willing, to pay higher tariffs that are called for by EDM for financial reasons. The survey was supposed to shed light on this issue by asking the randomly selected customers if they were be prepared to pay higher rates, and if not, which fuel they would substitute for electricity.

2.21 As is shown in Table 2.4, about 15% of the customers questioned expressed the view that they would cease using electricity if tariffs continued to rise.[25] The share of customers who said they would switch away from electricity varies from 9.1% in the southern system to formidable 36.3% in the northern system. Also, the customers' response indicates that the (revealed) willingness to accept higher tariffs does not significantly increase with income.

[25] Note, however, that the customers were not asked to tell at which point they would discontinue using electricity.

Table 2.4: Switch Away Customers (%)[1)]

	Income ('000 MT)			
	<500	500-1,500	> 1,500	Total Sample
System	15.3	15.4	13.4	14.6
South	9.9	7.9	10.4	9.1
Center	23.3	18.2	0	17.8
North	33.0	46.8	37.1	36.3

1) Percentage share of customers who would switch away from electricity if tariffs were continue to rise

2.22 Almost 40% of the customers said they would substitute kerosene for electricity if the latter were no longer affordable; 52% would replace electricity mainly with kerosene or with kerosene in combination with charcoal. And while kerosene scores best among the poorest households (straight kerosene is preferred by 42.1%, and kerosene in tandem with charcoal by 56%), one out of three customers with the highest income favors LPG and 53.6% opt either for straight LPG or for LPG in combination with charcoal (see Table 2.5).[26]

Table 2.5: Preferred Alternative to Electricity (%)[1)]

	Income ('000 MT)			
	<500	500-1,500	> 1,500	Total Sample
Charcoal	17.6	12.0	0	11.2
LPG	0	11.8	33.3	11.7
Kerosene	42.1	31.2	35.1	39.4
Char.+LPG	4.9	8.1	20.3	7.5
Char.+Kero	13.9	16.7	0	12.2
Ch.+LPG+Kero	4.9	4.0	0	3.8

1) As a percentage of customers who would cease using electricity if tariffs continued to increase

2.23 Another surprising finding is that almost no household would switch back to fuelwood, and only about one in ten respondents would use charcoal in lieu of electricity.[27] Thus, households would strive to replace electricity with high-quality fuels (LPG, kerosene) if electricity were no longer affordable. It is also worth noting the poorest households do not consider LPG as an option, most probably because the barriers to entry are comparatively high in this market.[28] Hence, their favorite second-best fuel is kerosene.

---

[26] It should be noted that the questionnaire did not explicitly ask for the end uses in which households would displace electricity. The customers only stated which fuel they would use in lieu of electricity if electricity were too expensive, without regard to a particular end use.

[27] In isolated areas, 33% of the households that would quit using electricity on account of higher tariffs favor fuelwood in combination with kerosene, and 22% would switch to charcoal in tandem with kerosene.

[28] It should be kept in mind that currently LPG is not distributed in the northern region and in most parts of the central region (but it used to be available in the past). This may partly explain why in the northern region, where income is lowest, no household questioned would substitute LPG for electricity. In Beira, however, 15% of the switch-away customers told they would choose LPG as a substitute for LPG.

2.24 In can be concluded that most customers interviewed do not want to miss electricity, even though it is a relatively expensive (albeit convenient) form of energy, and notwithstanding the fact that the quality of service leaves much to be desired. Therefore, rate increases on the order sought for by EDM are unlikely to crowd out a large number of households accustomed to electricity. This view is corroborated by the high preference given to kerosene and LPG as a potential substitute for electricity and the low willingness to switch back to traditional sources of energy such as charcoal or fuelwood.

2.25 The data gathered by the survey suggest, however, that the situation in the northern region may be more critical.[29] The northern system has the highest share of new customers.[30] It also has the largest proportion of customers saying they would cease to use electricity if tariffs continued to rise (ruling out the option to substitute LPG for electricity). In the same vein, the quality of service has been poor (and much worse than in the rest of the country). Most households connected to the grid still use woodfuel for cooking (87%), and on average their income is considerably lower than that in the southern or central region. In short, northern customers face tighter budget constraints and their attachment to electricity is not as deep as in other parts of the country. Still, in the final analysis, their exact response to higher tariffs is difficult to predict, but it can be assumed that there is a comparatively large share of northern customers finding it hard to bear increases in electricity tariffs, without being particularly averse to inferior forms of energy. Hence, the likelihood that customers drop out of the electricity market and resort to other fuels is considerably higher in the northern region than along the southern and central network.

Southern System (Maputo)

2.26 The southern system's domestic customers cover the entire range of income considered by the survey: 37.1% of the households interviewed earn less than 500,000 MT/month; 44.3% have between 500,000 and 1,500,000 MT/month; 11.8% between 1,500,000 and 3,000,000 MT/month; and the top 6.8% earn more than 3,000,000 MT/month. Those customers who are tenants and own a telephone have average monthly expenditures (net of food and transport) ranging from MT 362,000 (lowest income) to MT 3,165,000 (highest income).

2.27 Average monthly electricity consumption is 243 kWh, with a maximum load of 3.5 kVA.[31] Consumption rises with income, from 169 kWh (lowest income) to 303 kWh (second highest income) and to 635 kWh (highest income). The maximum load (rated capacity) ranges from 2.6 kVA (low income) to 7.7 kVA (highest income). The level of consumption is highly responsive to electric cooking and air conditioning: Households using an electric stove consume 57.5 kWh (23.7%) more than on average, while those with

---

[29] Similar arguments apply to the isolated areas.

[30] Almost 10% of its customers have been served for less than one year and 35.5% have been connected during the last five years.

[31] The maximum load is a weighted average based on the rated capacity charged for by EDM.

an air conditioner exceed the monthly average by 181.1 kWh (74.5%). In the absence of electric cooking, monthly consumption is 69.5 kWh below average, while households without an air conditioner consume roughly the same amount as on average.

Table 2.6: Cooking Habits and Air Conditioning by Income Level (%)[1)]

	Low Income	Semi-Low Income	Medium Income	High Income	Total Households
Cooking					
- Woodfuel[2]	42.7	21.0	9.8	5.7	26.7
- Electricity	27.1	47.6	50.8	37.2	39.7
- LPG	17.2	17.0	18.0	28.5	18.0
- Electricity cum LPG	5.2	8.3	18.0	28.7	9.7
Air Conditioning	5.7	17.0	31.2	54.3	17.0

1) Cooking fuel and air conditioner use as a percentage of households
2) Woodfuel means fuelwood and/or charcoal

2.28 As is shown in Table 2.6, about 40% of the households questioned cook with electricity, while only 27% use charcoal/fuelwood.[32] The share of households cooking with woodfuel drops significantly as income increases. Higher income induces households to replace woodfuel with electricity and LPG. And the higher the income, the stronger is the drift towards LPG: Among the most affluent households, 28.5% cook with LPG only and 28.7% use it in tandem with electricity. Cooking habits in the southern system are atypical by national standards: In the rest of the country, where electric cooking is less common and LPG plays only a marginal role, firewood and charcoal still are the dominant cooking fuels, notably in the northern region and in isolated areas.

2.29 According to the views expressed by the customers visited, the quality of service is relatively good. Outages are less frequent and their duration is shorter than in the rest of the country (except for Chimoio). However, service quality varies with income. While 37% of the lowest income group were affected by more than two outages a week, this happened to only 5.7% of the highest income group. About 43% of the former said the disruptions were longer than two hours; but only 23% of the latter had a similar experience.

2.30 About 55% of all respondents said the reliability of supply was improving; only 19.3% found that supply had become less reliable. Customers who experienced at least one outage a week (about 48.4% of all southern system customers, of which 90% belong to the two lowest income groups) see it different: About 53% said the trend in reliability was positive, but 18.4% felt the situation got worse. Even less favorable is the message conveyed by customers who were subject to disruptions with a duration of more than two hours (33.1% of all customers, of which 97% belong to the two lowest income groups): Almost one quarter of them told that reliability had deteriorated, and only 41.5% experienced a positive trend (see Table 2.7).

---

[32] There is a strong positive correlation between cooking with charcoal/fuelwood, low income, and wage earnings.

2.31 Households falling into the lowest income group (25% of all customers)[33] gave the worst ratings for reliability: 19.3% told that the trend was negative. The same was said by 26.5 % of the low-income customers hit by at least on outage a week, and by 31.3% suffering from disruptions with a duration of more than two hours (see Table 2.7).

Table 2.7: Reliability Trend (%)

	better	same	worse
All customers	55.7	31.5	12.8
Customers with at least one disruption per week[1)]	52.8	28.8	18.4
Customers affected by disruptions lasting more than two hours[2)]	41.5	35.7	22.8
LI-customers[3)]	55.2	25.5	19.3
LI-customers with at least one disruption per week[4)]	45.3	28.2	26.5
LI-customers affected by disruptions lasting more than two hours[5)]	43.4	25.3	31.3

1) 250 out of 517; 2) 171 out of 517; 3) customers group with lowest income; 4) 117 out of 250; 5) 83 out of 171

2.32 As is shown in Table 2.8, one out of five customers said EDM did a good job, while 22.4% told the opposite. Customers exposed to at least one outage a week gave a slightly more favorable assessment: Almost 27% said the service was good.[34] The worst rating was given by households who experienced disruptions with a duration of more than two hours. Only 13.4% of them regard the service as good, while 27% believe the service is bad.

2.33 Hence, the least satisfied customers are those who are most severely affected by EDM's dismal performance. Also, 90% of them fall into the two lowest income categories. What comes at a surprise, however, is that only a minority of these customers consider EDM's service as bad.

---

33 Note also that this group accounts for 46.8% of all customers affected by at least one outage a week, and for 48.5% of all customers affected by disruptions with a duration of at least two hours.

34 The 26.8% are almost entirely made up by customers of the lowest- and second-lowest in come group (44.8% and 52,1%, respectively).

Table 2.8: Service Assessment

	bad	reasonable	good
All customers	22.4	57.3	20.1
Customers with at least one disruption per week	19.6	53.6	26.8
Customers affected by disruptions lasting more than two hours	26.9	59.7	13.4

2.34 Only 9.1% of the customers would quit using electricity if it became too expensive. Even the households with the lowest (second-lowest) level of income, who make up 90% of the customers most affected by outages, show a strong leaning towards electricity: Less than 10% (8%) would cease using electricity if tariffs continued to rise.

2.35 Table 2.9 shows that among those customers who would switch away from electricity, the alternative quoted most is LPG (25.4%), followed by kerosene (17.0%), charcoal cum LPG (14.8%), and charcoal cum kerosene (10.1%).[35] The households interviewed did not mention fuelwood as an alternative, and only 8.5% would substitute charcoal for electricity. Also, while most higher income households favor straight LPG and only a few would opt for LPG cum charcoal or for kerosene, the preferences are much more diverse among the lower income customers. In particular, the poorest households tend to favor charcoal, mainly in combination with other fuels, but do not consider LPG as a potential substitute, while almost 50% of the customers pertaining to the second-lowest income class would choose LPG or kerosene. Hence, the fuel options considered by the poorest switch-away customers reflect the need to cut costs. The more affluent switch-away customers, however, are more concerned about fuel quality, i.e., tend to prefer close substitutes for electricity.

Table 2.9: Preferred Alternative to Electricity (%)[1)]

	Low Income	Semi-Low Income	Medium Income	High Income	Total
LPG	0	22.1	66.5	85.5	25.4
Kerosene	10.5	27.6	0	14.5	17.0
Charc.+LPG	10.5	22.1	33.5	0	14.8
Charc.+Keros.	21.0	5.5	0	0	10.1
Charcoal	15.8	5.5	0	0	8.5
LPG+Kerosene	10.8	0	0	0	4.2

1) As a percentage of customers who would cease using electricity if tariffs continued to rise

[35] Systemwide, however, 39.4% of the customers would replace electricity with kerosene and only 11.7% would replace it with LPG.

Central System

2.36 Of the 80 households interviewed in Beira and Chimoio, 32.5% earn less than 500,000 MT/month, 53.7% have between 500,000 and 1,500,000 MT/month, and 13.8% have an income ranging from 1,500,000 to 3,000,000 MT/month. While the survey results presented in Appendix 2 (as well as some of the findings discussed below) are tabulated for all three income groups, it should be kept in mind that the sample size of the customers with an income in excess of 1,500,000 MT/month is too small to draw statistically significant conclusions.[36]

2.37 By national standards and compared with the situation in Beira, households using electricity in Chimoio are well off: Almost 39% of the customers interviewed are self-employed, 69% are house owners, 46% own a telephone, 31% have a car, and 70% are equipped with a freezer.[37] In Beira, the corresponding figures are 16.4%, 9%, 27%, 22.4%, and 60%.

2.38 Average monthly electricity consumption is 337 kWh in Chimoio and 230 kWh in Beira. Households with the lowest income consume 239 kWh/month in Chimoio and only 113 kWh/month in Beira (compared with an average of 157 kWh/month that low-income households consume across the country). Beira's households on average pay 137,000 MT/month for electricity, while customers in Chimoio pay 286,000 MT/month (compared with a national average of 168,000 MT/month).

2.39 In both towns, the share of customers using electricity for cooking is close to the national average (38.5% in Chimoio and 35.8% in Beira). In Beira, one in two households cooks with woodfuel, 7.5% of the households use LPG, and 4.5% use LPG in tandem with electricity. About 38% of the households visited in Chimoio use air conditioners, compared to 16.4% in Beira.

2.40 While 38% of all customers interviewed were affected by more than two outages a week and 47% reported that the disruptions normally last longer than two hours, the reliability of supply was much better in Chimoio than in Beira. In fact, Chimoio enjoyed the highest standard of service throughout the country: Only 7.7% of its customers drawn into the sample experienced more than two outage a week, 15.4% said there was one outage a week, and 15.4% reported that the disruptions lasted longer than two hours. By contrast, in Beira the supply to 43.3% of the customers was disrupted twice a week, about 22.4% were affected by one outage a week, and one out of two customers said the duration the outages typically was two hours or longer.

---

[36] The same argument applies to the results for Chimoio where only 13 customers were interviewed.

[37] Also, Chimoio is the only place where a considerable proportion of the households interviewed operates water pumps (15%).

2.41 One out of five customers felt that the reliability of supply deteriorated, and 42.4% said it improved. But while 22.4% of the respondents living in Beira complained that the service quality went down, only 7.7% of the customers interviewed in Chimoio had this impression. Likewise, in Beira 15% of the customers consider EDM's performance as bad, compared to 7.7% in Chimoio.

2.42 On average, 17.8% of the customers interviewed in the central system would no longer use electricity if it became too expensive, 19.4% in Beira and only 7.7% in Chimoio.[38] In Beira, 31% of these customers would replace electricity with kerosene and another 31% would switch to charcoal in combination with kerosene. LPG would be preferred by 15%, and charcoal by 15.5%. In case of the low-income households, 60% would resort to kerosene, 20% to charcoal, and 20% to charcoal combined with kerosene (figures for Beira only).

Northern System

2.43 In the northern system, 161 customers were interviewed, 95 from Nampula and 66 from Quelimane. With 64.6%, the share of households with a monthly income of less than MT 500,000 is disproportionately large. 28.6% earn between MT 500,000 and MT 1,500,000 a month, and 6.8% have more than 1,500,00 MT/month.[39]

2.44 There are a number of household characteristics reflecting the comparatively low standard of living in the northern region: About two in three households interviewed cook and wash outdoors; more than 60% live in houses covered with grass or reeds; about 16% have a telephone, only 9% own a car; and electricity is used mainly for lighting and in other small-scale applications.

2.45 On average, monthly electricity consumption amounts to 146 kWh; low-income households use 121 kWh/month, while middle-income households consume 193 kWh/month. The low consumption levels are indicative of the fact that only a small number households cooks with electricity (6.3%) or uses air conditioners.[40] In fact, 95% of the low-income households and 75% of those with a middle-income cook with fuelwood and/or charcoal. None of the households interviewed uses LPG (which is not available in the northern region) or kerosene.

---

[38] All customers of the highest income group said they would continue using electricity if tariffs were to rise.

[39] Because of the small sample size, inferences about the most affluent households are not very reliable.

[40] An unreasonably high share of households interviewed (32%) claimed to use electricity for air conditioning. However, customers who reported to own an air conditioner consumed only 38 kWh/month more than on average (i.e., 184 kWh/month vs. 146 kWh/month), whereas systemwide the average consumption level of households owning an air conditioner 421 kWh/month.

2.46 Many of the northern system customers are relatively new clients. Almost 50% (40%) of the low (middle) income households questioned did not have access to electricity five years ago, and one in ten households uses electricity for less than twelve months. Most of them may not had the chance to enjoy the advantages of reliably supplied electricity. About 35% of the customers were exposed to one outage a week, and 44% said more than two outages per week were common. Almost two out of three customers complained that the disruptions lasted two hours or longer. Clearly, these figures are well above of what is the national average, even though EDM tried hard to rehabilitate and reinforce its northern network.

2.47 Northern customers seem to appreciate the efforts taken by EDM to improve the quality of service. About 65% of the customers, which is more than the national average of 55%, said the trend was for improvements in reliability. Among the low-income households, 71% supported this view. On the other hand, the proportion of households that rated EDM's service as "good", was 19%, which is close to the national average of 21%. But almost 32% of the northern customers considered the service as "bad" (compared to a national average of 23%). Hence, notwithstanding the improvements in reliability, households interviewed in the north made it clear that they are less satisfied than customers questioned in other regions.

2.48 Given that the economic development of the northern region lags behind that of the rest of the country, it comes at no surprise that a large share of electricity consumers are unwilling to pay higher tariffs. One third of the low-income households and almost 47% of the middle-income group stated they would stop using electricity if tariffs continued to rise. As is shown in Table 2.10, two out of three customers would like to substitute kerosene for electricity, and almost 17% would resort to charcoal or fuelwood. What strikes most about this response is the belief that when electricity proves too expensive, kerosene would be an affordable alternative.

Table 2. 10: Preferred Alternatives to Electricity (%)[1)]

	Low Income	Medium Income	High Income	Total
Fuelwood	3.2	16.7	0	6.4
Charcoal	9.6	16.7	0	10.7
Kerosene	80.3	39.5	66.7	68.8
Charc.+LPG	0	0	33.3	2.1
Charc.+Kerosene	3.2	18.7	0	7.5

1) Preferred fuel as a percentage of customers who would quit using electricity if it became too expensive

Isolated Areas

2.49 Of the 41 households interviewed in Pemba and Inhambane, 48.8% have a monthly income of less than MT 500,000, 43.9% earn between 500,000 and 1,500,000

MT/month, and 7.3% have a monthly income in excess of MT 1,500,000.[41] For 72.2% of the households, the income comes from civil servants. Two out of three households cook outdoors, and in every second house visited there is no bathroom. Only 7.3% have a telephone or a car. Those electricity users who are tenants and own a telephone said their monthly expenditures average MT 200,000 (net of food and transport), compared to 580,000 MT/month spent by the average household connected to the grid.

2.50 Data on electricity consumption are not available. On average, the households interviewed spend 54,000 MT/month on electricity, which is significantly less than what customers served through the grid pay for electricity (168,000 MT/month on average). Electricity is used mainly for lighting. Almost all households have a radio, 80% use an electric iron, and 44% own a freezer. Electric cooking and air conditioning are uncommon. About 83% of the households interviewed cook with woodfuel[42], about 10% use kerosene or LPG in combination with woodfuel, and only 2.4% have an electric stove.

2.51 Almost 66% of the households interviewed use electricity for more than five years.[43] The quality of service seems not much different from that along EDM's network. One out of four households were affected by more than two outages per week, and 22% experienced one outage a week. According to 46.4% of the households, the disruptions were longer than two hours.

2.52 Almost 74% of households visited in isolated areas expressed the view that the reliability of supply had improved, while the opposite was said by only 2.4%.[44] One out of five households considered the service as "good" (which is close to the national average), while 2.4% gave a "bad" rating (compared to 22.8% of the grid-customers).

2.53 If electricity became too expensive, 22% of the households interviewed would resort to other forms of energy. For 44.5% of these customers, kerosene would be the preferred alternative; one third would switch to fuelwood in combination with kerosene, and 22.2% would choose a charcoal-kerosene mix.

---

41 Again, due to the small sample size, it is not possible to draw meaningful conclusions about the highest income group.

42 One out of ten uses fuelwood only.

43 For comparison, along EDM's network the share of customers served for more than five years is 76%.

44 By contrast, only 55.5% of the grid-customers said there were improvements in reliability while 15.5% found that the situation got worse.

3. GENERAL CUSTOMERS

3.1 The survey was designed to classify general customers on the basis of their monthly turnover. However, the turnover ranges considered in the questionnaire proved inappropriate.[45] While customers with a monthly turnover of MT 10 million or less were fairly similar in terms of key business characteristics (e.g. number of employees, electricity consumption), customers with a turnover in excess of MT 10 million were considerably more diverse and, therefore, should have been split into two subgroups or so. But with the completion of the field work, additional screening was no longer possible. The only change introduced ex-post is that the customers with a turnover of MT 1-10 million have been lumped together. These customers are referred two as the LT-group, while those with a turnover of more than MT 10 million compose the HT-group.[46]

Maputo

3.2 Of the 68 customers interviewed, 51% have a monthly turnover of at most MT 10 million, while 48.5% exceed this limit. About 30% are in the retail business, 34% provide services, 6% run workshops, 5% own restaurants, and 25% fall into other categories (including those customers who did not specify their business).

3.3 In terms of business expenditures, the two customer groups differ by a factor of ten. While the LT-customers have average monthly expenditures of MT 3.6 million, the HT-customers spend MT 39.8 million. On average, the latter employ 26 workers, whereas the former have 6 employees. Average salaries paid per worker are MT 1.1 million (HT) and MT 0.327 million (LT).[47]

3.4 Average monthly electricity consumption ranges from 327 kWh (LT) to 913 kWh (HT). The corresponding average tariffs are 1,620 MT/kWh (LT) and 1,585 MT/kWh (HT), which is more than twice as much as domestic customers pay on average (740 MT/kWh).[48] While 54.2% of the LT-customers are charged for a load of 3.3 kVA or less, 51.5% of their HT-counterparts have a rated load of at least 6.6 kVA. All HT-customers interviewed use electricity for more than one year, 85% of them for more than five years. Of the LT-customers, 80% are serviced by EDM for more than five years, and 2.9% have a connection for less than one year.

