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Energy Sector Reform and the Pattern of the Poor: Energy Use and Supply, a Four Country Study: Botswana, Ghana, Honduras and Senegal

March 2006

ENERGY SECTOR MANAGEMENT ASSISTANCE PROGRAMME (ESMAP)

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Executive summary

Introduction

1. Energy sector reform has one of its principal goals the improvement of living standards in the country concerned and this is supposed to occur in three different ways:

- An increase in macroeconomic growth rate caused by the lack of infrastructure in the energy sector will be made possible by attracting private investment into the sector;
- Public finances will be strengthened when implicit and explicit subsidies to the sector will be gradually phased out. These resources will then be available for public goods or targeted subsidies which benefit the poor; and
- Cost of supply will be reduced by improving efficiency of the sector by introducing competition and by liberalising ownership and operation.

2. The general dimension of sector reform is linked to poor households through the supply agents. Such links have been studied for the supply of grid electricity where the performance of the company supplying power to the grid or owning the grid is examined as to improving supply, largely through cost reduction brought about by private sector ownership and/or competition.

3. Many poor have no electricity in their homes but all households consume energy for cooking and lighting. Energy sector reform may impact the poor by increasing the number of poor households connected to the grid. The way in which poor households get access to the electricity grid is of crucial importance to designing sector reform. The various barriers preventing poor households to get connected to electricity and using it are not well understood. Many households are too poor to fully benefit from grid electricity and their major source of energy will be other fuels or other methods of electricity supply. The better supply of these fuels will be the way in which sector reform has a direct impact.

4. Three interlinked aspects of the use of energy by poor households are important;

- Which sources of energy are used and which are not used and why are they not used by poor households?
- How are these various forms of energy supplied in different contexts and how are these supply chains linked to any possible sector reform?
- If the supply chains are linked to central reform how might this result in changed energy use and improved welfare of poor households?

5. Only through changes in the supply situation for energy can households find their welfare improving. It is therefore important to find out what supply sub-sectors are relevant and what supply elements can be impacted by reform carried out by government.

6. Many developing and developed countries have embarked on some form of energy sector reform. High-level reform that involves a range of measures on market liberalization, sector restructuring, introduction of competition, privatization, regulation, tariff reform etc., takes place against a background of continuous technological innovation, such as prepayment meters, which might also affect the poor. So far it has not been conclusively shown that high-level reform has improved the livelihoods of the poor in developing countries. Direct relations may not be easy to establish, but this study contributes to the knowledge base on how the poor use and choose fuels, and which supply channels for these fuels could be affected by reform.

7. Little attempt has been made to link extensive work on household energy demand to the supply side – from where reform normally comes. This project attempts to establish some linkage, seeking to explore whether alternative methods in the supply chain make a difference to the welfare of the poor. Energy sector reform may impact on different links in the supply chain. The performance of the final outlet is partly determined by the whole supply chain.

Objectives

8. The project had the following objectives:

- To undertake a detailed assessment for four countries of the steps taken to reform the energy sector and their impact (or not) on various groups of poor households.
- To identify patterns of energy use by poor households in various situations.
- To identify patterns of supply of energy to poor households.
- To identify links between the supply and the use of energy by poor households, which are capable of being directly impacted by sector reform. Such links include: the actual use of various sources of energy (e.g. electricity); the form in which the source is used (e.g. battery or grid connection); its associated cost (capital costs and fuel costs); and the nature of the delivery form (state utility or local off-grid company, retailer of batteries or of LPG).
- The design of a template for future assessment of the impact of sector reform on the poor in other countries.
- Through the use of local consultants, wherever possible, the engagement in capacity building for economic and policy analysis of the energy sector.

9. The study was conducted in four countries, which had similarities and differences in the energy sector reform programs and high proportions of poor people. Country size and location were considered, as well cultural and climatic regions, so as to get a fair representation of smaller and larger countries and different climatic zones and cultural traditions. It was important to identify reliable partners in these countries. Botswana, Ghana, Senegal in Africa and Honduras in Latin America for comparison were selected.

Methods

10. The terms of reference were designed by the World Bank staff. The main consultant, the Energy Research Centre (ERC) at the University of Cape Town, and four sub-consultants with experience in the energy sector from the participating countries carried out the work. The four subconsultants were:

- Energy, Environment, Computer and Geophysical Applications (EECG), Botswana;
- Environnement et Développement du Tiers Monde (ENDA – TM), Senegal ;
- Economia, Sociedad, Ambiente (ESA), Honduras; and
- Kumasi Institute of Technology and Environment (KITE), Ghana.

11. Information was gathered at two levels. First, the reforms or changes in the energy sector in the participating countries were described. In the second part, two detailed questionnaires, one for households and another one for communities, were designed and administered to find out how energy is supplied and how households choose and use energy. The main consultant developed a household questionnaire together with an instruction manual for interviewers and a community questionnaire with notes for supervisors. Extensive consultation with the sub-consultants took place until a household questionnaire was agreed upon which accommodated country- and culture-specific information and which the four sub-consultants could administer in the different regions of their countries.

12. It was found that the household questionnaire was too long and should be shortened when used as a template for surveys in other countries.

13. The four countries followed the same sampling method. 300 households were interviewed in each country. The sample was designed to give a fair representation of the population of the country as a whole, with a bias towards the poor.

Reforms, interventions and changes in the energy sector

14. The four countries are at different stages of energy sector reform. All have liberalised the petroleum sub-sector. Senegal regulated the fuelwood and charcoal sub-sector to prevent overexploitation and protect a sustainable supply in the future. Ghana introduced licences for the export of charcoal. There were no changes in the fuelwood sub-sector in Botswana and Honduras.

15. The electricity sector has undergone changes in all countries, but not necessarily high-level reforms. Botswana has not started on any structural reform in the electricity sector. Senegal attempted to privatise its utility twice without success. Honduras has privatised about one third of electricity generation and Ghana has plans in place but implementation is slow. All utilities are largely state-owned. Regulators have been established but not all appear to be independent of government. All four countries have

set up dedicated rural electrification agencies or programs, which are subsidized or cross-subsidized at various levels. Since most poor people in Africa live in rural areas, sustainable and affordable rural energy supply is most likely to improve the livelihoods of the poor. Ring-fenced rural electrification sections will be able to attract dedicated funding without having to compete with other sections of the electricity utility. Rural electrification schemes in Botswana have been successful at bringing affordable connections to rural households, and the process – which was gradually adjusted to the ability of the poor to pay – led to a five-fold rise in rural connections from 1996 to 2003 under full cost recovery.

Survey information on household fuel use, expenditure, appliances and fuel supply

16. A comparison of earlier surveys and this one show the following general trends:

- Fuelwood is still one of the major fuels but households are using less fuelwood for cooking.
- Households are making a transition to more efficient cooking fuels such as gas and charcoal.
- Electricity is not used as cooking fuel except in Honduras where 21% of households cook with it.
- Households accept the change to modern fuels more easily when the modern fuel is subsidized, such as gas in Senegal.
- Electricity use for lighting and media has increased.
- The proportion of households using electricity for lighting generally reflects the electrification rate.

17. Some of the most striking features of the present survey were the differences and similarities between countries:

- the use of different cooking fuels in each country;
- the almost exclusive use of electricity for lighting, media and some appliances;
- the consistent multiple fuel use through all income groups; and
- the gradual emergence of as cooking fuel.

18. Households in the four countries spent from 5% to 24% of their monthly income on fuel. In Botswana households spent more of their income (24%) on fuel than in any other of the three counties and by far the highest proportion was spent on electricity. The proportion of income spent on energy was relatively low (5%) in Ghana. In all four countries, rural households spent a slightly greater proportion of their income on fuel than did urban households. In absolute terms, urban households (with the exception of Ghana)

spent more money on modern energy such as electricity, gas and kerosene, while rural households spent more on the traditional fuelwood.

19. Although electricity was mostly used for lighting, media and some appliances and not for cooking, households spent on average two to four times more on electricity than on any other fuel. In Botswana household expenditure on electricity was unusually high. Urban households spent US$92, which was about ten times more than urban households in Ghana.

20. It was investigated whether appliance cost is a barrier to ownership and so fuel use. If this were the case, the proportion of appliance ownership in the lower income quintiles should be smaller than the one in the higher income quintiles. In most cases the data did not show an increasing progression from lower to higher income groups, indicating that appliance cost is not the major barrier to fuel use. It may be contributing to the barrier of fuel switching when households already own a gas stove and do not want to invest in an electric stove when they get an electricity connection.

Energy supply chains

21. The most common fuels the poor use are fuelwood and charcoal, kerosene, LPGas and electricity.

22. The four countries except Botswana generate most of their electricity supply from hydro and thermal plants. All expanded their electricity grids in recent years and the quality of supply seems to have improved. Electricity coverage ranged from low in Botswana (28%) to high in Honduras (75%). Further expansions of the electricity grid or alternatives are planned but the cost is high. In Honduras, power generation constraints were overcome by facilitating private investment in new generation.

23. Ghana, Senegal and Honduras generate most of their own electricity and Botswana imports 70% of its electricity, mostly from South Africa. Botswana and Honduras have substantially expanded their electric grid in the last fifteen years. Ghana and Senegal did not extend their coverage very much in recent years, apparently due to generation constraints. Honduras overcame the constraints by facilitating private investment in new generation and Botswana imported more electricity to meet domestic demand.

24. The four countries imported all their crude oil and some refined products. Senegal and Ghana had a refinery producing kerosene and gas but additional kerosene and gas were also imported.

25. Fuelwood was the most affordable energy source for poor households, which gather it for free or buy it from local sellers. Fuelwood was most commonly used in poor rural households and gathered close to home. Commercial production and supply of fuelwood and charcoal are generally decentralised and undertaken by private entrepreneurs. Intensive tree harvesting has led to forest and woodland degradation, leading to unsustainable fuelwood and charcoal supply, and governments are addressing

this problem in different ways. In Botswana, government offices had to switch from fuelwood to other energy sources. In Ghana, the export of charcoal is licensed. In Senegal the fairly large charcoal and transport industry is regulated by government. These regulations aim to keep forests as a sustainable fuelwood resource and give poor local people continued access to one of their most important energy sources.

26. The four countries import all their crude oil and some petroleum products. Kerosene is a common fuel for the poor, and is supplied by oil marketing companies and private entrepreneurs. The governments in all four countries have facilitated the supply of kerosene to poor households.

Patterns of energy use and expenditure

27. A wide range of fuels is available to households. Cost of fuel or energy source and household income play an important role in fuel choice and fuel use patterns. Fuelwood is still one of the most widely used cooking fuels and relating trends of its use to income reveals a distinct pattern. Fuelwood use consistently decreased from the poorest to the richest income groups, while if alternative fuels are subsidized (such as gas in Senegal) fuelwood was hardly used by all income groups.

28. Charcoal was used for cooking only in Ghana, where 50% of households used it. The proportion of households using it rose from the poorest quintile (31%) to the middle-income group (62%) and remained at about that level for the two highest income quintiles. Income clearly influences charcoal use because it has to be bought.

29. Kerosene was much more widely used for lighting than for cooking, but there was not consistent pattern of kerosene use across the countries.. Only 6% to 7% of households used it for cooking in Botswana and Honduras. In Botswana it was most common in the lowest income group and in Honduras it was most widely used in the three highest income groups.

30. The proportion of households using gas for cooking varied greatly from country to country, ranging from 9% in Ghana to more than 85% in Senegal. In Botswana, Ghana and Honduras the proportion of households using gas for cooking increased from the lowest to the highest income group. The exception was Senegal, where more than 85% of households used gas in all income quintiles, showing that the subsidy on gas and small cook stoves benefits the poor as much as everybody else.

31. Electricity was widely used for lighting and media, generally not for cooking. Less than 2% of households used it for cooking in Botswana, Ghana and Senegal, though in Honduras the proportion was 21% – where it is obviously a fuel for the well-to-do and its use rose from 2% for the lowest income quintile to 55% for the highest income group. When households get connected to the grid they add electricity to their energy portfolio and remain multiple fuel users. Households of all income groups were multiple fuel users and the majority used three to four fuels.

32. When households have little or only irregular income they can buy fuels only in small quantities – often just enough to cook one meal. Under these circumstances the choice of fuel is influenced by the smallest amount sold, such as a few pieces of charcoal or half a litre or less of kerosene. Availability of credit also influences household choice of the shop where the fuel is bought. These are usually small neighbourhood shops and they do not stock all fuels; so in this way credit availability limits the choice of fuels. Even if the fuel is more expensive than in a shop without credit facility such as a supermarket or petrol station, poor households will buy in credit-granting shops.

33. The fumes from fuelwood and charcoal have a negative impact on health and women and children in poor households are most affected because they are the greatest fuelwood and charcoal users.

Links between the supply and use of energy

34. The link between supply and use of fuels was investigated by asking households which fuels are available in their area and which of these they are using. For most fuels, in Botswana and Honduras, the proportion of households responding that fuels were available was higher in both urban and rural areas than the proportion of households using that fuel. This indicates that fuels were generally available and non-availability was generally not the reason why households did not use a particular fuel in Botswana. Households considered affordability to be most important when deciding which fuel to use. For electricity the cost of connection seemed to be the greatest barrier to electricity use for lighting and media, while high tariffs prevented households from using it for cooking.

35. Households were also asked what they choose as their second and third fuel when they did not have their preferred fuel. The second and third fuels were generally the fuels households used before they had access to more efficient fuels. Candles substituted for electricity for lighting, and fuelwood was the most common second and third fuel for cooking.

What works for the poor? Differences and similarities between countries

36. It is difficult to detect the impact of high-level power sector reform on poor households. The poor household is far removed from high-level decision making and the chain along which potential benefits are supposed to trickle down to the poor is long and depends on many institutions which often have insufficient capacity. It is doubtful that any such reforms have a selective positive impact on the poor. If a sector, by implementing reforms, becomes more efficiently organized, administered and governed, it will benefit the whole country, including the poor.

37. Low-level reforms and changes, which focus directly on the conditions of the poor, were most effective in increasing access to electricity without requiring subsidies.

In Botswana the implementation of the Rural Collective Scheme and Standard Costing was monitored and the period of repayment was extended twice until the poorer households could afford the smaller monthly payments over a longer period of time, and household connections to the grid increased substantially in the year 2000.

38. In all the four countries in this study, electricity was used for lighting, media and limited appliance use. Using electricity for lighting is a definite improvement in living conditions. Household members appreciate the bright light for reading, and housework and income generating activities can be done after nightfall. Shop owners and small businesses can open for longer hours. Refrigeration preserves food for longer and makes shops more attractive. The high proportion of TV owners indicates that access to media is highly valued by households of all income groups.

39. In Ghana and Senegal, less than 1%, and in Botswana less, than 5%, used electricity for cooking. Only in Honduras did a larger proportion of households (21%) cook with electricity. Electricity is not the cooking fuel of choice because the tariffs are too high and other cooking fuels have been promoted (in one case subsidized). Bottled gas (LPG) is used in Botswana and Senegal and charcoal in Ghana. Fuelwood has remained the most common cooking fuel in Honduras.

40. There are other strategies to improve access to cooking fuels for the poor. Fuelwood is, and will remain for some time, the dominant cooking fuel in many poor countries in Africa.

41. Income influenced the choice of fuel for cooking. Fuelwood was generally used by the poorer households. In Botswana, Ghana and Honduras the highest proportion of fuelwood users was in the poorest 20% of households, and fuelwood use consistently decreased from the poorest to the richest households. Senegal was the exception, and only 1.3% of all households used fuelwood. Households of all income groups had switched to gas, which they could afford because it was subsidized.

Conclusions, Recommendations, and Lessons Learned from the Study Methodology

42. The energy sector in all four countries underwent reforms and changes in the last 15 years although the type of reform and change varied greatly from country to country. One outcome of the reform process was that all the four countries have introduced cost recovery in the energy sector, particularly the electricity sector. Some countries such as Botswana have fully achieved cost recovery while others were working towards it. Government subsidies to utilities have been reduced or completely eliminated. If subsidies were paid, they were often targeted and had specific objectives, such as reducing tariffs for low-consumption customers – who were generally poor.

43. It is difficult to detect the impact of high-level power sector reform on poor households. It is doubtful that any such reforms have a selective positive impact on the

poor. If a sector, by implementing reforms, becomes more efficiently organized, administered and governed, it will benefit the whole country, including the poor.

44. Low-level reforms and changes, which focus directly on the conditions of the poor were most effective in increasing access to electricity without paying subsidies. Regular monitoring and evaluation were necessary to find out whether the poor benefit or not. The rural electrification scheme in Botswana was a successful example that benefited the poor. Reforms directly affecting cooking fuels were beneficial in Ghana and Senegal

45. Electricity connection rates have increased in all countries, though more in some than in others.

46. All four countries have strengthened their rural electrification programs. The large capital investment was the major obstacle, compounded by the fact that rural households used very little electricity and the revenue from their consumption did not cover operations and maintenance costs. Botswana's rural electrification program was particularly successful in increasing connection rates of rural households.

47. Households in the four countries spent from 5% to 24% of their monthly income on fuel. Although electricity was mostly used for lighting, media and some appliances and not for cooking households spent on average two to four times more on electricity than on any other fuel.

48. When changes are adjusted to the payment capacity of the poor, they are able to access modern energy. The rural electrification in Botswana evolved over several years until it became successful. Adjustment were made and monitored and evaluated several times. Only when the payment for the connections was spread over longer periods so as to make the monthly payment amount small enough to be affordable for the poor did connection rates increase rapidly.

49. It appears that the cost of appliances is only one of the barriers to the fuel use. Access to credit for the un-banked poor is important for appliance ownership. The poor are often excluded from normal credit facilities because they have no collateral and have uncertain or irregular incomes. In instances where these credit conditions were lowered or waived, poor households did access modern energy and appliances. In Southern Africa, furniture and appliance shops include financing in their services and have credit and lay-by systems, which enable many poor households to acquire appliances. Repayment rates are relatively small and are spread over a long time period. The consumer is apparently willing to pay the cost. The 'easy term' credit offered by cell phone marketing companies is another example of affordable credit for the poor.

Recommendations

50. All energy promotions need thorough information and education campaigns so that households fully understand the implications and payment requirements.

51. There is merit in considering low level reforms focused on benefiting the poor.

52. Reforms in the forestry sector are required to better manage forest and woodland resources to benefit communities living in forest and woodland areas.

53. There is an obvious need to include reforms for, and promote, modern cooking fuels other than electricity, and gas appeared to be affordable and acceptable.

54. The dissemination of efficient and smokeless stoves should continue and should be made a priority program in all areas where households use biomass or coal.

Lessons learned from the Study Methodology

55. One of the difficulties in measuring the impact of energy sector reforms on the poor is the lack of longitudinal data collected before and after reforms. The surveys designed for this study could be used in the future to monitor progress in implementing reforms.

56. Guidelines on information and data collection, cross-tabulation, analysis etc have to be very prescriptive to be comparable across countries.

57. It is therefore recommended that

- the large body of information in the individual country reports be edited and made more widely available, and
- further analysis be carried out on the questionnaire data of the four countries. This could be done in a capacity building exercise with the three African countries.

1

Introduction

1.1 Many developing and developed countries have embarked on some form of energy sector reform. Countries have followed different routes with varying degree of success. Reform takes place against a background of continuous technological innovation, which might also affect the poor, such as prepayment meters. This study attempts to find patterns in the ways poor people are accessing and using energy and to identify which of the changes impact on the poor. If such patterns are found it may inform and broaden the reform agenda.

1.2 In the context of this study high-level reforms imply commercialization, corporatization and privatization of state-owned utilities followed by unbundling and the introduction of competition. So far no African country has completed the transition to a fully private, competitive and unbundled electricity sector. But many African countries have implemented institutional, financial and technological reforms and changes that affect poor households directly. Such changes include concessionary loans for rural households to get an electricity connection in Botswana. The Self-Help-Electrification Program in Ghana where communities within 20 kilometers of the existing network were eligible for a connection if a minimum number of households applied and provide the required low-voltage wooden distribution poles.

1.3 The major questions are if and how energy sector reform impacts on the poor. So far, it has not been conclusively shown that the benefits of high-level reform have improved the living standards of poor people in developing countries. Direct effects may not be easy to establish, but this study aims to contribute to the knowledge base on how the poor use and choose fuels, and which supply channels for these fuels could be affected by energy sector reform.

1.4 Little attempt has been made to link extensive work on household energy demand to the supply side – from where reform normally comes. This project is attempting to establish this linkage, seeking to explore whether some alternative methods in the supply chain make a difference to the welfare of the poor. Energy sector reform may impact on different links in the supply chain, while the performance of the final outlet is partly determined by the whole supply chain. High-level sector reform may impact further upstream on the supply chain and this may or may not impact on the supply downstream.

1.5 Apart from high-level reform, the energy industry is continually attempting to improve efficiency. Many of these changes are technological in nature and affect the consumer directly, such as improved fuels, new and more efficient appliances, computerised metering and billing in the electricity sector. The project briefly describes the supply chains for different fuels in the four countries and tries to assess if recent changes in technology had substantial impact on the use and choice of energy by the poor.

1.6 Cooperating partners in Botswana, Ghana, Senegal and Honduras prepared detailed reports describing power sector reform intervention in the last 10 to 15 years covering the privatisation of electricity generation and supply or the plans leading to privatisation; electrification programs; liberalisation of gas (LPG) and kerosene markets; the role of the regulator; technological and institutional changes such as the introduction of prepayment meters; the introduction of poverty tariffs and subsidized fuels; rural electrification schemes and the obligation to supply in rural and urban areas.

1.7 The report describes the steps taken before the reform and the stages of reform, e.g., unbundling or restructuring, corporatization, commercialisation, privatisation, independent power producers. The impact of sector reform on the choices of energy by households is discussed.

1.8 The reports of the local consultants are summarised in this report and a comparison between the four countries is made. Differences and similarities are discussed.

1.9 A survey on energy use and supply was conducted and the results are contained in the country reports. This summary report attempts to compare the findings and the data of the four countries and analyse the similarities and differences. Emphasis was put on getting data that were comparable and linking them to changes or reforms that have demonstrably benefited the poor. A large amount of data has been collected and this report presents only the first stage of analysis and interpretation; the interesting initial results justify a more thorough and deep analysis.

1.10 One of the limitations of the report is the uneven spread of information across the four countries. This is generally due to the fact that the cooperating partners reported at different levels of detail.

2

Objectives

2.1 Important lessons on the design of energy sector reform and its impact on the poor still need to be learnt. There is a lack of systematic information about the impacts of energy sector reform on all the sources and methods of delivery of energy used or potentially used by poor households. Efforts should be made to measure the impact of reform on the poor: costs of supply may rise or fall, a larger range of fuels may become available, or financial or non-financial barriers to use may be reduced.

2.2 Many poor people do not have access to electricity, or cannot afford to use it when they are connected and continue to rely on other fuels for their energy needs. The study attempts to shed some light on three interlinked aspects of the use of energy by poor households:

- Which sources of energy are used and which are not used, and why are the latter not used?
- How are these various forms of energy supplied in different contexts, and how are these supply chains linked to any possible sector reform?
- If the supply chains are linked to central reform how might this result in changed energy use and improved welfare of poor households?

2.3 The common thread to these questions is the observation that only through changes in the supply situation for energy can households find their welfare improving (putting aside the possibility of a rise in income created by the reform process). Therefore, it is important to know, firstly, what supply sub-sectors are relevant (through an inventory of goods demanded under improved circumstances) and, secondly, what characteristics of these supply elements can potentially be impacted by reforms.

2.4 This project attempts to find out how the poor use and choose fuels and how changes in supply affect choice, and also aims to measure the impact of modern fuels and identify the barriers to their uptake. The project is designed to achieve several goals:

a) To identify patterns of energy use by poor households in various situations. In the "energy ladder" model, households progressively move to more efficient fuels when income rises. Understanding why the poor at lower income levels are not able to buy certain fuels might inform the design of sector reform and create conditions under which the poor are able to purchase more efficient fuels and the

appliances which go with them. The "multiple fuel use" model emphasizes the fact that households do not drop one fuel when they start using a more efficient fuel but retain a number of fuels over a wide range of income levels. The pattern of energy use in households supports the view that the two models are not exclusive of each other. The types of fuel in the portfolio may change when households move to a higher income level, and the number of fuels used may also change under certain circumstances. Substitution of one fuel for one end use may not displace the fuel for another end use; for example, when fuelwood for cooking is dropped in favour of gas the household may continue to use fuelwood for water heating. More generally, if for some reason it is optimal to use more than one fuel for a given end use, the change in the supply performance of one of these fuels may lead to its substitution out of one activity but not out of others.

b) To identify patterns of supply of energy to poor households. Reform may impact on different levels of the supply chain. It is important to link the impact of the supply chain to impacts on the poor.

c) To identify links between the supply and the use of energy by poor households which are capable of being directly impacted by sector reform. Such links include: the actual use of various sources of energy (e.g. electricity); the form in which the source is used (e.g. battery or grid connection); its associated cost (capital costs and fuel costs); and the nature of the delivery form (state utility or local off-grid company, retailer of batteries or LPG).

d) A detailed assessment for four countries of the steps taken to reform the energy sector and their impact (or not) on various groups of poor households. A description of the reform program and its constituent parts will provide insights into where reform is expected to impact directly on the poor. For each of the sub-sectors impacted by reform, a list of steps taken (privatization, liberalization etc) is needed, together with an account of how these steps were taken. The establishment of a regulator and regulatory rules are particularly relevant because these impact directly on two aspects that affect all users of electricity – price and quality. The new tariff setting regime has the potential to impact final prices and to alleviate price increases by lifeline tariffs for the poor.

e) The design of a template for future assessment of the impact of sector reform on the poor in other countries.

f) Through the use of local consultants, wherever possible, the engagement in capacity building for economic and policy analysis of the energy sector. The detailed study of how the poor and others buy energy can provide a template around which a reform program may be designed for this purpose.

2.5 The four countries selected for the study are Botswana, Ghana, Senegal and Honduras. Some basic relevant information on them is given in Table 2.1.

Table 2.1: Basic information on Botswana, Ghana, Senegal and Honduras (UNDP 2003)

	Botswana	Ghana	Senegal	Honduras
Population in 2001 (mill)	1.7	20.0	9.6	6.6
GDP per capita 2001 (PPP US$)	7 820	2 250	1 500	2 830
HDI (2001)	0.614	0.567	0.430	0.667
Household size			10[1]	
Electricity per capita consumption 2000 (kWh)	196[2]	288	121	499
GDP per unit of energy use 2000 (PPP US$ per kg of oil equivalent	2.75[3]	3.1	2.2	3.2
Electricity coverage (%)	28	49	30	75

Notes

1. Population census 1988
2. Considering only domestic electricity demand
3. EECG personal communication 2005

3

Methods

3.1 The project was designed by the World Bank staff. The main consultant, the Energy Research Centre (ERC) at the University of Cape Town, and four sub-consultants carried out the project. Information was gathered at two levels. First the reforms or changes implemented in the participating countries are described; in the second part two detailed questionnaires, one for households and the other one for communities, were administered to find out how energy is supplied and how households choose and use energy.