3.5 One out of three general customers (33.8%) were affected by more than two outages a week (LT: 37.1%, HT: 30.3%), and 41.2% said the normal length of the disruptions was at least two hours (LT: 48.5%, HT: 33.3%). Thus, judged on the basis of

---

[45] The customers were asked to select from the following ranges (in MT million): < 1; 1-5; 5-10; > 10.

[46] LT = low turnover; HT = high turnover.

[47] The HT-figure appears to be unreasonably high.

[48] The reason for this difference is that general customers are charged a higher rate for energy and tend to subscribe a higher capacity which is subject to increasing block rates.

the information provided by the respondents, the service to HT-customers was not quite as bad as that to the LT-group.[49]

3.6 Among the general customers located in Maputo, the share of respondents saying that the trend in reliability was positive (66.2%) is higher than that among their domestic counterparts (55.7%). However, in both customer groups (general and domestic) about 12% of the respondents felt that the reliability of the southern network had decreased.

3.7 In the southern system, general customers are less satisfied with EDM's service than households. About one in three said the service was "bad", compared with slightly more than one out of four domestic customers. Only 10% of the general customers gave EDM a good rating, compared with 20% of the households interviewed.

Table 3.1: Service Assessment (%)[1)]

	Bad	Reasonable	Good
All general customers:			
- LT	37.1	51.4	11.5
- HT	30.3	60.6	9.1
- Total	33.8	55.9	10.2
Customers affected by more than two outages a week:			
- LT	60.0	26.7	13.3
- HT	46.2	46.1	7.7
- Total	53.6	35.7	10.7
Customers affected by outages with a normal duration of more than two hours:			
- LT	47.1	52.9	0
- HT	45.6	45.5	9.1
- Total	46.4	50.0	3.6

1) As a percentage of customers

3.8 General customers who were affected by more than two outages a week expressed their anger by saying that EDM's service was bad: 53.6% supported this view (60% in the case of LT-customers), which is a much higher share of bad ratings than among all customers interviewed. On the other hand, those affected by outages with a duration of more than two hours showed their dissatisfaction by declining to give EDM a good rating: Only 3.6% of this subgroup said the service was good, compared with 11.5% of all general customers.

3.9 As expected, the share of general customers who would cease using electricity in the case of rising tariffs is much lower than among domestic users. Only 5.9%

[49] In fact, the likelihood that a LT-customer in Maputo is affected by more than two outages a week with a duration of more than two hours is fairly similar to the probability that this happens to a low-income domestic customer living in the Maputo area (see Section 2.2).

said they would switch away from electricity, 3% of the HT-group and 8.6% of the LT-group.

Rest of System

3.10 General customers interviewed in Beira, Chimoio, Quelimane, Nampula and Inhambane are lumped together because the subsamples are too small to capture regional differences in a statistically significant way. Of the 45 customers constituting the sample, 60% fall into the LT-group and 40% into the HT-category. Most of the businesses belong to the service sector; retailing plays a minor role, but there are a few larger factories among the customers interviewed.

3.11 Average monthly expenditures range between MT 4.8 million (LT) and MT 38.7 million (HT). LT-customers on average have 6.7 employees, while there are 52 employees per HT-customer[50]. The reported salaries are MT 459,5000 and MT 503,370 per worker.

3.12 Data on electricity consumption are incomplete. Monthly expenditures on electricity vary between MT 437,000 (LT) and MT 2,140,000 (HT). If the two customers with the largest electricity bills are excluded, the HT-average reduces to MT 1,500,000, which is more in line with the estimate for Maputo.[51] Almost three out of four customers interviewed use electricity for more than five years (LT: 63%, HT: 89%). No HT-customer, but 7.4% of the LT-customers were connected during the last year.

3.13 About one in two customers interviewed said power outages typically have a duration of more than two hours (LT: 51.9%, HT: 50.0%).[52] According to 35.6% of the respondents, the reliability of supply did improve, while 26.7% said the opposite. As regards EDM's service, 24.4% considered it as bad and 8.9% (16.7% in the case of HT-customers) gave EDM a good rating. Among those customers who experienced outages with a duration of more than two hours, the share of bad ratings was 30.4%. Only 6.7% of the respondents would cease using electricity if tariffs continued to rise (LT: 7.4%, HT: 6.7%).

---

50 The HT-figure is biased by three factories with 155, 146, and 300 employees.

51 The corresponding figures for Maputo are MT 529,000 (LT) and MT 1,447,700 (HT).

52 The data on the frequency of disruptions are incomplete.

Appendix 1: Sample Design

The survey method used is stratified random sampling with replacement. The focus is on EDM's low-voltage customers who fall into the "domestic" and "general" tariff category ("tarifa domestica" and "tarifa geral") and pay their electricity bill in local currency. These customers have been identified on the basis of EDM's billing statistics and are referred to as the total population. When the sample was designed (third quarter of 1995), the total population amounted to 160,616 customers, of which 137,000 were domestic users. Customers connected to the grid are stratified by region (southern, central and northern system), while customers served in isolated areas are lumped together into a separate group without regional stratification. This gives four population strata.

A stratified sample of 912 customers (799 domestic, 113 geral) was drawn from a sampling frame , i.e., a subset of 127,188 LV-customers (for details, see Table 1 and 2).[1] The frame is composed of seven billing areas distributed across the four population strata.[2] The seven areas were selected so as to reflect regional differences. For each area, a subsample was drawn. Initially, the chosen size of each subsample within a stratum was subject to the requirement that it be proportional to the number of customers registered in the billing area, adjusted for a factor that accounts for the difference between the stratum population and the number of customers contained in the corresponding sampling frame. In some areas, however, this relationship could not be maintained because it turned out during the field work that the actual number of area customers (from which the sample was drawn) did not match the figure that had been used to determine the sample size.

In more technical terms, the sample selection procedure can be described as follows:

The total population, denoted by **N**, consists of n_h =4 strata (sub-populations), so that

$$N = \sum_{i=1}^{n_h} N_i .$$

The sampling frame, denoted by **S**, is a subset of N comprising seven billing areas distributed across the strata. In each population stratum, there are k (≥1) areas. Let $\mathbf{S_{ij}}$

---

1 The reason why the sample was not drawn from the total population is that the project's budget was very tight. To divest the project of the risk that the field work implied in interviewing the randomly selected sample may become too expensive, it was decided to restrict the focus to a sampling frame covering a population subset that would be accessible at reasonable costs.

2 Initially, the stratified sample included Cuamba. For lack of time, however, the town was not visited.

be the sampling frame population in area j pertaining to stratum i, j=1,..,k, while S_i the sampling frame population in stratum i. Then

$$S_i = \sum_{j=1}^{k} S_{ij}, \quad and \quad S = \sum_{i=1}^{n_k} S_i.$$

On the other hand, let **n** be the predetermined size of the stratified sample. Also, we define

n_{ij} = size of the subsample drawn in area j pertaining to the population stratum i,

n_i = sample population drawn in stratum i.

Then

$$n_i = \sum_{j=1}^{k} n_{ij}, \quad and \quad n = \sum_{i=1}^{n} n_i.$$

Initially, the sample sizes n_{ij} were defined so as to satisfy (note that $S_i \leq N_i$)

$$(1) \quad \frac{n_{ij}}{S_{ij}} = \frac{N_i}{S_i}\frac{n}{N}.$$

The above condition implies that

$$\frac{S_i}{S} = \frac{N_i}{N} = \frac{n_i}{n},$$

i.e., the stratum samples n_i are proportionate. As is mentioned above, however, in some areas (notably in the northern system) the actual number of customers (S_{ij}) encountered during the field work differed from the number used to determine the sample size (which was done before the field work started). Hence, the corresponding stratum samples are not proportionate.

Now, let $y_{ij,1}, y_{ij,2}, \ldots, y_{ij\,n_{ij}}$ be selections of a population characteristic from the j-th area within stratum i. Based on the above sampling procedure, the corresponding area sample mean is (for details, see Appendix 3)

$$(2) \quad \bar{y}_{ij} = \frac{1}{n_{ij}} \sum_{m=1}^{n_{ij}} y_{ij,m},$$

while the unbiased i-th stratum sample mean is the weighted average

$$(3)\quad \bar{y}_i = \sum_{j=1}^{k} \frac{S_{ij}}{S_i} \bar{y}_{ij}.$$

By the same token, the unbiased stratified sample mean estimated for the population contained in the sampling frame amounts to

$$(4)\quad \bar{y} = \sum_{i=1}^{n_h} \sum_{j=1}^{k} \frac{S_{ij}}{S} \bar{y}_{ij} = \sum_{i=1}^{n_h} \frac{S_i}{S} \bar{y}_i.$$

In view of (1), (4) can be rewritten as

$$(4')\quad \bar{y} = \sum_{i=1}^{n_h} \frac{N_i}{N} \bar{y}_i = \sum_{i=1}^{n_h} \frac{n_i}{n} \bar{y}_i.$$

The following should be kept in mind, however:
Because of condition (1) and $S_i < N_i$, we have $n_{ij}/S_{ij} \neq n_i/S_i$, so that sampling is not proportionate.[3] Hence, (4) differs from the overall sample average

$$(5)\quad \bar{y}' = \frac{1}{n} \sum_{i=1}^{n_h} \sum_{j=1}^{k} \sum_{m=1}^{n_{ij}} y_{ij,m},$$

which is a biased estimator.[4]

Moreover, while $\bar{y}$ is an unbiased estimator of the mean of the sampling frame population, say μ_S, it cannot be considered an unbiased estimator of the overall population mean, say μ_N, since we do not know whether $\mu_S = \mu_N$ holds.

As is explained in Appendix 3, the variances of the above defined means can be estimated as follows:

$$(6)\quad Var(\bar{y}_{ij}) = \frac{s^2(y_{ij})}{n_{ij}} \quad , \quad where \quad s^2(y_{ij}) = \frac{1}{n_{ij} - 1} \sum_{m=1}^{n_{ij}} (y_{ij,m} - \bar{y}_{ij})^2 ,$$

$$(7)\quad Var(\bar{y}_i) = s^2(y_i) = \sum_{j=1}^{k} \left(\frac{S_{ij}}{S_i}\right)^2 \frac{s^2(y_{ij})}{n_{ij}},$$

$$(8)\quad Var(\bar{y}) = s^2(y) = \sum_{i=1}^{n_h} \sum_{j=1}^{k} \frac{S_{ij}^2}{S^2} \frac{s^2(y_{ij})}{n_{ij}} = \sum_{i=1}^{n_h} \left(\frac{S_i}{S}\right)^2 s^2(y_i).$$

---

[3] For reasons explained above, we may not even have $n_i = n(N_i/N)$.

[4] Again, this follows from condition (1), given that $S_i < N_i$.

Likewise, the sample proportion of a characteristic in area j pertaining to stratum i is

$$(9)\quad p_{ij} = \frac{1}{n_{ij}} \sum_{m=1}^{n_{ij}} D_{ij,m} ,$$

so that

$$(10)\quad p_i = \sum_{j=1}^{k} \frac{S_{ij}}{S_i} p_{ij}$$

$$(11)\quad p = \sum_{i=1}^{n_h} \frac{S_i}{S} p_i .$$

The corresponding (estimated) variances are

$$(12)\quad s^2(p_{ij}) = \frac{p_{ij}(1-p_{ij})}{n_{ij}}$$

$$(13)\quad s^2(p_i) = \sum_{j=1}^{k} \frac{S_{ij}^2}{S_i^2} s^2(p_{ij})$$

$$(14)\quad s^2(p) = \sum_{i=1}^{n_h} \frac{S_i^2}{S^2} s^2(p_i) .$$

Finally, the ratio estimators relevant in the present context are

$$(15)\quad r_{ij} = \frac{\bar{x}_{ij}}{\bar{y}_{ij}}; \quad r_i = \frac{\bar{x}_i}{\bar{y}_i}; \quad r = \frac{\bar{x}}{\bar{y}}.$$

As is shown in Appendix 3, Equation (14'), we have

$$(16)\quad s^2(r_{ij}) = \frac{1}{n_{ij}\bar{y}_{ij}^2} \left(\sum_{m=1}^{n_{ij}} x_{ij,m}^2 + r_{ij}^2 \sum_{m=1}^{n_{ij}} y_{ij,m}^2 - 2r_{ij} \sum_{m=1}^{n_{ij}} x_{ij,m} y_{ij,m} \right).$$

Hence

$$(17)\quad s^2(r_i) = \frac{1}{\bar{y}_i^2} \left(\sum_{j=1}^{k} \frac{S_{ij}^2}{S_i^2} \frac{s^2(x_{ij})}{n_{ij}} + r_i^2 \sum_{j=1}^{k} \frac{S_{ij}^2}{S_i^2} \frac{s^2(y_{ij})}{n_{ij}} - 2r_i \sum_{j=1}^{k} \frac{S_{ij}^2}{S_i^2} \frac{Cov(x_{ij}, y_{ij})}{n_{ij}} \right.$$

$$(18)\quad s^2(r) = \frac{1}{\bar{y}^2} \left(\sum_{i=1}^{n_h} \frac{S_i^2}{S^2} s^2(x_i) + r^2 \sum_{i=1}^{n_h} \frac{S_i^2}{S^2} s^2(y_i) - 2r \sum_{i=1}^{n_h} \frac{S_i^2}{S^2} \sum_{j=1}^{k} \frac{S_{ij}^2}{S_i^2} \frac{Cov(x_{ij}, y_{ij})}{n_{ij}} \right.,$$

where

$$Cov(x_{ij}, y_{ij}) = \frac{1}{n_{ij}} \sum_{m=1}^{n_{ij}} (x_{ij,m} - \bar{x}_{ij})(y_{ij,m} - \bar{y}_{ih}).$$

A program that uses the above formulas as built-in functions and therefore can be easily applied to the survey data is shown in Appendix 4. The program is embedded in Mathematica 2.2. A similar program could be devised for other types of software such as Econometric Views, which is available at EDM's planning department.

The following tables provide an overview of the target population, the sampling frame, and the sizes of the samples drawn in the survey of EDM's LV-customers. Table 1 refers to customers that are subject to the "domestic" tariff, while Table 2 covers the customers charged with the "general" tariff.

Table 1: Total Population, Sampling Frame, and Sample Size - Domestic Consumers

	Total Population	Sampling Frame	Sampling Frame Fractions(%)	Sample Size
Southern System[1]		73,171	66.3	517
- Maputo		73,171	66.3	517
Central System[1]		13,004	11.8	80
- Beira		11,224	10.2	67
- Chimoio		1,780	1.6	13
Northern System[2]		16,496	14.9	161
- Quelimane		4,252	3.8	66
- Nampula		12,244	11.1	95
Isolated Areas[3]		7,703	7.0	41
- Inhambane		3,375	3.1	15
- Pemba		4,328	3.9	26
Total		110,374	199.0	799

1) Excluding isolated areas.
2) Including Tete, excluding isolated areas.
3) Including Lichinga, Cuamba and Angoche.

Table 2: Total Population, Sampling Frame, and Sample Size - General Consumers

	Total Population	Sampling Frame	Sampling Frame Fractions (%)	Sample Size
Southern System[1]	14,364	11,079	65.9	68
- Maputo	11,553	11,079	65.9	68
Central System[1]	3,201	2,829	16.8	19
- Beira	2,325	2,325	13.8	13
- Chimoio	876	504	3.0	6
Northern System[2]	4,113	1,624	9.7	16
- Quelimane	1,007	600	3.6	9
- Nampula	1,024	1,024	6.1	7
Isolated Areas[3]	1,899	1,277	7.6	10
- Inhambane	753	750	4.5	5
- Pemba	542	527	3.1	5
Total	23,583	16,809	100.0	113

1) Excluding isolated areas.
2) Including Tete, excluding isolated areas.
3) Including Lichinga, Cuamba and Angoche.

Appendix 2: Survey Results

2.1 Maputo Domestic
2.2 Beira Domestic
2.3 Chimoio Domestic
2.4 Nampula Domestic
2.5 Quelimane Domestic
2.6 Pemba/Inhambane Domestic
2.7 Summary Domestic
2.8 Central System Domestic
2.9 Northern System Domestic
2.10 Total System Domestic
2.11 aputo Geral
2.12 Rest of System Geral

Remarks

The following definitions apply:

% := proportion (in %) of sample, subsample or income category, unless stated otherwise;

Average := per household/customer affected (i.e., possessing the characteristic of interest), unless stated otherwise.

It should be noted that due to errors in response to the questionnaire, there are minor inconsistencies among the tables shown below. For instance, Table 5 (fuels/energy used in addition to electricity) and Table 8 (fuels/energy used for cooking) do not match. Likewise, the share of respondents saying they use electricity for cooking (Table 6) differs from the share of respondents saying they cook with electricity (Table 8). However, since these errors are reasonably small, they resulting bias does not entail severe distortions.

Another point worth mentioning is that the tables on fuel/energy use have been compiled in a way that distinguishes between respondents using a single fuel and those using a (particular) fuel mix.

2.1: TABLES MAPUTO DOMESTIC

Table 1: Household Characteristics

Monthly Income			Occupation (%) 2)							Av. #	Av. #
Category 1)	#	% of Total	1	2	3	4	5	6	7	Person	Rooms
1	192	37.1	36.4	23.9	15.1	0	12.0	6.3	6.3	7.1	4.9
2	229	44.3	50.2	18.8	16.6	1.3	4.3	1.7	7.0	7.1	5.4
3	61	11.8	54.1	6.6	27.9	0	1.6	1.6	8.2	6.0	5.6
4	35	6.8	60.0	0	28.6	0	2.8	0	8.6	5.6	7.1
Total Sample	517	100.0	46.2	18.0	18.2	0.5	6.7	3.3	7.0	6.9	5.3

1) 1:= < 500,000 MT; 2:= 500,000 - 1,500,000 MT; 3:= 1,500,000 - 3,000,000 MT; 4:= > 3,000,000 MT
2) 1:= civil servant; 2:= worker; 3:= self-employed; 4:= student; 5:= retired; 6:= unemployed; 7:= other

Table 2: House Characteristics

	Rooms		House Ownership (%)		
Income Cat.	Kitchen Inside (%)	Bath Inside (%)	Own	Service	Rent
1	53.7	48.8	67.7	2.1	30.2
2	75.6	69.4	56.3	2.2	41.5
3	85.3	85.3	57.4	1.6	41.0
4	100.0	100.0	62.9	0	37.1
Total	70.2	65.6	61.1	1.9	37.0

Table 3: House Characteristics

	Walls (%)				Roof (%)			
Income	Bricks	Wood/Zinc	Reeds	Reed/Sand	Tiles	Zinc	Reed	Grass
1	91.7	8.3	0	0	44.8	53.1	0	0
2	94.8	4.4	0	0.4	64.2	33.2	0	0
3	98.4	1.6	0	0	83.6	16.4	0	0
4	100.0	0	0	0	94.3	0	0	0
Total	94.4	5.2	0	0.2	61.3	36.4	0	0

Table 4: Average Monthly Expenditures (1000 MT)

Income Cat.	Rent	Water	Electricity	Other Energy	Telephone	Total Exp. 1)	Tele. Owner (%)	Car Owner (%)
1	13.5	19.0	127.2	141.4	155.5	361.9	20.3	10.4
2	34.8	28.7	168.7	144.9	180.1	505.2	34.9	17.9
3	25.4	23.0	227.8	134.2	232.2	668.7	72.1	41.0
4	68.9	24.0	511.4	140.4	586.2	3165.0	88.6	80.0
Total 1	28.8	24.3	183.5	142.2	251.9	651.3	37.5	22.1

1) average sum of expenditures quantified

Table 5: Fuel/Energy Used in Addition to Electricity (%)

Income Category	1	2	3	4	Total
1. Fuelwood	4.2	0.4	0	0	1.7
2. Charcoal	39.1	35.4	23.0	2.9	33.1
3. LPG	10.4	17.0	32.8	57.1	19.2
4. Kerosene	0	0.4	0	0	0.2
6. FW+Charc.	15.1	12.7	8.2	5.7	12.6
7. FW+LPG	0	0.9	0	0	0.4
8. FW+Kero	0	0.4	0	0	0.2
9. Charc+LPG	16.7	20.5	18.0	8.6	18.0
10. Charc.+Kero	1.6	2.2	1.6	0	1.7
11. LPG+Kero	0.5	0	3.3	0	0.6
12. FW+Charc.+Kero	0.5	0.4	0	0	0.4
13. FW+Char+LPG	4.7	2.7	0	0	2.9
14. FW+Kero+LPG	0	0	0	0	0
15. Cha+Ker+LPG	1.6	0.4	1.6	2.9	1.2
16. Solar	0	0	0	0	0
18. No					

Table 6: Electricity End Uses (%)

Income	Lighting	Radio	TV	Freezing	Air Cond	Water Heat	Cooking	Others
1	100.0	85.9	63.0	62.0	5.7	2.6	38.0	20.8
2	100.0	93.9	79.9	78.2	17.0	3.9	59.0	30.1
3	100.0	93.4	91.8	85.3	31.2	14.6	75.4	57.4
4	100.0	100.0	100.0	97.1	54.3	54.3	77.1	74.3
Total	100.0	91.3	76.4	74.3	17.0	8.1	54.3	32.9

Table 7: Electric Appliances (%)

Income	Iron	Vac.cleanr	Kettle	Mixer	Termo Ac	Heater	Fan	Comp.	Hair Dryer	Toaster	MicroWave	Water Pump
1	72.4	2.1	9.9	7.3	2.1	0.5	36.5	0.5	6.8	3.1	1.0	0
2	89.5	4.8	21.8	15.7	3.5	0.9	52.0	3.9	10.9	3.1	0	3.1
3	96.7	14.8	34.4	57.4	18.0	6.6	75.4	6.6	31.2	113.1	0	3.3
4	97.1	34.3	54.3	57.1	48.6	11.4	54.3	28.6	60.0	45.7	8.6	20.0
Total	84.5	7.0	21.1	20.3	7.7	2.1	49.1	4.6	15.1	7.2	1.0	3.1