3.2 The four cooperating organisations prepared two reports: in the first phase a report on power sector reform and in the second phase a report based on the questionnaire results. The second report described energy use of and supply to the poor and the linkages to power sector reform.

3.3 The draft questionnaires went back and forth several times because it was advantageous for later analysis to have one household and one community questionnaire for four different countries, which still captured the cultural diversity of each country (if not regions within the country). In Senegal the questionnaire was translated into French and in Honduras into Spanish.

3.4 A pilot survey was run in all four countries for both the household and the community questionnaires and after making final adjustments to some question the final questionnaires were agreed upon. 300 household samples were determined, following the same sampling framework, so as to have a sample as representative as possible of the entire country.

3.5 The cooperating partners who did not meet face-to-face in the context of the project. All communication was through mail (predominantly email) and this was a challenge, which the partners faced extremely well in all phases of the project. However it might have been advantageous if the group would have met twice. The first meeting would have served to finalise the questionnaire in order to accommodate better the cultural and developmental differences of the four countries. The second meeting would have served to deepen the analysis of data and to enhance capacity building in that area.

3.6 This study did not find out if the savings from the tariff subsidies went to social or infrastructure projects.

Country selection criteria

3.7 The countries were to be selected from Africa where the issue of access to modern energy services by the poor is most severe. There is also very little information on power sector reform and on energy use of poor households. The countries were supposed to have some reform experience and some earlier data on household energy use. As a comparison a country from Latin America was to be included.

3.8 No country in Africa has completed all the major steps of high level power sector reform such as corporatization, commercialization and privatization but many countries have implemented some reform. The selected countries were to have introduced some reforms that were supposed to have benefited the poor.

3.9 In the first round of selection, African countries with high proportions of poor populations that are known to have similarities and differences in their energy reform programs were short-listed. Country size and location were taken into consideration so as to have countries in different cultural and climatic regions. It was important to identify cooperating partner institutions or individuals in the energy sector who could be relied upon to deliver the work required. ERC cooperates with a number of such partners within regional and global networks and the African partners were chosen from among these organisations.

3.10 As a next step a form (Appendix 2.1) was sent to short-listed countries to gather information on recent energy reforms and their driving forces and also to find out what household energy information was available and accessible from surveys and census. Adequate information was available in Botswana, Ghana and Senegal. For comparison a Latin American country was to be added and ESMAP suggested Honduras, where a reliable partner could deliver the work. A request for proposals was sent to the short-listed partners and upon receiving satisfactory proposals the following four organizations were appointed:

- Energy, Environment, Computer and Geophysical Applications (EECG), Botswana;
- Environnement et Développement du Tiers Monde (ENDA – TM), Senegal;
- Economia, Sociedad, Ambiente (ESA), Honduras; and
- Kumasi Institute of Technology and Environment (KITE), Ghana.

Mode of cooperation

3.11 The project was conceived by ESMAP, and ERC submitted a proposal for appointment as the main consultant. As described above, countries and cooperating partners were agreed upon, whereupon ESMAP directly contracted the partners as subconsultants.

3.12 The ESMAP task manager visited the main consultant three times first to discuss the motivation and general coverage, and then the progress of the work. The main consultant did not visit any of the partner organizations and countries and all communication was by email, mail or phone. The remote mode of cooperation made it necessary to provide detailed guidelines and report outlines, to ensure comparable results from the different countries. It might, however, be advisable to have face-to-face discussions with the cooperating partners particularly for questions on overall objectives, questionnaire content, data presentation and analysis.

3.13 The subconsultants carried out two main tasks. The first was to document the reforms and changes in the energy sector over the last 10 to 15 years and to find out household survey information, which might be used as a baseline to assess the impact of energy reforms on the poor. The second was to administer household and community questionnaires in order to identify energy use of and supply to poor households and how energy reforms impact on the link between supply and use.

Reforms and changes implemented in participating countries and household survey information

3.14 The energy interventions, reforms and changes might be high-level reforms (such as privatization of the national utility) or changes at the level of the consumer (such as access to loans for an electricity connection). The second part of this task was to identify surveys already carried out that contained relevant questions for measuring energy reform impact on the poor. This was to ascertain what type of analysis can be carried out on the existing data sets to investigate if the poor have better and more affordable access to energy services after specific energy interventions. Are data lacking and what additional data need to be collected? The main consultant prepared guidelines (Appendix A2) on selecting and describing the interventions and reforms and the household survey information for the subconsultants to ensure that comparable information was collected.

Household and community questionnaires

3.15 The main consultant developed a household questionnaire (Appendix A3) together with an instruction manual for interviewers (Appendix A4), and a community questionnaire (Appendix A5) with notes for supervisors (Appendix A6). Extensive consultation with the subconsultants took place. A draft questionnaire was prepared and sent to the subconsultants for comments and to include country-specific information and questions. This process was repeated until a household questionnaire was agreed upon that accommodated country- and culture-specific information and that the four subconsultants could administer in the different regions of their countries. The subconsultant in Senegal had the questionnaire translated into French and the main consultant checked the translation. The Spanish translation for Honduras was not checked.

3.16 At the same time a community questionnaire was developed to enhance the data collected at the household level. Government programs and services are often provided at

the community level and household surveys that gather information both at household and community level yield more policy relevant data than those that only collect household data. Also, some information can be more efficiently obtained from knowledgeable community leaders and members than from each household individually.

3.17 One community questionnaire was administered for each sampling cluster. The field supervisor was to gather the information in a meeting with knowledgeable community members.

3.18 It was found that the household questionnaire was too long and that the interviewees lost interest towards the end of the interview. If the questionnaire will be used as a template for other surveys it should be shortened. Which questions are to be left out will depend on the detailed objectives and the emphasis of the future surveys. The skip instructions could also be made clearer in order to shorten the interview time.

Guidelines for interviewers and supervisors

3.19 The main consultant prepared guidelines for interviewers and supervisors (Appendix A4 and Appendix A6) to ensure that concepts and interpretation of terms were applied and used in an identical manner. This was considered very important given the culturally diverse countries.

3.20 The instruction manual for interviewers was designed to guide fieldworkers and interviewers in undertaking the survey on household fuel use and supply, to help them understand the prime objectives of the survey, the rational for each section of the questionnaire, and the meaning of specific questions so as to maximise the accuracy of answers provided by individual households. The manual was designed to highlight the most important aspects of interviewing and the interview, on which the accuracy and the quality of the data depend entirely.

3.21 The community questionnaire was to be administered by fieldwork supervisors and the “Notes for supervisors” are guidelines to ensure that the supervisors use the same concepts, select the relevant representatives for the meeting to gather information, and follow the same procedure in data collection.

Sampling

3.22 The four countries followed the same sampling method and the main consultant had prepared “Sampling notes” (Appendix A7). 300 households were interviewed in each country. The sample was carefully designed to give a fair representation of the population of the country as a whole, as well as the subgroup this study is particularly interested in: poor people. Samples were drawn in two stages. In the first, a certain number of area units – primary sampling units (PSUs) – were selected. In the second stage, a certain number of households were selected in each of the designated PSUs.

Measuring impact

3.23 One of the objectives was to measure impact of reforms on all the sources and methods of delivery of energy used or potentially used by poor households. It was found that longitudinal data collected before and after reforms were not available. This project conducted only one survey. Some data from earlier surveys were found (see Table 5.2) but none of these surveys was before the reforms. The only available time series data were on electricity access rates for Botswana (Fig 8.1) and Senegal (Fig 8.2).

3.24 A comparison of data from earlier surveys and this survey showed trends of energy transitions which might have been influenced by reform. If the impact of a particular reform is to be measured, a before and after survey, specifically focused on the reform would be more adequate.

Data

3.25 The data and information obtained from the subconsultants are not evenly distributed. Some of the countries such as Botswana provided very detailed information while data from some other countries were more difficult to get. This limited some parts of the comparison.

4

Reforms, Interventions and Changes in the Energy Sector

4.1 This chapter begins with a brief description of energy institutions and energy planning tools in the four countries. It further covers energy reforms and interventions and includes changes at the lowest distribution level, which affect poor customers very directly. Rural electrification is described and analysed separately because one of the reform objectives was to set up separately funded rural electrification agencies or sections: the majority of poor people in Africa live in rural areas and grid extension will benefit them only if they can afford the connection. The information was largely extracted from the comprehensive country reports.

4.2 The major energy institutions and their ownership are given in Table 4.1. Structural reforms in the electricity sector in Botswana and Ghana are not very advanced. They have failed in Senegal, and only Honduras has succeeded of introducing some private electricity generation. All utilities are largely state-owned. Transmission and distribution in all four countries is state-owned. All four countries have dedicated rural electrification agencies or programs, which are subsidized or cross-subsidized at various levels.

Table 4.1: Major institutions in the energy sector of Botswana, Ghana, Senegal and Honduras

	Botswana	**Ghana**	**Senegal**	**Honduras**
Electricity				
Generation	State-owned utility	Largely state-owned utilities, 50 % of Abadze thermal power station owned by USA private company	National electricity company, companies generating for their own use and independent producers	State- and privately owned power stations
Transmission	State-owned	State-owned	State-owned	State-owned
Distribution	State-owned	State-owned	State-owned	State-owned

	Botswana	**Ghana**	**Senegal**	**Honduras**
Rural electrification agency				
	Department of Energy	Ministry of Energy	Senegalese Rural Electrification Agency (AsER)	-
Electricity regulator				
	Department of Energy (DOE) in the Ministry of Minerals, Energy and Water Resources	Energy Commission and Public Utilities Regulatory Commission (PURC)	Electricity Sector Regulatory Commission	Comicion Nacional de Energia
Petroleum				
Importers	Oil companies	Tema Oil Refinery and oil marketing companies	Societe Africaine de Raffinage owned jointly by oil companies and the state	-
Petroleum regulator				
	DOE	National Petroleum Tender Board and Energy Commission (licensing under deregulation)	National Hydrocarbon Committee	-
Woodfuel				
	DOE	Regulation planned including incentives for better management of the sector	95% of forests and woodlands are state owned. There are many players in the fuelwood supply chain. Regulated by Ministry of Environment	-
Charcoal				
		Generally unregulated but the Energy Commission regulates export	Regulated and licensed	-

4.3 All the four countries have electricity regulators (Table 4.1) but not all appear to be independent of government. There appears to be national energy plans or programs in place and they are regularly updated in some countries (Table 4.2). The energy plans address energy policies and energy development.

Table 4.2: National energy planning tools in the four countries

	Botswana	**Ghana**	**Senegal**	**Honduras**
Type of planning tool	Energy master plan	Short-medium term sector development programs. Since 2005 Strategic National Energy Plan (SNEP) 2005-2020	Policy Letter on the Development of the Energy Sector	-
Content	Energy policies addressing development issues	Strategic energy development and policies for economic growth	Reference framework for the development of the sector	-
Regular update	1996, 2004	Updated every 2 years, major review every 4 to 5 years	1997, 2003	-

Structural reforms

4.4 The four countries are at different stages of energy reform. Botswana has not started on any structural reform in the electricity sector and the utility is still state-owned, while Senegal attempted to privatise its utility twice without success (Table 4.3). Honduras has privatised about one third of electricity generation and Ghana has plans in place but implementation is slow. Many utilities in developing countries are subsidized by the state and when privatisation is planned cost recovery is one of the first steps to be undertaken. Tariffs rise sometimes very steeply, as in the case of Ghana, and the poor will be even less able to afford electricity. The government's savings on the subsidies are supposed to go to social services but the situation is not clear and it is sometimes difficult to ascertain if these savings are going to social services to benefit the poor.

4.5 This part of the report is based very closely on the first reports of the local consultants.

Table 4.3: Structural energy reforms and interventions in Botswana, Ghana, Senegal and Honduras

Reform/Intervention	Botswana	Ghana	Senegal	Honduras
Structural reforms	None in the electricity sector	Reforms initiated (1995), implementation in the electricity sector is slow	In the electricity, petroleum and forestry sectors	In the electricity sector
Privatisation	None	Planned	Two unsuccessful attempts of privatisation of state-owned utility. Process of privatisation still on-going	36.5% of electricity generation privatised
Commercialisation	None	The main distribution utility ECG commercialised and corporatised since 1997	None	
Licensing	Licensing in the petroleum sector	Licensing in the electricity and petroleum sector	Licensing in the petroleum sector	
Liberalisation of markets	Liberalisation of LPGas market	Liberalisation of petroleum market	Liberalisation of electricity generation; liberalisation of hydrocarbon imports and petroleum markets; liberalisation of charcoal prices	

Botswana

4.6 There are no high-level energy reforms in Botswana. The Department of Energy is investigating how to reform the electricity sector given the need to expand its generation capacity at Morupula the only power station in the country. The performance of the Botswana Power Corporation is good, it is making profit and it is able to provide new and maintain existing infrastructure. The management of the utility is transparent. Government has not yet made up its mind to restructure ESI but has commissioned studies to inform its decision. The Botswana Power Corporation (BPC) reorganized its operations to raise awareness of the need of cost reflective performance and created the following business units: rural division (in charge of rural electrification), distribution division, operations and transmission division, Morupula power station division and consumers division. The support services such as finance and administration are distributed between these divisions. Each business unit accounts for its financial operations. If a decision to restructure the ESI is made these organisational changes will facilitate the unbundling of the utility.

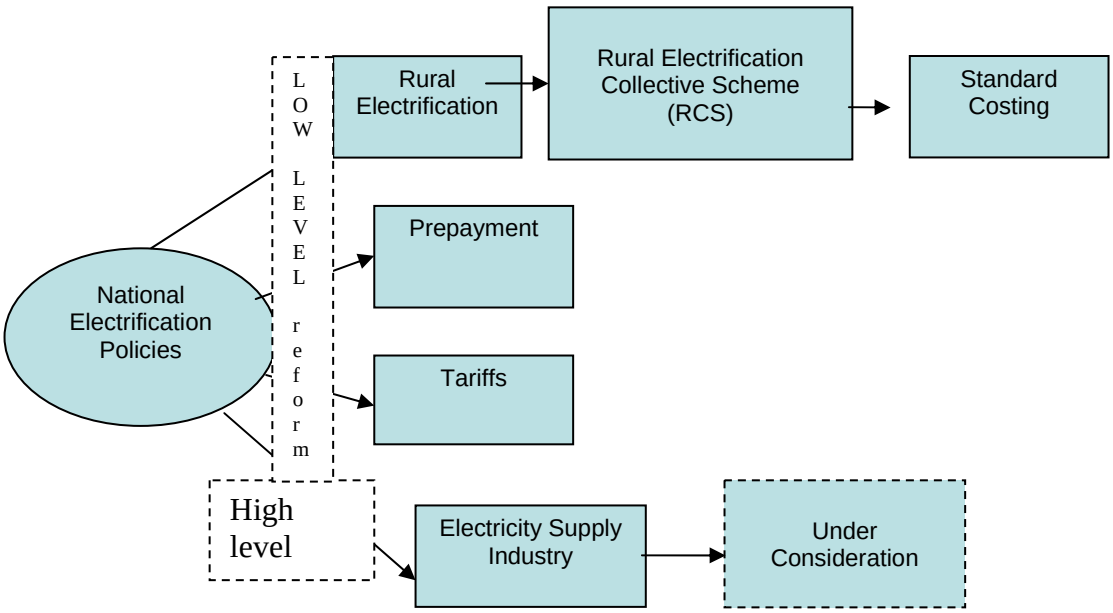
4.7 There is major concern about the exposure to the risk of increasing electricity imports. Local generation has remained constant and increasing demand has been met by imports. Since regional surplus supply will come to an end in 2007 this situation is threatening sustainability and security of supply.

Low-level reforms in Botswana

Electricity

4.8 Botswana has introduced a number of low-level reforms in the electricity sector such as government schemes and indirect subsidies, innovative energy technologies, institutional changes, tariff setting and community involvement. Figure 4.4 shows the linkages of the different high- and low-level reforms of the national electrification program.

Figure 4.4: Policy reforms for national electrification



Petroleum sector and fuelwood

4.9 The petroleum sector is fully liberalised. Multinational oil companies and local bottling companies import petroleum products from South Africa and distribute it in the country.

Ghana

Structural reforms in electricity

4.10 Structural reforms in the power sector were initiated in 1995. The government saw the reforms as the most productive response to the many problems in the power sector. At the time the World Bank made reform a condition attached to an IDA loan for building a 330 MW thermal power plant at Abadze near Takoradi. The government of Ghana designed and implemented the reforms and the Bank reviewed the process ensuring that reforms proceed in line with its principles. The stated objectives were:

- Enhance transparency in the regulation of the power sector, and also increasing management accountability in the existing public utilities, including more effective commercialization of the operations of the power utilities;
- Effect structural changes that would move the power sector away from the existing monopolistic and centralized structure towards a more decentralized structure that would expose the utilities to competition in both generation and distribution of electricity;
- Encourage private sector investment in the power sector through the establishment of independent power production schemes, and the provision of open access transmission service to facilitate direct electricity sales by IPPs to consumers;
- Minimize the extent to which public resources and/or GoG sovereign guarantees are relied upon by the power utilities to finance power generation projects by introducing alternative arrangements to address specific non-commercial (country-specific) risks to be faced by investors, and to target the application of available public resources to enhance the cost-effectiveness of power transmission and distribution projects under the NES; and,
- Establish a regulatory framework that is transparent and at the same time enables healthy competition to occur in the sector.

4.11 A Power Sector Reform Committee was set up to work out the modalities, milestones and timetables for the reform process. The committee completed its work in 1997 with the following recommendations;

- Enactment of new legislation to establish a regulatory framework that will introduce explicit regulation, rules of practice and standards of performance to cover all aspects of power sector operations;
- Engender competition in wholesale power supply transactions and introduce open access transmission services to facilitate competition in the supply of power to large customers and distribution utilities;
- Reorganize existing utilities into “strategic business units” and recapitalize them through public-private partnerships and joint ventures; and,

- Introduce specific guidelines and procedures to ensure transparency in the setting of tariffs for the power sector.

4.12 Regarding existing utilities the reform plan suggested unbundling of the Volta River Authority (VRA) and restricting its role to the existing hydro generation assets and new hydro generation in the Volta River Basin. In order to create competition in thermal power generation the VRA is allowed to build and own new thermal power plants on its own or in a joint venture partnership with private sector companies. A regulated distribution market was also proposed by merging the existing two distribution companies and creating five distribution business units.

4.13 The implementation of the reform has been slow and so far only the Energy Commission Act (Act 541) and the Public Utilities Regulatory Commission Act (Act 538) establishing two regulatory bodies were enacted. The electricity tariffs were increased to make them more cost reflective. Recently some steps to restructure the VRA and the Electricity Company of Ghana seem to have been taken. The Electricity Transmission Utility has been registered to take over transmission from the VRA.

4.14 So far only one private company entered the power sector in Ghana. The CMS of Michigan bought a 50% share in the Aboadze thermal power plant. The sector remains largely state-owned.

Structural reforms in petroleum

4.15 The distribution of petroleum is being deregulated and pricing has been liberalised to stimulate competitive marketing and pricing. Oil marketing companies will be allowed to import petroleum products or crude oil for processing at the refinery for a fee. Private investors will be allowed to build, own and operate refineries in the country. A National Petroleum Planning Committee has been set up to prepare and implement the proposed reform in the distribution of petroleum products.

Structural reforms regarding woodfuel

4.16 The production and supply of fuelwood and charcoal are already managed by the private sector. Reform is expected to introduce regulatory measures to ensure sustainability and better management of woodfuel resources, production and supply.

Senegal

4.17 Senegal has initiated several reforms. The first in 1980 and the second in 1991 the RENES (Redéploiment Energétique du Sénégal) did not achieve their objectives because

- The government was unable to raise the large amount of funding required to increase SENELEC's generation and transmission capacity and to valorize national energy resources;
- The improved furnace program, which was supposed to rationalize consumption of wood fuel and charcoal, was not implemented; and

- The country's dependence on external sources for oil products was increased by the consumption of butane gas, almost all of which was imported.

4.18 Building on the previous experience new energy reforms and forestry programs were designed and two Policy Letters on the Development of the Energy Sector were issues, the first in 1997 and the second in 2003. The 1997 letter is still today considered the basic charter guiding the energy sector. Its overall goals were to

- Eliminate inefficiency
- Reduce the supply cost for consumers
- Facilitate the financing of the development of the energy sector

4.19 The reforms regarding the subsidy issue for butane gas are described in section 4.2 below.

4.20 As a result of the 1997 policy letter the state-owned electricity utility SENELEC could transfer the majority share to a strategic partner, the Senegalese private sector and the employees of SENELEC. The strategic partner would be responsible for at least 33 % of the capital and will act as the operator.

4.21 A consortium, Hydro-Québeque International/Elyo, was selected as strategic partner and the partnership entered into force on 31 March 1999.

4.22 The investment objectives in generation were not reached and the generation facilities deteriorated further leading to mare frequent load shedding. The unsatisfactory out come of the this first privatisation can be attributed to the following:

- No contractual investment program was stipulated in the specifications.
- Only 34% of the capital was granted to the strategic partner despite the fact that it was suppose to have full responsibility for managing and guaranteeing the funding of investments;
- The electricity regulatory commission was set up too late.

4.23 On 21 September 2000, the Senegalese government and Hydro-Qébec-International/Elyio declared an amicable severence of their partnership.

4.24 The government was still committed to privatisation and introduced some modification for the next round. It decided to cede 51 % of SENELEC's shares to the strategic partner and retain only 49 % in order to interest serious investors who would make the necessary investment to develop the electricity sector. The electric lines which had earlier been removed from the public utility were re-integrated into it. Under the 2002 changes SENELEC retains its role of sole buyer. It is also responsible for developing new generation either on its own or by inviting independent generation companies.

4.25 The invitation to tender for the second privatisation was published on 10 July 2001. Two companies were short-listed but after long negotiations the government

declared on 12 July 2002 that the tender had not been successful. The privatisation drive was brought to an official halt. A task force of government and donors was set up to study SENELEC's future. It was concluded that investments estimated at 212 billion CFA Franc including additional generation capacity (3x60 MW by 2008) was needed. Rural electrification was to rise from 8 % to 15 % by 2005 and 62 % by 2025 at an estimated cost of US$400 million.

4.26 Most of the problems that were identified before the reforms still persisted after the reforms. The national utility is still heavily in debt, it is still difficult to raise finances for investment, generation and distribution facilities are obsolete and electrification remains low although some progress has been made in this area. In 2001 the elctrification rate had risen to 30 % compared to a global 60 %. The urban rate was 55 % and the rural rate was only 8 %.

4.27 On the positive side the supply capacity now exceeds demand. Power generation has been increased by 30 MW due to the new power plant at Manantali and the extension to the plant at Cap des Biches. The capacity increase led to a decrease in generation cost and less use of gas turbines.

4.28 Rural electrification rose from 5 % in 1997 to 8 % in 2001.

Honduras

4.29 In Honduras the national utility, the Empresa Nacional de Energia Electrica (ENEE), had a high degree of autonomy in carrying out its day-to-day business but depended on government for financing capital works and setting tariffs. Since the 1990s general fiscal crisis of the state, reforms of the electricity sector were advocated because the utility was incapable of increasing coverage and providing quality service reforms. Drought, increase in demand and mismanagement of the hydro-electric facilities triggered the reform process. The first stage was implemented in 1994 and the second from 1998 to 2001. The 1994 reform provided for the separation of the three functions – policy, regulation and production/service. The reform was supported by a loan from the World Bank and the IABD as part of the structural adjustment process that began in 1990. The proposed vertical unbundling was not implemented and the sector remains centred on the vertically integrated state monopoly and the utility remains in charge of all hydroelectric generation, transmission, distribution and indicative planning. Billing, collection and some generation was outsourced. Private companies generate electricity from thermal plants on contract to the national utility through power purchasing agreements, leasing contracts and co-generation agreements.

4.30 The reforms have improved the performance of the electricity sector. The utility has increased its internal efficiency and coverage has grown from 33% in 1989 to 75% in 2001. The service has become more reliable and outages are greatly reduced. Cost-based tariffs improved the utility's financial performance, but 7.5% of current income is paid by government as the consumption subsidy. The utility's debt has decreased from US$38

million in 1994 to US$25 million in 2001. Although many problems have been addressed by the reforms the following still remain:

4.31 Cost-reflective tariffs have improved the financial position of the utility but user tariffs are still low compared to the real cost of the system, distribution costs being underestimated and substantial subsidies being paid to most domestic consumers.

4.32 The supply and demand balance has improved through the addition of private capacity but the available balance is too heavily skewed to small plants with low capital cost and high variable cost resulting in unnecessarily high costs in generation.

4.33 Coverage has been significantly extended, requiring further subsidy for customers using less than 300 kWh per month and adding greatly to the number of loss-making customers. This may affect the sustainability of future grid expansion.

Pricing, taxation, subsidy

4.34 Post-reform changes in pricing, taxation and subsidy in the four countries are given in Table 4.4. One of the reasons for proposing reform was that the energy sector was running at a loss and did not cover its cost. Utilities charged low tariffs to consumers and government paid the shortfalls. When tariffs increased after the reforms, the poor could no longer afford the high charges. Lifeline tariffs for low-consumption customers were introduced in Ghana and Honduras to make electricity use affordable for the poor (Table 4.4 and Table 5.7). In Senegal the utility penalises low-consumption customers and charges them higher tariffs than high-consumption customers in order to recover its service cost (Table 5.7). There is no concessionary tariff in Botswana. There is just one tariff for all domestic customers (Table 5.7). The utility in Botswana has extended the credit for electricity connection fees to reduce the monthly re-payment amount. This has been achieved at no cost to the utility.

4.35 All four countries invested in rural electrification through the extension of the national grid or in many instances in remote rural areas through the distribution of stand-alone solar photovoltaic systems to clinics, schools and homes. Donors frequently financed projects involving solar systems.

Table 4.4: Pricing, taxation and subsidy reforms in Botswana, Ghana, Senegal and Honduras

	Botswana	**Ghana**	**Senegal**	**Honduras**
Pricing, taxation, subsidy	None	-	New pricing policy for the petroleum sector	-
Tariff	None	Introduction of cost-reflective tariffs in the electricity and petroleum sectors, leading to tariff increases since 1998	None	-

	Botswana	Ghana	Senegal	Honduras
Taxation	None	55% of ex-pump gasoline price. A combined VAT and NHIL of 15% charged on monthly electricity bills but lifeliners are exempted	Reduction of port duty on kerosene from 15% to 5% (1998)	-
Subsidy	Rural electrificatio n: extension of grid to village. Kerosene	Lifeline tariff for the poor and stepped tariff for all in the electricity sector; 6% and 18% cross-subsidy on kerosene and LPG respectively	Subsidy for rural electrification. Gradual withdrawal of subsidies for butane gas and electricity generation fuels from 1998 to 2002	High cost of privately generated power is off-set by lower financial cost of state-owned hydropower. Cross-subsidy from high-volume to low—volume consumers Lifeline tariff for the poor
Others	Loan schemes for new connections	-	Government is planning to include 15% of new and renewable energy (mostly solar) in the national energy balance by 2015	-

Botswana

4.36 For economic reasons the Botswana Power Corporation (BPC) is committed to keep tariffs stable and low. Over the five years the tariff has been increased only twice in February 1999 and June 2002. Each increase was 5%. BPC's internal target is that the tariff increase should not exceed 50 % of inflation.

4.37 There are six tariff categories for home small, medium and large business, government and water utility (Table 4.5) the government rate is the highest based on government's ability to pay and in turn cross-subsidising other consumers.

Table 4.5: Electricity tariff categories in Botswana

	Fixed Charge (Pula)	Energy charge (Pula)	Demand charge (Pula)	Comments
Home – Domestic (TOU 4)*	8.09	0.2914	-	This category is for domestic with outlets at 230V, 60A, 400V
Small business (TOU 6)	19.64	0.3024	-	Outlets with 60A, 400 V and less than 35kW
Medium business (tou 7)	19.64	0.1550	37.11	Not exceeding 400 V and more than 35 kW
Large Business (TOU 8)	19.64	0.1398	34.93	Above 11 kV
Government (TOU 2)	19.64	0.3918	-	Government lighting installations
Water pumping TOU 1)	19.64	0.3083	-	Water pumping use.
* TOU 4- Type of Use Tariff No. 4- for Domestic; similar for other categories that include small medium, large businesses, Government and Water Pumping. Source. BPC, 2003- pers. comm.				

4.38 Prepayment meters were introduced in some villages in the late 1990s but have been malfunctioning. They have not been installed in urban areas. The concept of prepayment seems to have been unofficially abandoned as no more prepayment meters are installed. No impact analysis of prepayment meters on poor households was carried out.

4.39 Government controls the retail price of kerosene and ensures that poor households can afford to use kerosene. The average consumption of kerosene in rural households is 8.55 litres in winter and 11.7 litres in summer per month. Table 4.6 shows kerosene consumption and in come group. 83 % of the poorest households with income of less than Pula100 use kerosene indicating that low income households are benefiting from the controlled price of kerosene.

Table 4.6: Kerosene consumption by household income group in Botswana for the year 2001 (EECG 2004)

Income	% Households with Income	% of Households with Income using Kerosene
Up to P100	17.13	83.0
P101-P150	28.46	90.1
P151-P250	14.99	94.3
P251-P500	18.01	89.1
>P500	21.41	80.3
Total Sample	100.0	

4.40 The supply of LPG is driven by the private sector including tariff setting. The private sector has been effective and is gaining a significant share of the market in both urban poor and rural households.

Ghana

4.41 In Ghana electricity tariffs and the prices of petroleum product have increased greatly since the reforms were implemented in 1998. The objective was to achieve full cost recovery by 2004. The first major electricity tariff increase was over 400% for all categories of consumers and the second increase was 103% in 2001. The combined increase in 2002 and 2003 was 72%. The increase in electricity tariffs was cushioned by a flat-rate lifeline tariff of Cedi14000 for 2002 per month for 50 kWh for customers whose monthly consumption does not exceed 50 kWh and this was increased to Cedi19978 (or 224.5 cUS) in 2003. The Ghanaian Cedi greatly depreciated in the years immediately following the steep tariff adjustments. The Cedi depreciated from Cedi2345 to the US$ in 1998 to Cedi8352 in 2002 leading to a sharp decline in the real value of the tariffs. Two further adjustments for Oct-Jan 2003/04 and Feb-Apr 2004 quarters have since been implemented.

4.42 Rural electrification is largely subsidized by government.

4.43 When petroleum prices were liberalized in Ghana in 2001 prices of gasoline, diesel and kerosene doubled. Increases in petroleum prices are passed on to consumers for goods and services through higher transport costs. The increase in the price of kerosene affects poor households in particular because 60% of the poor use it as their lighting fuel. It had the greatest impact on rural households where up to 82% use kerosene as the main fuel to provide light.

Senegal

4.44 The introduction of butane gas for cooking called butanization in Senegal, demonstrates the impact of subsidies on the uptake of cooking gas. By the time the subsidy was partially withdrawn in 1998 over 85 % of households had switched to cooking with gas.

4.45 In 1974 the government was alarmed by the high rates of deforestation caused by charcoal production for household use. The government aimed at reducing charcoal consumption by 50 % in the major urban areas by introducing policies to make butane gas accessible and affordable for poor households. Butane gas was to partially or totally replace charcoal and wood as cooking fuels. Initially in 1974 a cooking stove with an attached gas cylinder containing 2.7 kg gas was promoted and later in 1983 a more solid cooking stove with a 6 kg gas cylinder which was better adapted to the cooking habits and income levels was also subsidized.

4.46 Government exempted all butane-related equipment from custom duty and in 1976 subsidized the gas itself. Before 1976 the annual consumption was below 5 000 tons and it rose to 15 000 tons in 1987 and more than 100 000 tons in 2004.

4.47 In 1988 twelve years after the beginning of the butanization campaign the government felt that households were replacing charcoal with gas too slowly and decided to subsidise butane gas further. The retail price dropped by about 38 % and the demand for gas for the two models of cookers rose sharply. The price of a 6 kg refill fell from CFAF 1,183 to CFAF 725 and the price for a 2.75 kg refill fell from CFAF 522 to CFAF 325. The demand for 6 kg refills rose from 4,013 tons to 7,145 tons and the demand for Blip Banekh 2.75 kg refill doubled from 10,923 tons to 20,308 tons.

Table 4.7: Price and demand variations and price elasticity of demand after increased subsidy of the combined gas cooking stoves in Senegal

	Nopale (6 kg) stove	**Blip Banekh (2.75 kg) stove**
Relative price variation (%)	-38.7	-37.7
Relative demand variation (%)	+78.0	+57.2
Price elasticity of demand	-2.0	-1.5

Source: Ba 2005

4.48 The elasticity of demand for Nopale (6 kg) being -2 a 1 % price decrease resulted in a 2 % demand increase (Table 4.7) and for Blip Banekh (2.75 kg) a 1 % decrease in price led to a 1.5 % rise in demand. The demand for butane gas increased from 1988 to 1998 at an annual rate of 15 % while the demographic growth rate was just 2.9 % and urbanisation was increasing by 5 %. The subsidies, exemptions and tax reductions granted to butane gas and equipment were considered not only because higher gas use reduced the pressure on charcoal but also because reduced gas prices widened access to poor households which were earlier excluded due to high stove and cylinder costs.

4.49 As part of the wider energy sector reforms the government decided to gradually eliminate the subsidy of butane gas starting on 1 July 1998 (Table 4.8). The intention was to diminish the impact of fluctuating world oil price on public finances and to introduce cost-reflective pricing for consumers. The subsidy was to be reduced by 20% each year from 1 July 1998 to 31 December 2001. However, the last 20% of subsidy for 6 kg and 2.7 kg cylinders was retained in order to combat deforestation

4.50 The impact on the demand was influenced by devaluation and the withdrawal of subsidy. After the devaluation prices increased from F 121to F 158 a hike of 31 % but growth only dipped slightly to 13 % and then increased again from 1995 when it reached 15 % and 17.5 % between 1997 and 1998. The elimination of subsidies was supposed to start in 1998 (Table 4.8) but the first reduction started in July 1999 and the price of butane gas rose from F 158 before July 1999 to F 249 in 2001. Although the growth of demand slowed down from about 15 % before July 1999 to 6 % in 2001 the 80 % reduction of subsidies did not stop the still growing demand of butane gas

Table 4.8: Five-phase elimination of subsidies on butane gas in Senegal (Ba 2005)

Phase	Elimination date	Level of residual subsidy for 6 kg gas (F/ton)	Level of residual subsidy for 2.7 kg gas (F/ton)
1	1 July 1998	168 652	159 603
2	1July 1999	126 489	119 702
3	1 July 2000	84 326	79 802
4	1 July 2001	42 163	39 901
5	1 July 2002	0	0

Honduras

4.51 In Honduras two types of subsidies are intended to benefit the poor; one for domestic consumers using less than 300kWh per month (Table 5.7) and another subsidising new connections of the rural electrification program. 86% of the subsidy for customers using less than 300kWh per month is mis-targeted because it goes to non-poor households, which use more than 100kWh per month. Rapid grid expansion in low-income areas forced government to adjust the formula calculating the subsidy to keep within the budgeted amount even though it had increased the budget by 6.6% in real terms. In 1997 the government granted US$23.5 million for rural grid extension (US$300–500 per extension). The utility expects to lose money on these connections as they are to low-volume consumers whose consumption does not cover the cost of supplying them.

4.52 The tariff structure has a stepped rate with cross-subsidies in favour of small consumers (Table 4.4 and Table 5.7).

Rural electrification

4.53 All four countries have dedicated rural electrification programs subsidized by government.

Rural electrification in Botswana

4.54 In Botswana the government introduced a number of low-level reforms such as policies on technologies, price setting and community involvement which were intended to assist the rural poor to gain access to electricity. Over recent years electricity delivery and the mode of payment for connections have been adjusted to be more affordable to the poor. The process, which led to a five-fold rise in rural connections from 1996 to 2003 under full cost recovery for the utility, is described here in some detail.

Cost of connecting electricity to households

4.55 Monthly household expenditure on electricity is estimated to vary in urban and rural areas and is dependent on the income level of the household. For average rural households, the mean monthly payment for the connection fee was P38 and the cost of

consumption averaged P50 per month (the currency is the Pula; 1US$ = P5). 40% of rural households in Botswana are not able to afford the monthly bill (EECG/RIIC 2001; EDRC/EDG/FAB 2001). Table 4.9 indicates payments that would be required to cover monthly consumption bills as well as capital costs for two different financing scenarios. In the year 2003, the results indicated that while full capital recovery payments may be unaffordable to poorer households, concessionary financing of connections is likely to allow the majority of households to afford the connection.

Table 4.9: Connection, ready-board and hotplate finance repayments in Botswana, in Pula (BPC 2002)

	Cost	**Monthly payments with commercial financing (20% over 2 years)**	**Monthly payments with concessionary financing (10% over 20 years)**
Connection cost	10 000	545.5	97.9
Ready-Board	50	27.30	4.9
Small hot plate	300	16.4	2.9

4.56 The lowest monthly repayments for low-income households (Table 4.10) was far higher than the majority in rural households pay for energy sources and was more than 40% of mean rural incomes, implying that the majority cannot afford to connect to electricity under this cost recovery arrangement.

Table 4.10: Estimated monthly connection cost recovery, fixed cost, and energy charge payments for households in Botswana, in Pula (BPC 2002)

	Monthly energy consumption (kWh/month)	**Monthly payments with commercial financing (20% over 2 years) at current tariffs**	**Monthly payments with concessionary financing (10% over 20 years) at current tariffs**
Low-income households	20	603.4	158.8
Mid-income households (no cooking)	50	640.9	193.3
Mid-income household (cooking)	100	703.4	255.8
Higher-income households	400	1078.4	630.8

Policy reform and rural electrification schemes in Botswana

4.57 Botswana introduced a rural electrification scheme in 1988 and gradually adapted it to the needs of the rural customers, developing a financing scheme, which made connections affordable for the poor.

Rural Electrification Collective Scheme

4.58 The major policy reform to accelerate rural electrification is the Rural Electrification Collective Scheme (RCS). The scheme applies to rural customers in order to reduce the burden of upfront costs of connecting to the grid. Potential consumers are to form groups of four or more customers when applying for connection to benefit from economies of scale – i.e. they share the cost of extending the grid to their premises. This scheme, which began in 1988, has undergone several phases and modifications (Table 4.11). However, as of 2003, under this scheme prospective customers upon receipt of budgetary quotation by BPC, pay P100 each as down payment. This forms part of the 5% upfront down payment of total project cost required before connection work begins. The balance of 95% is repayable over 18, 60 or 180 months, depending on the customers' preference. BPC advances consumers the loan and consumers eventually pay it back in full. Government's rationale for insisting on full cost recovery is to sustain the electrification program. The subsidy is only in the provision of the grid infrastructure into the village.

Standard costing

4.59 Standard costing was implemented in 1993 as part of RCS and was intended to give a fair chance for customers in a village or area to pay the same amount for electricity connection. Standard costing aimed to increase access to electricity in addition to decreasing front-end down payment by customers. It is applicable to potential consumers who are within 500 metres of reticulation corridors. The cost of connection through standard costing approximates to the cost of acquiring a 50 Wp system (P5000–6500). There is more government subsidy in this payment arrangement because the government extends the grid deeper into the villages.

Evolution of RCS and its impacts on rural grid connections

4.60 The developments that have taken place in implementing electrification programs, particularly through RCS are given in Table 4.11.

Table 4.11: Evolution of the rural electrification collective scheme and its impact on connections in Botswana (EECG 2004)

Year	Policy measures	Cost of distribution extension covered	Cost of service connection covered	Impact of policy on Consumers particularly rural consumers
1975	Consumers to pay BPC in full for distribution extensions and service connections	√	√	Prohibitive for rural poor but affordable by affluent
1983-1988	Revolving Fund	√	Paid by consumers	143 connections only to rural consumers

Year	Policy measures	Cost of distribution extension covered	Cost of service connection covered	Impact of policy on Consumers particularly rural consumers
1990	Rural Electrification Collective Scheme	√	Paid by consumers	7 villages per annum were targeted for electrification.
1990		40% – paid by group of 4 consumers 60% advanced by government payable over 10 years at 8% interest		
1995		10% – paid by group of 4 consumers 90% paid by government, payable over 10 years at 9% interest		Over 3046 consumers used the RCS by 1995
1997		Standard Connection Costing based on flat rate for connection per village for consumers within 500m of reticulation corridors was introduced in 1993. (10% / 90%l payment applicable)		511 schemes supported made up of 5120 customers representing 68% from previous year. By 1997, 45 villages were electrified as part of rural electrification program.
2000		Customers requiring less than 35kW: 5% – paid upfront 95% paid by government, payable by consumers over 15 years at prime interest or 5 years at prime rate less 0.5%; or 18 months at no interest if less than P50000 or 18 months at prime rate less than one percent if balance is above P50 000.		By 1998, 8227 consumers connected (3% of total of 265 748 households in Botswana). As a result of revision of RCS by 2000 49170 households in urban area (43.3% of urban households) and about 50 000 households in rural villages (17.1% of rural village households) have been connected to the grid. Of all households in Botswana (rural villages and urban cities and towns excluding the localities) 24.5% were electrified.
		Customers requiring more than 35kW: 10% – minimum paid upfront 90% payable by consumers over 10 years at prime interest or 5 years at prime rate less 0.25%; or 12 months at no interest if less than P50000 or 12 months at prime rate less than one percent if balance above P50 000.		

Impact of RCS on customer base for grid electricity

4.61 Sample data on performance of RCS covering all districts in Botswana is shown for different sample sizes according to district in 1998 in Table 4.12. The program is

countrywide, targeting rural and urban village areas. Districts where rural communities dominate and which are remote have benefited less from the implementation of RCS.

Table 4.12: Survey data on RCS (Nov 1998 data) (EECG 1999)

District	Total schemes in district	% of schemes indistrict	Total consumers in district	% of consumers in district	Average scheme size (HH)
Central	279	35	2525	31	9
Kgatleng	73	9	858	10	12
Kweneng	136	17	1491	18	11
Southern	62	8	734	9	12
SE	97	12	1009	12	10
NE	38	5	491	6	13
Chobe	14	2	152	2	11
Kgalagadi	6	1	208	3	35
Ngamiland	90	11	732	9	8
Ghanzi	4	1	27	0	7
TOTAL	799	100	8227	100	10

The positive impacts of RCS

4.62 Rural electrification has been successful and many more households have been connected through RCS. Access to electricity increased five-fold from 1996 to 2003 for rural households. 80% of RCS beneficiaries could not have connected to the grid without RCS. Groupings increased affordability of rural electrification. Reticulations initially installed by those who could afford it eventually benefit poorer customers who can only connect when the grid is close to their households.

4.63 RCS loans have no requirement of income guarantee and security, and in some cases attract lower interest rates than commercial loans, hence improving affordability of low-income households. The uptake of RCS accelerated with positive changes in repayment terms since 1999 when an evaluation was done (EECG 1999).

4.64 However, despite all these encouraging gains, a significant proportion of households still cannot afford down-payments on a monthly basis due to low and irregular incomes and there is need for further comprehensive policy review for poor beneficiaries, as loan repayments have been jeopardized by high default repayment rates by consumers.

4.65 The rate of connections to the grid is not significant in the villages where the government has provided the grid. The level of electricity consumption is also low as electricity is largely being used for lighting and the households are too poor to pay for more consumption.

Rural electrification in Ghana

4.66 The National Electrification Scheme (NES) introduced in 1989 aims at electrifying the entire country by 2020. Grid electricity will be the major source but some remote parts will receive electricity from renewable sources, particularly solar energy. The capital cost of rural electrification is borne by government. In the case of self-help electrification the communities provide the low-tension poles and are required to wire 30% of houses; the rest of the cost is borne by government. Household connection is virtually free (Cedi5000) within the first 18 months of the community getting connected to the grid. All rural and urban households benefit from the lifeline tariff (Table 5.6).

Rural electrification in Senegal

4.67 The government made determined efforts to widen access to electricity in rural areas between 1995 and 2001. It set up a separate rural electrification agency (ASER) and allocated CFAF17 billion to rural electrification. Connections increased from 5% in 1997 to 8% in 2001, when 300 out of the total 600 electrified villages had electricity for the first time. 12 747 villages remained without electricity in 2001.

4.68 The government is at the same time implementing priority programs such as providing the major rural community centres with solar power as well as installing public solar lighting in 227 villages.

4.69 Electrification, whether through grid, generators or renewable energy technologies, requires high initial investments. In addition, poor households cannot pay for internal installations and the high cost of electricity itself. Consequently, rural households with low and usually seasonal incomes continue to use candles, kerosene and firewood for lighting and cooking, and physical energy for drawing water and basic productive activities.

Rural electrification in Honduras

4.70 The reform proposal (1998-2001) led to the strengthening of support for the Rural Electrification Fund. Capital expenditure for rural electrification is heavily subsidized. The subsidy to expand coverage totaled US$23.4 million from 1997 to 2000. The household connection cost ranges from US$300 to 500.

Consequences of reforms for poor households

4.71 The consequences of energy reforms for poor households are summarized in Table 4.13. In Africa the majority of the poor live in rural areas, and supporting rural electrification will benefit the poor if pro-poor programs accompany electrification and make access and use of electricity affordable. In many cases rural electrification is subsidized by government and it is generally considered an investment in development. The lifeline tariffs for the poor are subsidized by government through cross-subsidy from the industrial and commercial sector and/or high-consumption domestic customers.

4.72 The use of gas for cooking has been widely promoted and, in the case of Senegal, subsidized. Better management of fuelwood and charcoal resources was advocated. The distribution and use of fossil coal was promoted in Botswana. Kerosene is subsidized in some countries.

Table 4.13: Consequences of reforms for poor households

Botswana	**Ghana**	**Senegal**	**Honduras**
Increased/decreased tariffs			
Unreformed utility expanded coverage; relatively modest increase in tariffs. No lifeline tariffs.	Increased tariffs and introduction of lifeline tariffs for the poor	Increased tariffs. Stepped tariff which is higher for low-consumption customers (anti-poor)	Stepped tariffs for low-consumption customers
Financing of rural electrification			
Rural electrification financed through national utility	Rural electrification still the prerogative of government, financed through grants and concessionary loans	Rural electrification agency (ASER)	-
Rural electrification cross-subsidized through tariff levies on industrial, commercial and urban tariffs			
	There is an electrification levy of Cidi1.70/kWh paid by all categories of electricity consumers		
Other pro-poor measures			
Increased coverage. Extending loan periods to up to 15 years thus reducing monthly payments	Promotion of energy efficiency/conservation measures by a partly government sponsored NGO to minimise electricity consumed by households and industries	Increased coverage and improved supply	Increased coverage
Fuelwood, charcoal and coal			
Promotion of coal by government		Fuelwood consumption decreased from 90% to 60% of the national energy balance; but when gas subsidy was gradually removed fuelwood use increased slightly; overall reduction of indoor air pollution. New participatory forestry management	-

Botswana	**Ghana**	**Senegal**	**Honduras**
		programs benefited people living near forests.	
Gas			
No subsidies; gas marketing companies aggressively promote the use of gas	Increased tariffs and cross-subsidy from other petroleum products	Due to subsidies butane gas is commercially available and affordable in many villages; increase in gas prices	-
Kerosene			
	Increased tariffs and cross-subsidy from other petroleum products	Kerosene cannot compete with subsidized gas	-

5

Survey Information on Household Fuel Use and Expenditure, Appliances and Fuel Supply

5.1 This chapter gives first a brief description of the communities in which the surveys were conducted. This information was largely derived from the community questionnaires. It then sets out to compare fuel use from earlier surveys and this survey. It further analyses household fuel expenditure and appliance ownership.

Description of sampled communities

Botswana

5.2 In Botswana the survey sample was drawn from a total of 13 communities of which three were located in urban areas and ten in rural areas. A total of 74 community leaders and representatives participated in the community surveys. Eight of the 10 rural communities were made up of one principal population group and two or more smaller groups. The three communities with stagnant or declining populations were relatively new communities which existed for 10 to 20 years.

5.3 Only the community in the capital Gaborone had all 17 facilities listed in the community questionnaire (Appendix 5) and another urban community in Lobatse had 16 facilities. All 13 communities had a clinic and a place of worship. A road serviced all communities the urban and peri-urban communities had tarred road and most of the rural communities had only dirt or unpaved roads.

5.4 Rural communities had generally fewer community-based organizations than urban communities. The urban community in Francistown was very deprived and had fewer community organizations and less participation than most rural communities in this study.

5.5 All surveyed communities had builders, electricians and handymen except Khudumelapye and Werda.

5.6 All communities had electricity supplied by the national public supplier, the Botswana Power Corporation. Four of the rural communities had electricity for less than

five years. Participants in the community survey believed that electrification had improved the welfare of their communities.

5.7 All urban communities had public lighting but only four of the 10 rural communities had this service. Public lighting covered alt least half of the community and only in one community which had electrification for less than five years did it cover less than half of the community.

5.8 All communities had piped water in the house or in the yard. But some people still carried water to their yards and that is likely to be from public standpipes especially in urban and semi-urban communities. The principal sewage disposal method was pit latrines.

5.9 The majority of children under the age of seven attended pre-school in urban and semi/peri-urban communities but only a few children under the age of seven did so in rural communities because pre-schools charge fees which are not affordable by the poor households.

5.10 Irrigation was used in only the three communities of Gaborone, Gweta and Tonota. The energy source for water pumping was diesel or petrol.

5.11 Kerosene was still very common and more than half the households in all communities used it. Five out of the 113 communities indicated that all households used kerosene. Only three communities indicated that coal is being used in their community.

5.12 Males in rural communities usually worked in construction, socialized in bars or worked in cattle posts. Rural women were involved in drought relief programs, worked as housewives or were shop assistants.

5.13 The community survey complemented and confirmed the results of the household survey. It revealed many differences between rural and urban poor and their energy demand and consumption patterns. Urban communities are more ready to benefit from energy reforms and rural communities need programs designed to meet their particular needs. Nationally the poor are still too poor to benefit fully from energy reforms that do not take affordability into account.

Ghana

5.14 In Ghana poor urban households were identified in the slum areas within urban centres. There are planned and unplanned slums but even in the planned areas the residents do not adhere to the plans. Peri-urban areas are settlements on the fringes of urban areas. They are the result of urban sprawl and in most cases are unplanned with little or no site and service schemes. The rural areas identified for this survey are those categorized by the Ghana Statistical Service as rural.

5.15 Twenty communities were surveyed in Ghana. These comprised of eight urban communities, six peri-urban communities and six rural communities. All the communities visited had been in existence for more that 20 years. The selection of the urban

communities was biased towards communities known or likely to have higher incidence of poverty.

5.16 The majority of participants (49%) who took part in the group discussions indicated that they were opinion leaders, 26% were involved in service and commerce, 19% in agriculture and 6% in industry. Different tribal groups were identified in the communities interviewed. These tribal groups represent the key stakeholders to any plan or recommendation made and could also influence decision making. Secondly, their tribal differences meant different needs which could also affect their perspective on issues of importance to them.

5.17 Almost 90% of the communities had experienced growth in their population over the last five years. Ten out of the twenty communities (50%) think that living standards have improved, 5 of them were of the view that there has been no change in their living standards, while the remaining 5 indicated that standard of living have in fact worsened over the last five years.

5.18 The most prevalent social facility is 'the place of worship'; all but one of the 20 communities had places of worship, a pointer to the fact that the communities visited are highly religious. Telephone service is the second common facility available in 15 of the communities. This is followed by clinics and grocery shops common in 12 and 11 communities respectively. 10 communities (8 urban and 2 rural) also had access to either a doctor or a nurse who could be contacted in cases of emergency. There is however clear disparity between urban-rural access to social facilities and services. For instance even though telephone services was the second most prevalent social facility mentioned to exist in the community, only 1 rural community compared to 12 urban communities were found to have telephone facilities. The same applies to grocery shops. Again, information gathered suggests that rural communities covered in the survey have less access to petroleum products since only 2 (out of 6) had access to petrol station whiles 12 urban communities had petrol stations.

5.19 The two most prevalent social groups in the surveyed communities are women and youth groups; the former was found to exist in 16 communities while the latter exists in 17 communities. The membership of the two groups covered more than half of the total population in 12 communities. Other common social groups identified are saving groups, health committees and farmers groups.

5.20 All but one of the communities surveyed have access to electricity.

Senegal

5.21 In Senegal 55 % to 65 % of the population is poor. When poverty is defined as a person's capacity to meet a daily food intake of 2400 kilocalories a daily income of US$ 0.65 is required in Senegal (Poverty Reduction Strategy Paper 2002). In the years before the electricity reforms (1990 – 1998) the rate of urban poor with access to electricity was 1.7 % and it grew to 4.6 % between 1999 to 2001 (post-reform).In rural areas the trend is opposite. The rate of access dropped from 13.2 % before the reforms to 10.2 % after the

reforms. In urban areas only 10 % of the subscribers are poor, in rural areas 85 % (of the 12.2 %) are poor.