Table 8: Stove/Fuel Used For Cooking (%)

Income	1	2	3	4	Total
Stove/Fuel					
1. Fuelwood	0	0	0	0	0
2. Charcoal	0	0	0	0	0
3. LPG	17.2	17.0	18.0	28.6	18.0
4. Kerosene	0.5	0	0	0	0.2
5. Electricity	27.1	47.6	50.8	37.2	39.7
6. FW+Charc.	42.7	21.0	9.8	5.7	26.7
7. FW+LPG	0	0	0	0	0
8. FW+Kero	0	0	0	0	0
9. Charc.+LPG	0	0	0	0	0
10. Charc.+Kero	0	0	0	0	0
11. LPG+Kero	0	0	0	0	0
12. FW+Cha+Kero	1.0	2.6	3.3	0	1.9
13. FW+Cha+LPG	6.3	3.5	0	0	3.9
14. FW+Ker+LPG	0	0	0	0	0
15. Cha+Ker+LPG	0	0	0	0	0
16. Solar	0	0	0	0	0
17. Electr.+LPG	5.2	8.3	18.0	28.6	9.7
Cooking Time (Minutes)					
- Breakfast	26.2	24.6	24.1	21.8	25.0
- Lunch	117.7	101.8	113.3	104.1	109.0
- Dinner	76.9	71.1	68.3	56.8	71.9
- Total Time	230.8	197.5	205.7	182.7	205.9

Table 9: Reliability and Service Assessment

Income	Frequency of Disruptions (%) 1)				Duration of Disruptions (%) 2)			Reliability Trend (%)			Service Assessment (%)		
Cat.	1	2	3	4	1	2	3	better	same	worse	bad	reasonable	good
1	7.8	30.7	24.0	37.0	25.0	31.3	43.2	55.2	25.5	19.3	22.9	53.7	23.4
2	15.7	35.8	20.1	26.6	24.9	45.4	28.4	59.0	32.3	8.7	23.6	55.5	20.4
3	23.0	49.2	9.8	18.0	29.5	45.9	24.6	52.5	42.6	4.9	16.4	68.9	14.7
4	11.4	57.1	20.0	5.7	25.7	45.7	22.9	42.9	40.0	17.1	22.9	68.5	8.6
Total	13.4	36.9	20.3	28.1	25.5	40.2	33.1	55.7	31.5	12.8	22.4	57.2	20.1

1) 1:= once a year; 2:= once a month; 3:= once a week; 4:= more than twice a week
2) 1:= < 1 hour; 2:= about 1 hour; 3:= > 2 hours

Table 9a: Reliability Trend by Customers Affected by Poor Service

Income	Disruptions at least once a week			Disruptions lasting at least two hours		
Category	better	same	worse	better	same	worse
1	45.3	28.2	26.5	43.4	25.3	31.3
2	61.7	28.0	10.3	40.0	46.2	13.8
3	47.1	41.2	11.7	40.0	46.7	13.3
4	55.6	22.2	22.2	37.5	37.5	25.0
Total	52.8	28.8	18.4	41.5	35.7	22.8

Table 10: Electricity Consumption

Income Category	Period of Service (%)			Average Monthly Consumption (kWh)			
	< 1 year	1 - 5 years	> 5 years	Total	With Electric Cooking	Without Electric Cooking	With Air Conditioning
1	4.2	17.7	78.1	169.1	204.5	147.9	251.5
2	2.6	16.2	81.1	228.6	265.9	175.0	278.1
3	4.9	16.4	78.7	302.5	327.3	219.8	445.9
4	2.9	8.6	88.6	634.9	675.5	483.5	799.5
Total	3.5	16.2	80.3	243.0	300.5	173.5	424.1

Table 11: Metering and kVA-Rating

Income Category	Metering (%) 1)				Rating Code (%) 2)						
	1	2	3	4	1	2	3	6	9	13	16
1	86.5	0.5	9.4	3.6	30.2	38.0	17.2	9.4	1.0	1.0	0
2	82.5	0	8.7	8.8	19.7	33.2	23.1	20.1	1.8	0	0.9
3	72.1	0	13.1	14.8	11.5	18.0	29.5	36.1	3.3	1.6	0
4	60.0	2.9	14.3	22.8	5.7	14.3	11.4	25.7	14.3	11.4	14.3
Total	81.2	0.4	9.9	8.5	21.7	31.9	20.9	17.4	2.5	1.4	1.4

1) 1:= every month; 2:= every two months; 3:= irregular; 4:= do not know
2) 1:= 1.1 kVA; 2:= 2.2 kVA; 3:= 3.3 kVA; 6:= 6.6 kVA; 9:= 9.9kVA; 13:= 13.2kVA; 16:= 16.5kVA

2.2: TABLES BEIRA DOMESTIC

Table 1: Household Characteristics

Monthly Income			Occupation (%) 2)							Av. #	Av. #
Category 1)	#	% of Total	1	2	3	4	5	6	7	Person	Rooms
1	23	34.3	39.1	21.7	21.7	0	4.3	8.7	4.4	6.8	3.5
2	38	56.7	68.4	21.1	10.5	0	0	0	0	5.6	3.8
3	6	9.0	66.7	0	33.3	0	0	0	0	7.7	3.5
4	0	0	0	0	0	0	0	0	0	0	0
Total Sample	67	100.0	58.2	19.4	16.4	0	1.5	3.0	1.5	6.2	0

1) 1:= < 500,000 MT; 2:= 500,000 - 1,500,000 MT; 3:= 1,500,000 - 3,000,000 MT; 4:= > 3,000,000 MT
2) 1:= civil servant; 2:= worker; 3:= self-employed; 4:= student; 5:= retired; 6:= unemployed; 7:= Other

Table 2: House Characteristics

	Rooms		House Ownership (%)		
Income Cat.	Kitchen Inside (%)	Bath Inside (%)	Own	Service	Rent
1	91.3	87.0	26.1	8.7	65.2
2	100.0	100.0	0	7.9	92.1
3	100.0	100.0	0	0	100.0
4	0	0	0	0	0
Total	97.0	95.5	9.0	7.5	83.5

Table 3: House Characteristics

	Walls (%)				Roof (%)			
Income	Bricks	Wood/Zinc	Reeds	Reed/Sand	Tiles	Zinc	Reed	Grass
1	95.7	4.3	0	0	91.3	8.7	0	0
2	100.0	0	0	0	97.4	2.6	0	0
3	100.0	0	0	0	100.0	0	0	0
4	0	0	0	0	0	0	0	0
Total	98.5	1.5	0	0	95.5	4.5	0	0

Table 4: Average Monthly Expenditures (1000 MT)

Income Cat.	Rent	Water	Electricity	Other Energy	Telephone	Total Expend. 1)	Tel. Owner (%)	Car Owner (%)
1	13.9	19.3	86.4	86.3	243.6	276.8	13.0	8.7
2	55.1	22.5	144.3	111.6	243.2	488.9	31.6	34.2
3	71.0	46.8	279.3	203.6	343.6	1281.4	50.0	0
4	0	0	0	0	0	0	0	0
Total 1	45.3	23.8	136.5	108.6	260.0	487.0	26.7	22.4

1) sum of expenditures quantified

Table 5: Fuel/Energy Used in Addition to Electricity (%)

Income Category	1	2	3	4	Total
1. Fuelwood	0	0	0	0	0
2. Charcoal	95.7	50.0	50.0	0	65.7
3. LPG	0	7.9	16.7	0	6.0
4. Kerosene	0	7.9	0	0	4.5
6. FW+Charc.	0	0	0	0	0
7. FW+LPG	0	0	0	0	0
8. FW+Kero	0	0	0	0	0
9. Charc+LPG	0	13.2	0	0	7.5
10. Charc.+Kero	4.3	13.2	0	0	9.0
11. LPG+Kero	0	0	0	0	0
12. FW+Charc.+Kero	0	0	0	0	0
13. FW+Char+LPG	0	0	0	0	0
14. FW+Kero+LPG	0	0	0	0	0
15. Cha+Ker+LPG	0	2.6	0	0	1.5
16. Solar	0	0	0	0	0
18. No	0	5.2	33.3	0	5.8

Table 6: Electricity End Uses (%)

Income	Lighting	Radio	TV	Freezing	Air Cond.	Water Heat.	Cooking	Others
1	100.0	60.9	34.8	47.8	8.7	0	17.4	0
2	94.7	86.8	71.1	63.2	15.8	10.5	50.0	13.2
3	100.0	100.0	100.0	83.3	50.0	0	33.3	16.7
4	0	0	0	0	0	0	0	0
Total	97.0	79.1	61.2	59.7	16.4	6.0	37.3	9.0

Table 7: Electric Appliances (%)

Income	Iron	Vac.cleane r	Kettle	Mixer	Tonno Ac.	Heater	Fan	Comp.	Hair Dryer	Toaster	MicroWav e	Water Pump
1	56.5	0	0	0	0	0	43.5	0	8.7	0	0	0
2	86.8	5.3	2.6	13.2	5.3	0	47.4	0	15.9	7.9	2.6	5.3
3	100.0	0	16.7	33.3	0	0	100.0	0	50.0	16.7	0	16.7
4	0	0	0	0	0	0	0	0	0	0	0	0
Total	77.6	3.0	3.0	10.5	3.0	0	50.8	0	16.4	6.0	1.5	4.5

Table 8: Stove/Fuel Used For Cooking (%)

Income / Stove/Fuel	1	2	3	4	Total
1. Fuelwood	4.4	0	0	0	1.5
2. Charcoal	0	0	0	0	0
3. LPG	4.3	7.9	16.7	0	7.5
4. Kerosene	0	0	0	0	0
5. Electricity	17.4	44.7	50.0	0	35.8
6. FW+Charc.	73.9	39.5	33.3	0	50.7
7. FW+LPG	0	0	0	0	0
8. FW+Kero	0	0	0	0	0
9. Chrac.+LPG	0	0	0	0	0
10. Charc.+Kero	0	0	0	0	0
11. LPG+Kero	0	0	0	0	0
12. FW+Cha+Kero	0	0	0	0	0
13. FW+Cha+LPG	0	0	0	0	0
14. FW+Ker+LPG	0	0	0	0	0
15. Cha+Ker+LPG	0	0	0	0	0
16. Solar	0	0	0	0	0
17. Electr.+LPG	0	7.9	0	0	4.5
Cooking Time (Minutes)					
- Breakfast	28.7	30.4	30.0	0	29.8
- Lunch	107.6	86.8	115.0	0	96.5
- Dinner	100.4	73.0	92.5	0	84.3
- Total Time	236.7	190.2	237.5	0	210.6

Table 9: Reliability and Service Assessment

Income Cat.	Frequency of Disruptions (%) 1)				Duration of Disruptions (%) 2)			Reliability Trend (%)			Service Assessment (%)		
	1	2	3	4	1	2	3	better	same	worse	bad	reasonable	good
1	13.0	30.4	17.4	39.1	13.0	26.1	60.9	34.8	30.4	34.8	8.7	69.6	21.7
2	2.6	29.0	26.3	42.1	15.8	34.2	50.0	42.1	39.5	18.4	18.4	63.2	18.4
3	16.7	0	16.7	66.7	33.3	33.3	33.3	66.7	33.3	0	16.7	66.7	16.6
4	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	7.5	26.9	22.4	43.3	16.4	31.3	52.3	41.8	35.8	22.4	14.9	65.7	19.4

1) 1:= once a year; 2:= once a month; 3:= once a week; 4:= more than twice a week
2) 1:= < 1 hour; 2:= about 1 hour; 3:= > 2 hours

Table 10: Electricity Consumption

Income Category	Period of Service (%)			Average Monthly Consumption (kWh)				
	< 1 year	1-5 years	> 5 years	Total	With Electric Cooking	Without Electric Cooking	With Air Conditioning	Without Air Conditioning
1	0	13.0	87.0	113.2	175.3	93.5	275.2	99.0
2	5.2	21.1	73.7	182.0	202.6	170.3	244.3	172.9
3	0	16.7	83.3	1272.5	1352.5	na	1352.5	na
4	0	0	0	0	0	0	0	0
Total	3.0	17.9	79.1	229.6	416.9	132.2	693.8	138.2

Table 11: Metering and kVA-Rating

Income Categ.	Metering (%) 1)				Rating Code (%) 2)						
	1	2	3	4	1	2	3	6	9	13	16
1	95.7	0	4.3	0							
2	94.7	0	5.3	0							
3	100.0	0	0	0							
4	0	0	0	0							
Total	95.5	0	4.5	0							

1) 1:= every month; 2:= every two months; 3:= irregular; 4:= do not know
2) 1:= 1.1 kVA; 2:= 2.2 kVA; 3:= 3.3 kVA; 6:= 6.6 kVA; 9:= 9.9kVA; 13:= 13.2kVA; 16:= 16.5kVA

2.3: TABLES CHIMOIO DOMESTIC

Table 1: Household Characteristics

Monthly Income			Occupation (%) 2)							Av. #	Av. #
Category 1)	#	% of Total	1	2	3	4	5	6	7	Person	Rooms
1	3	23.0	100.0	0	0	20	0	0	0	5.7	3.0
2	5	38.5	60.0	0	20.0	0	0	0	0	6.0	4.0
3	5	38.5	20.0	0	80.0	0	0	0	0	5.8	3.8
4	0	0	0	0	0	0	0	0	0	0	0
Total Sample	13	100.0	53.8	0	38.5	7.7	0	0	0	5.8	3.7

1) 1:= < 500,000 MT; 2:= 500,000 - 1,500,000 MT; 3:= 1,500,000 - 3,000,000 MT; 4:= > 3,000,000 MT
2) 1:= civil servant; 2:= worker; 3:= self-employed; 4:= student; 5:= retired; 6:= unemployed; 7:= Other

Table 2: House Characteristics

	Rooms		House Ownership (%)		
Income Cat.	Kitchen Inside (%)	Bath Inside (%)	Own	Service	Rent
1	100.0	100.0	33.3	0	66.7
2	80.0	80.0	80.0	20.0	0
3	60.0	60.0	80.0	0	20.0
4	0	0	0	0	0
Total	76.9	76.9	69.2	7.7	23.1

Table 3: House Characteristics

	Walls (%)				Roof (%)			
Income	Bricks	Wood/Zinc	Reeds	Reed/Sand	Tiles	Zinc	Reed	Grass
1					100.0	0		
2					100.0	0		
3					60.0	40.0		
4					0	0		
Total	100.0	0	0	0	84.6	15.4	0	0

Table 4: Average Monthly Expenditures (1000 MT)

Income Cat.	Rent	Water	Electricity	Other Energy	Telephone	Total Exp. 1)	Tele. Owner	Car Owner
1	10.2	18.7	193.3	63.3	90.0	312.2	33.3	0
2	0	5.0	104.0	45.0	280.0	377.0	40.0	40.0
3	80.0	165.0	523.6	65.0	1016.7	1918.2	60.0	40.0
4	0	0	0	0	0	0	0	0
Total	33.4	65.2	286.0	57.3	616.7	954.8	46.2	30.8

1) average sum of expenditures quantified

Table 5: Fuel/Energy Used in Addition to Electricity (%)

Income Category	1	2	3	4	Total
1. Fuelwood	0	20.0	0	0	7.7
2. Charcoal	33.3	20.0	40.0	0	30.7
3. LPG					0
4. Kerosene					0
6. FW+Charc.	0	20.0	20.0	o	15.4
7. FW+LPG					0
8. FW+Kero					0
9. Charc+LPG	33..3	0	20.0	0	15.4
10. Charc.+Kero					0
11. LPG+Kero					0
12. FW+Charc.+Kero	33.3	20.0	0	0	15.4
13. FW+Char+LPG					0
14. FW+Kero+LPG					0
15. Cha+Ker+LPG					0
16. Solar					0
18. No					

Table 6: Electricity End Uses (%)

Income	Lighting	Radio	TV	Freezing	Air Cond	Water Heat.	Cooking	Others
1								
2								
3								
4								
Total	100.0	100.0	46.2 69.2	38.5	30.8	30.8	46.2	

Table 7: Electric Appliances (%)

Income	Iron	Vac cleane r	Kettle	Mixer	Termo Ac	Heater	Fan	Comp	Hair Dryer	Toaster	MicroWav e	Water Pump
1												
2												
3												
4												
Total	92.3	7.7	15.4	23.1	23.1	15.4	38.5	0	15.4	7.7	7.7	15.4

Table 8: Stove/Fuel Used For Cooking (%)

Income	1	2	3	4	Total
Stove/Fuel					
1. Fuelwood					0
2. Charcoal					0
3. LPG					0
4. Kerosene					0
5. Electricity	33.3	40.0	40.0	0	38.5
6. FW+Charc.	0	60.0	40.0	0	38.5
7. FW+LPG					0
8. FW+Kero					0
9. Chrac.+LPG	33.3	0	0	0	7.7
10. Charc.+Kero					0
11. LPG+Kero					0
12. FW+Cha+Kero					0
13. FW+Cha+LPG	33.3	0	0	0	7.6
14. FW+Ker+LPG					0
15. Cha+Ker+LPG					0
16. Solar					0
17. Electr.+LPG	0	0	20	0	7.7
Cooking Time (Minutes)					
- Breakfast					28.8
- Lunch					101.5
- Dinner					60.0
- Total Time					190.3

Table 9: Reliability and Service Assessment

Income	Frequency of Disruptions (%) 1)				Duration of Disruptions (%) 2)			Reliability Trend (%)			Service Assessment (%)		
Cat.	1	2	3	4	1	2	3	better	same	worse	bad	reasonable	good
1													
2													
3													
4													
Total	46.1	30.8	15.4	7.7	53.8	30.8	14.4	46.1	46.2	7.7	7.7	23.1	69.2

1) 1:= once a year; 2:= once a month; 3:= once a week; 4:= more than twice a week
2) 1:= < 1 hour; 2:= about 1 hour; 3:= > 2 hours

Table 10: Electricity Consumption

Income	Period of Service (%)			Average Monthly Consumption (kWh)				
Category	< 1 year	1 - 5 years	> 5 years	Total	With Electric Cooking	Without Electric Cooking	With Air Conditioning	Without Air Conditioning
1				239.0	na	239.0	na	239.0
2				109.8	256.2	61.0	256.2	256.2
3				612.1	1113.1	111.2	1113.1	111.2
4				0	0	0	0	0
Total	0	15.4	84.6	336.6	827.4	126.2	827.4	126.2

2.4: TABLES NAMPULA DOMESTIC

Table 1: Household Characteristics

Monthly Income			Occupation (%) 2)							Av. # Person	Av. # Rooms
Category 1)	#	% of Total	1	2	3	4	5	6	7		
1	70	73.7	42.9	8.6	37.1	0	5.7	4.3	1.4	6.1	3.8
2	19	20.0	42.1	5.3	47.4	0	5.2	0	0	7.1	3.9
3	6	6.3	33.3	0	66.7	0	0	0	0	8.2	4.7
4	0	0	0	0	0	0	0	0	0	0	0
Total Sample	95	100.0	42.1	7.4	41.1	0	5.3	3.2	0.9	6.5	3.9

1) 1:= < 500,000 MT; 2:= 500,000 - 1,500,000 MT; 3:= 1,500,000 - 3,000,000 MT; 4:= > 3,000,000 MT
2) 1:= civil servant; 2:= worker; 3:= self-employed; 4:= student; 5:= retired; 6:= unemployed; 7:= Other

Table 2: House Characteristics

	Rooms		House Ownership (%)		
Income Cat.	Kitchen Inside (%)	Bath Inside (%)	Own	Service	Rent
1	24.3	28.6	80.0	0	20.0
2	36.8	42.1	63.2	0	31.6
3	83.3	83.3	66.7	0	33.3
4	0	0	0	0	0
Total	30.5	34.7	75.8	0	23.2

Table 3: House Characteristics

	Walls (%)				Roof (%)			
Income	Bricks	Wood/Zinc	Reeds	Reed/Sand	Tiles	Zinc	Reed	Grass
1	72.9	0	4.3	22.8	25.7	27.1	0	47.2
2	73.7	0	5.3	15.8	36.8	31.6	5.3	21.3
3	100.0	0	0	0	33.3	66.7	0	0
4	0	0	0	0	0	0	0	0
Total	74.7	0	4.3	20.0	28.4	30.5	1.1	39.0

Table 4: Average Monthly Expenditures (1000 MT)

Income Cat.	Rent	Water	Electricity	Other Energy	Telephone	Total Expen. 1)	Tel. Owner (%)	Car Owner (%)
1	20.2	20.1	102.6	55.0	121.5	206.4	11.4	10.0
2	16.9	18.7	203.8	71.3	234.0	381.5	26.3	5.3
3	14.1	25.8	139.2	241.0	472.0	836.5	50.0	16.7
4	0	0	0	0	0	0	0	0
Total	18.6	20.2	124.3	72.0	222.4	280.1	16.8	9.5

1) sum of expenditures quantified

Table 5: Fuel/Energy Used in Addition to Electricity (%)

Income Category	1	2	3	4	Total
1. Fuelwood	22.9	5.3	0	0	17.9
2. Charcoal	30.0	42.1	50.0	0	33.7
3. LPG	0	0	0	0	0
4. Kerosene	0	5.3	0	0	1.1
6. FW+Charc.	12.9	15.8	0	0	12.6
7. FW+LPG	0	0	0	0	0
8. FW+Kero	0	0	0	0	0
9. Charc+LPG	0	0	16.7	0	1.1
10. Charc.+Kero	8.6	10.5	0	0	8.4
11. LPG+Kero	0	0	0	0	0
12. FW+Charc.+Kero	18.6	10.5	33.3	0	17.9
13. FW+Char+LPG	0	0	0	0	0
14. FW+Kero+LPG	0	0	0	0	0
15. Cha+Ker+LPG	1.4	5.3	0	0	2.1
16. Solar	0	0	0	0	0
17. No	5.6	5.2	0	0	5.2