Honduras

5.22 In Honduras 26 communities were surveyed, 14 in urban and 12 in rural areas. In 23 communities the chief of the community development committee participated. Other participants were traders, teachers, employees from local schools, health centres, education authority, municipality, electricity office and people in charge of water supply.

5.23 The predominant ethnic group is “mestizo” people of mixed Native American and Spanish descent. Only one community is dominated by “lencas” descendants of native Indians. The urban communities of two major cities on the north coast of Honduras (San Pedro Sula and la Ceiba) reported “garifuna” as the second largest ethnic group. The garifuna are people of African origin established in Central America in the 17th century.

5.24 Five communities indicated that living conditions have not changed in the last five years. Seven urban and three rural communities reported that living conditions have become worse in the last five years due to lack of employment, low income and security problems. Nine communities reported an improvement in their living conditions due to employment opportunities, remittances received from other countries, improved services and better education opportunities.

5.25 Only two communities, San Pedro Sula and La Ceiba, had all 18 infrastructure facilities asked for in the community survey (Appendix 5). Urban communities had more facilities than rural communities. Manu urban communities had a grocery store or market, nurse/doctor, bank, post office, petrol station and sport facilities. In rural communities the most common facilities were grocery store, place of worship, nurse/doctor, sport facilities, adult education centres and telephone service. There was a lack of regular market, petrol stations, fire brigades, banks and post offices in rural communities.

5.26 Urban communities have one to eight community based organizations and two urban communities have no organization. Rural communities have one to seven community based organizations and five rural communities have no organizations. Only a small number of urban and rural residents participate in community based organizations. Only two urban communities reported more than half the population participated in youth and saving groups. One rural community indicated that the majority of residents participated in the health group and two rural communities reported that more than half of the residents are members of the farmers’ and women’s groups. In urban areas a negligible number of residents participated in the electricity action group and cooperatives. In rural areas negligible participation was recorded for the electricity action group, cooperatives and saving groups.

5.27 Overall only a small proportion of residents in urban and rural communities participated in community-based organizations.

Household fuel use

5.28 Households used a great variety of fuels and energy sources (Table 5.1). In each country at least 9 fuels/energy sources were used. This large number of fuels emphasises the fact that all households are multiple fuel users.

5.29 Fuelwood remained one of the important fuels in all the four countries. Kerosene and electricity were widely used, gas was gaining importance and was very widely used in Senegal because it was subsidized.

Table 5.1: Fuels used by households for all end uses in Botswana, Ghana and Senegal (%)

	*Botswana**	*Ghana*	*Senegal*
Candles	-	26.0	94.3
Car batteries	15.9	1.3	1.7
Charcoal	14.4	83.3	93.3
Coal	3.4	0	0
Dry cell batteries	33.1	57.3	2.3
Electricity	21.3	75.0	58.6
Firewood	44.9	53.0	54.0
Gas	40.1	14.0	86.0
Generator		0.3	4.0
Kerosene	45.9	84.5	32.3
Other fuels (crop residue)	82.7	1.3	0.3
* For Botswana the table includes principal fuels/energy sources only			

Comparison with earlier surveys

5.30 Fuel use data from earlier surveys (Table 5.1) were available from Botswana, Ghana and Senegal; data on lighting only were available from Honduras. The data are from different types of surveys and comparisons have to be made with some caution and should be taken as indicators of trends rather than reliable absolute figures. The data show a general trend of households using less fuelwood for cooking now than at the time of the earlier surveys two to four years before the survey of this project, and households seem to make a transition to more efficient fuels such as gas, kerosene and charcoal. In Ghana charcoal use increased substantially from 2000 to 2004; LPG use went up in Botswana and in Ghana. The widespread use of LPG for cooking in Botswana is remarkable because LPG is not subsidized and is imported from neighbouring South Africa – where only 3% of households use LPG for cooking (SSA 2003). Senegal's subsidized gas program started in 1989 and gas for cooking was distributed in all parts of

the country. The subsidy of the cooking stove and the gas made it more affordable for all income groups (Table 7.1).

Household fuels and their end uses

5.31 There have been changes over the last years in household fuel uses. Promotion campaigns by government and easier access appear to have influenced the changing pattern of household fuel use. The two most important lighting and cooking fuels in each country are:

	Lighting				*Cooking*			
Botswana:	Kerosene	57	Electricity	30	Gas	51	Wood	40
Ghana:	Electricity	72	Kerosene	25	Charcoal	51	Wood	39
Senegal:	Candles	94	Electricity	35	Gas	86	Charcoal	3
Honduras:	Electricity	82	Kerosene	13	Wood	59	Electricity	21

5.32 There was quite a variety of fuels used and almost no two countries used the same most important fuels for cooking and lighting. Only Ghana and Honduras both use electricity and kerosene as their most important lighting and cooking fuel respectively.

Lighting

5.33 Electricity and kerosene were the most widely used lighting fuels, with kerosene more frequently used in rural than in urban areas because of the lower electrification rate there. Electricity was the most common fuel for lighting, with 31% to 71% of households using it in their homes, but not more than 3% cooking with electricity (Table 5.2). In the four countries the preferences were slightly different. In Botswana the most common lighting fuel was kerosene (57%), in Ghana it was electricity and kerosene (25%), and electricity was preferred in Senegal and in Honduras (64%).

5.34 Kerosene use for lighting ranged from 57% in Botswana to 13% in Honduras. In Ghana, because of electrification, fewer rural households used kerosene in 1999 (82%) as compared to 93% in 1989 (GSS 2000). In urban areas of Ghana electrification has progressed much faster than in rural areas and 90% of households in the capital Accra and 72% in other urban areas used electricity for lighting.

Cooking

5.35 The most important cooking fuels were LPG in Botswana (51%) and Senegal (more than 85%), charcoal in Ghana (51%), and fuelwood in Honduras (59%). Kerosene is used little for cooking and the highest proportion of households cooking with kerosene was found in Botswana (10%), and it was not used at all for cooking in Ghana.

5.36 In Botswana the government promoted the use of LPG. In Ghana LPG was promoted by the Department of Energy, and in Accra the use of LPG went up from 6% in

1989 to 23% in 1999. In Senegal gas was subsidized under the butanization program and although 80% of the subsidy was withdrawn by 2001, households continued to cook with it. Gas for cooking was promoted or subsidized in all four countries, and households responded to the campaigns and increasingly cooked with it.

5.37 The high LPG use for cooking in Botswana both in urban (71% and rural (41%) is surprising. LPG was generally promoted as a cooking fuel but it was not subsidized. The LPG subsector is fully privatised. Compared to the earlier survey in 2001 there is a 10% in the last three years. At the same time fuelwood decreased by about 5%. Botswana is an arid country and fuelwood is becoming scarce. Households which can afford it would more easily buy LPG than households in countries like Ghana and Honduras where fuelwood can much more easily be collected.

5.38 Generally when households are connected to the grid they prefer electricity for lighting but continue to use other fuels for cooking. The reasons why households choose a particular fuel for cooking are not always immediately obvious and depend on a number of factors. The widespread use of charcoal in Ghana and Senegal is primarily dependent on good forest and woodland resources and a well established charcoal producing and transport industry. In Senegal households use charcoal in the cool season from November to February/March and it is customary to add incense to the charcoal so that a pleasant fragrance permeates the house.

Table 5.2: Most common fuels used for cooking, space heating and lighting (%) – comparison of results from two surveys[1]

	Botswana (CSO 2001) This survey, EECG 2004b			**Ghana (Ghana Statistical Survey 2000) This survey, KITE 2004**			**Senegal (PROGEDE 2002) This survey, ENDA 2004**			**Honduras (INE 2002) This survey, ESA 2005**		
	Urb	Rur	Nat	Urb[2]	Rur	Nat	Urb	Rur	Nat	Urb	Rur	Nat
Fuelwood												
Cooking	22.8 *13.1*	77.3 *53.5*	45.7 *40.1*	34.2 *19.4*[3]	84.4 *76.4*	62.5 *39.4*	*1.33*	-	*1.3*	*44.4*	*90.6*	*59.1*
Space heating	*39.9*	*82.7*	*57.8*	na	na	na	*0*	*0*	*0*	na	na	na
Water heating	*30.3*	*72.6*	*58.7*	*22.8*	*72.6*	*41.5*	*0*	*31.0*	*16.0*	*46.8*	*86.5*	*59.5*
Lighting	0.6 *0*	12.5 *1.5*	5.6 *1.0*	*0*	*0*	*0*	-	-	15.8	0.4 *0.5*	16.4 *4.2*	8.6 *1.6*
Charcoal												
Cooking	*0*	*0*	*0*	57.2 *68.6*	13.0 *18.9*	30.6 *50.8*	*3.0*	-	*3.0*	-	-	-
Space heating	*0*	*0.5*	*0.3*	na	na	na	26.0	0	18.0	na	na	na

	Botswana (CSO 2001) This survey, EECG 2004b			**Ghana (Ghana Statistical Survey 2000) This survey, KITE 2004**			**Senegal (PROGEDE 2002) This survey, ENDA 2004**			**Honduras (INE 2002) This survey, ESA 2005**		
	Urb	Rur	Nat	Urb[2]	Rur	Nat	Urb	Rur	Nat	Urb	Rur	Nat
Water heating	*0*	*0.5*	*0.3*	*65.2*	*23.2*	*49.6*	*3.0*	-	*3.0*	-	-	-
Lighting	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	-	-	-
Kerosene												
Cooking	10.5 *13.1*	3.5 *4.5*	7.5 *7.4*	1.3 *0*	0.4 *0*	1.1 *0*	*0*	*0*	*0*	*8.7*	*0*	5.9
Space heating	2.0	1.3	1.7	na	na	na	*0*	*0*	*0*	na	na	na
Water heating	*13.1*	*3.0*	*6.3*	0	0	0	*0*	*0*	*0*	*8.4*	*0*	*5.7*
Lighting	5.2 *50.5*	7.1 *59.2*	6.0 *56.5*	*20.8*	*33.6*	*25.4*	*1.0*	*5.0*	*3.0*	2.8 *4.8*	40.3 *31.3*	21.9 *13.2*
LPG												
Cooking	57.7 *70.7*	17.0 *40.5*	40.6 *50.5*	5.2 *11.5*	0.6 *4.7*	4.1 *9.1*	68.9 -	31.1 -	55.9 *86.3*	*17.4*	*6.3*	*13.9*
Space heating	3.4	1.0	2.4	na	na	na	-	-	-	na	na	na
Water heating	*41.4*	*16.9*	*25.0*	*8.2*	*3.2*	*6.3*	*65.0*	*28.6*	-	*15.3*	*7.3*	*12.7*
Lighting	*0*	*0*	*0*				1.3	1.0	1.3			
Electricity												
Cooking	7.6 *3.0*	1.1 *1.0*	4.9 *2.2*	0.4 *0.5*	0.3 -	0.4 *0.3*	*0*	*0*	*0*	*29.5*	*3.1*	*21.1*
Space heating	12.5	2.4	8.3	na	na	na	*0*	*0*	*0*	na	na	na
Water heating	*15.2*	*7.0*	9.7	*3.8*	*1.1*	*2.8*	-	-	-	*29.1*	*6.3*	*21.7*
Lighting	37.0 *37.4*	8.1 *26.4*	24.8 *30.0*	*76.6*	*64.5*	*71.9*	*58.6*	*13.3*	*35.0*	94.3 *93.3*	35.0 *57.3*	64.2 *81.9*

Notes

Available information from existing surveys in Roman, and figures from this survey in italic

In the earlier surveys water heating and coking is not separated

Excluding Accra

* Figure under review

Figures in this table include main fuels/energy sources only

5.39 Households generally prefer modern fuels for cooking and electricity is one of the most preferred fuels. When households use electricity for lighting but not for cooking (Table 5.3) it indicates that they cannot afford the service cost and the appliances. In Ghana 72% used electricity for lighting but only 0.3% cooked with it, and in Botswana only 2% cooked with electricity although 31% used it for lighting. In Honduras the largest proportion (21%) of households cooked with electricity. In Senegal households did not generally cook with electricity although a few households owned stoves (Table 5.9). Electricity cannot compete with subsidized gas as a cooking fuel: in all four countries it is too expensive. How far the cost of electrical appliances is a barrier to electricity use is discussed in section 5.4.1 below. The difference of the proportion of households using electricity for cooking and lighting is an energy indicator of poverty.

Table 5.3: Proportion of households using electricity for lighting and cooking in Botswana, Ghana, Senegal and Honduras (%)

	Botswana		**Ghana**		**Senegal**		**Honduras**	
	Lighting	**Cooking**	**Lighting**	**Cooking**	**Lighting**	**Cooking**	**Lighting**	**Cooking**
Urban	37	3	77	0.5	59	0	93	30
Rural	26	1	25	0	13	0	57	3
National	31	2	52	0.3	-	-	82	21

Second and third fuels used

5.40 Most households have a principal fuel and a second and third fuel (see Table 8.3), which they use for the same end use when the principal fuel is not available (see section 8.2).

Household fuel expenditure

5.41 Households of different income groups used different fuels for different end uses and the higher the income the more convenient energy sources such as electricity is used. Table 5.4 shows how different household types in Botswana use more and more electrical appliances as income rises.

Table 5.4: Household electricity consumption levels in Botswana and Ghana

	Botswana (BPC 2002)		Ghana	
Appliance usage	**Monthly energy use (kWh/mth)**	**Monthly payments (Pula)**	**Monthly energy use (kWh/mth)**	**Monthly payments**
Low-income house				
Lights & radio	20	36	24	13560
Mid-income house (no cooking)				
Radio, lights Iron, kettle	50	60	53	29 150
Mid-income house				
Radio, lights Iron, kettle Hot plate Some small appliances	100	150	129	70 950
High-income house				
Radio, lights Iron, kettle Hot water geyser, stove & oven Some small appliances	400	350	310	297 312

5.42 Households spent between 4.5% and 23.7% of their monthly income on fuel (Table 5.5). The proportion of household income spent on fuel gives some indication how expensive fuel is in the individual countries. In Botswana households spent more than the other countries on energy (24% of their income) and by far the highest proportion was spent on electricity (Table 5.6). The energy proportion in Ghana (4.5%) was relatively low and this may be due to the fact that households collect fuelwood free of charge and self-collected fuelwood is not included in these figures.

5.43 In all four countries rural households spent a slightly greater proportion of their income on fuels than urban households. The difference of rural and urban fuel expenditure was largest in Honduras (2.4%) and negligible in Ghana (0.03) (Table 5.5). In absolute terms urban households spent more money on modern energy such as electricity, gas and kerosene (with the exception of Ghana) while rural households spent more on fuelwood (Table 5.6).

Table 5.5: Proportion of household income spent on fuel in Botswana, Ghana, Senegal and Honduras

	Botswana			Ghana			Senegal			Honduras		
	Urb	**Rur**	**Nat**	**Urb**	**Rur**	**Nat**	**Urb**	**Rur**	**Nat**	**Urb**	**Rur**	**Nat**
This survey	22.95	24.11	23.72	4.51*	4.54*	3.40	7.6	10.0	8.8	4.87	7.22	5.16

Note
For Botswana these proportions include both fuel and cost of transporting fuels-which is not the case in the earlier surveys.
* Under review

5.44 Most energy in poor households is used for cooking. Although only very few households cooked with electricity and electricity was mostly used for lighting, media and some appliances, households spent on average two to four times more on electricity than on any other fuel (Table 5.6). It is obvious that for the majority of households electricity was too expensive for cooking. Only a few higher-income households could afford to cook with electricity and the poorest could simply not afford it for cooking. Even when poor households had access, the barrier to electricity use for cooking was the high tariff.

5.45 In Botswana household expenditure on electricity was unusually high. Urban households in Botswana spent US$92, which was about ten times more than urban households in Ghana, and rural households spent US$38 – also much more than rural households in any of the other countries spent.

Table 5.6: Mean monthly household energy expenditure for fuel type per month (US$)

	Botswana			Ghana			Senegal			Honduras		
	Urb	**Rur**	**Nat**	**Urb**	**Rur**	**Nat**	**Urb**	**Rur**	**Nat**	**Urb**	**Rur**	**Nat**
Electricity	91.63	38.23	83.28	8.74	6.75	8.30	48	8.0	24	14.78	3.79	11.31
LPG	35.12	32.87	33.86	3.48	2.93	3.62	7.5	5.8	6.6	3.70	1.59	3.03
Kerosene	3.67	3.49	3.54	2.11	4.25	2.18	1.4	2.8	2.1	1.63	1.07	3.03
Charcoal	3.45	0	3.45	4.46	3.66	4.25	4.2	5.0	4.7	0.21	0	0.14
Fuelwood[1]	31.54	13.16	19.23	5.98	2.93	4.59	8.9	3.1	6.0	3.79	2.89	3.50
Car battery	3.64	11.34	8.58	11.11	2.46	4.95	1.7	5.3	3.5	0	0.15	0.05
Candles	2.78	2.21	2.39	0.81	0.76	0.77	-	-	-	0.36	0.47	0.40
Generators	0.68	5.23	4.01	0	0	0	-	-	-	0	0	0

1. Includes only purchased fuelwood. Most household collect firewood ‘free of charge’.

5.46 A comparison of electricity tariffs in the four countries (Table 5.7) is informative and sheds some light as to why households do not use electricity for cooking. Cooking is a high energy use and the tariffs are too high to use electricity for cooking. The electricity

tariff in Botswana was 6 USc per kWh, in Ghana and Senegal 12 USc. Ghana, Senegal and Honduras had concessionary tariffs. In Ghana and Honduras these tariffs were intended to benefit the low-consumption customers. In Senegal the low-consumption customers (0 – 20 kWh per month) paid almost double (23 USc), of what customers pay who consumed more than 50kWh per month. Since most low-consumption customers were poor households this tariff penalised the poor. In Honduras the concessionary tariff did not necessarily benefit the poor for whom it was intended (see below).

Table 5.7: Cost of electricity and lifeline tariffs in Botswana, Ghana, Senegal and Honduras

	Botswana (2004)	**Ghana (Oct 2003)**	**Senegal (2004)**	**Honduras (2000)**
Standing charge (USc)	178.0[1]	249.4		
Tariff (USc/kWh)	6.0	3-step tariff: Step 1: 0-50kWh@224.5 (flat rate) Step 2: 51-300kWh@6.9 Step 3: >300@12.0	3-step tariff[3]: Step1: 0-20kWh @ 23 Step2: 21 – 50kWh@ 16 Step 3: >50kWh@12	4-step tariff[4]: Step 1: 0-20kWh @8.03 (flat rate) Step 2: 21-80kWh @ 0.81 Step 3: 81-300 @1.18 Step 4: >300 @ 1.38
Tariff for prepayment meters	6.0[1]	No prepayment meters	Prepayment meters are under test since March 2005. Will be applied after June 2005	No prepayment meters
Concessionary tariffs, lifeline tariffs etc. Indicate (conditions)	None	0-50kWh/month @224.5 USCent/month flat rate[2]	Special domestic tariff similar to general domestic tariff. Low-consumption customers pay the highest tariff	See stepped tariff above
Notes VAT of 10% not included. Estimated unit rate is 6.9 USc/kWh assuming 23kWh consumption per month. In Senegal the electricity tariff for less than 380V has three steps and the customer with the lowest consumption pays the highest tariff. Amounts are in Lempiras				

5.47 Table 5.8 gives the structure of residential consumption and tariffs in Honduras and Ghana. The low-consumption customers in Honduras who use less than 20kWh per

month were eligible for the flat-rate tariff of 8 Lempiras per month. These customers used only very small amounts of electricity (4.5kWh per month) resulting in high average unit cost of 1.8 Lempiras per kWh.

Table: 5.8 Structure of residential consumption and tariffs in Honduras, June 2000 (ESA 2003) and Ghana, October 2003 (PSIA 2004)

Honduras					
Tariff steps (kWh)	0-20	21-100	101-300	>300	
% of users	17.6	18.2	45.1	19.1	
Lempiras/customer	8.0	32.5	184.5	698.2	
KWh/customer	4.5	49.7	195.4	558.8	
Lempiras/kWh	1.8	0.7	0.9	1.2	
Ghana , October 2003 (PSIA 2004)					
Tariff steps (kWh)	0 – 50 (Flat Rate)	51-150	151-300	301-600	> 600
% of users	24.6	57.0		18.0	
KWh/customer	23	156	156	582	
Cedis/kWh	13000	550	550	960	960
Av. Cedis/consumer/mth (ECG 2003)	14,002	63,414		355,908	

Appliances

5.48 There was a wide range of appliances used in the households, and since most households were multiple fuel users they have several appliances fitting the energy source for the same end use such as cooking or lighting.

Electrical appliances

5.49 The 18 most commonly owned electric appliances are listed in Table 5.9. Some patterns are discernable, such as where radio and black-and-white TV are being replaced by colour TV. Urban areas are generally ahead of rural areas in such modernisation trends. The ownership of a cell phone charger by over 20% is another such trend.

5.50 The most frequently owned electrical appliances in all four countries were iron, colour TV, fridge/freezer, radio and electric fan (Table 5.9 and Table 5.10), though the order of preference varies. There are some cultural differences relating to food preparation in Honduras, where a blender was relatively high on the priority list: at the national level 51% of households owned one (Table 5.9) – but only 21% of the poorest households (quintile 1) compared to 73% of quintile 5, so that cost is obviously a barrier.

5.51 Only a relatively small proportion of households owned electric stoves and they were not among the top five most frequently owned appliances (Table 5.9 and Table 5.10).

5.52 In Botswana the cost of an electric stove does not appear to be a barrier to ownership. Households in the third (38%) and first quintile (25%) most frequently owned electric stoves (Table A1.1). Only 18% of the highest income group (quintile 5) owned electric stoves. The ownership of hotplates, the cheapest stove, is generally comparable. In Botswana it is most likely that poor households have access to easy credit such as hire purchase or a lay-by system under which the poor are enabled to own relatively expensive appliances. Comparing this result with the reasons households in Botswana gave as to why they did not have an electric connection reveals some contradiction, because the highest proportion of households indicated that they could not afford appliances (Table 8.2). Such contradictions of what people say what they will do when they get an electric connection and what they do when they have one and have to pay monthly service charges are not uncommon (Mapako and Prasad 2005). Households generally switch to electricity for lighting but continue to use other traditional fuels including fuelwood for cooking because electricity is or is believed too expensive (Table 5.2 and Table 5.3).

Table 5.9: Electrical appliances used by households in Botswana, Ghana, Senegal and Honduras (%)

	Botswana*			**Ghana**			**Senegal**			**Honduras**		
	Urb	**Rur**	**Nat**	**Urb**	**Rur**	**Nat**	**Urb**	**Rur**	**Nat**	**Urb**	**Rur**	**Nat**
Radio/cassette elec.[1]	27.7	17.2	21.3	64.8	43.9	57.3	73.2	49.4	61.5	56.0	56.6	56.1
Music centre/ Hi-Fi system	8.9	5.7	7.0	9.8	2.8	7.3	11.9	7.3	9.7	51.8	32.1	47.5
Colour TV	29.7	15.3	20.7	14.5	3.7	10.7	69.4	46.6	58.0	81.7	52.8	75.4
B/W TV	4.0	5.3	5.0	3.6	1.9	3.0	1.9	1.4	1.7	13.1	22.6	15.2
Cell phone charger	29.7	16.7	21.7	7.8	1.9	5.7	46.0	32.0	39.5	28.3	17.0	25.8
Kettle	18.8	13.4	15.7	1.6	0	1.0	0	0	0	18.8	13.3	17.6
Hotplate-one plate	0.0	0.5	0.3	1.6	0	1.0	0	0	0	3.7	1.9	3.3
Hotplate-two plate	3.0	3.8	3.7	1.0	0	0.3	0	0	0	15.7	3.8	13.1
Two-plate stove with oven	5.0	1.9	3.0	0	0	0	2.8	1.1	2.0	0.5	1.9	0.8
Electric stove with oven	5.9	3.3	4.3	0.5	0	0.3	1.4	0.6	1.0	28.3	7.5	23.8
Electric fridge/freezer	29.7	18.7	23.0	37.3	2.8	25.0	45.0	31.7	38.5	70.2	54.7	66.8
Electric toaster	11.9	4.8	7.3	2.1	0	1.3	0	0	0	12.6	0	9.8
Electric iron	26.7	17.7	21.3	40.4	3.7	27.3	11.0	4.3	7.7	90.1	64.2	84.4
Electric heater	13.9	9.1	11.0	5.7	0	3.7	0	0	0	8.4	1.9	7.0

	Botswana*			Ghana			Senegal			Honduras		
	Urb	**Rur**	**Nat**	**Urb**	**Rur**	**Nat**	**Urb**	**Rur**	**Nat**	**Urb**	**Rur**	**Nat**
Electric fan	15.8	15.3	16.0	46.6	2.8	31.0	58.9	39.1	49.5	57.1	62.3	58.2
Grooming equipment	8.9	7.7	8.3	0	0.9	0.3	6.22	2.45	4.5	17.8	11.3	16.4
Blender	0	0	0	0	0	0	0	0	0	56.0	32.1	50.8
Other	0	0	0	0	0	0	0	0	0	33.0	11.3	28.3
* In Senegal the responses include radio/cassettes run on batteries												

5.53 In the following section we are trying to analyse if the cost of appliances is a barrier to a particular fuel use. Table 5.10 list the five or six most common electrical appliances owned by income quintile. Table 5.11 gives an exhaustive list of 18 electrical appliances ownership by income quintile. If affordability is a barrier to ownership then the proportion in the lower-income quintiles (Q1–Q3) should be smaller than the proportion in the high-income quintiles (Q4–Q5). Table 5.10 is arranged in order of appliance priority, which varies from country to country. In Botswana the most commonly owned electrical appliance was a fridge/freezer, with an ownership level of 23% (Table 5.10). The poorest 20% owned the lowest proportion of fridges and only 75% in that group owned a fridge. The highest proportion of ownership (100%) was found in the middle-income group (Q3); Q2 and Q4 were about equal (87% to 88%). Fewer households in the highest income group (94%) owned a fridge than in the middle-income group so that cost is obviously not the only factor influencing fridge ownership in Botswana. In the other countries, as well, ownership of fridge/freezer did not follow an increasing progression from lowest to highest income household. In Botswana this may be influenced by easy access to credit, and households in Q2 and Q3 could show some kind of regular income and thus be eligible for hire purchase, which is widespread in Southern Africa and makes relatively expensive appliances affordable for poor households. The interest on hire purchase is high (estimated to be about 60%).

5.54 Ownership of a cell phone charger assumes that a person in the household owns a cell phone, and such phones are relatively high on the list of priorities (Table 5.10), considering that they have been introduced recently. Electricity is needed for the charging. The lowest ownership was found in Ghana (5.7%), followed by Botswana (22%), Honduras (26%), and the highest proportion was found in Senegal with 40%. The ‘easy terms’ marketing and the absence of landlines have made cell phones an attractive means of communication for many households in developing countries. The relatively inexpensive way of sending messages boosted sales greatly. Cell phone ownership is much more common in urban than in rural areas and this might be influenced by access to electricity (Table 5.10), lifestyle, higher functional literacy rates and some cash income. Only in Honduras did cell phone ownership show an increasing progression (Table 5.11) from lowest (0%) to highest income household (56%). In Botswana the middle income group (Q3) had the highest proportion (100%) and in Senegal the highest proportion of cell phone owners was found in Q2 (47%) and in the poorest quintile 39% households

owned a cell phone – only 3% less than the highest quintile (42%). In Botswana, Ghana and Honduras the lowest income group did not own cell phones (Table 5.11).

Table 5.10: Most frequently owned electrical appliances by income quintile in Botswana, Ghana, Senegal and Honduras

	Q1 (low)	Q2	Q3	Q4	Q5 (high)	Total
Botswana						
Electric fridge/freezer	75.0	87.5	100.0	87.0	93.9	90.8
Cell phone charger	.0	87.5	100.0	87.0	90.9	85.5
Electric Iron	75.0	87.5	75.0	78.3	90.9	84.2
Radio/cassette	75.0	100.0	87.5	73.9	87.9	84.2
Colour TV	50.0	75.0	62.5	82.6	90.9	81.6
Electric fan	50.0	75.0	37.5	65.2	66.7	63.2
Ghana						
Radio / cassette	26.2	54.1	60.3	73	73.7	57.3
Electric fan	1.6	19.7	32.8	41.3	61.4	31
Electric iron	1.6	18	25.9	33.3	59.6	27.3
Electric fridge	3.3	23	17.2	31.7	50.9	25
Colour TV	0	3	8	7	14	32
Music / Hi-Fi system	1.6	9.8	8.6	4.8	12.3	7.3
Senegal						
Radio / cassette	56.7	60.0	55.9	57.8	80	61.5
Colour TV	52.5	55.0	50.8	59.4	76.4	58.5
Electric fan	49.2	45.0	50.8	42.2	61.8	49.5
Cell phone charger	39.2	46.7	39.0	31.3	41.8	39.5
Electric fridge	37.7	36.7	28.8	35.9	54.5	38.5
Music centre / hi-fi system	6.6	8.3	8.5	7.8	18.2	9.7

	Q1 (low)	Q2	Q3	Q4	Q5 (high)	Total
Honduras						
Electric iron	57.7	82.9	77.6	89.1	95.7	84.4
Colour TV	30.8	71.4	73.5	79.7	91.4	75.4
Electric fridge/freezer	34.6	60.0	57.1	65.6	90.0	66.8
Electric fan	43.6	51.4	61.2	64.1	62.9	58.2
Radio/cassette	61.5	57.1	42.9	53.1	65.7	56.1
Blender	23.1	45.7	34.7	53.1	72.9	50.8

5.55 It is most likely that the "easy terms" of credit for cell phones make their ownership and use affordable for poorer and middle-income households although the poorest households are excluded from access to some forms of easy credit. The exception is Senegal where 39% of the poorest households (Q1) owned a cell phone (Table 5.10) and this proportion is almost as high as any other quintile.

Table 5.11: Electrical appliances ownership by income quintile in Botswana, Ghana, Senegal and Honduras (%)

Botswana						
	Q1	**Q2**	**Q3**	**Q4**	**Q5**	**Total**
Radio/cassette	75.0	100.0	87.5	73.9	87.9	84.2
Music/Hi-fi system	.0	12.5	12.5	43.5	27.3	27.6
Colour TV	50.0	75.0	62.5	82.6	90.9	81.6
B/W TV	25.0	62.5	37.5	17.4	6.1	19.7
Cell phone charger	.0	87.5	100.0	87.0	90.9	85.5
Kettle	25.0	75.0	50.0	47.8	75.8	61.8
Hotplate-one plate	.0	.0	.0	.0	3.0	1.3
Hotplate-two plates	.0	12.5	12.5	17.4	15.2	14.5
Two-plate stove with oven	.0	12.5	25.0	8.7	12.1	11.8
Electric stove with oven	25.0	12.5	37.5	8.7	18.2	17.1
Electric fridge/freezer	75.0	87.5	100.0	87.0	93.9	90.8
Electric toaster	.0	12.5	.0	26.1	45.5	28.9
Electric iron	75.0	87.5	75.0	78.3	90.9	84.2
Electric heater	50.0	37.5	.0	43.5	54.5	43.4

Electric fan	50.0	75.0	37.5	65.2	66.7	63.2
Grooming equipment	.0	37.5	12.5	21.7	48.5	32.9
Blender	-	-	-	-	-	-
Other						
Ghana						
	Q1	Q2	Q3	Q4	Q5	Total
Radio/cassette	26.2	54.1	60.3	73.0	73.7	57.3
Music/Hi-Fi system	1.6	9.8	8.6	4.8	12.3	7.3
Colour TV	0	4.9	13.8	11.1	24.6	10.7
B/W TV	3.3	1.6	5.2	1.6	3.5	3
Cell phone charger	0	1.6	6.9	6.3	14.0	5.7
Kettle	0	0	1.7	1.6	1.8	1
Hotplate-one plate	0	0	0	4.8	0	1
Hotplate-two plates	0	0	0	1.6	0	0.3
Two-plate stove with oven	0	0	0	0	0	0
Electric stove with oven					1.8	0.3
Electric fridge/freezer	3.3	23.0	17.2	31.7	50.9	25
Electric toaster	1.6	1.6	0	1.6	1.8	1.3
Electric iron	1.6	18.0	25.9	33.3	59.6	27.3
Electric heater	1.6	1.6	5.2	1.6	8.8	3.7
Electric fan	1.6	19.7	32.8	41.3	61.4	31
Grooming equipment	0	0	0	1.6	0	0.3
Blender	0	0	0	0	0	0
Other	0	0	0	0	0	0
Senegal						
	Q1	Q2	Q3	Q4	Q5	Total
Radio/cassette	55.7	60.7	55.9	57.8	80.0	61.5
Music/Hi-fi system	6.6	8.3	8.5	7.8	18.2	9.7
Colour TV	52.5	55.0	50.8	59.4	76.4	58.5
B/W TV	1.6	3.3	1.7	1.6	0.0	1.7

Cell phone charger	39.3	46.7	39.0	31.3	41.8	39.5
Kettle	0.0	0.0	0.0	0.0	0.0	0.0
Hotplate-one plate	0.0	0.0	0.0	0.0	0.0	0.0
Hotplate-two plates	0.0	0.0	0.0	0.0	0.0	0.0
Two-plate stove with oven	3.3	0.0	1.7	4.7	0.0	2.0
Electric stove with oven	0.0	0.0	0.0	0.0	0.0	0.0
Electric fridge/freezer	37.7	36.7	28.8	35.9	54.5	38.5
Electric toaster	0.0	0.0	0.0	0.0	0.0	0.0
Electric iron	13.1	3.3	1.7	0.0	21.8	7.7
Electric heater	0.0	0.0	0.0	0.0	0.0	0.0
Electric fan	49.2	45.0	50.8	42.2	61.8	49.5
Grooming equipment	13.1	0.0	0.0	0.0	9.1	4.3
Blender	0.0	0.0	0.0	0.0	0.0	0.0
Other	0.0	0.0	0.0	0.0	0.0	0.0
Honduras						
	Q1	Q2	Q3	Q4	Q5	Total
Radio/cassette	61.5	57.1	42.9	53.1	65.7	56.1
Music/Hi-Fi system	30.8	31.4	30.6	50.0	71.4	47.5
Colour TV	30.8	71.4	73.5	79.7	91.4	75.4
B/W TV	19.2	17.1	20.4	17.2	7.1	15.2
Cell phone charger	0	11.4	12.2	21.9	55.7	25.8
Kettle	7.7	8.6	4.1	15.6	37.1	17.6
Hotplate-one plate	0	2.9	0	6.3	4.3	3.3
Hotplate-two plates	11.5	8.6	20.4	12.5	11.4	13.1
Two-plate stove with oven	3.8	0	0	0	1.4	0.8
Electric stove with oven	3.8	5.7	14.2	20.3	50.0	23.8
Electric fridge/freezer	34.6	60.0	57.1	65.6	90.0	66.8
Electric toaster	0	2.9	0	9.4	24.3	9.8

Electric iron	57.7	82.9	77.6	89.1	95.7	84.4
Electric heater	3.8	0	2.0	7.8	14.3	7.0
Electric fan	43.6	51.4	61.2	64.1	62.9	58.2
Grooming equipment	0	5.7	4.1	9.4	42.9	16.4
Blender	23.1	45.7	34.7	53.1	72.9	50.8
Other	3.8	14.3	18.4	20.3	58.6	28.3

Kerosene appliances

5.56 Lamps and lanterns are the most commonly owned kerosene appliances and in all four countries (Table 5.12) they were more frequently owned by rural than by urban households, reflecting the low electrification rate in rural areas. In Ghana urban households used more wick lamps than rural households but if wick lamps and the more common lanterns were combined, a slightly higher proportion of rural households used kerosene lamps. Only in Botswana and Senegal did households own kerosene cook-stoves. Kerosene fridges were used in Senegal (33%) and a few in Botswana but no households owned a kerosene fridge in Ghana and Honduras.

Table 5.12: Kerosene appliances used by households in Botswana, Ghana, Senegal and Honduras (%)

	Botswana			**Ghana**			**Senegal**			**Honduras**		
	Urb	**Rur**	**Nat**	**Urb**	**Rur**	**Nat**	**Urb**	**Rur**	**Nat**	**Urb**	**Rur**	**Nat**
Wick lamp	65.3	78.5	76.7	26.9	14.0	22.3	28.0	42.8	32.9	36.0	95.5	56.2
Lantern	0	0	0	65.8	81.3	71.3	57.0	56.0	32.9	0	0	0
Flame stove	10.9	11.5	11.7	2.1	2.8	2.3	28	42.8	32.9	68.6	2.3	46.2
Primus stove	27.7	14.8	19.7	1.0	0	0.7	0	0	0			
Heater	0.0	0.0	0.0	0	0	0	0	0	0	0	0	0
Fridge	0.0	0.5	0.3	0	0	0	71.0	56.0	32.9	0	0	0
Other (Gas lamp?)	0.0	0.0	0.0	0	0	0	0	0	0	4.7	2.3	3.8

Gas appliances

5.57 The most common gas appliances were gas burners or stoves (Table 5.13). In Botswana 46% of households owned a gas stove with oven, an appliance almost as expensive as an electric stove. Much fewer households owned the less expensive varieties of gas cookers such as a gas bottle with burner (5%) or a stove without oven (11%). Some households (6%) which used gas owned gas fridges in Botswana. In Ghana the most common gas appliances were stoves (13%) and gas lamps (12%). In Senegal most

households owned gas bottles with burners – an inexpensive appliance introduced and subsidized at the time of the butanization campaign in 1989. Gas lamps were also common in Senegal (11.6%) and three times more households use them in rural than in urban areas. In the absence of electricity rural households obviously light their homes with kerosene and gas lamps. In Honduras gas stoves without oven (48%) and gas stoves with oven (47%) were mostly owned. The less expensive gas bottle with burner was owned by only 5.5% of households.

Table 5.13: Gas appliances used by households in Botswana, Ghana, Senegal and Honduras

	Botswana			**Ghana**			**Senegal**			**Honduras**		
	Urb	**Rur**	**Nat**	**Urb**	**Rur**	**Nat**	**Urb**	**Rur**	**Nat**	**Urb**	**Rur**	**Nat**
Gas lamp	1.0	1.4	1.3	3.6	0	2.3	7.1	21.9	11.6	1.7	0	1.4
Gas bottle with burner	2.0	5.7	4.7	0	0	0	7.2	21.9	11.6	6.9	0	5.5
Stove without oven	17.8	6.7	10.7	10.9	5.6	9.0	0	0	0	48.3	46.7	47.9
Stove with oven	60.4	36.4	45.7	2.1	0.9	1.7	0	0	0	44.8	53.3	46.6
Heater	0.0	0.5	0.3	2.1	0	1.3	0	0	0	0	0	0
Fridge	9.9	3.8	6.0	0	0.9	0.3	0	0	0	1.7	0	1.4

6

Energy Supply Chains

6.1 The energy supply chains describe the supply of fuels to urban and rural households. It includes the availability of energy sources, distance travelled and cost to obtain the fuels. If a household has potential access, the fuel the household chooses is a demand decision, if the fuel is not available it is a supply constraint.

6.2 This chapter relies very closely on the information given in the first report of the local consultants.

6.3 The four countries except Botswana generate most of their own electricity supply (Table 6.1). Botswana imports two thirds of its electricity from South Africa. The electricity in Botswana is mostly generated from coal and some hydro, in Ghana the sources are mostly hydro and some thermal, in Senegal it is mostly thermal, and in Honduras hydro and thermal. All four countries plan to expand electricity generation because of rising demand and the desire of governments to extend grid electricity to all the people.

Table 6.1: Electricity supply in Botswana, Ghana, Senegal and Honduras

	Botswana	**Ghana**	**Senegal**	**Honduras (1999)**
Electricity supply	1954.8 GWh	1952GW	1 724 385 MWh	3564 GWh
In-country generation	30%	85%	-	Public: 63.5
				Private: 36.5%
Import	70%	15%	-	3.8%
Imported from	South Africa and STEM[1]	Ivory Coast	-	-
Southern African Power Pool – short-term energy market				

6.4 All four countries expanded their electricity grid in recent years (Table 6.2). The electricity coverage ranges from low in Botswana (28%) to high in Honduras (75%). Senegal's coverage is also fairly low at 30% and Ghana at 49% has a middle position. Botswana is a large country with a small population and the low electrification rate is to a large extent explained by the high expense of extending and servicing the grid over long

distances to bring electricity to few people. Solar systems have been installed in some of the remote villages. Having access to relatively cheap energy from the region, Botswana has deferred investment in power generation. The regional capacity is expected to run out by 2007.

6.5 Ghana and Senegal have not extended their coverage very much in the last years and this seems to be due to generation constraints. In Honduras generation constraints were overcome by facilitating private investment in new generation.

Table 6.2: Household electricity connections in the four countries (%)

	Botswana		**Ghana**		**Senegal**		**Honduras**	
	1996	***2003***	***2000***	***2003***	***1997***	***2001***	***1989***	***2004***
Urban	24	50	77	78.8	50.3	55	33	75
Rural	4	20	17	23.8	5	8	-	-
National	10	28	43.7	49.0	26.6	30	-	-

6.6 The four countries import all their crude oil and some of the petroleum products. Senegal, Ghana and have a refinery producing kerosene and gas but additional kerosene and gas were also imported. Gas and kerosene were distributed from central depots throughout the countries by petroleum marketing companies. Households bought their products from petroleum marketing companies or local retailers.

Energy supply in Botswana

6.7 Several general and specific linkages between energy supply and household used can be identified. Candles, kerosene and fuelwood are associated with poorer households particularly in rural areas. Electricity is the most expensive energy supply and is mainly associated with lighting and media use and only a small proportion (7%) of the highest income group used it for cooking.

6.8 The availability and use of the different fuels in the survey area is indicated in Table 8.1 where the links between supply and use are discussed.

Fuelwood supply

6.9 Fuelwood is the cheapest energy source for households. It can be self collected for free or bought in various amounts such as a load carried on the head or transported in a wheel barrow, on a bicycle, a donkey cart or vehicle. The use of fuelwood is most common in poor rural households.

6.10 The widespread use of fuelwood by poor households in rural and urban areas and uncontrolled harvesting will in the long term denude the woodlands with negative consequences for agricultural use of land. In SE Botswana where 80% of the population lives, fuelwood harvesting can be linked to woodland degradation. It is important for

government to intervene and increase the supply of alternative and clean sources of household energy and to make them affordable to poor households.

6.11 Reforms to reduce the use of fuelwood and encouraging the use of cleaner fuels and electricity are being instituted in Botswana. It was recommended that large consumers such as government institutions switch to other energy sources. In the eastern part of the country where most of the woodlands are located, the Fuelwood Inventory and Monitoring program (FIMP) monitors woodland resources since the year 2000 using satellite imagery and aerial photographs. In addition to these measures community management of woodland resources were also recommended.

6.12 Charcoal is rarely used in Botswana and there is hardly any production of it.

Kerosene supply

6.13 Kerosene is imported from South Africa and transported by rail and road by international companies and bottling companies and is supplied to households through stores petrol stations. Kerosene as well as LPG is distributed by private dealers in both rural and urban areas. In rural areas both fuels are generally sold by stores and suppliers take advantage of these rural stores as the paraffin and LPG supply points in the villages. Kerosene is still a major fuel in rural households and is also extensively used in urban areas.

LPGas supply

6.14 All petroleum products in Botswana are imported. The international oil companies Engen, BP, Caltex, Shell and Total in cooperation with three main bottling companies supply LPG to households in Botswana. The companies can source LPG from wherever they get reliable supply and their major source is South Africa.

6.15 LPG prices are not regulated by government and operate under a liberalised market. LPG is used for cooking in higher income rural households and medium income households in urban areas.

6.16 Reforms regarding the supply of LPG relate predominantly to safety regulations. They set standards for the handling, storage and distribution of LPG in domestic, commercial and industrial applications and installations, symbolic safety signs on cylinders/bottles, and fire hose reel assembly at LPG supplier and user premises. These standards will improve safety and reduce cross border trade in LPG cylinders which may not meet safety standards but they will also increase the marginal cost of the product.

Coal supply

6.17 Botswana has very large coal reserves estimated at 48.6 billion tonnes. Government is promoting the use of coal and is financing the infrastructure for two coal depots one in Gaborone the capital and another one in Francistown. Coal distributors obtain their supply from these depots and then transport, stock, screen and package the coal at their own cost before retailing it.

Electricity supply

6.18 The Botswana Power Corporation (BPC) is the only electricity company and it is government owned. It is responsible for generation, transmission and distribution. The Rural Electrification Policy program is part of BPC and it is aggressively pursued and the number of connected rural households is steadily increasing (see Section 4.41).

Energy supply in Ghana

Fuelwood and charcoal supply

6.19 About 90% of fuelwood and charcoal resources are obtained from the natural forest and 10% are from wood waste such as logging and sawmill residue and planted forests. A large proportion of households gathers fuelwood for themselves usually near their homes and do not pay for it. Most rural households (76 % see Table 5.2) still cook with fuelwood while only 19 % of urban households still use it for cooking. Free and easy availability also explains why rural fuelwood decreased only by 8 % from 2000 to 2004 while urban fuelwood decreased by 15 % (Table 5.2).

6.20 There is also commercial production and supply of fuelwood and charcoal and these activities are decentralised and are undertaken by individual entrepreneurs all over Ghana. The transition and savannah districts of Kintampo, Nkoranza, Wenchi, Afram Plains and Damongo districts provide most of the resources for fuelwood and charcoal.

6.21 The practices of charcoal production are wasteful and unsustainable. The deforestation rate in Ghana is 3% per year and consequently charcoal producers have to travel longer distances in search of appropriate wood species for charcoal production and fuelwood harvesters have to spend more time collecting wood from the forest.

6.22 Most of the charcoal and fuelwood are taken from the production sites which are predominantly in rural areas to the major cities and other urban centres where they are sold by wayside retailers to the consumers. A small amount of charcoal, 32 328 TOE in 2000, is exported to West African and European markets.

6.23 The fuelwood and charcoal industry is largely unregulated. The only exception is the export of charcoal. Exported charcoal has to be produced from approved sources such as sawmill residues or planted forest but the wood should not be harvested from natural forest. Since July 2003 exporters of charcoal have to obtain a permit from the Energy Commission.

Supply of petroleum product

6.24 Ghana imports all its crude oil. It is refined by the Tema Oil refinery (TOR) with a capacity of 45 000 BSPD. TOR also undertakes the bulk sale and export of petroleum product and since 2001 TOR took over bulk storage and primary distribution of gasoline, kerosene and diesel. The primary distribution of petroleum products is carried out by pipeline, ocean transfer using small marine vessels and by large barges on the Volta lake.

Bulk road vehicles were used earlier but since 2001 the government has restricted the use of bulk road vehicles in order to cut cost of primary distribution.

6.25 Oil marketing companies and retailers manage secondary distribution and retail of petroleum products. There are about 1200 retail outlets.

6.26 Kerosene is the main lighting fuel in rural areas which are not yet electrified and because of earlier supply constraints the government initiated the Rural Kerosene Distribution Improvement Program (RDDIP). The aim was to ensure that kerosene is made widely available at all times and at officially approved prices. Kerosene tanks were provided and the District Assemblies selected vendors to sell kerosene from the tanks. By 2010 over 2400 kerosene reseller outlets are to be established. So far 500 tanks have been distributed.

6.27 There are 85 mini-filling plants for LPG, 52 in and around Accra and 11 in Kumasi.

6.28 Kerosene is cross subsidized and it remains the second most common lighting fuel in both rural and urban areas (Table 5.2).

6.29 Only 9 % of households used LPG for cooking, 5 % in rural and 12 % in urban areas. LPG is not easily available in rural areas and this contributes the fact that few rural households use it.

6.30 LPG was subsidized by 18 % to off-set the increase in petroleum prices. Its household use increased by only 5 % from 2000 to 2004.

Electricity supply

6.31 Before power sector reform in 1998 electricity was generated by the Volta River Authority, a publicly owned utility. Since the reforms in 1998 a private partner, CMS of Michigan, has acquired a 50 % share in the Aboadze thermal power plant (230 mW).

6.32 The transmission network is owned and operated by the publicly owned Volta River Authority.

6.33 Distribution is undertaken by two companies. The Electricity Company of Ghana (ECG) is distributing electricity in the southern regions and has a customer base of 900 000 in 2001. The Northern Electricity Department (NED) is a subsidiary of VRA distributing electricity in the northern regions of Ghana having a customer base of 120 000.

6.34 Although the distribution utilities are obliged to supply customers within their area, new electricity connections in residential areas can be delayed for a long time. If customers want faster service they will have to make contributions to the line extension such as buying main distribution poles which by law would become the property of the utilities.

6.35 Most customers have credit meters and are billed at the end of the month. Customers who don’t have meters pay flat rates. In 1999 the Electricity Company of

Ghana introduced prepaid meters in some areas in the major cities to reduce non-technical losses and to increase collection rates. Progress has been slow due to lack of funds to buy prepayment meters. Load limiters were introduced for lifeline customers who were billed on a flat rate basis in order to assess the amount of electricity used and adjust the flat rate tariff.

6.36 The relatively high proportion of rural households using electricity for lighting indicates that the rural electrification program has reached many villages and households.

Energy supply in Senegal

6.37 In 1998 the final energy consumption in Senegal was 1.5 million TOE of which 46% was fuelwood, 40.6 % was oil products and 6.6 % was electricity

Biomass supply

6.38 The use of woodfuels is widespread in Senegal. There are some 12 million hectares of woodlands predominantly in the south and southeast of the country. The total annual gross production is estimated at around 10 million cubic metres. Other biomass such as peanut husks and bagasse are used in the oil and sugar industry respectively. There is also a considerable potential for other plant waste products such as straw, cotton stems, rice haff and rise stems.

Fuelwood and charcoal

6.39 The fuelwood supply for consumption in rural areas is obtained from fallow land or forests near the villages. It is gathered free of charge by women and children and, when it is very far, by men.

6.40 There is a fairly large commercial charcoal production and it is regulated by government. Wood and charcoal produced in the Tambacounda and Kolda regions is supplied to urban households in the major cities and to the capital city Dakar which is more than 400 km northwest of the production area.

6.41 The wood cutting season begins in December and closes in July/August. Cooperatives, commercial groups and companies in the sector include foresters who are accredited by the Ministry of Environment and Sanitation. There are about 100 such companies and groups and they also distribute ligneous fuels to consumers. So far exploitation is only authorised on the woodlands of Tambacounda and Kolda.

6.42 The forestry operators of the groups and companies employ charcoal makers, called sourghas, to cut and collect the wood and the make and to monitor the traditional earth kilns. The yield by weight is about 18 % and various attempts have been made to train the sourghas in more efficient techniques of destructive distillation such as the Casamance earth kiln. The sourghas work under the supervision of a foreman and are paid at a rate of 500-600 CAF per bag of charcoal produced. They are responsible for filling the bag and loading them on the trucks which carry them to the consumption

centres. A good sourgha is expected to fill 600 bags in a season. Until very recently being a sourgha was considered degrading and most sourhgas were not Senegalese but Guinean.

6.43 Transport to the urban consumption centres is by 10-15 tons trucks. They are owned by an operator, a driver or a 'coxeur' who is an active middleman in the distribution chain. The coxeur is the important broker ensuring the smooth flow of the operation and he has a number of sales points manned by his staff enabling him to control the pace of production. The coxeurs are hardened businessmen who also serve as bankers and financiers. They buy entire freight loads and release them on account to independent retailers or bring waged retailers into their fold.

6.44 The retailers manage the neighbourhood charcoal stores and try to sell them on foot from house to house. They depend on the coxeurs and are remunerated on the basis of a contract with the coxeur or on commission on each bag sold. There are more than 1000 retail outlets in Dakar.

Regulation of forestry

6.45 Wood harvesting for commercial purposes is regulated by government and the cutting coincides with the dry season so as to allow for the regeneration of plant life. At the beginning of each season the Ministry of Environment acting on a proposal from the Forests and waterways Board, sets production quotas for each region and each type of product (wood, charcoal,etc). Available resources and demand for fuel determine the quotas.

6.46 The regional quotas are split between operators accredited by the Forests and Waterways Board; a "professional forest" card is issued to formalise the accreditation. On the basis of this quota the forester is then given a cutting license and he must pay tax on the amount of charcoal produced and not on the amount of wood cut down to produce the charcoal. The regional Forests and waterways Service delimits the exploitable areas and issues foresters with employment certificates for the sourghas.

6.47 The forester has to obtain a distribution license from the Regional Service to transport the charcoal to the consumption centres. There are several checkpoints en route where transporters have to show the license. At the entrance point to the city to which the charcoal is delivered the license is handed over to the forestry service.

6.48 Charcoal remains the most widely used biomass fuel.

6.49 The licensing of the charcoal industry will improve the sustainability of the forestry resources. The major end use of charcoal is space heating in winter and 18% of households use it for that purpose and 16% of households still use fuelwood for water heating. The successful butanization program has largely replaced charcoal and fuelwood as household fuels reducing further the pressure on wood felling.

Kerosene supply

6.50 The hydrocarbon sector is dominated by private companies. They are either monopolies such as the refinery (Societé Africaine de Raffinage (SAR)) or cartels distributing gas and kerosene. Under present reforms the hydrocarbon market will be liberalised to stimulate competition and reduce cost.