Table 6: Electricity End Uses (%)

Income	Lighting	Radio	TV	Freezing	Air Cond.	Water Heat	Cooking	Others
1	100.0	75.7	11.4	15.7	27.1	0	0	47.1
2	94.7	84.2	42.1	26.3	42.1	5.3	10.5	89.5
3	100.0	100.0	16.7	50.0	66.7	0	0	83.3
4	0	0	0	0	0	0	0	0
Total	99.0	79.0	17.9	20.0	32.6	1.1	2.1	57.9

Table 7: Electric Appliances (%)

Income	Iron	Vac.cleane r	Kettle	Mixer	Termo Ac.	Heater	Fan	Comp.	Hair Dryer	Toaster	MicroWav e	Water Pump
1	44.3	0	1.4	1.4	0	0	25.7	0	0	1.4	0	0
2	89.5	0	5.3	5.3	0	5.3	36.8	0	5.3	5.3	0	0
3	100.0	0	0	16.7	0	0	66.7	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0
Total	56.8	0	2.1	3.2	0	1.1	30.5	0	1.1	2.1	0	0

Table 8: Stove/Fuel Used For Cooking (%)

Income / Stove/Fuel	1	2	3	4	Total
1. Fuelwood	1.4	0	0	0	1.1
2. Charcoal	2.9	0	0	0	2.1
3. LPG	0	0	0	0	0
4. Kerosene	0	0	0	0	0
5. Electricity	2.9	21.1	16.7	0	7.4
6. FW+Charc.	91.4	68.4	83.3	0	86.3
7. FW+LPG	0	0	0	0	0
8. FW+Kero	0	0	0	0	0
9. Chrac.+LPG	0	0	0	0	0
10. Charc.+Kero	0	0	0	0	0
11. LPG+Kero	0	0	0	0	0
12. FW+Cha+Kero	1.4	0	0	1.1	1.1
13. FW+Cha+LPG	0	5.3	0	1.1	1.1
14. FW+Ker+LPG	0	0	0	0	0
15. Cha+Ker+LPG	0	0	0	0	0
16. Solar	0	0	0	0	0
17. Electr.+LPG	0	0	0	0	0
Cooking Time (Minutes)					
- Breakfast	40.2	35.1	37.5	0	39.0
- Lunch	98.9	93.5	90.0	0	97.3
- Dinner	106.3	96.8	95.0	0	103.4
- Total Time	245.4	225.4	222.50	0	239.7

Table 9: Reliability and Service Assessment

Income Cat.	Frequency of Disruptions (%) 1)				Duration of Disruptions (%) 2)			Reliability Trend (%)			Service Assessment (%)		
	1	2	3	4	1	2	3	better	same	worse	bad	reasonable	good
1	0	18.6	44.3	37.1	12.9	25.7	61.4	84.3	2.9	12.8	34.3	44.3	21.4
2	0	10.5	21.1	68.4	0	21.1	78.9	63.2	0	36.8	42.1	47.4	5.3
3	0	0	16.7	83.3	16.7	33.3	50.0	33.3	0	66.7	66.7	16.7	16.6
4	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	15.8	37.9	46.3	10.5	25.3	64.2	76.8	2.1	21.1	37.9	43.2	17.9

1) 1:= once a year; 2:= once a month; 3:= once a week; 4:= more than twice a week
2) 1:= < 1 hour; 2:= about 1 hour; 3:= > 2 hours

Table 10: Electricity Consumption

Income Category	Period of Service (%)			Average Monthly Consumption (kWh)				
	< 1 year	1 - 5 years	> 5 years	Total	With Electric Cooking	Without Electric Cooking	With Air Conditioning	Without Air Conditioning
1	7.1	38.6	54.3	140.7	na	140.7	173.2	127.8
2	10.5	21.3	63.2	225.6	404.7	201.7	237.5	217.3
3	0	33.3	66.7	320.6	na	320.6	377.3	235.5
4	0	0	0	0	0	0	0	0
Total	7.4	34.8	56.8	169.3	404.7	163.4	212.5	148.0

Table 11: Metering and kVA-Rating

Income Categ.	Metering (%) 1)				Rating Code (%) 2)						
	1	2	3	4	1	2	3	6	9	13	16
1	92.9	1.4	1.4	4.3	na	na	na	na	na	na	na
2	78.9	0	10.5	5.4	na	na	na	na	na	na	na
3	66.7	0	16.7	16.6	na	na	na	na	na	na	na
4	0	0	0	0	0	0	0	0	0	0	0
Total	88.4	1.1	4.2	5.3	na	na	na	na	na	na	na

1) 1:= every month; 2:= every two months; 3:= irregular; 4:= do not know
2) 1:= 1.1 kVA; 2:= 2.2 kVA; 3:= 3.3 kVA; 6:= 6.6 kVA; 9:= 9.9kVA; 13:= 13.2kVA; 16:= 16.5kVA

2.5: TABLES QUELIMANE DOMESTIC

Table 1: Household Characteristics

Monthly Income			Occupation (%) 2)							Av. #	Av. #
Category 1)	#	% of Total	1	2	3	4	5	6	7	Person	Rooms
1	34	51.5	52.9	0	32.4	0	8.8	5.9	0	5.7	3.8
2	27	40.9	48.2	11.1	33.3	0	0	7.4	0	7.1	4.1
3	5	7.6	100.0	0	0	0	0	0	0	5.6	4.2
4	0	0	0	0	0	0	0	0	0	0	0
Total Sample	66	100.0	54.5	4.5	30.3	0	4.6	6.1	0	6.3	3.9

1) 1:= < 500,000 MT; 2:= 500,000 - 1,500,000 MT; 3:= 1,500,000 - 3,000,000 MT; 4:= > 3,000,000 MT
2) 1:= civil servant; 2:= worker; 3:= self-employed; 4:= student; 5:= retired; 6:= unemployed; 7:= Other

Table 2: House Characteristics

	Rooms		House Ownership (%)		
Income Cat.	Kitchen Inside (%)	Bath Inside (%)	Own	Service	Rent
1	29.4	23.5	88.2	5.9	5.9
2	48.2	48.2	66.7	0	33.3
3	60.0	60.0	60.0	0	40.0
4	0	0	0	0	0
Total	39.4	36.4	77.3	3.0	19.7

Table 3: House Characteristics

	Walls (%)				Roof (%)			
Income	Bricks	Wood/Zinc	Reeds	Reed/Sand	Tiles	Zinc	Reed	Grass
1	47.1	29.4	2.9	20.6	29.4	41.2	20.6	8.8
2	48.2	33.3	0	18.5	48.22	25.9	14.8	11.1
3	80.0	20.0	0	0	80.0	20.0	0	0
4	0	0	0	0	0	0	0	0
Total	50.0	30.3	1.5	18.2	40.9	33.3	16.7	9.1

Table 4: Average Monthly Expenditures (1000 MT)

Income Cat.	Rent	Water	Electricity	Other Energy	Telephone	Total Expend. 1)	Tel. Owner (%)	Car Owner (%)
1	14.9	29.0	51.4	52.9	225.0	237.1	5.9	2.9
2	98.6	36.3	81.7	80.9	236.0	368.9	22.2	14.8
3	21.0	15.8	72.0	58.8	173.3	419.0	60.0	0
4	0	0	0	0	0	0	0	0
Total	69.6	30.8	65.5	64.7	216.8	304.8	16.7	7.6

1) sum of expenditures considered in Table 4

Table 5: Fuel/Energy Used in Addition to Electricity (%)

Income Category	1	2	3	4	Total
1. Fuelwood	0	3.7	0	0	1.5
2. Charcoal	92.4	88.8	40.0	0	81.8
3. LPG	0	0	0	0	0
4. Kerosene	0	0	0	0	0
6. FW+Charc.	2.9	3.7	20.0	0	4.6
7. FW+LPG	0	0	0	0	0
8. FW+Kero	0	0	0	0	0
9. Charc+LPG	0	0	0	0	0
10. Charc.+Kero	5.9	0	40.0	0	6.1
11. FW+LPG+Kero	0	0	0	0	0
12. FW+Charc.+Kero	5.9	0	0	0	3.0
13. FW+Char+LPG	0	0	0	0	0
14. FW+Kero+LPG	0	0	0	0	0
15. Cha+Ker+LPG	0	0	0	0	0
16. Solar	0	0	0	0	0
18. No					

Table 6: Electricity End Uses (%)

Income	Lighting	Radio	TV	Freezing	Air Cond	Water Heat	Cooking	Others
1	97.1	82.4	5.9	11.8	23.5	0	0	55.9
2	100.0	77.8	14.8	33.3	37.0	3.7	0	66.7
3	100.0	100.0	20.0	80.0	40.0	0	0	100.0
4	0	0	0	0	0	0	0	0
Total	98.5	81.8	10.6	25.8	30.3	1.5	0	63.6

Table 7: Electric Appliances (%)

Income	Iron	Vac.cleane r	Kettle	Mixer	Termo Ac	Heater	Fan	Comp	Hair Dryer	Toaster	MicroWav e	Water Pump
1	47.1	0	0	2.9	0	0	29.4	0	2.9	0	0	0
2	66.7	0	7.4	11.1	0	0	37.0	0	14.8	3.7	0	3.7
3	100.0	0	0	20.0	0	0	40.0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0
Total	59.1	0	3.0	7.6	0	0	33.3	0	7.6	1.5	0	1.5

Table 8: Stove/Fuel Used For Cooking (%)

Income / Stove/Fuel	1	2	3	4	Total
1. Fuelwood	0	0	0	0	0
2. Charcoal	2.9	11.1	0	0	6.1
3. LPG	0	0	0	0	0
4. Kerosene	0	0	0	0	0
5. Electricity	2.9	3.7	0	0	3.0
6. FW+Charc.	94.1	81.5	100.0	0	89.4
7. FW+LPG	0	0	0	0	0
8. FW+Kero	0	0	0	0	0
9. Chrac.+LPG	0	0	0	0	0
10. Charc.+Kero	0	0	0	0	0
11. LPG+Kero	0	0	0	0	0
12. FW+Cha+Kero	0	0	0	0	0
13. FW+Cha+LPG	0	0	0	0	0
14. FW+Ker+LPG	0	0	0	0	0
15. Cha+Ker+LPG	0	0	0	0	0
16. Solar	0	0	0	0	0
17. Electr.+LPG	0	3.7	0	0	1.5
Cooking Time (Minutes)					
- Breakfast	56.3	64.0	66.0	0	60.2
- Lunch	125.3	131.9	144.0	0	129.4
- Dinner	112.7	116.8	132.0	0	115.9
- Total Time	294.3	312.7	342.0	0	305.5

Table 9: Reliability and Service Assessment

Income Cat.	Frequency of Disruptions (%) 1)				Duration of Disruptions (%) 2)			Reliability Trend (%)			Service Assessment (%)		
	1	2	3	4	1	2	3	better	same	worse	bad	reasonable	good
1	0	44.1	35.3	20.6	11.8	26.5	61.7	32.4	38.2	29.4	11.8	67.6	20.6
2	3.7	25.9	14.8	55.6	3.7	37.0	59.3	33.3	33.3	33.3	14.8	66.7	18.5
3	20.0	20.0	20.0	40.0	0	20.0	80.0	0	60.0	40.0	20.0	20.0	60.0
4	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	3.0	34.9	25.6	36.4	7.6	30.3	62.1	30.3	37.9	31.8	13.6	63.6	22.8

1) 1:= once a year; 2:= once a month; 3:= once a week; 4:= more than twice a week
2) 1:= < 1 hour; 2:= about 1 hour; 3:= > 2 hours

Table 10: Electricity Consumption

Income Category	Period of Service (%)			Average Monthly Consumption (kWh)				
	< 1 year	1 - 5 years	> 5 years	Total	With Electric Cooking	Without Electric Cooking	With Air Conditioning	Without Air Conditioning
1	20.6	41.2	38.2	62.4	na	62.4	137.0	39.7
2	14.8	37.0	48.2	97.2	na	97.2	92.3	100.7
3	0	20.0	80.0	91.2	na	91.2	24.5	134.0
4	0	0	0	0	o	0	0	0
Total	16.7	37.9	45.4	79.4	na	79.4	102.0	68.7

Table 11: Metering and kVA-Rating

Income Categ.	Metering (%) 1)				Rating Code (%) 2)						
	1	2	3	4	1	2	3	6	9	13	16
1	94.2	0	2.9	2.9							
2	77.8	0	14.8	7.4							
3	100.0	0	0	0							
4	0	0	0	0							
Total	87.9	0	7.6	4.5							

1) 1:= every month; 2:= every two months; 3:= irregular; 4:= do not know
2) 1:= 1.1 kVA; 2:= 2.2 kVA; 3:= 3.3 kVA; 6:= 6.6 kVA; 9:= 9.9kVA; 13:= 13.2kVA; 16:= 16.5kVA

2.6: TABLES PEMBA/INHAMBANE DOMESTIC

Table 1: Household Characteristics

Monthly Income			Occupation (%) 2)							Av. #	Av. #
Category 1)	#	% of Total	1	2	3	4	5	6	7	Person	Rooms
1	20	48.8	65.0	5.0	20.0	0	10.0	0	0	6.1	3.8
2	18	43.9	72.2	0	22.2	0	5.6	0	0	7.3	4.1
3	3	7.3	66.7	33.3	0	0	0	0	0	3.7	4.3
4	0	0	0	0	0	0	0	0	0	0	0
Total Sample	41	100.0	68.3	4.9	19.5	0	7.3	0	0	6.4	3.9

1) 1:= < 500,000 MT; 2:= 500,000 - 1,500,000 MT; 3:= 1,500,000 - 3,000,000 MT; 4:= > 3,000,000 MT
2) 1:= civil servant 2:= worker; 3:= self-employed; 4:= student; 5:= retired; 6:= unemployed; 7:= Other

Table 2: House Characteristics

	Rooms		House Ownership (%)		
Income Cat.	Kitchen Inside (%)	Bath Inside (%)	Own	Service	Rent
1	25.0	40.0	90.0	5.0	5.0
2	33.3	50.0	66.7	5.5	27.8
3	100.0	100.0	66.7	33.3	0
4	0	0	0	0	0
Total	34.2	48.9	78.1	7.3	14.6

Table 3: House Characteristics

	Walls (%)				Roof (%)			
Income	Bricks	Wood/Zinc	Reeds	Reed/Sand	Tiles	Zinc	Reed	Grass
1	45.0	10.0	15.0	30.0	30.0	15.0	50.0	5.0
2	66.7	0	22.2	11.1	61.1	16.7	22.2	0
3	100.0	0	0	0	100.0	0	0	0
4	0	0	0	0	0	0	0	0
Total	58.5	4.9	17.1	19.5	48.9	14.6	34.1	2.4

Table 4: Average Monthly Expenditures (1000 MT)

Income Cat.	Rent	Water	Electricity	Other Energy	Telephone	Total Expen. 1)	Tel. Owner (%)	Car Owner (%)
1	6.2	22.1	49.6	68.4	0			
2	24.8	18.3	53.1	103.0	100.0			
3	0	87.5	110.0	79.0	0			
4	0	0	0	0	0			
Total 1	21.7	24.9	54.2	83.4	100.0			

1) sum of expenditures quantified

Table 5: Fuel/Energy Used in Addition to Electricity (%)

Income Category	1	2	3	4	Total
1. Fuelwood	40.0	27.8	0	0	31.7
2. Charcoal	40.0	33.3	66.7	0	39.0
3. LPG	0	0	0	0	0
4. Kerosene	0	0	0	0	0
6. FW+Charc.	10.0	16.7	0	0	12.2
7. FW+LPG	0	11.1	33.3	0	7.3
8. FW+Kero	0	5.6	0	0	2.4
9. Charc+LPG	0	0	0	0	0
10. Charc.+Kero	5.0	0	0	0	2.4
11. LPG+Kero	0	0	0	0	0
12. FW+Charc.+Kero	5.0	0	0	0	2.4
13. FW+Char+LPG	0	0	0	0	0
14. FW+Kero+LPG	0	0	0	0	0
15. Cha+Ker+LPG	0	0	0	0	0
16. Solar	0	0	0	0	0
18. No					

Table 6: Electricity End Uses (%)

Income	Lighting	Radio	TV	Freezing	Air Cond.	Water Heat	Cooking	Others
1	100.0	90.0	0	35.0	15.0	0	0	50.0
2	100.0	88.9	11.1	50.0	16.7	0	11.1	50.0
3	100.0	33.3	33.3	66.7	66.7	0	33.3	66.7
4	0	0	0	0	0	0	0	0
Total	100.0	85.4	7.3	43.9	19.5	0	7.3	51.2

Table 7: Electric Appliances (%)

Income	Iron	Vac.cleaner	Kettle	Mixer	Tenno Ac	Heater	Fan	Comp.	Hair Dryer	Toaster	MicroWave	Water Pump
1	75.0	0	15.0	5.0	0	0	25.0	5.0	0	5.0	0	0
2	83.3	0	5.6	11.1	0	0	50.0	0	5.6	0	0	0
3	100.0	0	0	66.7	0	0	66.7	0	33.3	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0
Total	80.5	0	9.8	12.2	0	0	39.0	2.4	4.9	2.4	0	0

Table 8: Stove/Fuel Used For Cooking (%)

Income / Stove/Fuel	1	2	3	4	Total
1. Fuelwood	10.0	11.1	0	0	9.8
2. Charcoal	0	0	33.3	0	2.4
3. LPG	5.0	0	0	0	2.4
4. Kerosene	0	0	0	0	0
5. Electricity	0	0	33.3	0	2.4
6. FW+Charc.	80.0	72.2	0	0	70.7
7. FW+LPG	0	0	0	0	0
8. FW+Kero	0	0	0	0	0
9. Chrac.+LPG	0	0	0	0	0
10. Charc.+Kero	0	0	0	0	0
11. LPG+Kero	0	0	0	0	0
12. FW+Cha+Kero	5.0	0	0	0	2.4
13. FW+Cha+LPG	0	11.1	33.3	0	7.4
14. FW+Ker+LPG	0	0	0	0	0
15. Cha+Ker+LPG	0	0	0	0	0
16. Solar	0	0	0	0	0
17. Electr.+LPG	0	0	0	0	0
Cooking Time (Minutes)					
- Breakfast	40.5	41.3	40.5	0	40.8
- Lunch	105.0	105.9	105.0	0	105.8
- Dinner	88.2	76.8	88.2	0	79.5
- Total Time	233.7	224.1	233.7	0	226.1

Table 9: Reliability and Service Assessment

Income Cat.	Frequency of Disruptions (%) 1)				Duration of Disruptions (%) 2)			Reliability Trend (%)			Service Assessment (%)		
	1	2	3	4	1	2	3	better	same	worse	bad	reasonable	good
1	15.0	50.0	15.0	20.0	20.0	20.0	60.0	80.0	15.0	5.0	0	70.0	30.0
2	5.6	38.9	27.8	27.8	33.3	27.8	38.9	66.7	27.8	5.5	0	88.9	11.1
3	0	33.3	33.3	33.3	33.3	66.7	0	66.7	33.3	0	33.3	66.7	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	9.8	43.9	21.9	24.4	26.8	26.8	46.4	73.2	22.0	4.8	2.4	78.1	19.5

1) 1:= once a year; 2:= once a month; 3:= once a week; 4:= more than twice a week
2) 1:= < 1 hour; 2:= about 1 hour; 3:= > 2 hours

Table 10: Electricity Consumption

Income Category	Period of Service (%)			Average Monthly Consumption (kWh)			
	< 1 year	1 - 5 years	> 5 years	Total	With Electric Cooking	Without Electric Cooking	With Air Conditioning
1	0	30.0	70.0	na			
2	5.6	33.3	61.1	na			
3	0	33.3	66.7	na			
4	0	0	0	0			
Total	2.4	31.7	65.9	na			

Table 11: Metering and kVA-Rating

Income Categ.	Metering (%) 1)				Rating Code (%) 2)						
	1	2	3	4	1	2	3	6	9	13	16
1	70.0	15.0	15.0	0							
2	83.3	0	11.1	5.6							
3	66.7	0	0	33.3							
4	0	0	0	0							
Total	75.6	7.3	12.2	4.9							

1) 1:= every month; 2:= every two months; 3:= irregular; 4:= do not know
2) 1:= 1.1 kVA; 2:= 2.2 kVA; 3:= 3.3 kVA; 6:= 6.6 kVA; 9:= 9.9kVA; 13:= 13.2kVA; 16:= 16.5kVA

2.7: TABLES SUMMARY DOMESTIC

Table 1: Household Characteristics

			Occupation (%) 1)							Av. # Person	Av. # Rooms
	#	% of Total	1	2	3	4	5	6	7		
Maputo	517		46.2	18.0	18.2	0.5	6.7	3.3	7.0	6.9	5.3
Beira	67		58.2	16.4	16.4	0	1.5	3.0	0	6.2	3.6
Chimoio	13		53.8	38.5	38.5	7.7	0	0	0	5.8	3.7
Quelimane	66		54.5	30.3	30.3	0	4.6	6.1	0	6.3	3.9
Nampula	95		42.1	41.1	41.1	0	5.3	3.2	0.9	6.5	3.9
Inhambane/ Pemba	42		68.3	19.5	19.5	0	7.3	0	0	6.4	3.9

1) 1:= civil servant; 2:= worker; 3:= self-employed; 4:= student; 5:= retired; 6:= unemployed; 7:= Other

Table 2: House Characteristics

	Rooms		House Ownership (%)		
	Kitchen Inside (%)	Bath Inside (%)	Own	Service	Rent
Maputo	70.2	65.6	61.1	1.9	37.0
Beira	97.0	95.5	9.0	7.5	83.5
Chimoio	76.9	76.9	69.2	7.7	23.1
Quelimane	39.4	46.4	77.3	3.0	19.7
Nampula	30.5	34.7	75.8	0	23.2
Inhambane/ Pemba	34.2	48.9	78.1	7.3	14.6