6.51 Kerosene is distributed by the companies Mobil, Shell and Total. Kerosene was used as a lighting fuel and with increasing electrification kerosene use has declined. There are no longer any kerosene wholesalers. Petrol stations selling kerosene are supplied by their companies. Neighbourhood shops are supplied by peddlers operating from trucks fitted with tanks and positive displacement metres containing 5,000 to 10,000 litres or 200 litres.

6.52 The subsidized gas has displaced kerosene as a cooking fuel and many neighbourhood shops don't sell kerosene any longer.

6.53 There are other problems affecting the distribution of kerosene; fraud was detected in sales declarations; distribution is not sufficiently regulated; the quality of kerosene is not always guaranteed and the price structure does not always offer a sufficient margin to the retailer.

LPGas supply

6.54 The gas supplied in Senegal is butane. Some is refined locally by SAR and some is imported. The refinery is a semi-state company in which the oil companies Mobil, Shell and Total hold a majority share and the state is represented by Pétrosen. The oil companies also distribute the gas and they have invested in receiving, storing and processing infrastructure.

6.55 Since some years the refinery no longer met the national demand and additional gas had to be imported. Until 2004 SAR had the monopoly of the gas import.

6.56 Before the reforms of 1998 all distributors had to get their supplies from SAR shareholders who controlled the storage infrastructure. After 1998 all operators could get their supplies directly from the refinery. A new operator Touba-gaz entered the distribution market and in 2003 Vitogaz took over Shell's gas department. The distributors supply wholesalers and some of their bigger clients such as local authorities, hospitals and buildings connected to gas. There are 100 wholesalers who distribute to retailers of all sizes and kinds (department stores, shopping chains, neighbourhood shops and a few petrol stations). Wholesalers are increasingly transporting gas; at the same time the gas filling infrastructure is being decentralised in places such as Kaolack and Saint-Louis.

6.57 Gas is sold in cylinders:

- 38 kg and 12 kg; the larger cylinders are bought by local authorities and well-off households using gas cookers; these two sizes are not subsidized

- 6 kg and 2.75 kg aimed at poorer households; they are subsidized.

6.58 The gas supply and subsidy of the 6 kg and 2.75 kg cylinders have been so successful that gas is everywhere available even in the remotest villages and more than 85 % of households use it for cooking.

Electricity supply

6.59 Senegal's electricity production was 1 724 385 MWh of which more than 2/3 was generated by SENELEC and about 1/3 by self-generating companies such as chemical, cement and other industries.

6.60 The country's hydroelectric potential is limited and through the OMVG (Organisation pour la Mise en Valeur du Fleuve Gambie) and the OMVS (organisation pou la Mise en Valeur du Fleuve Sénégal) Senegal can access electricity in the organisations' member states. At present Senegal receives 30 % of the output of the power station at Manantali in Mali. Feasibility studies are being conducted at two sites upstream from Manantali along the West 225 kV transmission line.

6.61 The limited electricity generation has contributed to low electrification rates particularly in rural areas where electrification has increased from 5 % in 1997 to 8 % in 2001. Low electrification rates, relatively high tariffs and no concessionary tariff for poor households restrict the use of electricity to mainly lighting.

Energy supply in Honduras

Electricity supply

6.62 The supply of electricity has improved considerably since 1994 when there were frequent blackouts due to the long draught, which affected the Fransisco Marazán dam. Private thermal generation rose from 0 % in 1990 to 32 % in 1994 and 37 % in 1999. Also distribution losses mainly due to theft were reduced by 11 % from 1995 to 2001.

6.63 In Honduras 48 % of available electricity supply is generated by hydrolelectric plants and 52 % is from thermal plants. Private companies supply 405 MW of the total 473 MW of thermal generation. The thermal plants are small and have relatively high unit cost.

6.64 Honduras will need to increase energy generation by 2860 GWh between 2000 and 2010 to meet growing demand. Most of this new generation is expected to be privately provided.

6.65 Honduras is the only one of the four countries which succeeded in attracting substantial private investment in electricity generation and consequently had sufficient capacity to increase connections from 33 % in 1989 to 75 % in 2004 (Table 6.2). This is the highest increase among the four countries. Connection rates as indicated by households using electricity for lighting (Table 5.2) increased significantly more in rural

than in urban areas. A fairly high proportion of households (21 %) cook with electricity in Honduras.

6.66 The 4-step tariff starting with a relatively low flat-rate tariff for the first 20 kWh and rising to Lempiras 1.38 above 300 kWh (Table 5.7) was introduced to assists poor household to use a basic amount of electricity.

Expenditure on fuel transport

6.67 The expenditure on fuel transport for the household varied. In some cases the gas vendors included the delivery charge in the price of the gas, in other cases not. In Botswana the LPG vendor/distributor charged a mean of P9.82 for delivering a gas bottle to the household. In Honduras just over one third of households using gas had to pay for delivery, the amount varying from 5 to 90 Lempiras.

6.68 The question as to whether transport cost affected household choice of fuel needs further analysis.

Reliability of supply

Reliability of electricity supply

6.69 The reliability of electricity supply was estimated by asking households about the frequency and duration of power failures and brown outs (Table 6.3 and Table 6.4).

Frequency and duration of power failures

6.70 The most frequent power failures were in Senegal where 53% of households experienced a power failure every day or several times a week (Table 6.3). In Ghana 37%of households experienced power failure at the same frequency and in Botswana and Honduras it was only 11% to12% – suggesting a more reliable power supply, probably partly due, in the case of Botswana, to the fact that most of its electricity is imported from South Africa where generation is generally reliable. Most power failures in the four countries lasted only a few hours but in Ghana 39% of power failures lasted one to three days (Table 6.3).

Table 6.3: Frequency and duration of power failures experienced by households in Botswana, Ghana, Senegal and Honduras (%)

	Botswana			Ghana			Senegal			Honduras		
	Urb	**Rur**	**Nat**	**Urb**	**Rur**	**Nat**	**Urb**	**Rur**	**Nat**	**Urb**	**Rur**	**Nat**
Frequency												
Every day to several times a week	10.0	13.9	12.1	41.9	20.0	35.6	56.6	44.6	53.1	10.8	12.5	11.2
Once a week to several times a month	26.6	13.9	19.7	20.0	20.0	20.0	35.0	50.8	45.9	19.1	30.3	21.6
Seldom/ occasional, every 2 to 3 months	33.3	47.2	40.9	38.1	49.2	41.3	8.4	4.9	1.0	63.9	50.0	60.8
Never	30	25	27.3	0	10.8	3.1	0	0	0	0.5	5.4	1.6
Duration												
Few hours	70.00	83.33	77.3	54.9	58.2	55.7	57.3	80.9	69.1	83.4	54.7	77.2
1 to 3 days	3.33	5.56	3.00	40.6	34.5	39.1	0	0	0	11.9	39.6	17.9
4 to 7 days	3.33	5.56	4.50	4.0	5.5	4.3	0	0	0	0.5	1.9	0.8
3 to 4 weeks	3.33	0	1.50	0.6	11.8	0.9	0	0	0	2.6	1.9	2.4

Frequency and duration of brown-outs

6.71 Brown-outs were much less frequent than power failures in all four countries (Table 6.4). They were about equally common in Botswana and Ghana and occured less frequently in Honduras and rarely in Senegal. In Botswana, Ghana, Senegal and Honduras they lasted only a few hours.

Table 6.4: Frequency and duration of brown-outs experienced by households in Botswana, Ghana, Senegal and Honduras (%)

	Botswana			Ghana			Senegal			Honduras		
	Urb	**Rur**	**Nat**	**Urb**	**Rur**	**Nat**	**Urb**	**Rur**	**Nat**	**Urb**	**Rur**	**Nat**
Frequency												
Every day to several times a week	0	37.5	21.4	21.9	18.5	20.9	4.7	3.2	5.3	17.0	7.7	15.1
Once a week to several times a month	16.7	0	7.1	13.1	6.2	11.1	8.6	2.1	7.0	13.6	25.7	16.1
Once a month to several times a year and seldom/ occasional, every 2 to 3 months	33.3	50.0	42.9	5.6	0	4.0	33.4	55.4	46.5	69.4	66.7	68.8
Never	50	12.5	28.6	57.5	53.8	56.4	53.3	49.3	41.2	0	0	0
Duration												
Few hours	75*	50	50	80.1	71.8	78.4	48.8	20.8	40.5	56.5	74.4	60.2
1 to 3 days	0	0	0	18.5	23.1	19.5	2.3	3.2	2.7	4.1	5.1	4.3
4 to 7 days	0	0	0	1.4	5.1	2.2	4.3	0	3.0	0.7	0	0.5
3 to 4 weeks	0	0	0	0	0	0	0	0	0	0	0	0
* Linked to total of those who experience brownouts												

7

Patterns of Energy Use and Expenditure

7.1 Energy use patterns in households are determined by household income, availability/access, reliability, prices and cost, end use convenience and preferences, social values, energy technology, health and environmental impact. Many of these criteria depend on the level of national development. In this survey the fuel use patterns for lighting, cooking, water heating and ironing were investigated.

Influence of income on fuel use pattern and expenditure for cooking

7.2 Cost of fuel and income play an important role in fuel choice and they largely determine fuel use patterns.

Patterns of fuelwood use for cooking

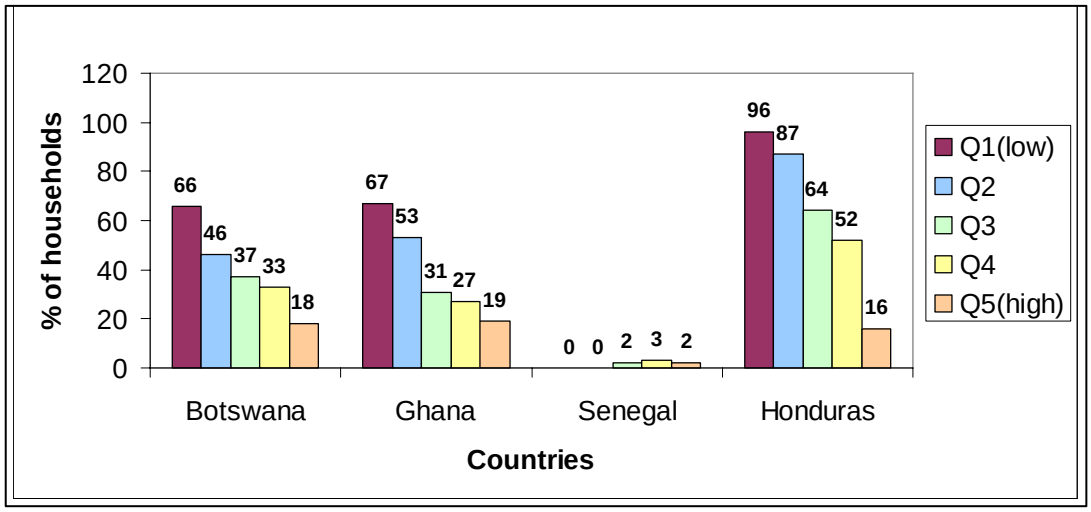
7.3 The trends of fuelwood used for cooking were similar in Botswana and Ghana, where fuelwood was the second most common energy source used (Table 5.2). Table 7.1 and Figure 7.1 show fuelwood use for cooking by income quintile. In Botswana, Ghana and Honduras the poorest 20% of households (Q1) had the highest proportion of fuelwood users (96%–67%) and fuelwood use consistently decreased from the poorest 20% (Q1) to the wealthiest 20% (Q5) and only 16% to 19% of Q5 households used fuelwood for cooking. The use of fuelwood decreased with rising income in the three countries. In Honduras the gradient from the poorest to the wealthiest households is steeper than in Botswana and Ghana because a higher percentage of Q1 (96 %) and Q2 (87 %) households used fuelwood. Fuelwood use of the highest income quintile ranged from 19 % to 16 % suggesting that this proportion of the highest income quintile used fuelwood for cultural and taste preferences.

7.4 Senegal was the exception and only 1.3% of all households used fuelwood. The two poorest quintiles did not use any fuelwood and only 2% to 3% of households in the three highest quintiles (Q3 – Q5) used fuelwood. Households of all income groups in Senegal had switched to gas, which they could afford because it was subsidized.

7.5 The pattern of fuelwood use is clearly determined by household income, availability and fuel cost. Fuelwood appeared to be generally available and poor households collect it free of charge.

7.6 In Senegal the pattern of very low fuelwood use is definitely influenced by the butanization program. In Botswana where fuelwood availability is lower (55 %) than in the other countries government and other institutions have to use other fuels than fuelwood to preserve the national fuelwood resources for poor households.

Figure 7.1: Proportion of households in Botswana, Ghana, Senegal and Honduras using fuelwood for cooking by income quintile



Patterns of charcoal use for cooking

7.7 Charcoal was not used for cooking in Botswana and Honduras, and only 3% of households used it in Senegal. It was widespread in Ghana, accounting for half the households (Table 5.2), and 31% of the poorest quintile (Table 7.1); this proportion rose to 62% for Q3 and remained at about that level for the two highest income quintiles (Q4 and Q5). The pattern of charcoal use is income dependent because the poorest households rely more on fuelwood (Figure 7.1) than on charcoal which has to be bought and fuelwood is self-collected without charge. Households in Q3 and higher can afford to buy charcoal.

7.8 In Senegal the pattern was similar but not as consistently increasing with income and the level of charcoal use was much less than in Ghana, ranging from 0% to 11%. The low use of charcoal for cooking is influenced by the butanization program whose subsidies make gas less expensive than charcoal.

Patterns of kerosene use for cooking

7.9 The very low use of kerosene for cooking was surprising and it is not quite obvious why this was so. It was however widely used as lighting fuel where there was no access to electricity indicating that it was widely available. Households in Ghana and Senegal did not cook with it and only 6% to 7% of households used it in Botswana and

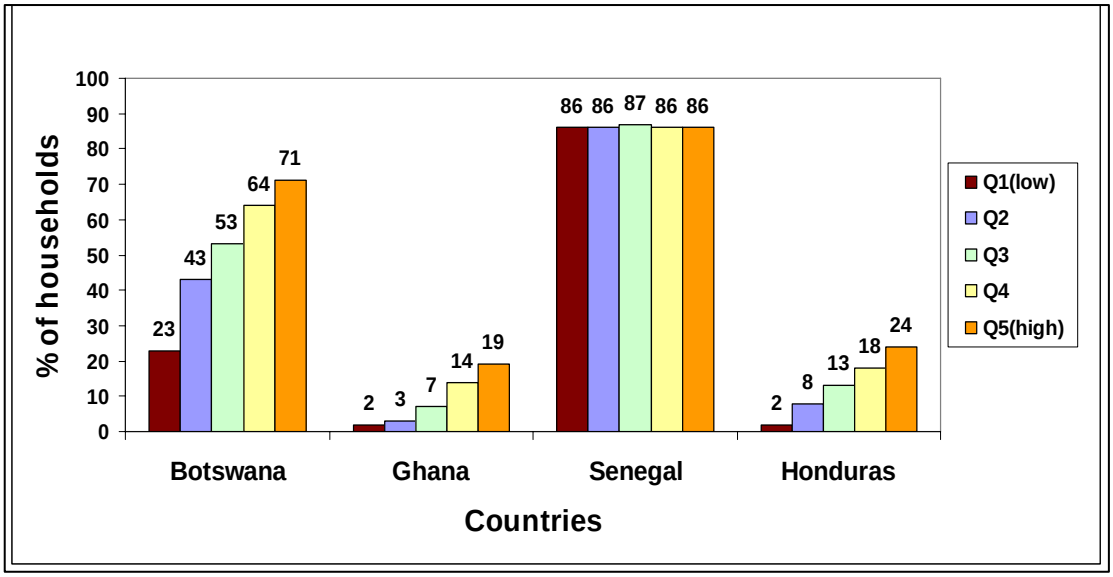
Honduras. In Botswana a greater proportion of households (9%–11%) in the lowest income quintile than in the higher income groups used kerosene for cooking and only 3% to 5% of the two highest quintiles used kerosene for cooking. This seemed to indicate that kerosene is a fuel used by the poor in Botswana when wood is not available or a meal has to be quickly cooked.

7.10 In Honduras the trend is opposite, the two lowest income groups used it less (0% – 2%) than the three highest income groups (6% – 14%) suggesting that the poor cannot afford it and some of the better-off households use it possibly in areas which are not yet electrified.

Patterns of LPG use for cooking

7.11 The proportion of households using gas for cooking varied greatly from country to country. It was 9% in Ghana, 14% in Honduras, 51% in Botswana and more than 85% in Senegal. In Botswana, Ghana and Honduras the proportion of households using gas increased from the lowest to the highest income quintile (Figure 7.2) clearly indicating that the use was income dependent in the three countries. Senegal was the exception and more than 85% of households in all income quintiles use gas showing that the subsidy on gas and small cooking stoves benefited the poor as much as everybody else. The wide use of gas for cooking in Botswana was due to effective marketing and the fact that in many areas gas was introduced before households got electricity and when electricity was installed they already had gas appliances and the gas cylinder and many households continued using them and did not invest in new electrical appliances.

Figure 7.2: Proportion of households in Botswana, Ghana, Senegal and Honduras using gas for cooking by income quintile



Patterns of electricity use for cooking

7.12 It was surprising to find that electricity was hardly used for cooking. When households have a connection all income groups use it for lighting and media but the tariffs are too high for cooking which is much more energy intensive. It was not used at all in Senegal and only 0.3 to 2% used it in Ghana and Botswana. It was more widely used in Honduras where 21% of households cooked with it. It is obviously a fuel for the higher income groups and the proportion of households using it rose from 2% for the lowest income group to 55% for the wealthiest 20% in Honduras (Table 7.1; fuels/energy sources in this table include main fuels/energy sources). Low incomes and high tariffs obviously limited the use of electricity for cooking.

Table 7.1: Fuel use for cooking by income quintile in Botswana, Ghana, Senegal and Honduras

	Q1(low)	Q2	Q3	Q4	Q5(high)	Total
Fuelwood						
Botswana	66.1	46.4	37.3	32.8	18.0	40.1
Ghana	67.2	52.5	31.0	27.0	19.3	39.8
Senegal	0.0	0.0	1.7	3.1	1.8	1.3
Honduras	96.1	86.5	63.9	51.5	15.6	59.1
Charcoal						
Botswana	0	0	0	0	0	0
Ghana	31.1	44.3	62.1	57.1	61.4	50.8
Senegal	1.6	0.0	5.1	0.0	10.9	3.3
Honduras	0	0	0	0	0	0
Kerosene						
Botswana	9.7	10.7	8.5	3.3	4.9	7.4
Ghana	0	0	0	0	0	0
Senegal	0.0	0.0	0.0	0.0	0.0	0.0
Honduras	0.0	1.9	6.6	13.6	5.6	5.9
LPG						
Botswana	22.6	42.9	52.5	63.9	70.5	50.5
Ghana	1.6	3.3	6.9	14.3	19.3	9.0
Senegal	86.1	86.3	86.5	86.0	85.5	86.0
Honduras	2.0	7.7	13.1	17.6	23.9	13.9
Electricity						
Botswana	0	0	1.7	0	6.6	1.7
Ghana	0	0	0	1.6	0	0.3
Senegal	0	0	0	0	0	0
Honduras	2.0	3.8	16.4	17.6	54.9	21.1

Preferred fuels and fuel transitions

7.13 The fuel transitions in the four countries differed and no two countries had identical transition patterns. The patterns are as follows;

Botswana: from wood to gas

Ghana: from wood to charcoal and gas

Senegal: from wood and charcoal to gas

Honduras: from wood to electricity and gas

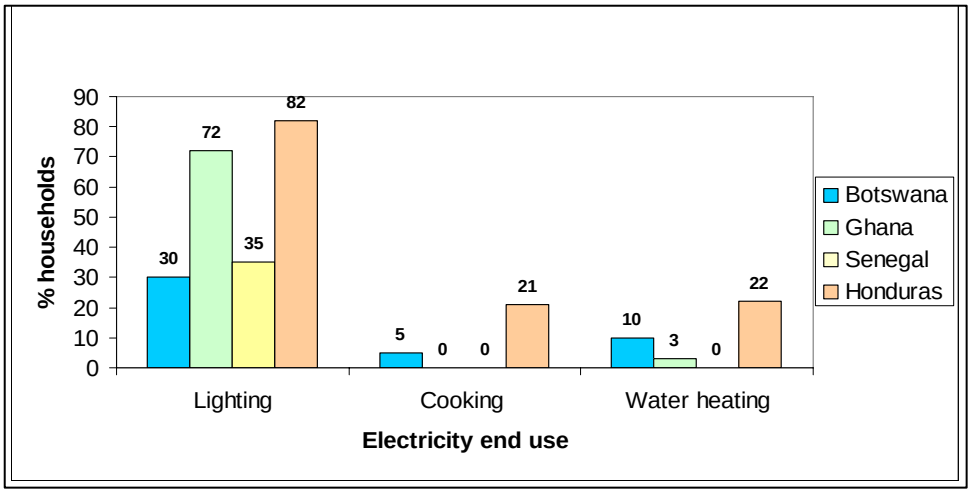
7.15 In spite of the variety the following general trends were found in all the four countries.

- All countries switched from wood to a more energy intensive fuel
- Households increasingly use gas for cooking
- It is much more widely used in urban than in rural areas
- Households are switching from wood to gas, to charcoal or to electricity

Transition to electricity

7.16 When households get first connected to electricity they use electricity for lighting, media and a few other appliances (Figure 7.3). They do not generally use electricity for the most energy-intensive uses such as cooking, water heating and space heating.

Figure 7.3: Proportion of households in Botswana, Ghana, Senegal and Honduras using electricity for lighting, cooking and water heating



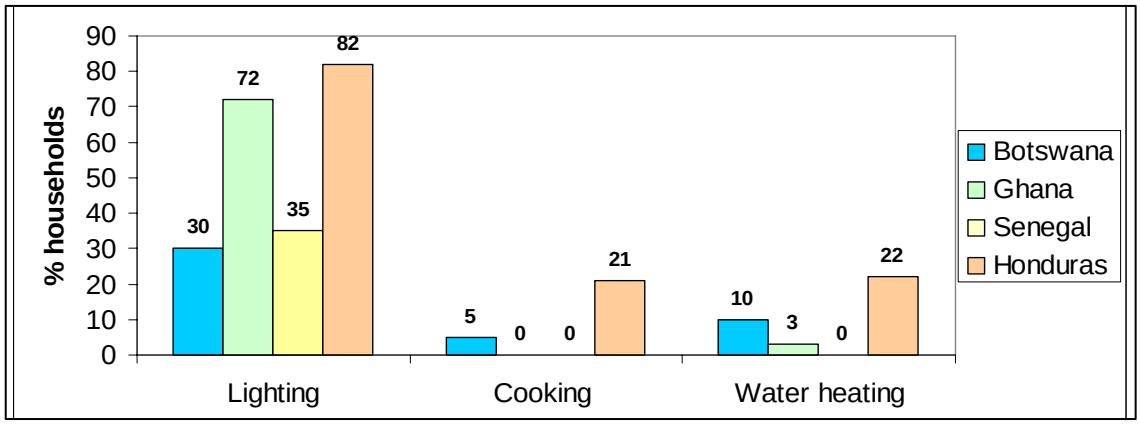
7.17 Households continue to use the cooking fuels they used before electrification and just add electricity to their energy portfolio. They remain multiple fuel users, because they cannot afford to pay for the high electricity tariffs even if they would prefer to use electricity for cooking or switch on a geyser for heating water. Generally fuelwood

remains one of the most preferred fuels. In most cases households can collect fuelwood themselves, spending only time and labour gathering it. When households have no or little money, fuelwood is the energy source they have most control over.

Transition to gas

7.18 The general trend to use increasingly gas is shown in Figure 7.4 although the proportion of households using gas ranges very widely from 5% in urban Ghana to 69% in urban Senegal in the year 2001. This trend is seen in both urban and rural areas although the proportion of rural households using gas is lower than urban households.

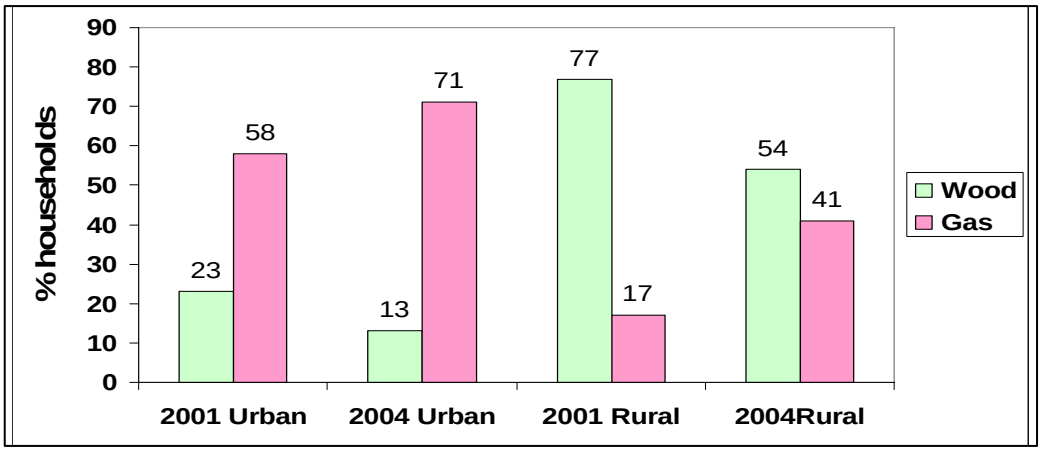
Figure 7.4: Transition to gas for cooking in Botswana, Ghana and Senegal



7.19 In Botswana gas had become the most common cooking fuel (Figure 7.5) – 51% of households were using it in 2004 – since the last survey in 2001 when 46% cooked with fuelwood and 41% with gas; this change can only be considered as a trend because data were collected in different types of surveys.

7.20 While the proportion of households using gas increased from 2001 to 2004 the proportion of households using fuelwood decreased in both rural and urban Botswana (Figure 7.5). Households were obviously replacing fuelwood with gas. Fuelwood is increasingly scarce in Botswana and therefore more and more difficult to collect free of charge and this and the greater convenience of using gas may have contributed to the switch towards gas.

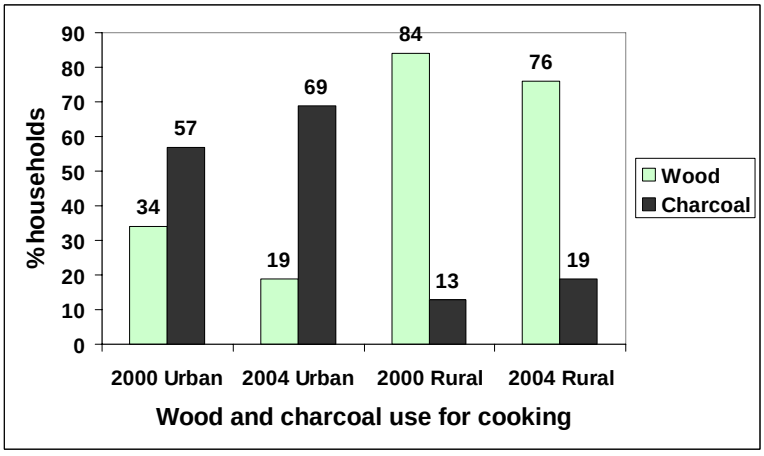
Figure 7.5: Transition from fuelwood to gas for cooking in rural and urban Botswana



Transition to charcoal in Ghana

7.21 In Ghana households switched from fuelwood to charcoal for cooking (Figure 7.6). Gas was not widely used and only 9% households used gas for cooking. In urban areas the transition to charcoal was much more pronounced than in rural areas and in 2004 69% of urban households used charcoal as compared to only 19% of rural households. Higher urban incomes make charcoal more affordable in urban areas. As the use of charcoal increased the use of fuelwood declined (Figure 7.6).

Figure 7.6: Transition from fuelwood to charcoal in Ghana

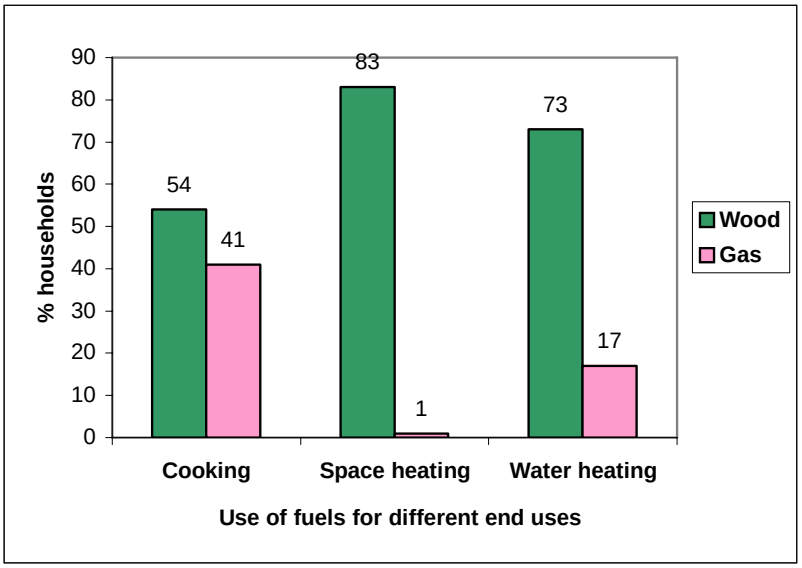


Fuel switching patterns

7.22 In the 2004 Botswana survey (Table 5.2) fuelwood had remained the most preferred fuel for water heating (60%) as compared to 25% of households heating water with gas. In Honduras there was practically no difference between the proportion of households using fuelwood for cooking (59.1%) and for water heating (59.4%). The high cost of electricity and gas prevented more households and particularly the poorer ones switching to these convenient fuels for water heating.

7.23 Households switched from fuelwood to a new more efficient fuel in two different ways. They either switched partially that is they switched for one end use but retained the traditional fuel for other end uses or they switched to the new fuel for all or almost all end uses. Figure 7.7 shows partial switching for rural Botswana. 41% households use the new fuel in this case gas for cooking but hardly for space heating (1%). A higher proportion of households (17%) have started to use gas for water heating.

Figure 7.7: Proportion of households using fuelwood and gas for cooking, space heating and water heating in rural Botswana



7.24 In Ghana the switch from fuelwood to charcoal for all end uses was different and almost the same proportion of households use charcoal for cooking and water heating (Table 5.2). Households appeared to make a complete switch from one fuel to another.

Multiple fuel use

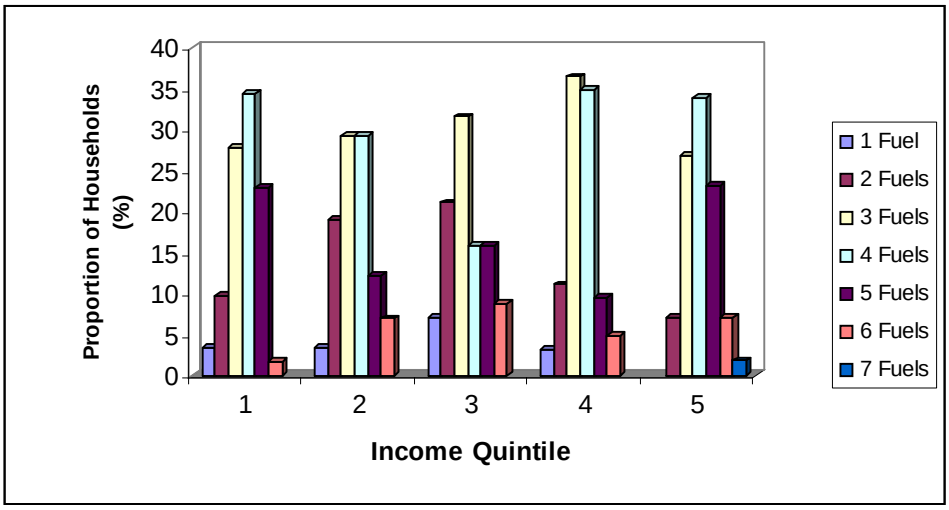
7.25 Multiple fuel use is complex and not easy to analyse because households are multiple fuel users for different reasons. In some cases households are permanent multiple fuel users and they use different fuels for different end uses such as electricity

for lighting, gas for cooking and fuelwood for water heating. In other cases households switch from one fuel to another – such as from gas to fuelwood or gas to kerosene, which can be bought in small quantities when financial resources are low.

Income levels and the number of fuels used

7.26 Cross-tabulating the pattern of multiple fuel use with income quintiles in Ghana (Figure 7.8) showed that households of all income groups were multiple fuel users. They used three to four fuels generally and only very few households used only one to two fuels or five to six fuels. In Ghana income did not appear to influence the number of fuels used.

Figure 7.8: Household income levels and multiple use of fuels in Ghana



Expenditure and payment patterns

7.27 When households have little or only irregular income they can buy fuels only in small quantities – often just enough to cook one meal. Under these circumstances the choice of fuel is influenced by the smallest amount sold, such as a few pieces of fuelwood or half a litre or less of kerosene. Charcoal purchases in Ghana demonstrated this fact very well. 92% of households using charcoal purchased 1kg or less of charcoal at a time and up to 68% of households purchased a maximum of 300g of charcoal at a time – an amount estimated to cook one meal.

7.28 Availability of credit also influences household choice of the shop where the fuel is bought. These are usually small neighbourhood shops and they do not stock all fuels and in this way the credit availability limits the choice of fuels. Even if the fuel is more expensive than in a shop without credit facility such as a supermarket or petrol station, poor households will buy in credit-granting shops.

Prepayment of electricity

7.29 The national utility supplies electricity to the majority of customers in all the four countries and customers are billed for the amount shown on their meters, generally at the end of the month after they have used the electricity. In some countries, such as South Africa and to some extent Botswana, a prepayment system was successfully introduced: customers buy an electricity token or a card and pay before they use the electricity. In Botswana 15% of rural household pre-bought electricity at vending machines and in Senegal prepayment meters are being tested at the moment. The initial incentive for the utility to install prepayment systems was to improve revenue collection. The prepayment service was not extended to large customers requiring capacity of more than 60A three-phase.

7.30 In Botswana the prepayment system has advantages for customers. The cost of installation is free; customers buy electricity only when they have money and they cannot get into debt; customers are not disconnected for non-payment and they do not have to pay or wait for reconnection. The quality of power provided is good and customers are in general more satisfied with the utility. For poor customers the prepayment system means they are in better control of their electricity expenditure.

7.31 For the utility there are obvious advantages in providing the prepayment service. The cost of meter reading and billing is reduced, particularly in a large and sparsely populated country like Botswana. Also, the loss of electricity due to pilfering and fraud is reduced; the revenue collection is improved. The installation of prepayment meters is easy. In the short-to-medium term the introduction of the prepayment metering system is a financial burden on the utility. At the moment the utility pays all cost of procuring and installing prepayment meters. Some form of cost sharing between the utility and the customer would reduce the financial burden.

Impact of fuel use patterns on health

7.32 This section explores the effect of fuel choice and fuel use pattern on health.

Fuelwood

7.33 In poor households fireplaces generally have no chimney, and long exposure to indoor air pollution from wood fires leads to respiratory and other diseases. Questions on health did not reveal any complaints consistent with effects of inhaling wood fumes. From experience elsewhere we believe that specialised health questionnaires have to be used to find out the incidence of respiratory and other diseases related to inhaling fumes from cooking fires.

7.34 The questionnaire included a question on the location and type of wood fireplaces, giving an indication of the exposure rate of household members doing the cooking. Results for households using firewood appliances in Honduras are presented in Table 7.2. For the lowest income fifth, 63% of households used an inside fireplace, and 40% had a fireplace outside the house. For the highest income fifth, 63% had an outside fireplace,

whereas 37% had an inside fireplace. The proportion of households with an inside fireplace decreased from the lowest to the highest income quintile and the inverse was true for the outside fireplace. Members of low-income households were shown to be more exposed to indoor air pollution from cooking stoves than the higher income groups.

Table 7.2: Type of fireplace, by household income quintile in Honduras

	Q1(low)		**Q2**		**Q3**		**Q4**		**Q5(high)**		**Total**	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	%
Outside fireplace	19	39.6	20	45.8	22	45.8	30	68.2	12	63.2	103	50.0
Inside fireplace	30	62.5	27	57.4	24	50	14	31.8	7	36.8	102	49.5
Special woodstove	1	2.1	0	0	2	4.2	0	0	0	0	3	1.5
Total	48	100	47	100	48	100	44	100	19	100	208	100

7.35 In Senegal (Table 7.3) and Ghana (Table 7.4) there was not such an obvious pattern of fuelwood appliances (Table 7.3). Most households have a fireplace outside rather than inside the house. There was no obvious difference between the proportion of fireplaces in the different income groups. In Botswana wood stoves are rarely used.

Table 7.3: Type of fireplace by household income quintile in Senegal

	Q1(low)		Q2		Q3		Q4		Q5(high)		Total	
	n	%	n	%	n	%	n	%	n	%	n	%
Outside fireplace	23	88.5	17	89.5	30	100	36	81.8	31	91.2	137	89.5
Inside fireplace	2	7.7	2	10.5	0	0	1	2.3	0	0	5	3.3
Special woodstove	1	3.8	0	0	0	0	7	15.9	3	8.8	11	7.2
Total	26	100	19	100	30	100	44	100	34	100	153	100

Table 7.4: Type of fireplace by household income quintile in Ghana

	Q1(low)		Q2		Q3		Q4		Q5(high)		Total	
	n	%	n	%	n	%	n	%	n	%	n	%
Outside fireplace	29	61.7	25	64.1	13	46.4	13	61.9	12	6.0	92	59.4
Inside fireplace	10	21.3	8	20.5	8	28.6	5	23.8	7	35.0	38	24.5
Special wood stove	8	17.0	6	15.4	7	25.0	3	14.3	1	5.0	25	16.1
Total	47	100	39	100	28	100	21	100	20	100	155	100

Kerosene

7.36 Burning kerosene for cooking or lighting impacts on indoor air quality, and constant exposure to fumes from kerosene burning affects the health of women and children – who are most exposed to it. In addition children get poisoned when they accidentally drink kerosene, which is often transported and stored in soft drink bottles. Also, disastrous fires occur frequently in densely populated up slum areas when kerosene stoves malfunction or topple over. Kerosene was, however, little used in the four countries of this survey and when it was used, as in the case of Honduras, it tended to be used in better off homes which were more widely spaced and with easier access to fire hydrants and fire engines. In Botswana, it was more widely used by the lower-income households.

8

Links Between the Supply and Use of Energy by Poor Households

8.1 In many countries governments are trying to make fuels for household use more easily available and affordable for the poor. In Botswana there are plans to beneficiate local coal and distribute it more widely. The butanization program in Senegal is a notably successful example of making gas for cooking widely available and affordable to households. Ghana has planned to extend electrification to all households by 2020. Honduras also aims at extending electricity to everyone.

Availability of fuels

8.2 When desirable fuels are not available or are difficult or expensive to get, households substitute more easily available fuels. The link between supply and use of fuels was investigated by asking households what fuels were available in their area and which of these they used at that time of the year.

8.3 For most fuels, in Botswana (Table 8.1), Ghana (Table 8.2), Senegal (Table 8.3) and Honduras (Table 8.4), the proportion of households responding that fuels were available was higher in both urban and rural areas than the proportion of households using that fuel. This indicates that fuels were generally available and non-availability was generally not the reason why households did not use a particular fuel. In Botswana (Table 8.1) the exceptions were anthracite and briquettes but only two households responded to the question on the availability of anthracite and one on the availability of briquettes, so that no valid conclusion could be drawn.

8.4 Electricity is in a different category because even if it was available in the area and some households were connected to it the respondent household may not have been able to afford the connection.

Table 8.1: Fuel availability in area and use by households for rural, urban and national localities in Botswana (EECG 2004b)

Fuel	Whether fuel is generally available in the area				Whether household uses the fuel at this time of the year			
	n	Rural %	Urban %	National %	n	Rural %	Urban %	National %
Anthracite	2	33.3	0	28.6	4	66.7	100	71.4
Briquettes	1	20.0	0	16.7	4	80	100	83.3
Car battery	158	85.4	81.7	84.1	27	14.6	18.3	15.9
Charcoal	142	81.6	93.3	85.6	32	18.4	6.7	14.4
Coal	82	95.3	98.4	96.6	4	4.7	1.6	3.4
Dry cell batteries	157	67.4	66.2	66.9	76	32.6	33.8	33.1
Electricity	193	80.4	75.6	78.7	191	19.6	24.4	21.3
Fuelwood	187	51.9	63.3	55.1	173	48.1	36.7	44.9
Gas	187	63.6	53.5	59.9	107	36.4	46.5	40.1
Kerosene	191	52.8	57.1	54.1	171	47.2	42.9	45.9
Other fuels	47	3.5	6.3	4.0	10	79.7	93.8	82.7

Table 8.2: Fuel availability in area and use by households for rural, urban and national localities in Ghana (KITE 2004)

Fuel	Whether fuel is generally available in the area				Whether household uses the fuel at this time of the year			
	N = 300	Rural %	Urban %	National %	N = 300	Rural %	Urban %	National %
Candles	245	70.8	87.6	81.6	78	17.8	30.6	26.0
Car battery	45	6.5	19.6	14.9	4	2.8	0.5	1.3
Charcoal	262	70.1	96.9	87.3	250	66.4	92.7	83.3
Dry cell batteries	267	90.7	88.1	89.0	172	65.4	52.8	57.3
Electricity	273	74.8	100	91.0	225	60.7	82.9	75.0
Fuelwood	238	89.7	73.6	79.3	129	86.0	34.7	53.0
Gas	69	6.5	33.0	23.0	43	6.5	18.7	14.3
Generator	39	3.8	17.4	13.0	1	0	0.5	0.3
Kerosene	292	95.3	98.4	97.3	261	91.6	84.5	87.0
Other fuels (crop residue	4	-	3.7	1.4	4	0	3.7	1.3

8.5 For comparison, the same information is given for Senegal in Table 8.3. Three fuels –candles, charcoal and gas – were 100% available. Candles were used by 94% of households, charcoal by 93% and gas by 86%. The survey was held in the cool season and at that time households heated their homes with charcoal (to which incense is customarily added). Gas was the widely used cooking fuel because it is subsidized. Coal is not marketed and therefore not used at all.

Table 8.3: Fuel availability in area and use by households for rural, urban and national localities in Senegal

Fuel	Whether fuel is generally available in the area				Whether household uses the fuel at this time of the year			
	n	Rural %	Urban %	National %	n	Rural %	Urban %	National %
Candles	300	98.9	100	100	283	83.5	99.0	94.3
Car battery	255	81.3	86.6	85.0	5	2.2	1.4	1.7
Charcoal	300	99	100	100	280	81.3	98.6	93.3
Coal	0	0	0	0	0	0	0	0
Dry cell batteries	7	2.2	2.4	2.3	7	2.2	2.4	2.3
Electricity	211	38.5	84.2	61.3	176	10.6	68.8	58.6
Fuelwood	288	96.7	95.7	96.0	162	59.3	51.7	54.0
Gas	300	99.0	100	100	258	67.0	94.3	86.0
Generator	12	11.0	1.0	4.0	12	11.0	1.0	4.0
Kerosene	287	94.5	96.2	95.7	97	44.0	27.3	32.3
Other fuels (crop residue	220	69.2	75.1	73.3	1	1.1	0	0.3

8.6 In Honduras when asked the reasons for the choice of fuel for cooking 50 % of respondents indicated that affordability had determined their choice and only 18 % indicated that they used the fuel because it was easily available.

Table 8.4: Fuel availability in area and use by households for rural, urban and national localities in Honduras (%)

Fuel	Whether fuel is generally available in the area				Whether household uses the fuel at this time of the year			
	n	Rural %	Urban %	National %	n	Rural %	Urban %	National %
Candles	301	96.9	100	99.0	-	-	-	-
Electricity	274	83.6	93.7	91.2	-	-	-	-
Fuelwood	301	100	74.1	82.4	-	-	-	-
Gas	301	30.2	55.6	47.5	-	-	-	-
Kerosene	303	83.3	86.5	85.5	-	-	-	-

8.7 Households were also asked why they did not have an electricity connection. The major barriers to acquiring an electricity connection in Botswana were stated as cost of appliances, cost of connection and monthly bills (Table 8.5). Three times more households (25%) indicate the cost of connection rather than the monthly bill (8%) to be too expensive for them. This opinion of households is borne out by the increase of connections made in 1996 and 2000 (Fig 8.1).

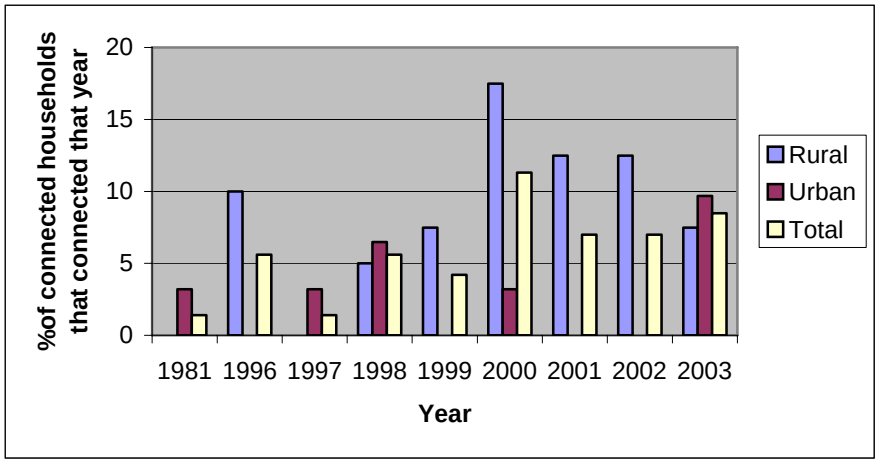
Table 8.5 Reasons why households do not have electricity connection in rural and urban areas of Botswana, Ghana, Senegal and Honduras (%)

Reason	Botswana			Ghana			Senegal			Honduras		
	Urb	Rur	Nat	Urb	Rur	Nat	Urb	Rur	Nat	Urb	Rur	Nat
Connection fee/ deposit too expensive	33.9	21.7	25.4	26.5	21.4	25.0	68.2	80.6	74.4	46.2	40.0	43.5
Monthly bills too expensive	5.1	9.4	8.1	26.5	35.7	29.2	9.4	12.9	11.1	7.7	0	4.3
Connection fee/ deposit and monthly bills too expensive	23.7	32.6	29.9	17.6	0	12.5	20.7	5.7	13.2	23.1	0	13.0
Household cannot afford appliances	33.9	36.2	35.5	0	7.1	2.1	.4	.2	.3	7.7	30.0	17.4
Household does not like electricity	3.4	0	1.0	0	0	0	1.3	.7	1.0	0	0	0

8.8 In 1996 the deposit and repayments for the Rural Collective Scheme changed from 40% to 10% with a repayment period of 10 years. In 1999, after the evaluation of the Scheme, the deposit was dropped further to 5% with a repayment period of 15 years and most villages qualified for uniform connection fee (standard costing). The connections were still substantial after 2000 but declining. The graph (Figure 8.1) suggests that the reforms of the Scheme had a direct positive impact on the rate of rural

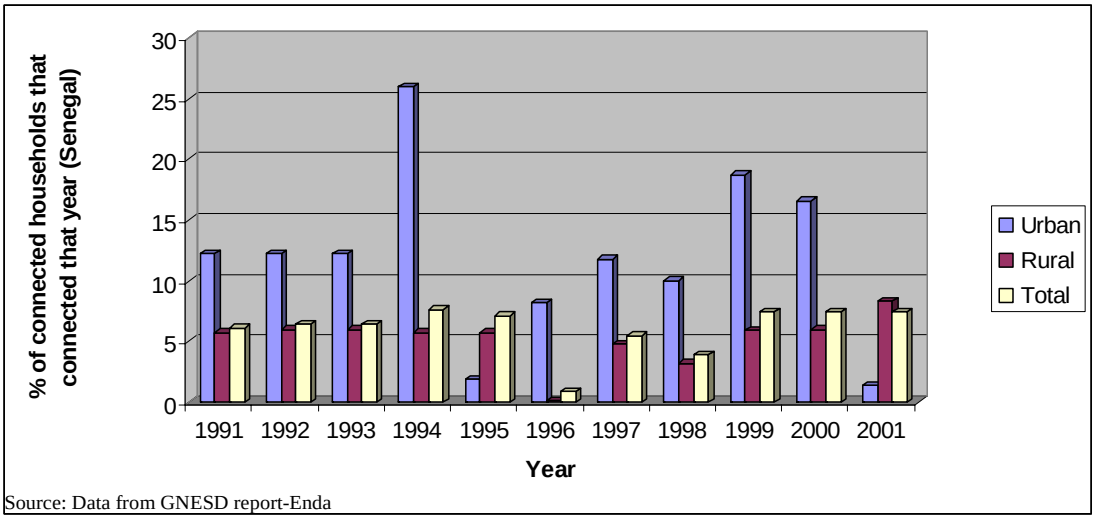
household connections. The reactions to the payment modalities are much more pronounced in rural areas than in urban localities. The reforms targeted rural customers and urban areas did not benefit.

Figure 8.1: Rate of household connections by year for rural and urban households in Botswana (EECG 2004b)



8.9 There was no steep increase in the rate of rural electricity connections in Senegal (Figure 8.2) but urban connection rates increased by about 12% in 1994 and to some degree in 1999 and 2000. The 1994 increase in connections was due to an agreement between government and the utility to increase connections. The 1999/2000 increases coincided with elections in 1999.

Figure 8.2: Rate of household connections by year for rural and urban households in Senegal



Source: Data from GNESD report-Enda

8.10 It appears that cost of fuels and in the case of electricity cost of connection influences the choice of fuels much more than availability in the area where the household resides.

First, second and third fuel choice for the same end uses

8.11 A different way of looking at the same problem was behind asking households what they use as their second and third fuels when they did not have their preferred fuel. The reason why they do not have their preferred fuel was not asked but can be inferred from other questions. It may be that the preferred fuel was not available at the shop at the time or the household was not able to purchase it for temporary financial constraints or in the case of electricity there was a power failure.

8.12 For Botswana (Table 8.6) it was found that the second and third fuels are generally those that households used before they had access to the more efficient fuels. Candles substituted for electricity for lighting and fuelwood was the most common second and third fuel for cooking.

Links between supply and use of energy

8.13 Fuelwood use decreased in all four countries. This may be due to a number of factors; fuelwood is getting scarcer and therefore women and children take longer time to gather wood or modern fuels have become available and more affordable. Governments are also trying to improve fuelwood supply by including communities in the management of fuelwood resources but it is doubtful whether these attempts have so far led to improved fuelwood availability for poor households.

8.14 In Botswana 77 % of rural households used fuelwood for cooking in 2001 (Table 5.2) and this proportion declined to 54 % in 2004. At the same time the use of gas for cooking in rural households increased from 17 % to 41 % obviously replacing fuelwood. In Ghana the use of fuelwood for cooking decreased from 63 % in 2000 to 39 % in 2004 (Table 5.2). In Ghana charcoal replaced fuelwood and the use of charcoal for cooking increased in both rural and urban areas and nationally it increased from 31 % to 51 %. The availability of wood resources is apparently not the deciding factor in Ghana because the production of charcoal requires substantial amounts of wood. Household obviously desired and bought a more efficient and convenient fuel for cooking.

8.15 Kerosene use did not show any obvious trends or patterns. It is widely available in all four countries and it was generally regarded as the lighting fuel of the poor. In Botswana where it is not subsidized kerosene for lighting increased from 6 % in 2001 to 57 % in 2004. In Ghana 25 % of households use kerosene for lighting and most households (59 %) use electricity for lighting. Kerosene prices doubled when petroleum prices were liberalised as part of the reforms. Kerosene is hardly used in Senegal. In Honduras kerosene for lighting decreased from 22 % in 2002 to 13 % in 2005. Kerosene was replaced by electricity when households got connected to the grid and electricity used for lighting increased from 64% in 2002 to 82 % in 2005 (Table 5.2). Only in

Botswana (7 %) and Honduras (6 %) was kerosene used for cooking (Table 5.2). In Botswana it was mainly used by the urban poor (Table 7.1) and in Honduras it was used by the better-off urban households.

8.16 LPG use was increasing generally and this was apparently due to government programs and subsidies and aggressive marketing by the gas distribution companies in a liberalised market. In Botswana gas had become widely available and only one rural community (Khudumelopye) experienced barriers to the use of gas. Gas is sold in four cylinder sizes (9kg, 14kg, 19kg and 48 kg). The most households (44%) bought 19kg cylinders and 30 % of households bought 48 kg cylinders. This is consistent with the fact that gas is more commonly used by well-to-do household – 71 % of the highest income quintile- than by the poor – 23 % of the lowest income quintile. In Ghana the market was liberalised but LPG use was quite low. It had increased from 4 % in 2000 to 9 % in 2004. In Senegal when gas was heavily subsidized it became quickly widely available in all parts of the country. Although 80 % of the subsidy was gradually withdrawn by 2001 gas remained the most common cooking fuel and 92 % of households used it for cooking in 2004. A 20 % subsidy is retained on the 6 kg and 2.7 kg gas cylinders making the fuel affordable for the poor.