Table 3: House Characteristics

	Walls (%)				Roof (%)			
	Bricks	Wood/Zinc	Reeds	Reed/Sand	Tiles	Zinc	Reed	Grass
Maputo	94.4	5.2	0	0.2	61.3	36.4	0	0
Beira	98.5	1.5	0	0	95.5	4.5	0	0
Chimoio	100.0	0	0	0	84.6	15.4	0	0
Quelimane	50.0	30.3	1.5	18.2	40.9	33.3	16.7	9.1
Nampula	74.7	0	4.3	20.0	28.4	30.5	1.1	39.0
Inhambane/ Pemba	58.5	4.9	17.1	19.5	48.9	14.6	34.1	2.4

Table 4: Average Monthly Expenditures (1000 MT)

	Rent	Water	Electricity	Other Energy	Telephone	Total Exp. 1)	Tele. Owner	Car Owner
Maputo	28.8	24.3	183.5	142.2	251.9	651.3	37.5	22.1
Beira	45.3	23.8	136.5	108.6	265.3	487.0	26.9	22.4
Chimoio	33.4	65.2	286.0	57.3	616.7	954.8	46.2	30.8
Quelimane	69.6	30.8	65.5	64.7	216.8	304.8	16.7	7.6
Nampula	18.6	20.2	124.3	72.0	224.4	280.1	16.8	9.5
Inhambane/ Pemba	21.7	24.9	54.2	83.4	100.0			

1) sum of expenditures quantified

Table 5: Fuel/Energy Used in Addition to Electricity (%)

Income Category	Maputo	Beira	Chimoio	Quelimane	Nampula	Inhamb/Pemba
1. Fuelwood	1.7	0	7.7	1.5	17.9	31.7
2. Charcoal	33.1	65.7	30.7	81.8	33.7	39.0
3. LPG	19.2	6.0	0	0	0	0
4. Kerosene	0.2	4.5	0	0	1.1	0
6. FW+Charc.	12.6	0	15.4	4.6	12.6	12.2
7. FW+LPG	0.4	0	0	0	0	7.3
8. FW+Kero	0.2	0	0	0	0	2.4
9. Charc+LPG	18.0	7.5	15.4	0	1.1	0
10. Charc.+Kero		9.0	0	6.1	8.4	2.4
11. LPG+Kero	0.6	0	0	0	0	0
12. FW+Charc.+Kero	0.4	0	15.4	3.0	17.9	2.4
13. FW+Char+LPG	2.9	0	0	0	0	0
14. FW+Kero+LPG	0	0	0	0	0	0
15. Cha+Ker+LPG	1.2	1.5	0	0	2.1	0
16. Solar	0	0	0	0	0	
18. No		5.8			5.2	

Table 6: Electricity End Uses (%)

	Lighting	Radio	TV	Freezing	Air Cond.	Water Heat.	Cooking	Others
Maputo	100.0	91.3						
Beira	100.0	79.1						
Chimoio	100.0	100.0						
Quelimane	98.5	81.8						
Nampula	100.0	79.0						
Inhamb/ Pemba	100.0	85.4						

Table 7: Electric Appliances (%)

	Iron	Vaccleaner	Kettle	Mixer	Termo Ac	Heater	Fan	Comp	Hair Dryer	Toaster	MicroWave	Water Pump
Maputo												
Beira												
Chimoio												
Quelima												
Nampula												
Inhamb/ Pemba												

Table 8: Stove/Fuel Used For Cooking (%)

	Maputo	Beira	Chimoio	Quelimane	Nampula	Inhambane/ Pemba
1. Fuelwood	0	1.5	0	0	1.1	9.8
2. Charcoal	0	0	0	6.1	2.1	2.4
3. LPG	18.0	7.5	0	0	0	2.4
4. Kerosene	0.2	0	0	0	0	0
5. Electricity	39.7	35.8	38.5	3.0	7.4	2.4
6. FW+Charc.	26.7	50.7	38.5	89.4	86.3	70.7
7. FW+LPG	0	0	0	0	0	0
8. FW+Kero	0	0	0	0	0	0
9. Chrac.+LPG	0	0	7.7	0	0	0
10. Charc.+Kero	0	0	0	0	0	0
11. LPG+Kero	0	0	0	0	0	0
12. FW+Cha+Kero	1.9	0	0	0	1.1	2.4
13. FW+Cha+LPG	3.9	0	7.6	0	1.1	7.4
14. FW+Ker+LPG	0	0	0	0	0	0
15. Cha+Ker+LPG	0	0	0	0	0	0
16. Solar	0	0	0	0	0	0
17. Electr.+LPG	9.7	4.5	7.7	1.5	0	0
Cooking Time (Minutes)						
- Breakfast						
- Lunch						
- Dinner						
- Total Time						

Table 9: Reliability and Service Assessment

	Frequency of Disruptions (%) 1)				Duration of Disruptions (%) 2)			Reliability Trend (%)			Service Assessment (%)		
	1	2	3	4	1	2	3	better	same	worse	bad	reasonable	good
Maputo	13.4	36.9	20.3	28.1	25.5	40.2	33.1	55.7	31.5	12.8	22.4	57.2	20.1
Beira	7.5	26.9	22.4	43.3	16.4	31.3	52.3	41.8	35.8	22.4	14.9	65.7	19.4
Chimoio	46.1	30.8	15.4	7.7	53.8	30.8	15.4	46.1	46.2	7.7	7.7	23.1	69.2
Quelimane	3.0	34.9	25.6	36.4	7.6	30.3	62.1	30.3	37.9	31.8	13.6	63.6	22.8
Nampula	0	15.8	37.9	46.3	10.5	25.3	64.2	76.8	2.1	21.1	37.9	43.2	17.9
Inhamb/ Pemba	9.8	43.9	21.9	24.4	26.8	26.8	46.4	73.2	22.0	4.8	2.4	78.1	19.5

1) 1:= once a year; 2:= once a month; 3:= once a week; 4:= more than twice a week
2) 1:= < 1 hour; 2:= about 1 hour; 3:= > 2 hours

Table 10: Electricity Consumption

	Period of Service (%)			Average Monthly Consumption (kWh)				
	< 1 year	1 - 5 years	> 5 years	Total	With Electric Cooking	Without Electric Cooking	With Air Conditioning	Without Air Conditioning
Maputo	3.5	16.2	80.3	243.0	300.5	173.5	424.1	204.2
Beira	3.0	17.9	79.1	229.6	416.9	132.2	693.8	138.2
Chimoio	0	15.4	84.6	336.6	827.4	126.2	827.4	126.2
Quelima	16.7	37.9	45.4	79.4	na	79.4	101.9	68.7
Nampula	7.4	34.8	56.8	169.3	404.7	183.4	212.5	148.0
Inhamb/ Pemba	2.4	31.7	65.9	na	na	na	na	na

Table 11: Metering and kVA-Rating

	Metering (%) 1)				Rating Code (%) 2)						
	1	2	3	4	1	2	3	6	9	13	16
Maputo	81.2	0.4	9.9	8.5							
Beira	95.5	0	4.5	0							
Chimoio	100.0	0	0	0							
Quelimane	87.9	0	7.6	4.5							
Nampula	88.4	1.1	4.2	5.3							
Inhambane/ Pemba	75.6	7.3	12.2	4.9							

1) 1:= every month; 2:= every two months; 3:= irregular; 4:= do not know 2) 1:= 1.1 kVA; 2:= 2.2 kVA; 3:= 3.3 kVA; 6:= 6.6 kVA; 9:= 9.9kVA; 13:= 13.2kVA; 16:= 16.5kVA

2.8: TABLES CENTRAL SYSTEM DOMESTIC (STRATIFIED)

Table 1: Household Characteristics

Monthly Income			Occupation (%) 2)							Av. #	Av. #
Category 1)	#	% of Total	1	2	3	4	5	6	7	Person	Rooms
1	26	32.5	47.5	18.8	18.8	0	3.8	7.5	3.7	6.6	3.4
2	43	53.7	67.3	18.2	11.8	2.7	0	0	0	5.7	3.8
3	11	13.8	60.3	0	39.7	0	0	0	0	7.4	3.5
4	0	0	0	0	0	0	0	0	0	0	0
Total Sample	80	100.0	57.6	16.7	19.4	1.1	1.3	2.6	1.3	6.1	3.7

1) 1:= < 500,000 MT; 2:= 500,000 - 1,500,000 MT; 3:= 1,500,000 - 3,000,000 MT; 4:= > 3,000,000 MT
2) 1:= civil servant; 2:= worker; 3:= self-employed; 4:= student; 5:= retired; 6:= unemployed; 7:= Other

Table 2: House Characteristics

	Rooms		House Ownership (%)		
Income Cat.	Kitchen Inside (%)	Bath Inside (%)	Own	Service	Rent
1	92.5	88.7	27.1	7.5	65.4
2	97.3	97.3	11.0	9.6	79.5
3	94.5	94.5	11.0	0	89.0
4	0	0	0	0	0
Total	94.3	93.0	17.2	7.5	75.3

Table 3: House Characteristics

	Walls (%)				Roof (%)			
Income	Bricks	Wood/Zinc	Reeds	Reed/Sand	Tiles	Zinc	Reed	Grass
1	96.3	3.7	0	0	92.5	7.5	0	0
2	100.0	0	0	0	97.7	2.3	0	0
3	100.0	0	0	0	94.5	5.5	0	0
4	0	0	0	0	0	0	0	0
Total	98.8	1.2	0	0	94.0	6.0	0	0

Table 4: Average Monthly Expenditures (1000 MT)

Income Cat.	Rent	Water	Electricity	Other Energy	Telephone	Total Expend. 1)	Tel. Owner (%)	Car Owner (%)
1	13.4	19.2	101.1	83.1	222.5	281.7	15.8	7.5
2	46.2	10.1	138.8	102.5	248.3	473.5	32.7	35.0
3	72.5	63.0	312.8	184.7	435.8	1176.8	51.4	5.5
4	0	0	0	0	0	0	0	0
Total 1	43.4	39.4	157.0	101.6	308.9	551.1	29.5	23.5

1) sum of expenditures considered in Table 4

Table 5: Fuel/Energy Used in Addition to Electricity (%)

Income Category	1	2	3	4	Total
1. Fuelwood	0	2.7	0	0	1.1
2. Charcoal	87.1	45.9	48.6	0	60.9
3. LPG	0	6.8	14.4	0	5.2
4. Kerosene	0	6.8	0	0	3.9
6. FW+Charc.	0	2.7	2.7	0	2.1
7. FW+LPG	0	0	0	0	0
8. FW+Kero	0	0	0	0	0
9. Charc+LPG	4.6	11.4	2.7	0	8.6
10. Charc.+Kero	3.8	11.4	0	0	7.7
11. LPG+Kero	0	0	0	0	0
12. FW+Charc.+Kero	4.6	2.7	0	0	2.1
13. FW+Char+LPG	0	0	0	0	0
14. FW+Kero+LPG	0	0	0	0	0
15. Cha+Ker+LPG	0	2.3	0	0	1.3
16. Solar	0	0	0	0	0
18. No					

Table 6: Electricity End Uses (%)

Income	Lighting	Radio	TV	Freezing	Air Cond.	Water Heat	Cooking	Others
1	100.0	67.2	34.6	56.3	12.7	0	15.0	0
2	95.5	89.0	66.0	59.4	16.5	12.1	45.9	20.8
3	100.0	100.0	93.5	82.8	51.6	9.8	36.9	23.7
4	0	0	0	0	0	0	0	0
Total	97.4	82.5	58.8	61.3	20.0	10.0	36.4	15.0

Table 7: Electric Appliances (%)

Income	Iron	Vac cleane r	Kettle	Mixer	Termo Ac	Heater	Fan	Comp.	Hair Dryer	Toaster	MicroWav e	Water Pump
1	63.6	0	0	0	0	0	47.3	0	7.3	0	0	0
2	85.7	4.4	5.5	11.0	7.7	0	42.9	0	16.5	6.6	2.2	4.4
3	100.0	3.3	17.2	37.7	6.5	6.5	90.3	0	45.1	17.2	3.3	20.5
4	0	0	0	0	0	0	0	0	0	0	0	0
Total	80.0	3.8	5.0	12.5	6.3	2.5	48.8	0	16.3	6.3	2.5	6.3

Table 8: Stove/Fuel Used For Cooking (%)

Income / Stove/Fuel	1	2	3	4	Total
1. Fuelwood	3.8	0	0	0	1.3
2. Charcoal	0	0	0	0	0
3. LPG	3.8	6.8	14.4	0	6.4
4. Kerosene	0	0	0	0	0
5. Electricity	19.6	44.1	48.6	0	36.2
6. FW+Charc.	63.8	42.3	34.3	0	49.1
7. FW+LPG	0	0	0	0	0
8. FW+Kero	0	0	0	0	0
9. Chrac.+LPG	4.6	0	0	0	1.1
10. Charc.+Kero	0	0	0	0	0
11. LPG+Kero	0	0	0	0	0
12. FW+Cha+Kero	0	0	0	0	0
13. FW+Cha+LPG	4.6	0	0	0	1.1
14. FW+Ker+LPG	0	0	0	0	0
15. Cha+Ker+LPG	0	0	0	0	0
16. Solar	0	0	0	0	0
17. Electr.+LPG	0	6.6	2.7	0	4.9
Cooking Time (Minutes)					
- Breakfast	28.9	29.9	30.0	0	29.6
- Lunch	109.6	89.3	110.9	0	97.3
- Dinner	95.5	69.9	87.2	0	80.4
- Total Time	234.0	189.1	228.1	0	207.3

Table 9: Reliability and Service Assessment

Income Cat.	Frequency of Disruptions (%) 1)				Duration of Disruptions (%) 2)			Reliability Trend (%)			Service Assessment (%)		
	1	2	3	4	1	2	3	better	same	worse	bad	reasonable	good
1	16.3	30.9	20.0	32.8	21.7	27.3	51.0	45.4	25.5	29.1	7.3	63.7	29.0
2	12.0	27.5	25.3	35.2	16.5	38.4	45.1	38.5	46.1	15.4	15.4	52.9	31.7
3	20.4	6.5	14.0	59.1	40.9	27.9	31.2	62.3	34.4	3.3	17.2	62.3	20.5
4	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	13.8	27.5	21.2	37.5	22.5	31.2	46.3	42.5	37.5	20.0	13.8	58.7	27.5

1) 1:= once a year; 2:= once a month; 3:= once a week; 4:= more than twice a week
2) 1:= < 1 hour; 2:= about 1 hour; 3:= > 2 hours

Table 10: Electricity Consumption

Income Category	Period of Service (%)			Average Monthly Consumption (kWh)			
	< 1 year	1 - 5 years	> 5 years	Total	With Electric Cooking	Without Electric Cooking	With Air Conditioning
1	0	16.3	83.7	130.5	na	115.1	na
2	4.4	17.6	78.0	172.1	209.2	155.8	243.4
3	0	17.2	82.8	1170.8	1296.9	na	1296.9
4	0	0	0	0	0	0	0
Total	2.5	17.5	80.0	242.6	465.6	132.6	700.4

Table 11: Metering and kVA-Rating

Income Categ	Metering (%) 1)				Rating Code (%) 2)						
	1	2	3	4	1	2	3	6	9	13	16
1	96.4	0	3.6	0							
2	95.6	0	4.4	0							
3	100.0	0	0	0							
4	0	0	0	0							
Total	96.3	0	3.7	0							

1) 1:= every month; 2:= every two months; 3:= irregular; 4:= do not know
2) 1:= 1.1 kVA; 2:= 2.2 kVA; 3:= 3.3 kVA; 6:= 6.6 kVA; 9:= 9.9kVA; 13:= 13.2kVA; 16:= 16.5kVA

2.9: TABLES NORTHERN SYSTEM DOMESTIC (STRATIFIED)

Table 1: Household Characteristics

Monthly Income			Occupation (%) 2)							Av. # Person	Av. # Rooms
Category 1)	#	% of Total	1	2	3	4	5	6	7		
1	104	64.6	45.5	6.4	35.9	0	6.5	4.7	1.1	6.0	3.8
2	46	28.6	43.7	6.8	43.7	0	3.9	1.9	0	7.1	4.0
3	11	6.8	50.5	0	49.5	0	0	0	0	7.5	4.5
4	0	0	0	0	0	0	0	0	0	0	0
Total Sample	161	100.0	45.3	6.6	38.3	0	5.1	3.9	0.8	6.4	3.9

1) 1:= < 500,000 MT; 2:= 500,000 - 1,500,000 MT; 3:= 1,500,000 - 3,000,000 MT; 4:= > 3,000,000 MT
2) 1:= civil servant; 2:= worker; 3:= self-employed; 4:= student; 5:= retired; 6:= unemployed; 7:= Other

Table 2: House Characteristics

Income Cat.	Rooms		House Ownership (%)		
	Kitchen Inside (%)	Bath Inside (%)	Own	Service	Rent
1	25.6	27.3	82.1	1.5	16.4
2	39.8	43.7	64.1	0	32.0
3	77.3	77.3	64.9	0	35.1
4	0	0	0	0	0
Total	32.8	35.2	76.2	0.8	22.2

Table 3: House Characteristics

Income	Roof (%)				Walls (%)			
	Tiles	Zinc	Reeds	Grass	Bricks	Wood/Zinc	Reed	Reed/Sand
1	26.7	30.8	5.3	37.3	66.2	7.6	3.9	22.3
2	38.8	30.1	7.7	18.5	67.1	8.6	3.9	16.5
3	45.4	54.6	0	0	94.8	5.2	0	0
4	0	0	0	0	0	0	0	0
Total	31.6	31.3	5.1	31.2	68.3	7.8	3.5	19.5

Table 4: Average Monthly Expenditures (1000 MT)

Income Cat.	Rent	Water	Electricity	Other Energy	Telephone	Total Exp. 1)	Tele. Owner	Car Owner
1	18.9	22.3	89.3	54.4	148.2	214.3	10.0	8.2
2	37.9	23.2	172.3	73.8	234.5	378.3	25.3	7.7
3	15.9	23.2	121.8	194.0	394.9	728.8	52.6	12.4
4	0	0	0	0	0	0	0	0
Total 1	31.8	22.9	109.1	70.1	220.9	286.5	16.8	9.0

1) average sum of expenditures considered in Table 4

Table 5: Fuel/Energy Used in Addition to Electricity (%)

Income Category	1	2	3	4	Total
1. Fuelwood	17.0	4.9	0	0	13.7
2. Charcoal	43.5	54.2	47.4	0	46.1
3. LPG	0	0	0	0	0
4. Kerosene	0	3.9	0	0	0.8
6. FW+Charc.	10.3	12.7	5.2	0	10.54
7. FW+LPG	0	0	0	0	0
8. FW+Kero	0	0	0	0	0
9. Charc+LPG	0	0	12.4	0	0.8
10. Charc.+Kero	7.9	7.8	10.3	0	7.8
11. LPG+Kero	0	0	0	0	0
12. FW+Charc.+Kero	15.3	7.8	34.7	0	14.1
13. FW+Char+LPG	0	0	0	0	0
14. FW+Kero+LPG	0	0	0	0	1.5
15. Cha+Ker+LPG	1.1	3.9	0	0	0
16. Solar	0	0	0	0	
18. No				0	

Table 6: Electricity End Uses (%)

Income	Lighting	Radio	TV	AC	Freezing	Water Heat	Cooking	Others
1	99.2	77.4	9.9	26.2	14.9	0	0	49.4
2	96.1	82.6	35.1	40.8	28.1	4.8	7.8	83.6
3	100.0	100.0	17.5	59.8	57.7	0	0	87.6
4	0	0	0	0	0	0	0	0
Total	98.8	79.7	16.0	32.0	21.5	1.2	1.6	59.4

Table 7: Electric Appliances (%)

Income	Iron	Vac.cleane r	Kettle	Mixer	Termo Ac	Heater	Fan	Comp	Hair Dryer	Toaster	MicroWav e	Water Pump
1	45.0	0	1.1	1.8	0	0	26.7	0	0.8	1.1	0	0
2	83.6	0	5.8	6.8	0	3.9	36.9	0	7.7	4.9	0	1.0
3	100.0	0	0	17.5	0	0	59.8	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0
Total	57.4	0	2.3	4.3	0	0.8	31.3	0	2.7	2.0	0	0.4

Table 8: Stove/Fuel Used For Cooking (%)

Income / Stove/Fuel	1	2	3	4	Total
1. Fuelwood	1.1	0	0	0	0.8
2. Charcoal	2.9	2.9	0	0	3.1
3. LPG	0	0	0	0	0
4. Kerosene	0	0	0	0	0
5. Electricity	2.9	16.6	12.4	0	6.3
6. FW+Charc.	92.1	71.8	87.6	0	87.1
7. FW+LPG	0	0	0	0	0
8. FW+Kero	0	0	0	0	0
9. Charc.+LPG	0	0	0	0	0
10. Charc.+Kero	0	0	0	0	0
11. LPG+Kero	0	0	0	0	0
12. FW+Cha+Kero	1.1	0	0	0	0.8
13. FW+Cha+LPG	0	3.9	0	0	0.8
14. FW+Ker+LPG	0	0	0	0	0
15. Cha+Ker+LPG	0	0	0	0	0
16. Solar	0	0	0	0	0
17. Electr.+LPG	0	1.0	0	0	0.4
Cooking Time (Minutes)					
- Breakfast	44.3	42.6	44.9	0	44.5
- Lunch	105.7	103.4	103.9	0	105.6
- Dinner	107.9	102.0	104.6	0	106.9
- Total Time					

Table 9: Reliability and Service Assessment

Income Cat.	Frequency of Disruptions (%) 1)				Duration of Disruptions (%) 2)			Reliability Trend (%)			Service Assessment (%)		
	1	2	3	4	1	2	3	better	same	worse	bad	reasonable	good
1	0	25.2	41.9	32.9	12.6	25.9	61.5	70.9	12.0	17.1	28.5	50.3	21.2
2	1.0	14.4	19.4	65.1	1.0	25.2	73.9	55.5	8.6	35.9	35.0	52.3	8.7
3	5.2	5.2	17.5	72.2	12.4	29.0	57.4	24.7	15.5	59.8	54.6	17.5	27.9
4	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0.8	20.6	34.8	43.7	9.8	26.6	63.7	64.8	11.3	23.8	31.6	48.5	19.1

1) 1:= once a year; 2:= once a month; 3:= once a week; 4:= more than twice a week
2) 1:= < 1 hour; 2:= about 1 hour; 3:= > 2 hours

Table 10: Electricity Consumption

Income Category	Period of Service (%)			Average Monthly Consumption (kWh)			
	< 1 year	1 - 5 years	> 5 years	Total	With Electric Cooking	Without Electric Cooking	With Air Conditioning
1	10.6	39.2	50.1	120.5	na	120.5	163.8
2	11.6	25.2	59.3	192.5	na	174.8	200.1
3	0	29.9	70.1	261.4	na	261.4	286.3
4	0	0	0	0	na	0	0
Total	9.8	35.5	53.9	146.1	na	141.4	184.0

2.10: TOTAL SYSTEM DOMESTIC (STRATIFIED)[1]

Table 1: Household Characteristics

Monthly Income			Occupation (%) 2)							Av. #	Av. #
Category 1)	#	% of Total	1	2	3	4	5	6	7	Person	Rooms
1	322	42.5	39.3	20.5	18.9	0	10.0	6.2	5.1	6.9	4.5
2	318	42.0	51.3	16.8	20.3	1.3	3.7	1.5	5.0	6.9	5.0
3	118	15.5	55.8	3.0	33.0	0	1.5	0.7	5.9	6.3	5.5
Total Sample	758	100.0	47.5	16.0	21.6	0.6	5.8	3.3	5.2	6.7	4.9

1) 1:= < 500,000 MT; 2:= 500,000 - 1,500,000 MT; 3≥ 1,500,000
2) 1:= civil servant; 2:= worker; 3:= self-employed; 4:= student; 5:= retired; 6:= unemployed; 7:= Other

Table 2: House Characteristics

	Rooms		House Ownership (%)		
Income Cat.	Kitchen Inside (%)	Bath Inside (%)	Own	Service	Rent
1	54.1	50.2	64.9	2.7	32.5
2	72.5	68.8	51.8	2.8	44.7
3	89.0	89.0	54.2	0.7	45.1
Total	67.3	64.2	58.0	2,5	39.5

Table 3: House Characteristics

	Walls (%)				Roof (%)			
Income	Bricks	Wood/Zinc	Reeds	Reed/Sand	Tiles	Zinc	Reed	Grass
1	88.2	7.6	0.6	3.6	47.6	43.7	0.8	6.0
2	91.0	4.5	0.6	2.9	64.5	28.8	1.2	3.0
3	98.4	1.6	0	0	81.6	16.9	0	0
Total	90.8	5.2	0.6	3.3	60.7	31.7	0.8	5.0

Table 4: Average Monthly Expenditures (1000 MT)

Income Cat.	Rent	Water	Electricity	Other Energy	Telephone	Total Exp. 1)	Tele. Owner	Car Owner
1	14.3	19.5	117.9	120.1	162.7	328.0	18.1	9.7
2	na	26.7	165.5	128.1	197.5	480.8	33.3	18.4
3	39.0	28.5	294.2	151.6	389.0	1408.5	70.6	42.1
Total 1	31.1	24.7	168.3	125.5	254.4	580.5	33.2	20.1

1) average sum of expenditures considered in Table 4

[1] Excluding isolated areas.

Table 5: Fuel/Energy Used in Addition to Electricity (%)

Income Category	1	2	3	Total
1. Fuelwood	5.7	1.4	0	3.6
2. Charcoal	45.8	39.7	24.9	38.7
3. LPG	7.4	13.0	31.5	14.3
4. Kerosene	0	1.8	0	0.8
6. FW+Charc.	12.4	11.4	6.4	10.9
7. FW+LPG	0	0.6	0	0.3
8. FW+Kero	0	0.3	0	0.1
9. Charc+LPG	12.5	16.1	12.7	14.0
10. Charc.+Kero	2.9	4.2	2.4	3.5
11. LPG+Kero	0.4	0	1.5	0.4
12. FW+Charc.+Kero	3.4	1.9	4.0	2.8
13. FW+Char+LPG	3.3	1.9	0	2.1
14. FW+Kero+LPG	0	0	0	0
15. Cha+Ker+LPG	1.3	1.2	1.5	1.2
16. Solar	0	0	0	0
18. No				

Table 6: Electricity End Uses (%)

Income	Lighting	Radio	TV	Freezing	Air Cond.	Water Heat	Cooking	Others
1	99.9	82.1	50.9	53.5	9.8	1.9	29.0	22.8
2	98.9	91.4	71.1	67.8	20.8	5.1	49.1	37.4
3	100.0	97.0	82.4	83.6	44.3	21.9	58.9	62.2
Total	99.5	88.3	64.5	64.1	19.7	7.2	43.6	34.8

2.11: TABLES MAPUTO GENERAL

Table 1: Customer Characteristics

	Turnover		Av # of Rooms	Av. # of Employees
Category 1)	#	%		
1	35	51.5	3.4	5.9
2	15	22.1	3.0	4.3
3	20	29.4	3.7	7.1
4	33	48.5	7.4	25.6
Total	68	100.0	5.3	15.4

1) 1:= 1 - 10 million MT; 2:= 1 - 5 million MT; 3:= 5 - 10 million MT; 4:= > 10 million MT

Table 2: House /Office Characteristics

Turnover	Rooms		House Ownership (%)		
	Kitchen Inside (%)	Bath Inside (%)	Own	Service	Rent
1	25.7	na	20.0	0	80.0
2	26.7	na	26.7	0	73.3
3	25.0	na	15.0	0	85.0
4	27.3	na	9.1	0	90.9
Total	26.5	na	14.7	0	85.3

Table 3: House/Office Characteristics

	Walls (%)				Roof (%)			
Turnover	Bricks	Wood/Zinc	Reeds	Reed/Sand	Tiles	Zinc	Reed	Grass
1	100.0	0	0	0	94.3	5.7	0	0
2	100.0	0	0	0	93.3	6.7	0	0
3	100.0	0	0	0	95.0	5.0	0	0
4	100.0	0	0	0	93.9	6.1	0	0
Total	100.0	0	0	0	9401	5.9	0	0

Table 4: Average Monthly Expenditures (1000 MT)

Turnover Cat	Rent	Water	Electricity	Other Energy	Transport	Telephone	Salaries	Other
1	340	175	529	315	650	415	21482	10143
2	231	78	263	185	300	242	11370	9250
3	416	226	729	401	737	556	2893	11333
4	3428	332	1448	467	6177	3740	288802	32556
Tota l	1884	259	975	372	4976	2106	150965	22750

Table 5: Fuel/Energy Used in Addition to Electricity (%)

Turnover	1	2	3	4	Total
1. Fuelwood	0	0	0	0	0
2. Charcoal	0	0	0	0	0
3. LPG	0	0	0	12.1	5.9
4. Kerosene	0	0	0	0	0
6. FW+Charc.	8.6	13.3	5.0	0	4.4
7. FW+LPG	0	0	0	0	0
8. FW+Kero	0	0	0	0	0
9. Charc+LPG	0	0	0	0	0
10. Charc.+Kero	0	0	0	0	0
11. LPG+Kero	0	0	0	0	0
12. Charc.+Kero	0	0	0	0	0
13. FW+Char+LPG	8.6	6.7	10.0	0	4.4
14. FW+Kero+LPG	0	0	0	0	0
15. Cha+Ker+LPG	0	0	0	0	0
16. Solar	0	0	0	0	0
18. Diesel	0	0	0	0	0

Table 6: Electricity End Uses (%)

Turnover	Lighting	Radio	TV	Freezing	Air Cond.	Water Heat	Cooking	Others
1	100.0	48.6	8.6	31.4	25.7	5.7	8.6	
2	100.0	53.3	0	13.3	13.3	0	0	
3	100.0	45.0	15.0	45.0	35.0	10.0	15.0	
4	100.0	36.4	18.2	51.5	63.6	9.1	9.1	
Total	100.0	42.7	13.2	41.2	44.1	7.4	8.8	

Table 7: Reliability and Service Assessment

Turnover	Frequency of Disruptions (%) 1)				Duration of Disruptions (%) 2)			Reliability Trend (%)			Service Assessment (%)		
Cat.	1	2	3	4	1	2	3	better	same	worse	bad	reasonabl	good
1	22.9	22.9	5.7	37.1	22.9	28.6	48.5	71.4	20.0	8.6	37.1	51.4	11.5
2	13.3	13.3	13.3	46.7	20.0	20.0	60.0	80.0	13.3	6.7	46.7	33.3	20.0
3	30.0	30.0	0	30.0	25.0	35.0	40.0	65.0	25.0	10.0	30.0	65.0	20.0
4	21.2	39.4	9.1	30.3	45.5	21.2	33.3	60.6	24.2	15.2	30.3	60.6	9.1
Total	22.1	30.9	7.4	33.9	33.8	25.0	41.2	66.2	22.1	11.7	33.8	55.9	10.2

1) 1:= once a year; 2:= once a month; 3:= once a week; 4:= more than twice a week
2) 1:= < 1 hour; 2:= about 1 hour; 3:= > 2 hours

Table 8: Electricity Consumption

Turnover	Period of Service (%)			Average Monthly Consumption (kWh)			
	< 1 year	1 - 5 years	> 5 years	Total	With Electric Cooking	Without Electric Cooking	With Air Conditioning
1				326.6			
2				195.1			
3				425.8			
4				913.4			
Total				612.0			

Table 9: Metering and kVA-Rating

Turnover	Metering (%) 1)				Rating Code (%) 2)						
	1	2	3	4	1	2	3	6	9	13	16
1	88.6	2.9	8.5	0	11.4	31.4	11.4	25.7	8.6	5.7	2.9
2	86.7	0	13.3	0	6.7	46.7	6.7	33.3	0	6.6	0
3	90.0	5.0	5.0	0	15.0	20.0	15.0	20.0	15.0	5.0	5.0
4	84.8	0	9.1	6.1	9.1	12.1	12.1	21.2	18.2	3.0	9.1
Total	86.8	1.5	8.8	2.9	10.3	22.1	11.8	23.5	13.2	4.4	5.9

1) 1:= every month; 2:= every two months; 3:= irregular; 4:= do not know
2)

Appendix 3: Sample Survey Methods - An Overview

This appendix provides an overview of tools and concepts that play a key role in the analysis of data generated by sample surveys. For additional information on sample survey techniques, the reader is referred to V.Barnett, Sample Survey Principles and Methods (1991, Wiley, New York), which is a fairly comprehensive short course text. The standard textbook, which has become a classic, is Morris H.Hansen et.al., Sample Survey Methods and Theory, Vol.I+II (1993, Wiley, New York). A good introduction to probability theory is Sheldon M.Ross, Introduction to Probability Models (1985, Academic Press, Orlando). Appendix 1 applies the tools discussed in this appendix to the sample design underlying the survey of EDM's LV-customers. A program that uses these tools as built-in functions is shown in Appendix 4.

The abbreviations referred to in this appendix are:

Cov = covariance
E = expectation operator
Prob = probability
t = Student's t statistics
Var = variance
z = standard normal distribution

The following terminology is used:

A population is the collection of elements, occasionally referred to as elementary units or population members. A stratum is a sub-group of the population, while a sample is a subset drawn with random sampling. Random sampling means that each possible sample of a given size has the same probability of being selected. A randomly selected group of elements is called a sampling unit. A population characteristic is a variable describing a feature of the population.

1. Simple Random Sampling with Replacement

Throughout this appendix, the samples are assumed to be drawn with replacement. That is, each element drawn from the population is replaced so that the composition of the population remains the same from selection to selection. Random sampling means that each subset of population members that may constitute a sample of a given size has the same probability of being selected.

In particular, let **N** be the size of the finite population, while Y_1, Y_2, ..., Y_N are the values of a characteristic displayed by the different population members. Then there

are $\mathbf{N^n}$ possible samples of size **n**; and if random sampling is done with replacement, for each sample of size n the probability of being selected is $\mathbf{N^{-n}}$.

Moreover, in the case of random sampling with replacement, the selections, which are denoted by $y_1, y_2, ..., y_n$, are binomially distributed with parameters **n** and $\mathbf{N^{-1}}$. As a consequence, the probability that the i-th population member with characteristic Y_i is selected **j** times in a sample of size n is

$$(1) \quad \Pr ob\left\{\sum_{i=1}^{n} y_i = j\right\} = \binom{n}{j} N^{-j} \left(\frac{N-1}{N}\right)^{n-j}, \text{ where}$$

$$\binom{n}{j} = \frac{n!}{(n-j)!\,j!}.$$

The above formula implies that, for instance,

- the probability that the i-th element is selected n times is N^{-n},
- the probability that the sample does not contain the i-th element is $(N-1)^n/N^n$,
- the probability that the i-th element is selected at least once is $1-(N-1)^n/N^n$,
- the probability that the sample contains the i-th element twice is $(n/(n-2)((N-1)^{n-2})/N^n)$.

Also, by applying the permutation rule, it follows that the probability that the sample is composed of n distinct elements is $N!/((N-n)!/N^n))$, where N!/(N-n)! is the number of permutations of size n from a population of size N.

Estimating a Mean

Let Y_i denote the value of a particular characteristic pertaining to the i-th population member. Then the population mean of this characteristic is

$$(2) \quad \mu = \frac{1}{N}\sum_{i=1}^{N} Y_i,$$

and the variance of the population characteristic can be expressed as

$$(2') \quad \sigma^2 = \frac{1}{N}\sum_{i=1}^{N}(Y_i - \mu)^2 = \frac{1}{N}\left(\sum Y_i^2 - N\mu^2\right).$$

In the special case where the population (characteristic) is normally distributed with mean μ and variance σ^2, the third central moment is

$$(3) \quad \frac{\sum_{i=1}^{N}(X_i - \mu)^3}{N} = 0,$$

i.e., there is no skewness[1], and

$$(3') \quad \frac{\sum_{i=1}^{N}(X_i - \mu)^3}{N} = 3\sigma^4.$$

(3') states that the fourth moment of a normally distributed variable is three times the square of its variance. If, however, the fourth moment exceeds this value, the variable displays excess kurtosis, i.e., the variable has thicker tails than in the case of a normal distribution.

Since the random selections $y_1,...,y_n$ are independent, they have a common mean and variance. In fact, since at each selection the probability that a particular population element is drawn into the sample is 1/N, we have

$$E[y_i] = \sum_{j=1}^{N} \frac{1}{N} Y_j = \mu, \qquad \textit{and}$$

$$Var(y_i) = E[(y_i - \mu^2)] = \frac{1}{N}(\sum_{j=1}^{N} Y_j^2 - N\mu^2) = \sigma^2, \quad i = 1,2,...,n..$$

Therefore, the sample mean

$$(4) \quad \bar{y} = \frac{1}{n}\sum_{i=1}^{n} y_i$$

has expectation

$$E[\bar{y}] = \frac{1}{n} E[\sum_{i=1}^{n} y_i = \mu,$$

1 If the third central moment proves positive (negative), the distribution is skewed to the right (left).

and the sample variance (variance of the sample mean) is

$$(5)\quad Var(\bar{y}) = Var(\frac{1}{n}\sum_{i=1}^{n} y_i) = \frac{1}{n^2} nVar(y_i) = \frac{\sigma^2}{n}.$$

Hence, the sample mean is an unbiased estimator of the population mean. The sample variance, however, is deflated by the sample size (i.e., the sample mean has a smaller variance then the individual selections) and has expectation $\sigma^2(n-1)/n$, i.e., is biased.[2] Note that the standard error of the sample mean is $\sigma/\sqrt{n}$; the coefficient of variation (standard error of sample mean divided by the population mean), which is a measure of the relative precision of the sample estimate, is defined as

$$V_{\bar{x}} = \frac{\sqrt{Var(\bar{y})}}{\mu} = \frac{\sigma}{\mu\sqrt{n}} = \frac{V}{\sqrt{n}}, \qquad with \quad V = \frac{\sigma}{\mu}.$$

In practice, population characteristics and, thus, the population variance, are likely to be unknown. A proxy for σ^2, which can be estimated from the sample data, is

$$(6)\quad s^2 = \frac{1}{n-1}\sum_{i=1}^{n}(y_i - \bar{y})^2.$$

The above measure is unbiased. In fact, taking the expectation of s^2 yields

$$E[s^2] = \frac{1}{n-1}\left(E[\sum_{i=1}^{n} y_i^2] - E[n\bar{y}^2]\right) = \frac{1}{n-1}\left((\sum_{i=1}^{N} Y_i^2 / N) - \frac{\sigma^2}{n} - \mu^2\right) = \frac{n}{n-1}(\sigma^2 - \frac{\sigma^2}{n}) = \sigma^2.$$

So we substitute s^2 for σ^2 and obtain

$$(5')\quad Var(\bar{y}) \approx \frac{s^2}{n}.$$

Replacing σ^2 with s^2 is acceptable provided the sample size is not too small. In this connection, it should be kept in mind that the variance of s^2 is highly sensitive to the fourth central moment of the population values. To show this, consider the square of V_s, the coefficient of variation of s, which can be approximated by[3]

---

2 For a proof, see the discussion following equation (6).

3 For details, see Hansen et.al., Volume 2, p.102

$$(6') \quad V_{s^2}^2 = \frac{Var(s^2)}{\sigma^2} \approx \frac{\beta - 1}{4n}, \quad where$$

$$\beta = \frac{\sum_{i=1}^{N} (Y_i - \mu)^4}{N} \frac{1}{\sigma^4}.$$

The term β is the Kurtosis coefficient, the ratio of the fourth moment to the square of the variance of the population mean. Clearly, if the population is normally distributed, we have β=3 (in view of equation 3') and thus

$$V_s^2 \approx \frac{0.5}{n}.$$

The above approximation shows that with a normally distributed population a sample size of n ≅ 50 would be large enough to ensure that the coefficient of variation of s will be 0.1 or less[4] (which is usually considered a reasonable level of precision).

For other distributions, however, the coefficient β may be significantly greater than 3, thus requiring a larger sample size for a reasonably reliable estimate of s.

When the population characteristics are unknown but the sample is fairly large, the unknown Kurtosis coefficient can be estimated from the sample data[5] and inserted, together with the given sample size, in equation (6'). If the resulting coefficient of variation of s, i.e.

$\sqrt{V_s^2}$, does not exceed 0.1, the estimated variance can be deemed reasonably reliable.

The situation is less complicated with respect to the sample mean. Due to the central limit theorem, the distribution of the sample mean will always be approximately normal (no matter whether the population is normal or not).[6] As a consequence, we can use the z-table, so that the 95% confidence interval[7] for μ is

---

4 This is equivalent to saying that the coefficient of variation of s^2 is 0.2 or less.

5 This is because sample moments consistently estimate population moments, i.e., converge to the population moment as the sample size tends to infinity.

6 The central limit theorem states that if the random variables $Y_1, Y_2, ..., Y_n$ are independent and identically distributed, each with mean μ and variance σ^2, then the distribution of

$$\frac{\sum_{i=1}^{n} Y_i - n\mu}{\sigma\sqrt{n}} = \frac{(\sum_{i=1}^{n} \frac{Y_i}{n} - \mu)\sqrt{n}}{\sigma}$$

approaches the standard normal as n->∞, no matter what is the distribution of the Y_i's.

7 That is, we can be 95% confident that the interval will contain the true (unknown) mean μ.

$$\bar{y} - 1.96\frac{\sigma}{\sqrt{n}} < \mu < \bar{y} + 1.96\frac{\sigma}{\sqrt{n}}.$$

The central limit theorem can also be used to determine the sample size relative to a desired level of precision in estimating the sample mean. Suppose, for instance, that the sample size should be such that the difference between the sample mean and the population mean does not exceed a particular level M with a probability of, say, 0.95. Since the sample mean is approximately normal, n has to satisfy

$$0.95 \leq \Pr ob|\bar{y} - \mu| \leq M\} = \Pr ob\{-\frac{M\sqrt{n}}{\sigma} \leq \frac{(\bar{y} - \mu)\sqrt{n}}{\sigma} \leq \frac{M\sqrt{n}}{\sigma}\}.$$

Using z=1.96 (from the z-table), we obtain $\sqrt{n}=1.96\sigma/M$, so that[8]

$$n = \frac{(1.96)^2 \sigma^2}{M^2}.$$

If, however, the population variance is unknown, we have to resort to s^2. Then the normality assumption implies that

$$\sqrt{n}(\bar{y} - \mu) / s$$

has a **t** distribution with n-1 degrees of freedom, so that we can say with $100(1-\alpha)$ percent confidence that

$$(7) \quad \bar{y} - t_{n-1,\alpha/2}\frac{s}{\sqrt{n}} < \mu < \bar{y} + t_{n-1,\alpha/2}\frac{s}{\sqrt{n}}.$$

Estimating a Proportion

Let **P** be the proportion of the population exhibiting a particular characteristic. Then NP population members have the characteristic, while N(1-P) do not possess it. Moreover, let D_i be a dummy variable defined as

---

[8] Likewise, we could argue that the relative difference between the sample mean and the population mean should not exceed some multiple **m** of the population mean with probability, say, 0.95. Then

$$n = (1.96)^2 \frac{\sigma^2}{\mu^2 m^2} = (1..96)^2 \frac{V^2}{m^2}.$$

For instance, if the coefficient of variation V were known to be 0.5 and m is set at 0.03, we would have to select a sample of size $n \cong 1067$.

$$D_i = \begin{cases} 1 & ,\text{if the } i\text{-th population member has the characteristic} \\ 0 & ,\text{otherwise.} \end{cases}$$

Hence, the fraction of the sampled population possessing the characteristic can be expressed as

$$(8) \quad p = \frac{1}{n}\sum_{i=1}^{n} D_i = \frac{1}{n} D.$$

Clearly, $\mathbf{D}=\sum\mathbf{D}_i$ is a binomial random variable. Therefore

$$E[D] = E[np] = nP,$$
$$Var(D_i) = P(1-P), \quad and$$
$$Var(D) = nP(1-P).$$

Hence

$$(9) \quad E[p] = E[\sum_{i=1}^{n} \frac{D_i}{n}] = P,$$

i.e., p is an unbiased estimator of P, and

$$(10) \quad Var(p) = Var(\sum_{i=1}^{n} \frac{D_i}{n}) = \frac{1}{n^2} nP(1-P) = \frac{P(1-P)}{n}.$$

Typically, P and, thus, Var(p), are unknown. However, we can approximate the variance by substituting p (which can be estimated from the sample data) for P, yielding

$$(10') \quad s_p^2 = \frac{p(1-p)}{n}.$$

Moreover, since D is a binomial random variable, the distribution

$$\frac{D - nP}{nP(1-P)}$$

approaches the standard normal distribution as n->∞. The normal approximation is fairly accurate for values of n satisfying nP(1-P)≥10. Assuming this is the case and using the sample variance defined by (10'), the 100(1-α) percent confidence interval for P is

$$(11) \quad p \pm t_{n-1,\alpha/2} \sqrt{\frac{p(1-p)}{n}}.$$

Furthermore, we can use the normality assumption to calculate the sample size needed to yield some desired level of precision in estimating p. Suppose, for instance, that p should be within a fraction m, say 0.05, of P with probability 0.95. Then

$$0.95 \le \Pr ob\{|p-P| \le 0.05\} \le \Pr ob\{-\frac{0.05\sqrt{n}}{\sqrt{P(1-P)}} \le \frac{(p-P)\sqrt{n}}{\sqrt{P(1-P)}} \le \frac{0.05\sqrt{n}}{\sqrt{P(1-P)}}\}.$$

Using the z-table and noting that the maximum value P can assume is 0.5, we obtain

$$n = \frac{(1.96)^2 P(1-P)}{0.05^2} \le \frac{(1.96)^2}{0.05^2} 0.25 \approx 384.$$

Hence, given the value of the desired fraction m and the confidence level, one is on the safe side in assuming that the value of P, which is usually not known, is 0.5. This will always yield a sample size which is more than large enough to meet the desired level of precision.

Estimating a Ratio

Let X_i and Y_i denote two characteristics pertaining to the i-th population member (say energy expenditures and total expenditures of a household). Then the population ratio of these characteristics (e.g., the share of population expenditures accounted for by energy) is defined as

$$(12) \quad R = \frac{\sum_{i=1}^{N} X_i}{\sum_{i=1}^{N} Y_i} = \frac{\mu_x}{\mu_y},$$

while the ratio of the sample averages is

$$(13) \quad r = \frac{\bar{x}}{\bar{y}} = \frac{\sum_{i=1}^{n} x_i}{\sum_{i=1}^{n} y_i}.$$

Note that

$$Cov(X,Y) = \frac{1}{N}\sum_{i=1}^{N}(X_i - \mu_x)(Y_i - \mu_y) = Cov(x_i, y_i)$$

and

$$Cov(\bar{x},\bar{y}) = \frac{1}{n^2}\sum_{n=1}^{n} Cov(x_i, y_i) = \frac{1}{n} Cov(X,Y).$$

As a consequence, r will generally be a biased estimator of R. Based on a Taylor series expansion around μ_y, the bias can be approximated by

$$E[r-R] = E[\frac{\bar{x}-R\bar{y}}{\bar{y}}] \approx -\frac{1}{\mu_y^2}[(E[\bar{y},\bar{x}) - \mu_x\mu_y) - R(E[\bar{y}^2] - \mu_y^2)]$$
$$= \frac{1}{n\mu_y^2}[R\sigma_y^2 - Cov(X,Y)] \neq 0,$$

unless X=RY.[9]

Similarly, the variance of r can be approximated by

$$(14) \quad Var(r) = \frac{1}{n\mu_y^2}[\sigma_x^2 + R^2\sigma_y^2 - 2RCov(X,Y)].$$

Assuming that the sample size is large enough to yield an (almost) unbiased estimator r, we can use the sample information to estimate a proxy for the unknown Var(r):

$$(14') \quad s^2(r) = \frac{1}{n\bar{y}^2}(\sum_{i=1}^{n} x_i^2 + r^2\sum_{i=1}^{n} y_j^2 - 2r\sum_{i=1}^{n} y_i x_i).$$

In view of (14'), the 100(1-α) percent confidence interval for R is

$$(15) \quad r - t_{n-1,\alpha/2}s(r) < R < t_{n-1,\alpha/2}s(r).$$

2. Stratified Random Sampling with Replacement

The rationale for taking a stratified sample is that if there are different population groups each with fairly homogenous characteristics, the stratified sample mean will be more efficient (i.e., has a smaller variance) than its unstratified counterpart. The larger the differences between the group-specific means, the greater will be the efficiency gain.

---

[9] If X=RY, we have Cov(Y,X)=Cov(Y,RY)=R(E[Y^2]-E[Y]E[Y])=RVar(Y), and, therefore, E[r-R]≈0.

Estimating a Stratified Mean

Suppose that a population of size N can be subdivided in k non-overlapping groups (strata) of sizes N_1, ..., N_k, with

$$N = \sum_{i=1}^{k} N_i.$$

Let Y_{ij} be a characteristic (e.g. electricity consumption) attributable to the j-th member of the i-th group. Then the aggregate value of the characteristic in the i-th group is

$$Y_i = \sum_{j=1}^{N_i} Y_{ij}, \quad i = 1,2,\ldots,n.$$

Likewise, the corresponding stratum mean is

$$\mu_i = \frac{1}{N_i} \sum_{j=1}^{N_i} Y_{ij}$$

while the variance amounts to

$$\sigma_i^2 = \frac{1}{N_i} \sum_{j=1}^{N_i} (Y_{ij} - \mu_i)^2, \quad i = 1,2,\ldots,k.$$

Thus, the population mean is the weighted average of stratum means

$$(16) \quad \mu = \frac{1}{N} \sum_{i=1}^{k} N_i \mu_i = \sum_{i=1}^{k} w_i \mu_i, \quad with \quad w_i = \frac{N_i}{N},$$

and the population variance amounts to

$$(17) \quad \sigma^2 = \frac{1}{N} \sum_{i=1}^{k} \sum_{j=1}^{N_i} (Y_{ij} - \mu)^2 = \sum_{i=1}^{k} \sum_{j=1}^{N_i} [(Y_{ij} - \mu_i) + (\mu_i - \mu)]^2 =$$
$$\sum_{i=1}^{k} w_i \sigma_i^2 + \sum_{i=1}^{k} w_i (\mu_i - \mu)^2.$$

Accordingly, let the sample of size n be composed of k independently selected stratum samples n_i so that

$$n = \sum_{i=1}^{k} n_i .$$

The means of the randomly selected sub-samples are

$$\bar{y}_i = \frac{1}{n_i} \sum_{j=1}^{n_i} y_{ij}$$

and their variances are

$$Var(\bar{y}_i) = \frac{\sigma_i^2}{n_i}, \quad i = 1,2,\ldots,k.$$

The stratified sample mean is

$$(18) \quad \bar{y} = \sum_{i=1}^{k} w_i \bar{y}_i$$

and has expectation equal to μ (i.e., is unbiased), while the variance of the stratified sample mean is

$$(19) \quad Var(\bar{y}) = \sum_{i=1}^{k} w_i \frac{\sigma_i^2}{n_i}.$$

With proportionate sampling[10], i.e., $n_i = nw_i$, (18) can be written as

$$(18') \quad \bar{y} = \frac{1}{n} \sum_{i=1}^{k} \sum_{j=1}^{n_{ij}} y_{ij},$$

and (19) simplifies to

$$(19') \quad Var(\bar{y}) = \frac{1}{n} \sum_{i=1}^{k} w_i \sigma_i^2 .$$

---

[10] Proportionate sampling means that each population member has the chance of being selected with stratified random sampling.

Now let the unstratified sample mean, which has variance σ^2/n, be y*. If stratification is done with proportionate sampling, the difference between the variance of the unstratified mean, expressed in terms of equation (17), and that of its stratified counterpart, defined by equation (19'), is

$$Var(y^*) - Var(\bar{y}) = \frac{1}{n}(\sum_{i=1}^{k} w_i[\sigma_i^2 + (\mu_i - \mu)^2 - \sigma_i^2]) = \frac{1}{n}\sum_{i=1}^{k} w_i(\mu_i - \mu)^2.$$

The above expression will be positive unless the stratum-specific means are identical. Hence, the larger the differences between the stratum means, the greater is the potential reduction in the variance of the sample mean due to stratification with proportionate sampling.

If the stratum variances are unknown, the unbiased estimators

$$(20) \quad s_i^2 = \frac{1}{n_i - 1}\sum_{j=1}^{k}(y_{ij} - \bar{y}_i)^2, \quad i = 1,2,\ldots,k,$$

can be used as a proxy. Then

$$(21) \quad s^2(\bar{y}) = \sum_{i=1}^{k} w_i^2 \frac{s_i^2}{n_i} \quad \textit{and}$$

$$(21') \quad s^2(\bar{y}) = \frac{1}{n}\sum_{i=1}^{k} w_i s_i^2$$

are unbiased estimators of (19) and (19'), respectively. Clearly, the corresponding $100(1-\alpha)$ confidence interval for μ is analogous to equation (7).

Estimating a Proportion

Let p_i be the sampled proportion in the i-th stratum, corresponding to the true proportion P_i. Then the stratified sample proportion is

$$(22) \quad p = \sum_{i=1}^{k} w_i p_i$$

while its variance amounts to

$$(23) \quad Var(p) = \sum_{i=1}^{k} \frac{w_i^2}{n_i} P_i(1 - P_i)$$

which in the case of proportionate sampling can be written as

$$(23') \quad Var(p) = \frac{1}{n}\sum_{i=1}^{k} w_i P_i (1 - P_i).$$

If the true strata proportions P_i are unknown, we use the sample proportions p_i as a proxy. Then

$$(24) \quad s^2(p) = \sum_{i=1}^{k} \frac{w_i^2}{n_i} p_i (1 - p_i)$$

or, if sampling is proportionate,

$$(24') \quad s^2(p) = \frac{1}{n}\sum_{i=1}^{k} w_i p_i (1 - p_i).$$

Also, the 100(1-α) confidence interval for P is

$$(25) \quad p \pm t_{n-1,\alpha/2} s(p).$$

Estimating a Ratio

In this study, the ratio of two random variables (characteristics) from a stratified sample is estimated in terms of averages, i.e.

$$(26) \quad r = \frac{\bar{x}}{\bar{y}} = \frac{\sum_{i=1}^{k} \frac{N_i}{n_i} \sum_{j=1}^{n_i} x_{ij}}{\sum_{i=1}^{k} \frac{N_i}{n_i} \sum_{j=1}^{n_i} y_{ij}}.$$

Clearly, r is biased. If a proportionate sample is taken, its variance can be approximated by

$$(27) \quad \sigma_r^2 \approx \frac{1}{n\mu_y^2}[\sum_{i=1}^{k} w_i \sigma_i^2(X_i) + R^2 \sum_{i=1}^{k} w_i \sigma_i^2(Y_i) - 2R \sum_{i=1}^{k} w_i Cov(X_i, Y_i)].$$

If the population characteristics underlying (27) are unknown, the sample information can be used to estimate

$$(28) \quad s^2(r) = \frac{1}{n\bar{y}^2}[\sum_{i=1}^{k} w_i s_i^2(x_i) + r^2 \sum_{i=1}^{k} w_i s_i^2(y_i) - 2r \sum_{i=1}^{k} w_i Cov(x_i, y_i)\ ,$$

where

$$Cov(x_i, y_i) = \frac{1}{n_i} \sum_{j=1}^{n_i} (x_{ij} - \bar{x}_i)(y_{ij} - \bar{y}_i) .$$

Substituting the above estimate into equation (15) gives the corresponding 100(1-α) confidence interval for the population ratio R.

Appendix 4: Mathematica Package For Survey Data Processing

```
(*:Name: Sample *)
(*:Title: Sample Survey Tools *)
(*:Author: W.Teplitz-Sembitzky, February 1996 *)
(*:Version: Mathematica 2.2 *)
(*:Keywords: sampling with replacement, mean, variance, covariance *)

BeginPackage["Sample`"]

Mean::usage = "Mean[list_] computes the arithmetic mean of the list."

VarS::usage = "VarS[list_] computes the sample variance of list."

VarM::usage = "VarM[list_] computes variance of sample mean."

Cov::usage = "Cov[x1_, x2_] computes covariance of equal-length
lists."

CenMom::usage = "CenMom[list_, r_] computes the r-th central moment of
list."

Kurtosis::usage = "Kurtosis[list_] computes Kurtosis of list."

Prop::usage = "Prop[list_, n_] computes the proportion of elements with a
value equal to n."

PropG::usage = "PropG[list_, n_] computes the proportion of elements with
a value greater than n."

VarP::usage = "VarP[list_, n_] computes variance of proportion."

StratP::usage = "StratP[LL_, n_, F_] computes the stratified proportion of
elements with a value equal to n."

StratPG::usage = "StratPG[LL_, n_, F_] computes stratified proportion of
elements with a value greater than n."

VarStratP::usage = "VarStratP[LL_, n_, F_] computes variance of stratified
proportion."
```

```
StratM::usage = "StratM[LL_, F_] computes stratified sample
mean. LL is a list of lists, where each list represents the data from a
particular sample. F is a vector of sampling fractions."

VarStratM::usage = "VarStratM[[LL_, F_] computes the
variance of a stratified sample mean. LL is a list of lists and F is the
vector of sampling fractions."

VarRatio::usage = "VarRatio[x1_, x2_] computes the variance of a ratio
estimate, i.e., the ratio of the mean of x1 to the mean of x2."

VarStratRatio::usage = "VarStratRatio[L1_, L2_, F_] computes the variance of
the ratio estimate based on a stratified sample. Each L is a list of lists.
F denotes the sampling fractions."

Begin["`Private`"]

Mean[list_] := N[Apply[Plus, list]/Count[list, x_/; x>0]]

VarS[list_] := N[(list.list - Count[list, x_/; x>0] Mean[list]^2)/
(Count[list, x_/; x>0]-1)]

VarM[list_] := N[VarS[list]/Count[list, x_/; x>0]]

Cov[x1_, x2_] := N[(Cases[x1, x_/; x>0] - Mean[x1]).(Cases[x2, x_/; x>0]
- Mean[x2])/Count[x1, x_/; x>0]]

CenMom[list_, r_] := N[Apply[Plus, (Cases[list, x_/; x>0]
- Mean[list])^r]/Count[list, x_/; x>0]]

Kurtosis[list_] := N[CenMom[Cases[list, x_/; x>0], 4]/VarS[list]^2]

Prop[list_, n_] := N[Count[list, x_/; n-1 < x <n+1]/Length[list]]

PropG[list_, n_] := N[Count[list, x_/; x>n]/Length[list]]

VarP[list_, n_] := N[Prop[list, n]*(1-Prop[list, n])/Length[list]]

StratP[LL_, n_, F_] := N[Table[Prop[LL[[i]], n], {i, 1, Length[F]}].F]

StratPG[LL_, n_, F_] := N[Table[PropG[LL[[i]], n], {i, 1 ,Length[F]}].F]

VarStratP[LL_, n_, F_] := N[Table[VarP[LL[[i]], n], {i,1,Length[F]}].F]

StratM[LL_, F_] := N[Table[Mean[LL[[i]]], {i,1,Length[F]}].F]
```

```
VarStratM[LL_, F_] := N[Table[VarM[LL[[i]]], {i,1,Length[F]}].F]

VarRatio[x1_, x2_] := Block[{r}, r = Mean[x1]/Mean[x2];
N[(x1.x1 + r^2 x2.x2 - 2 r Cov[x1, x2]/Count[x2, x_/; x>0])/
(Count[x2, x_/; x>0] Mean[x2]^2)]]

VarStratRatio[L1_, L2_, F_] := Block[{r}, r=StratM[L1, F]/Strat[L2, F];
N[Table[VarM[L1[[i]]] + r^2 VarM[L2[[i]]] - 2 r Cov[L1[[i]], L2[[i]]],
{i, 1, Length[F]}].F/StratM[L2, F]^2]]


End[]
EndPackage[]
```

Appendix 5: Questionnaire

DOMESTIC

1. Resident (year): <1, 1-4, 4-9, >10
2. Status: single, separated, married, widowed
3. Education: primary, secondary, technical, medical, superior, special
4. Occupation: civil servant, worker, self-employed, student, retired, unemployed, other
5. Profession:
6. Monthly household income (`000 MT): <500; 500-1,500; 1,500-3,000; > 3,000
7. Number of persons per household:
8. Number of persons by age (years): <5, 5-15, 16-20, >20
9. How many of those older than five years: study, work, are unemployed, are retired
10. Do those who work or are retired contribute to household income: yes, no, how much
11. Monthly expenditures (`000 MT): <300; 300-1,000; 1,000-3,00; >3,000
12. Number of rooms:
13. Kitchen inside: yes, no
14. Bathroom inside: yes, no
15. Walls are made of: bricks, wood/zinc, reeds, reeds/sand
16. Roof is made of: tiles, zinc, reed, grass
17. House is: owned, provided, rent
18. If owned, financed by loan: yes, no; if yes, loan paid back (yes; no: monthly installment)

Monthly expenditure (MT) for:

19. Water; 20. Electricity

21. Energy other tnan electricity: fuelwood, charcoal, LPG, kerosene, candle, battery; monthly expenditure (MT)

22. Car ownership: yes, no; if yes, monthly expenditure (MT)

23. Monthly household expenditure for transport (MT); <50; 50-100; >100

24. Monthly expenditure for food (`000 MT): <150; 150-500; >500

25. Telephone: no, yes; if yes, monthly expenditure (MT)

26. Other expenditure: no, yes; if yes, amount (MT)

27. Electricity use: lighting, radio/TV, cooling, air conditioning, water heating, cooking, other

28. Type of light (number): incandescent, florescent, efficient

29. Radio/TV: yes, no

30. Air conditioner (AC): yes, no

31. AC use: morning, afternoon, at night, hot days

32. Type of stove: fuelwood/charcoal, kerosene, LPG, electricity; number of plates/ovens

33. Stove used for preparing (hours): breakfast, lunch, dinner

34. Electric appliances: iron, vacuum cleaner, kettle, mixer, thermal accumulator, heater. fan, computer, hair dryer, toaster, micro wave, water pump

35. Electricity use since (years): <1, 1-5, >5

36. Frequency of disruptions: once a year, once a month, once a week, more than once a week

37. Duration of disruptions (hours): <1, 1, >2

38. Reliability of service: improves, no change, gets worse

39. Disconnections: no, yes; if yes, how often

40. Switch to other energy, if tariffs continue to rise: no, yes; if yes, what type of energy

41. Meter reading by EDM: each month, every two months, irregular

42. Check on meter reading: yes, no

43. Assessment of EDM`s services: bad, reasonable, good

GENERAL

1. Type work/service

2. Number of employees

3. Number of employees by age (years): 18-35, >35

4. Number of rooms

5. Kitchen: yes, no

6. Walls are made of: bricks, wood/zinc, reed, reed/sand

7. Roof is made of: tiles, zinc, reed, grass

8. Monthly turnover (`000 MT): <1,000; 1,000-5,000; 5,000-10,000; >10,000

9. Establishment leased: yes, no; monthly rent (MT)

10. If owned, financed by loan: yes, no; if yes, loan paid back (yes; no: monthly installment)

11. Monthly expenditure for water

12. Monthly expenditure for electricity

13. Energy other than electricity: woodfuel, LPG, kerosene; monthly expenditure (MT)

14. Vehicle fleet: yes, no; if yes, monthly expenditure (MT)

15. Monthly expenditure for telephone (MT)

16. Monthly salaries paid (MT)

17. Other expenditure

18. Electricity use: lighting, radio/TV, cooling, air conditioning, water heating, cooking, other

19. Type of light (number): incandescent, florescent, efficient

20. Radio/TV: yes, no

21. Fridge: yes (number), no

22. Air conditioning: yes (number), no

23. Use of air conditioner: morning, afternoon, at night, hot days

24. Other electric appliances

25. Since when is electricity used (year): <1, 1-5, >5

26. Frequency of disruptions: once a year, once a month, once a week, more than once a week

27. Duration of disruptions (hours): <1, 1, >2

28. Reliability of service: improves, no change, gets worse

29. Disconnections: no, yes; if yes, how often

30. Switch to other energy, if tariffs continue to rise: no, yes; if yes, what type of energy

31. Meter reading by EDM: each month, every two months, irregular

32. Check on meter reading: yes, no

33. Assessment of EDM`s services: bad, reasonable, good

Joint UNDP/World Bank

ENERGY SECTOR MANAGEMENT ASSISTANCE PROGRAMME (ESMAP)

LIST OF REPORTS ON COMPLETED ACTIVITIES

Region/Country	*Activity/Report Title*	*Date*	*Number*
	SUB-SAHARAN AFRICA (AFR)		
Africa Regional	Anglophone Africa Household Energy Workshop (English)	07/88	085/88
	Regional Power Seminar on Reducing Electric Power System Losses in Africa (English)	08/88	087/88
	Institutional Evaluation of EGL (English)	02/89	098/89
	Biomass Mapping Regional Workshops (English)	05/89	--
	Francophone Household Energy Workshop (French)	08/89	--
	Interafrican Electrical Engineering College: Proposals for Short- and Long-Term Development (English)	03/90	112/90
	Biomass Assessment and Mapping (English)	03/90	--
	Symposium on Power Sector Reform and Efficiency Improvement in Sub-Saharan Africa (English)	06/96	182/96
Angola	Energy Assessment (English and Portuguese)	05/89	4708-ANG
	Power Rehabilitation and Technical Assistance (English)	10/91	142/91
Benin	Energy Assessment (English and French)	06/85	5222-BEN
Botswana	Energy Assessment (English)	09/84	4998-BT
	Pump Electrification Prefeasibility Study (English)	01/86	047/86
	Review of Electricity Service Connection Policy (English)	07/87	071/87
	Tuli Block Farms Electrification Study (English)	07/87	072/87
	Household Energy Issues Study (English)	02/88	--
	Urban Household Energy Strategy Study (English)	05/91	132/91
Burkina Faso	Energy Assessment (English and French)	01/86	5730-BUR
	Technical Assistance Program (English)	03/86	052/86
	Urban Household Energy Strategy Study (English and French)	06/91	134/91
Burundi	Energy Assessment (English)	06/82	3778-BU
	Petroleum Supply Management (English)	01/84	012/84
	Status Report (English and French)	02/84	011/84
	Presentation of Energy Projects for the Fourth Five-Year Plan (1983-1987) (English and French)	05/85	036/85
	Improved Charcoal Cookstove Strategy (English and French)	09/85	042/85
	Peat Utilization Project (English)	11/85	046/85
	Energy Assessment (English and French)	01/92	9215-BU
Cape Verde	Energy Assessment (English and Portuguese)	08/84	5073-CV
	Household Energy Strategy Study (English)	02/90	110/90
Central African Republic	Energy Assessement (French)	08/92	9898-CAR
Chad	Elements of Strategy for Urban Household Energy The Case of N'djamena (French)	12/93	160/94
Comoros	Energy Assessment (English and French)	01/88	7104-COM
Congo	Energy Assessment (English)	01/88	6420-COB
	Power Development Plan (English and French)	03/90	106/90
Côte d'Ivoire	Energy Assessment (English and French)	04/85	5250-IVC
	Improved Biomass Utilization (English and French)	04/87	069/87
	Power System Efficiency Study (English)	12/87	--
	Power Sector Efficiency Study (French)	02/92	140/91
	Project of Energy Efficiency in Buildings (English)	09/95	175/95

Region/Country	*Activity/Report Title*	*Date*	*Number*
Ethiopia	Energy Assessment (English)	07/84	4741-ET
	Power System Efficiency Study (English)	10/85	045/85
	Agricultural Residue Briquetting Pilot Project (English)	12/86	062/86
	Bagasse Study (English)	12/86	063/86
	Cooking Efficiency Project (English)	12/87	--
	Energy Assessment (English)	02/96	179/96
Gabon	Energy Assessment (English)	07/88	6915-GA
The Gambia	Energy Assessment (English)	11/83	4743-GM
	Solar Water Heating Retrofit Project (English)	02/85	030/85
	Solar Photovoltaic Applications (English)	03/85	032/85
	Petroleum Supply Management Assistance (English)	04/85	035/85
Ghana	Energy Assessment (English)	11/86	6234-GH
	Energy Rationalization in the Industrial Sector (English)	06/88	084/88
	Sawmill Residues Utilization Study (English)	11/88	074/87
	Industrial Energy Efficiency (English)	11/92	148/92
Guinea	Energy Assessment (English)	11/86	6137-GUI
	Household Energy Strategy (English and French)	01/94	163/94
Guinea-Bissau	Energy Assessment (English and Portuguese)	08/84	5083-GUB
	Recommended Technical Assistance Projects (English & Portuguese)	04/85	033/85
	Management Options for the Electric Power and Water Supply Subsectors (English)	02/90	100/90
	Power and Water Institutional Restructuring (French)	04/91	118/91
Kenya	Energy Assessment (English)	05/82	3800-KE
	Power System Efficiency Study (English)	03/84	014/84
	Status Report (English)	05/84	016/84
	Coal Conversion Action Plan (English)	02/87	--
	Solar Water Heating Study (English)	02/87	066/87
	Peri-Urban Woodfuel Development (English)	10/87	076/87
	Power Master Plan (English)	11/87	--
	Power Loss Reduction Study (English)	09/96	186/96
Lesotho	Energy Assessment (English)	01/84	4676-LSO
Liberia	Energy Assessment (English)	12/84	5279-LBR
	Recommended Technical Assistance Projects (English)	06/85	038/85
	Power System Efficiency Study (English)	12/87	081/87
Madagascar	Energy Assessment (English)	01/87	5700-MAG
	Power System Efficiency Study (English and French)	12/87	075/87
	Environmental Impact of Woodfuels (French)	10/95	176/95
Malawi	Energy Assessment (English)	08/82	3903-MAL
	Technical Assistance to Improve the Efficiency of Fuelwood Use in the Tobacco Industry (English)	11/83	009/83
	Status Report (English)	01/84	013/84
Mali	Energy Assessment (English and French)	11/91	8423-MLI
	Household Energy Strategy (English and French)	03/92	147/92
Islamic Republic of Mauritania	Energy Assessment (English and French)	04/85	5224-MAU
	Household Energy Strategy Study (English and French)	07/90	123/90
Mauritius	Energy Assessment (English)	12/81	3510-MAS
	Status Report (English)	10/83	008/83
	Power System Efficiency Audit (English)	05/87	070/87

Region/Country	*Activity/Report Title*	*Date*	*Number*
Mauritius	Bagasse Power Potential (English)	10/87	077/87
	Energy Sector Review (English)	12/94	3643-MAS
Morocco	Energy Sector Institutional Development Study (English and French)	07/95	173/95
Mozambique	Energy Assessment (English)	01/87	6128-MOZ
	Household Electricity Utilization Study (English)	03/90	113/90
	Electricity Tariffs Study (English)	06/96	181/96
	Sample Survey of Low Voltage Electricity Customers	06/97	195/97
Namibia	Energy Assessment (English)	03/93	11320-NAM
Niger	Energy Assessment (French)	05/84	4642-NIR
	Status Report (English and French)	02/86	051/86
	Improved Stoves Project (English and French)	12/87	080/87
	Household Energy Conservation and Substitution (English and French)	01/88	082/88
Nigeria	Energy Assessment (English)	08/83	4440-UNI
	Energy Assessment (English)	07/93	11672-UNI
Rwanda	Energy Assessment (English)	06/82	3779-RW
	Status Report (English and French)	05/84	017/84
	Improved Charcoal Cookstove Strategy (English and French)	08/86	059/86
	Improved Charcoal Production Techniques (English and French)	02/87	065/87
	Energy Assessment (English and French)	07/91	8017-RW
	Commercialization of Improved Charcoal Stoves and Carbonization Techniques Mid-Term Progress Report (English and French)	12/91	141/91
SADC	SADC Regional Power Interconnection Study, Vols. I-IV (English)	12/93	--
SADCC	SADCC Regional Sector: Regional Capacity-Building Program for Energy Surveys and Policy Analysis (English)	11/91	--
Sao Tome and Principe	Energy Assessment (English)	10/85	5803-STP
Senegal	Energy Assessment (English)	07/83	4182-SE
	Status Report (English and French)	10/84	025/84
	Industrial Energy Conservation Study (English)	05/85	037/85
	Preparatory Assistance for Donor Meeting (English and French)	04/86	056/86
	Urban Household Energy Strategy (English)	02/89	096/89
	Industrial Energy Conservation Program (English)	05/94	165/94
Seychelles	Energy Assessment (English)	01/84	4693-SEY
	Electric Power System Efficiency Study (English)	08/84	021/84
Sierra Leone	Energy Assessment (English)	10/87	6597-SL
Somalia	Energy Assessment (English)	12/85	5796-SO
South Africa Republic of	Options for the Structure and Regulation of Natural Gas Industry (English)	05/95	172/95
Sudan	Management Assistance to the Ministry of Energy and Mining	05/83	003/83
	Energy Assessment (English)	07/83	4511-SU
	Power System Efficiency Study (English)	06/84	018/84
	Status Report (English)	11/84	026/84
	Wood Energy/Forestry Feasibility (English)	07/87	073/87
Swaziland	Energy Assessment (English)	02/87	6262-SW
Tanzania	Energy Assessment (English)	11/84	4969-TA
	Peri-Urban Woodfuels Feasibility Study (English)	08/88	086/88
	Tobacco Curing Efficiency Study (English)	05/89	102/89
	Remote Sensing and Mapping of Woodlands (English)	06/90	--
	Industrial Energy Efficiency Technical Assistance (English)	08/90	122/90
Togo	Energy Assessment (English)	06/85	5221-TO

Region/Country	*Activity/Report Title*	*Date*	*Number*
Togo	Wood Recovery in the Nangbeto Lake (English and French)	04/86	055/86
	Power Efficiency Improvement (English and French)	12/87	078/87
Uganda	Energy Assessment (English)	07/83	4453-UG
	Status Report (English)	08/84	020/84
	Institutional Review of the Energy Sector (English)	01/85	029/85
	Energy Efficiency in Tobacco Curing Industry (English)	02/86	049/86
	Fuelwood/Forestry Feasibility Study (English)	03/86	053/86
	Power System Efficiency Study (English)	12/88	092/88
	Energy Efficiency Improvement in the Brick and Tile Industry (English)	02/89	097/89
	Tobacco Curing Pilot Project (English)	03/89	UNDP Terminal Report
	Energy Assessment (English)	12/96	193/96
Zaire	Energy Assessment (English)	05/86	5837-ZR
Zambia	Energy Assessment (English)	01/83	4110-ZA
	Status Report (English)	08/85	039/85
	Energy Sector Institutional Review (English)	11/86	060/86
	Power Subsector Efficiency Study (English)	02/89	093/88
	Energy Strategy Study (English)	02/89	094/88
	Urban Household Energy Strategy Study (English)	08/90	121/90
Zimbabwe	Energy Assessment (English)	06/82	3765-ZIM
	Power System Efficiency Study (English)	06/83	005/83
	Status Report (English)	08/84	019/84
	Power Sector Management Assistance Project (English)	04/85	034/85
	Power Sector Management Institution Building (English)	09/89	--
	Petroleum Management Assistance (English)	12/89	109/89
	Charcoal Utilization Prefeasibility Study (English)	06/90	119/90
	Integrated Energy Strategy Evaluation (English)	01/92	8768-ZIM
	Energy Efficiency Technical Assistance Project: Strategic Framework for a National Energy Efficiency Improvement Program (English)	04/94	--
	Capacity Building for the National Energy Efficiency Improvement Programme (NEEIP) (English)	12/94	--

EAST ASIA AND PACIFIC (EAP)

Asia Regional	Pacific Household and Rural Energy Seminar (English)	11/90	--
China	County-Level Rural Energy Assessments (English)	05/89	101/89
	Fuelwood Forestry Preinvestment Study (English)	12/89	105/89
	Strategic Options for Power Sector Reform in China (English)	07/93	156/93
	Energy Efficiency and Pollution Control in Township and Village Enterprises (TVE) Industry (English)	11/94	168/94
	Energy for Rural Development in China: An Assessment Based on a Joint Chinese/ESMAP Study in Six Counties (English)	06/96	183/96
Fiji	Energy Assessment (English)	06/83	4462-FIJ
Indonesia	Energy Assessment (English)	11/81	3543-IND
	Status Report (English)	09/84	022/84
	Power Generation Efficiency Study (English)	02/86	050/86

Region/Country	*Activity/Report Title*	*Date*	*Number*
Indonesia	Energy Efficiency in the Brick, Tile and Lime Industries (English)	04/87	067/87
	Diesel Generating Plant Efficiency Study (English)	12/88	095/88
	Urban Household Energy Strategy Study (English)	02/90	107/90
	Biomass Gasifier Preinvestment Study Vols. I & II (English)	12/90	124/90
	Prospects for Biomass Power Generation with Emphasis on Palm Oil, Sugar, Rubberwood and Plywood Residues (English)	11/94	167/94
Lao PDR	Urban Electricity Demand Assessment Study (English)	03/93	154/93
Malaysia	Sabah Power System Efficiency Study (English)	03/87	068/87
	Gas Utilization Study (English)	09/91	9645-MA
Myanmar	Energy Assessment (English)	06/85	5416-BA
Papua New Guinea	Energy Assessment (English)	06/82	3882-PNG
	Status Report (English)	07/83	006/83
	Energy Strategy Paper (English)	--	--
	Institutional Review in the Energy Sector (English)	10/84	023/84
	Power Tariff Study (English)	10/84	024/84
Philippines	Commercial Potential for Power Production from Agricultural Residues (English)	12/93	157/93
	Energy Conservation Study (English)	08/94	--
Solomon Islands	Energy Assessment (English)	06/83	4404-SOL
	Energy Assessment (English)	01/92	979-SOL
South Pacific	Petroleum Transport in the South Pacific (English)	05/86	--
Thailand	Energy Assessment (English)	09/85	5793-TH
	Rural Energy Issues and Options (English)	09/85	044/85
	Accelerated Dissemination of Improved Stoves and Charcoal Kilns (English)	09/87	079/87
	Northeast Region Village Forestry and Woodfuels Preinvestment Study (English)	02/88	083/88
	Impact of Lower Oil Prices (English)	08/88	--
	Coal Development and Utilization Study (English)	10/89	--
Tonga	Energy Assessment (English)	06/85	5498-TON
Vanuatu	Energy Assessment (English)	06/85	5577-VA
Vietnam	Rural and Household Energy-Issues and Options (English)	01/94	161/94
	Power Sector Reform and Restructuring in Vietnam: Final Report to the Steering Committee (English and Vietnamese)	09/95	174/95
	Household Energy Technical Assistance: Improved Coal Briquetting and Commercialized Dissemination of Higher Efficiency Biomass and Coal Stoves (English)	01/96	178/96
Western Samoa	Energy Assessment (English)	06/85	5497-WSO
	SOUTH ASIA (SAS)		
Bangladesh	Energy Assessment (English)	10/82	3873-BD
	Priority Investment Program (English)	05/83	002/83
	Status Report (English)	04/84	015/84
	Power System Efficiency Study (English)	02/85	031/85
	Small Scale Uses of Gas Prefeasibility Study (English)	12/88	--
India	Opportunities for Commercialization of Nonconventional Energy Systems (English)	11/88	091/88

Region/Country	*Activity/Report Title*	*Date*	*Number*
India	Maharashtra Bagasse Energy Efficiency Project (English)	07/90	120/90
	Mini-Hydro Development on Irrigation Dams and Canal Drops Vols. I, II and III (English)	07/91	139/91
	WindFarm Pre-Investment Study (English)	12/92	150/92
	Power Sector Reform Seminar (English)	04/94	166/94
Nepal	Energy Assessment (English)	08/83	4474-NEP
	Status Report (English)	01/85	028/84
	Energy Efficiency & Fuel Substitution in Industries (English)	06/93	158/93
Pakistan	Household Energy Assessment (English)	05/88	--
	Assessment of Photovoltaic Programs, Applications, and Markets (English)	10/89	103/89
	National Household Energy Survey and Strategy Formulation Study: Project Terminal Report (English)	03/94	--
	Managing the Energy Transition (English)	10/94	--
	Lighting Efficiency Improvement Program Phase 1: Commercial Buildings Five Year Plan (English)	10/94	--
Sri Lanka	Energy Assessment (English)	05/82	3792-CE
	Power System Loss Reduction Study (English)	07/83	007/83
	Status Report (English)	01/84	010/84
	Industrial Energy Conservation Study (English)	03/86	054/86
	EUROPE AND CENTRAL ASIA (ECA)		
Bulgaria	Natural Gas Policies and Issues (English)	10/96	188/96
Eastern Europe	The Future of Natural Gas in Eastern Europe (English)	08/92	149/92
Poland	Energy Sector Restructuring Program Vols. I-V (English)	01/93	153/93
Portugal	Energy Assessment (English)	04/84	4824-PO
Romania	Natural Gas Development Strategy (English)	12/96	192/96
Turkey	Energy Assessment (English)	03/83	3877-TU
	MIDDLE EAST AND NORTH AFRICA (MNA)		
Arab Republic of Egypt	Energy Assessment (English)	10/96	189/96
Morocco	Energy Assessment (English and French)	03/84	4157-MOR
	Status Report (English and French)	01/86	048/86
	Energy Sector Institutional Development Study (English and French)	05/95	173/95
Syria	Energy Assessment (English)	05/86	5822-SYR
	Electric Power Efficiency Study (English)	09/88	089/88
	Energy Efficiency Improvement in the Cement Sector (English)	04/89	099/89
	Energy Efficiency Improvement in the Fertilizer Sector (English)	06/90	115/90
Tunisia	Fuel Substitution (English and French)	03/90	--
	Power Efficiency Study (English and French)	02/92	136/91
	Energy Management Strategy in the Residential and Tertiary Sectors (English)	04/92	146/92
	Renewable Energy Strategy Study, Volume I (French)	11/96	190A/96
	Renewable Energy Strategy Study, Volume II (French)	11/96	190B/96

Region/Country	*Activity/Report Title*	*Date*	*Number*
Yemen	Energy Assessment (English)	12/84	4892-YAR
	Energy Investment Priorities (English)	02/87	6376-YAR
	Household Energy Strategy Study Phase I (English)	03/91	126/91
	LATIN AMERICA AND THE CARIBBEAN (LAC)		
LAC Regional	Regional Seminar on Electric Power System Loss Reduction in the Caribbean (English)	07/89	--
	Elimination of Lead in Gasoline in Latin America and the Caribbean (English and Spanish)	04/97	194/97
Bolivia	Energy Assessment (English)	04/83	4213-BO
	National Energy Plan (English)	12/87	--
	La Paz Private Power Technical Assistance (English)	11/90	111/90
	Prefeasibility Evaluation Rural Electrification and Demand Assessment (English and Spanish)	04/91	129/91
	National Energy Plan (Spanish)	08/91	131/91
	Private Power Generation and Transmission (English)	01/92	137/91
	Natural Gas Distribution: Economics and Regulation (English)	03/92	125/92
	Natural Gas Sector Policies and Issues (English and Spanish)	12/93	164/93
	Household Rural Energy Strategy (English and Spanish)	01/94	162/94
	Preparation of Capitalization of the Hydrocarbon Sector	12/96	191/96
Brazil	Energy Efficiency & Conservation: Strategic Partnership for Energy Efficiency in Brazil (English)	01/95	170/95
Chile	Energy Sector Review (English)	08/88	7129-CH
Colombia	Energy Strategy Paper (English)	12/86	--
	Power Sector Restructuring (English)	11/94	169/94
	Energy Efficiency Report for the Commercial and Public Sector (English)	06/96	184/96
Costa Rica	Energy Assessment (English and Spanish)	01/84	4655-CR
	Recommended Technical Assistance Projects (English)	11/84	027/84
	Forest Residues Utilization Study (English and Spanish)	02/90	108/90
Dominican Republic	Energy Assessment (English)	05/91	8234-DO
Ecuador	Energy Assessment (Spanish)	12/85	5865-EC
	Energy Strategy Phase I (Spanish)	07/88	--
	Energy Strategy (English)	04/91	--
	Private Minihydropower Development Study (English)	11/92	--
	Energy Pricing Subsidies and Interfuel Substitution (English)	08/94	11798-EC
	Energy Pricing, Poverty and Social Mitigation (English)	08/94	12831-EC
Guatemala	Issues and Options in the Energy Sector (English)	09/93	12160-GU
Haiti	Energy Assessment (English and French)	06/82	3672-HA
	Status Report (English and French)	08/85	041/85
	Household Energy Strategy (English and French)	12/91	143/91
Honduras	Energy Assessment (English)	08/87	6476-HO
	Petroleum Supply Management (English)	03/91	128/91
Jamaica	Energy Assessment (English)	04/85	5466-JM
	Petroleum Procurement, Refining, and Distribution Study (English)	11/86	061/86
	Energy Efficiency Building Code Phase I (English)	03/88	--

Region/Country	*Activity/Report Title*	*Date*	*Number*
Jamaica	Energy Efficiency Standards and Labels Phase I (English)	03/88	--
	Management Information System Phase I (English)	03/88	--
	Charcoal Production Project (English)	09/88	090/88
	FIDCO Sawmill Residues Utilization Study (English)	09/88	088/88
	Energy Sector Strategy and Investment Planning Study (English)	07/92	135/92
Mexico	Improved Charcoal Production Within Forest Management for the State of Veracruz (English and Spanish)	08/91	138/91
	Energy Efficiency Management Technical Assistance to the Comision Nacional para el Ahorro de Energia (CONAE) (English)	04/96	180/96
Panama	Power System Efficiency Study (English)	06/83	004/83
Paraguay	Energy Assessment (English)	10/84	5145-PA
	Recommended Technical Assistance Projects (English)	09/85	--
	Status Report (English and Spanish)	09/85	043/85
Peru	Energy Assessment (English)	01/84	4677-PE
	Status Report (English)	08/85	040/85
	Proposal for a Stove Dissemination Program in the Sierra (English and Spanish)	02/87	064/87
	Energy Strategy (English and Spanish)	12/90	--
	Study of Energy Taxation and Liberalization of the Hydrocarbons Sector (English and Spanish)	120/93	159/93
Saint Lucia	Energy Assessment (English)	09/84	5111-SLU
St. Vincent and the Grenadines	Energy Assessment (English)	09/84	5103-STV
Trinidad and Tobago	Energy Assessment (English)	12/85	5930-TR

GLOBAL

Energy End Use Efficiency: Research and Strategy (English)	11/89	--
Women and Energy--A Resource Guide The International Network: Policies and Experience (English)	04/90	--
Guidelines for Utility Customer Management and Metering (English and Spanish)	07/91	--
Assessment of Personal Computer Models for Energy Planning in Developing Countries (English)	10/91	--
Long-Term Gas Contracts Principles and Applications (English)	02/93	152/93
Comparative Behavior of Firms Under Public and Private Ownership (English)	05/93	155/93
Development of Regional Electric Power Networks (English)	10/94	--
Roundtable on Energy Efficiency (English)	02/95	171/95
Assessing Pollution Abatement Policies with a Case Study of Ankara (English)	11/95	177/95
A Synopsis of the Third Annual Roundtable on Independent Power Projects: Rhetoric and Reality (English)	08/96	187/96

ESMAP
The World Bank
1818 H Street, N. W.
Washington, D. C. 20433
U. S. A.