Table 8.6: End uses of first, second and third fuel by locality in Botswana (EECG 2004b)

	Lighting								
	Rural	Urban	National	Rural	Urban	National	Rural	Urban	National
Fuel Type	Principal Lighting Fuel			Second fuel used for lighting			Third fuel used for lighting		
Electricity	26.4	37.4	30.9	3.6	5.3	4.3	8.6	0	**8.6**
Candles	12.4	12.1	12.3	72.2	76	73.4	34.3	60	**39.4**
Kerosene (paraffin)	59.2	50.5	56.6	22.5	18.7	21.5	20	0	**20.0**
Gas	0	0		1.2	0	1.2	8.6	0	**8.6**
Wood	1.5	0	1.5	0.6	0	0.6	22.9	20	**22.6**
Dung / Crop residues	0	0	0.0	0	0	0.0	5.7	20	**10.5**
Coal	0.5	0	0.5	0	0	0.0	0	0	**0.0**
Charcoal	0	0		0	0		0	0	**0.0**
Solar	0	0	0.0	0	0	0.0	0	0	**0.0**
	100	100	101.9	100	100	101.0	100		100
	Cooking								
	Rural	Urban		Rural	Urban		Rural	Urban	
Fuel Type	Principal Cooking Fuel			Second fuel used for cooking			Third fuel used for cooking		
Electricity	1	3	2.2	6.3	8.6	7.2	4.5	0	4.5
Candles	0	0	0.0	0	3.4	3.4	4.5	0	4.5
Kerosene (paraffin)	4.5	13.1	9.6	23.6	32.8	27.2	18.2	18.2	18.2
Gas	40.5	70.7	54.5	18.9	12.1	17.4	9.1	9.1	9.1
Wood	53.5	13.1	49.1	44.9	41.4	43.9	31.8	45.5	37.5
Dung / Crop residues	0	0	0.0	6.3	0	6.3	22.7	27.3	24.4
Coal	0	0	0.0	0	1.7	1.7	0	0	0.0
Charcoal	0	0	0.0	0	0	0.0	4.5	0	4.5
Solar	0.5	0	0.5	0	0	0.0	4.5	0	4.5
	100	100	115.9	100	100	107.0	100		100
	Rural	Urban		Rural	Urban		Rural	Urban	
Fuel Type	Principal water heating fuel			Second fuel used for water heating			Third fuel used for water heating		
Electricity	7	15.2	11.2	3.7	5.9	4.6	9.5	0	9.5
Candles	0	13.1	0.0	0	0	0.0	0	0	0.0
Kerosene (paraffin)	3	41.4	29.3	23.4	31.4	26.5	23.8	33.3	27.4
Gas	16.9	30.3	24.2	43	37.3	41.3	23.8	11.1	21.7
Wood	72.6	0	60.2	23.4	21.6	22.9	14.3	33.3	23.8
Dung / Crop residues	0	0	0.0	5.6	2	5.1	23.8	22.2	23.3
Coal	0	0	0.0	0	0	0.0	4.8	0	4.8
Charcoal	0.5	0	0.5	0	0	0.0	0	0	0.0
Solar	0	0	0.0	0.9	2	1.5	0	0	0.0
	100	100	125.5	100	100		100		110
	Rural	Urban		Rural	Urban		Rural	Urban	
Fuel Type	Principal ironing fuel			Second fuel used for ironing			Third fuel used for ironing		
Electricity	13.6	30.3	**22.4**	8.8	7.7	8.5	8.3	0	**8.3**
Candles	0.5	0	**0.5**	0	2.6	0.0	0	0	**0.0**
Kerosene (paraffin)	2	12.1	**9.6**	21.3	33.3	26.5	16.7	40	**24.5**
Gas	14.6	31.3	**23.2**	36.3	25.6	33.6	33.3	0	**33.3**
Wood	64.3	25.3	**57.9**	23.8	25.6	24.4	29.2	40	**31.6**
Dung / Crop residues	0	0	**0.0**	5	0	5.0	4.2	0	**4.2**
Coal	0	0	**0.0**	0	0	0.0	4.2	0	**4.2**
Charcoal	5	1	**4.6**	5	5.1	5.0	4.2	20	**12.1**
Solar	0	0	**0.0**	0	0	0.0	0	0	**0.0**
	100	100	**0.0**	100	100		100.1		100

9

What works for the poor? Differences and similarities between countries

9.1 It is difficult to detect the impact of high-level power sector reform on poor households. The poor household is far removed from high-level decision making and the chain along which potential benefits are supposed to trickle down to the poor is long and depends on many institutions which often have insufficient capacity. It is doubtful that any such reforms have a selective positive impact on the poor. If a sector, by implementing reforms, becomes more efficiently organized, administered and governed it will benefit the whole country, including the poor.

9.2 Reforms in the energy sector will impact on poor households in any of the following ways: price of energy service, access to energy services, quality of supply and service provision, improvement in social services such as health and education, stimulation of economic development and public sector finances (Davies et al, 2003). Reforms that are to assist the poor must be located as close as possible to where the poor household needs the service.

9.3 The poor often do not know enough about the project from which they are supposed to benefit and generally do not have sufficient political voice to effectively demand the services due to them. Information and education about energy programs must be clearly and repeatedly communicated to the target communities and households well before the program starts. Community participation is essential so that the program is supported by the community. This is particularly important in large and capital-intensive projects, such as electrification, in which theft in various forms can undermine the project. The community must become the guardian and proud owner of its electrification program.

9.4 At the household level, members of the household need to be fully informed about the opportunities, limitations, obligations and payment requirements of their new energy source. False expectations have meant that many household which participated in well intentioned energy projects have been left disappointed.

What works for the poor?

Rural electrification in Botswana

9.5 Low-level reforms and changes, which focus directly on the conditions of the poor, were most effective in increasing access to electricity without requiring subsidies. In Botswana the implementation of the Rural Collective Scheme and Standard Costing was monitored and the period of repayment was extended twice until the poorer households could afford the smaller monthly payments over a longer period of time, and household connections to the grid increased substantially in the year 2000. All energy promotions need thorough information and education campaigns so that households fully understand the implications and payment requirements.

Electricity for lighting, media and limited appliance use

9.6 In all the four countries in this study electricity was used for lighting, media and limited appliance use. Using electricity for lighting is a definite improvement in living conditions. Household members appreciate the bright light for reading. Housework and income generating activities can be done after nightfall. Shop owners and small businesses can open for longer hours. Refrigeration preserves food for longer time and makes shops more attractive.

9.7 Electricity makes access to media much easier and cheaper than the use of car batteries. The high proportion of TV owners indicates that access to media is highly valued by households of all income groups.

9.8 In Ghana and Senegal less than one percent and in Botswana less than five percent used electricity for cooking. Only in Honduras did a larger proportion of households (21%) cook with electricity. Electricity is not the cooking fuel of choice because the tariffs are too high and other cooking fuels have been promoted (in one case subsidized). Gas is used in Botswana and Senegal and charcoal in Ghana. Fuelwood has remained the most common cooking fuel in Honduras. There is an obvious need to promote modern cooking fuels other than electricity, and gas appeared to be affordable and acceptable.

LPG for cooking

9.9 Senegal promoted gas for cooking very successfully by subsidising the gas and small gas stoves. When 80% of the subsidy was removed over a period of four years few households reverted to fuelwood and over 90% continued to cook with gas. The subsidy had the effect of introducing a new cooking fuel quite rapidly to all parts of the country. With a suitable exit strategy for the subsidy the uptake of new cooking fuels could be successfully promoted and the subsidy could be weighed against environmental gains in reducing deforestation by commercial wood harvesting and charcoal production.

9.10 In Botswana the proportion of households using gas for cooking has increased by 10% in the last three years and in 2004 51% of households used gas for cooking. Gas is

not subsidized in any form by government. Many households used gas before they were connected to the grid and once they got the electricity connection they continued to use it because they had the appropriate appliances and the gas cylinder. Gas had also been very strongly promoted by gas marketing companies.

Other strategies

9.11 There are other strategies to improve access to cooking fuels for the poor. Fuelwood is, and will remain for some time, the dominant cooking fuel in many poor countries in Africa. Reforms in the forestry sector are required to better manage forest and woodland resources to benefit communities living in forest and woodland areas.

9.12 The dissemination of efficient and smokeless stoves should continue and should be made a priority program in all areas where households use biomass or coal.

Changes and reforms specifically targeted at the poor

9.13 When changes are adjusted to the payment capacity of the poor, they are able to access modern energy. The rural electrification in Botswana evolved over several years until it became successful. Adjustment were made and monitored and evaluated several times. Only when the payment for the connections were spread over longer periods so as to make the monthly payment amount small enough to be affordable for the poor did connection rates increase rapidly.

9.14 The poor are often excluded from normal credit facilities because they have no collateral and uncertain or irregular income. In instances where these credit conditions were lowered or waved poor households did access modern energy and appliances. In Southern Africa furniture and appliance shops have credit and lay-by systems, which enable many poor households to acquire appliances. Repayment rates are relatively small and are spread over a long time period. The consumer is apparently willing to pay the cost. The ‘easy term’ credit offered by cell phone marketing companies is another example of affordable credit for the poor.

Development expenditure or subsidy?

9.15 When the electric grid was extended further into villages in Botswana under the Standard Costing scheme, the question arose as to whether this is a subsidy or development expenditure. What conditions and expectations make such grid extensions development expenditure? Can tariff subsidies for the poor be considered development expenditure assuming that the poor, if given some assistance, will work their way out of poverty? These questions are beyond the scope of this project and should be taken up in another context.

10

Conclusion

Methods and mode of cooperation

10.1 This project relied on cooperating partners who did not meet face-to-face in the context of the project. Considering that almost all communication was through mail (predominantly email) this was a challenge, which the partners faced extremely well in all phases of the project. However it might have been advantageous if all partners would have met twice. The first meeting would have served to finalise the questionnaire in order to accommodate better the cultural and developmental differences of the four countries. The second meeting would have served to deepen the analysis of data and to enhance capacity building in that area.

Energy sector reforms

10.2 The energy sector in all four countries underwent reforms and changes in the last 15 years although the type of reform and change varied greatly from country to country. One outcome of the reform process was that all the four countries have introduced cost recovery in the energy sector particularly the electricity sector. Some countries such as Botswana have fully achieved cost recovery while others were working towards it. Government subsidies to utilities have been reduced or completely eliminated. If subsidies were paid they were targeted and had specific objectives such as reducing tariffs for low-consumption customers who were generally poor.

10.3 Electricity connection rates have increased in all countries and more in some than in others. Honduras has achieved the highest coverage rate (75%) and Botswana the country with the highest GDP the lowest (28%). Botswana is a large country with a small population living in widely dispersed villages. Extending the electric grid requires large capital investment and servicing it is not very cost effective. Solar systems have been tried in some remote locations.

Rural electrification

10.4 The majority of poor in Africa live in rural areas. Access to infrastructure services in rural areas lag far behind these services in urban areas although most countries are making efforts to provide at least clean water and education. In 1996, rural electrification

in Botswana covered only 4% of the rural population, 5% in Senegal in 1997 and 17% in Ghana in 2000. In Senegal that was ten times less than the coverage in urban areas. In the last ten years rural electrification was administratively and financially separated, and received dedicated projects and funding. As a result rural coverage increased faster than urban coverage but it is still relatively low (Table 6.2). Botswana implemented the most successful rural electrification program and household uptake of electricity increased from 4% in 1996 to 20% in 2003. Rural electrification was supported by funding and the projects were regularly monitored, evaluated and adjusted until a large part of the targeted population could afford the electricity connection to their homes. The utility extended the electricity line into the village and then households had to pay for the line to their houses. Households located near to each other were to form groups of four or more and apply for connection so as to reduce connection cost. The initial down payment was 5% of the total connection cost and was to be paid before connection work started. The balance of 95% was payable over 18, 60 or 180 months depending on the customers' preference. Government insisted on full cost recovery to sustain the rural electrification program. Access to electricity increased five-fold in the years 1996 to 2003 for rural households. 80% of the rural beneficiaries could not have connected to the grid without the program.

10.5 However there is a need for further policy review because a significant proportion of poor households in Botswana cannot still afford monthly payments due to no, low and irregular income. A number of very poor beneficiaries defaulted on repayment of the connection fee affecting the sustainability of the rural electrification program.

10.6 Ghana, Senegal and Honduras have all strengthened their rural electrification program. The large capital investment was the major obstacle compounded by the fact that rural households used very little electricity and the revenue from their consumption did not cover service fees.

Survey information on household fuel use, expenditure and appliances

Comparison of survey data

10.7 One of the objectives of the project was to find out in how far data from earlier surveys can be compared to this survey and yield valid information. All the four countries had some earlier data. They were more complete in Botswana and Ghana than in Senegal and Honduras. Since questions asked were not always the same and they were not asked in the same context, interpretation should be done with caution and differences should be considered as trends and not absolute values. The following trends could be identified:

- Fewer households are using fuelwood for cooking
- Households are making a transition to more efficient cooking fuels such as gas, kerosene and charcoal
- More households accept the change to more modern fuels when the modern fuel is subsidized such as gas for cooking in Senegal

- Electricity use for lighting has increased but electricity is not used for cooking except in Honduras where 21 % of households cook with electricity.

Intercountry similarities and differences

10.8 One of the most striking features of the present survey were the differences and similarities between the countries:

- the use of different cooking fuels in each country;
- the almost exclusive use of electricity for lighting, media and some appliances;
- the consistent multiple fuel use through all income groups; and
- the gradual emergence of gas as cooking fuel.

Fuels for lighting

Electricity was the most common lighting fuel for Ghana, Senegal and Honduras. Only in Botswana was kerosene the most common lighting fuel (57%) and this was due to the relatively low electrification rate. 25% of households used kerosene in Ghana, 13% in Honduras and hardly any households used it in Senegal. Kerosene was more widely used in rural than in urban areas and this was apparently related to the lower electrification rates in rural areas.

Fuels for cooking and water heating

10.9 In Botswana the most common cooking fuel nationally was gas and 51% of households used it. Its use had increased since the 2001 survey when fuelwood was still the most common cooking fuel. For rural households fuelwood was still the most used cooking fuel in 2004 although the proportion of households using it had decreased by 24% and the use of gas had increased by 24%. The switch to modern fuels such as gas for water heating was much slower, and 60% of households still heat water with fuelwood and only 25% use gas.

10.10 In Senegal, more than 85% of households cooked with gas, as a result of a very successful and subsidized promotion of gas and gas stoves.

10.11 In Honduras, fuelwood was still the dominant fuel for cooking (59%) and water heating (60%). The second fuel for cooking was electricity (21%). Honduras was the only country in which a substantial proportion of households use electricity for cooking. In the other three countries the proportion of households cooking with electricity was 2% and less.

Household fuel expenditure

10.12 Households in the four countries spent from 5% to 24% of their monthly income on fuel. In Botswana households spent more of their income (24%) on fuel than in any other of the three and by far the highest proportion was spent on electricity. The energy proportion of income in Ghana was relatively low (5%). In all four countries rural

households spent a slightly greater proportion of their income on fuel than urban households. In absolute terms urban households (with the exception of Ghana) spent more money on modern energy such as electricity, gas and kerosene, while rural households spent more on the traditional fuelwood.

10.13 Although electricity was mostly used for lighting, media and some appliances and not for cooking households spent on average two to four times more on electricity than on any other fuel. In Botswana household expenditure on electricity was unusually high. Urban households spent US$92, which was about ten times more than urban households in Ghana.

Appliances

10.14 The ownership of appliances was analyzed in some detail because the cost of appliances might have influenced the choice of fuel and might have been a barrier to the uptake of fuels. Electrical, gas, kerosene and fuelwood appliances were investigated. The most frequently owned electrical appliances in the four countries were irons, color TVs, fridge/freezers, radios and electric fans. The order of priority varied from country to country. Only a relatively small proportion of households owned electric stoves and this appliance was not among the first five most frequently owned appliances.

10.15 Cross-tabulating appliance ownership by income quintile showed that appliance ownership was not necessarily a barrier to fuel use. In Botswana a higher proportion of households in the middle income quintile (38%) and the poorest quintile (25%) owned electric stoves (Table 5.10). Only 11.8% of the highest income group owned electric stoves. Obviously the high cost was not a barrier to acquiring an electric stove in Botswana.

10.16 It is most likely that poor households in some countries such as Botswana had access to easy credit such as hire purchase or a lay-by system under which the poor are enabled to own relatively expensive appliances.

10.17 Cell phone ownership measured by the ownership of cell phone chargers was relatively high and it is quite likely that the ‘easy terms’ of credit for cell phones made their ownership and use affordable for poorer and middle-income households although the poorest households were excluded from access to some forms of easy credit. The exception was Senegal where 39% of the poorest households owned a cell phone and this proportion was almost as high as any other quintile.

10.18 Lamps and lanterns were the most commonly used kerosene appliances and in all four countries they were more frequently owned by rural than by urban households reflecting the low electrification rates in rural areas. Only in Botswana and Senegal did some households own kerosene cook stoves and in Senegal 33% of households used kerosene fridges. Except for lighting kerosene appliances were not widely used.

10.19 Gas burners or stoves were the most common gas appliances. In Botswana and Honduras about 50% of households using gas owned the expensive stove with oven. The

inexpensive gas burners with an attached gas bottle were the most common gas appliances in Senegal.

Energy supply chains

10.20 Ghana, Senegal and Honduras generate most of their own electricity and Botswana imports 70% of its electricity mostly from South Africa. Botswana and Honduras have substantially expanded their electric grid in the last fifteen years. Ghana and Senegal did not extend their coverage very much in the last years and it seemed to be due to generation constraints. Honduras overcame the generation constraints by facilitating private investment in new generation and Botswana just imported more electricity to meet domestic demand.

10.21 The four countries imported all their crude oil and some of the refined products. Senegal and Ghana had a refinery producing kerosene and gas but additional kerosene and gas were also imported.

10.22 The reliability of electricity supply was estimated by asking households about the frequency and duration of power failures and brow-outs. In Senegal 53% of households experienced a power failure every day to several times a week. In Ghana 37% of households experienced power failure at the same frequency and in Botswana and Honduras it was only 11% to 12% suggesting a more reliable power supply in the two latter countries. Most power failures in the four countries lasted only a few hours but in Ghana 39% of households reported power failures lasting 1 to 3 days.

Patterns of energy use and expenditure

10.23 Income influenced the choice of fuel for cooking. Fuelwood was generally used by the poorer households. In Botswana, Ghana and Honduras the highest proportion of fuelwood users (67%–96%) was in the poorest 20% of households (Q1) and fuelwood use consistently decreased from the poorest 20% (Q1) to the richest 20% (Q5). Senegal was the exception and only 1.3% of all households used fuelwood. Households of all income groups had switched to gas, which they could afford because it was subsidized.

10.24 Only in Ghana was charcoal widely used for cooking and 51% of households cooked with it. 31% of the poorest quintile used it and this proportion rose to 62% for Q3 and remained at about that level for the highest two income groups (Q4and Q5).

10.25 Kerosene was widely used for lighting but was not common for cooking. There was no consistent pattern for kerosene use across the countries.

10.26 The proportion of households using gas for cooking varied from 9% in Ghana, 14% in Honduras 51% in Botswana and more than 85% in Senegal. In Botswana, Ghana and Honduras the proportion of households using gas increased from the lowest (Q1) to the highest income quintile (Q5). The exception was Senegal where gas use was uniformly high (86%-98%) through all income quintiles indicating that the subsidy benefited the poor as much as everybody else. The wide use of gas for cooking in

Botswana was due to effective marketing and the fact that in many areas gas was introduced before households got electricity and when electricity was installed they already had gas appliances and the gas cylinder and continued using them.

10.27 Electricity was hardly used for cooking in Botswana, Ghana and Senegal (less than 2% of household). In Honduras it was used by 21% of households, being obviously a fuel of the well-to-do, and the proportion of households using it rose from 2% in the lowest income group to 55% in the highest income group.

Preferred fuels

10.28 In all the four countries electricity was the preferred energy source for lighting, media and some appliances. Electricity was generally not used for cooking, water heating and space heating. When households got connected to electricity they continued to use cooking fuels they had used before electrification and just added electricity to their energy portfolio. Households remained multiple fuel users because they could not afford to pay for the electricity even if they would prefer to use electricity for cooking or switch on the geyser for water heating. Overall fuelwood remained the most used fuel for cooking and water heating. The trend of gas use is increasing and gas is gradually replacing fuelwood in the countries where it is not subsidized.

Multiple fuel use

10.29 Analysing multiple fuel use was complex because households were multiple fuel users for different reasons. It appeared that households in all four countries were multiple fuel users. It was found that in Ghana households of all income groups are multiple fuel users and the same pattern is expected in the three other countries.

Expenditure and payment patterns

10.30 When households have little or only irregular income they can buy fuels only in small quantities – often just enough to cook one meal. Under these circumstances the choice of fuel is influenced by the smallest amount sold, such as a few pieces of fuelwood or half a litre or less of kerosene. Availability of credit also influences household choice of the shop where the fuel is bought. These are usually small neighbourhood shops and they do not stock all fuels and in this way the credit availability limits the choice of fuels. Even if the fuel is more expensive than in a shop without credit facility such as a supermarket or petrol station, poor households will buy in credit-granting shops.

10.31 In Botswana 15% of rural households had prepayment meters and poor households are generally very satisfied with this mode of payment because they had better control over their electricity expenditure and could not get into debt with the utility. Senegal is trying out prepayment metering at present.

Availability of fuels

10.32 The availability of fuels was investigated by asking households which fuels were available in their area and which of these they used at that time of the year. The proportion of households responding that fuels were available was higher in both urban and rural areas than the proportion of households using that fuel indicating that unavailability of fuels was not the reason for not using particular fuels.

10.33 Electricity is in a different category because connection costs are high and even if the electricity line is in the area households may not be able to afford the connection. The Rural Collective Scheme in Botswana has shown that if the connection fee is adjusted to the capacity of the poor to pay – in this case the monthly repayment fee was lowered and the repayment time was extended up to 15 years – many more poor households were able to connect to electricity.

10.34 The increases in connections in Senegal in 1994 were due to higher subsidy from government and the 1999/2000 increases coincided with elections.

What works for the poor

10.35 It is difficult to detect the impact of high-level power sector reform on poor households. The poor household is far removed from high-level decision making and the chain along which potential benefits are supposed to trickle down to the poor is long and depends on many institutions which often have insufficient capacity. It is doubtful that any such reforms have a selective positive impact on the poor. If a sector, by implementing reforms, becomes more efficiently organized, administered and governed it will benefit the whole country, including the poor.

Rural electrification in Botswana

10.36 Low-level reform and changes which focus directly on the conditions of the poor were most effective in increasing access to electricity without paying subsidies. Regular monitoring and evaluation were necessary to find out whether the poor benefit or not. If necessary several adjustments have to be made which should also be monitored. The Rural Electrification Scheme in Botswana was a successful example of changes that benefit the poor and how such changes should be implemented and if necessary adapted to the conditions of the poor.

Electricity for lighting, media and limited appliance use

10.37 In all four countries of this study electricity was used only for lighting, media and some appliance use. It was generally not used for cooking. Electricity was too expensive and other cooking fuels such as gas had been effectively promoted. This division of particular fuels for specific purposes appeared to work for the households in the four countries making them multiple fuel users.

LPG for cooking

10.38 LPG was emerging as the cooking fuel of choice gradually replacing fuelwood. In some areas gas had been there before electricity and when they got electricity households just continued using gas because they had the appliances. Gas is distributed by private marketing companies and it is more aggressively marketed than electricity whose distribution is carried out by government-owned utilities.

Changes and reforms specifically targeted at the poor

10.39 When changes are adjusted to the payment capacity of the poor, they are able to access modern energy as the case of rural electrification in Botswana has shown. The poor are often excluded from normal credit facilities because they have no collateral and uncertain or irregular income. In instances where these credit conditions were lowered or waved poor households did access modern energy and appliances. In Southern Africa furniture and appliance shops have credit and lay-by systems, which enable many poor households to acquire appliances. The ‘easy term’ credit offered by cell phone marketing companies is another example of affordable credit for the poor.

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Appendices

Appendix 1

Matrix for Country Selection for Project on Energy Sector Reform and the Poor

Energy Reform Matrix:

Driving factor	***Progress/Impact***		
	Electricity	**LPG**	***etc***
Main motivation for reforms			
Attraction of private participation/ investment inflow			
Promotion of competition			
Improved quality/reliability of service			
Transparent regulatory system			
Widened access			
Tariff increase or decrease			
Adverse effect on the poor			
Improved financial health of the sector			
Removal of barriers inhibiting pace of reforms, especially tariffs below economic levels			
Public participation/ inclusion			
Energy efficiency benefits			
Renewable energy technology (RET) prospects & Environmental impacts			
Unbundling/restructuring – progress, status and plans of reform			

Household Energy Information Matrix

How current & frequent is the data?			
Extent of categorisation of data into socio-economic groups eg. income			
Energy expenditure & pricing information			
Energy consumption information			
Energy end-use information			
Rural/urban/peri-urban access			
Energy preferences			
Accessibility/level of aggregation of data			
Geographic coverage			

Impact of lifeline tariffs or subsidies			
Energy preferences/perceptions			
Extent of data spread over time of reforms			
Energy connection/access cost			
Appliance ownership & credit availability			

Appendix 2: Selecting and Describing the Interventions/Reforms

Guide for Cooperating Partners

In an introductory paragraph we state objectives of research, methodology, methods and procedures for the tasks expected from cooperating partners. This outline specifies:

1. What information we need
2. How best to go about obtaining this information
3. Who and from where they could obtain the information, i.e., interviews with key informants see below, national survey data, original HH interviews

(Can we find typologies/patterns or stages of intervention? What might the secrets of success be?)

Here are points to consider when identifying all kinds of the energy interventions/reforms undertaken in your country and their impact on the poor. Look at each link of the supply chain from generation to end user. The first part (A) is on the energy reform process and its impact the second part (B) concerns household surveys and their use of energy. Part B will be used to assess the impact on the poor.

ENERGY REFORM

Identify the energy intervention in the last 10-15 years
Information from focused interviews with key respondents (Managers of energy organizations, distributors, etc.)

What are the energy interventions in the last 10-15 years in your country?
E.g., privatisation of electricity generation and/or supply, electrification programs, liberalisation of gas (LPG) and/or kerosene markets but also such changes as the introduction of prepayment meters, introduction of poverty tariffs or subsidised fuels. Which of these had the most widespread and strong impact (negative or positive) on the poor?

Type of intervention/reform
Information from focused interviews with key respondents in government, e.g., energy minister.
Describe the policies relating to the interventions. Outline problem(s) to be addressed, objectives, activities, expected outcomes.

Legal situation
Ownership

Major motivation for intervention
Information from focused interviews with key respondents e.g., minister for public enterprise, finance etc.
Who are the major policy makers? Who initiated the reform, external pressures, a particular government party, utility?

Attraction of private capital/investment, promotion of competition, improved health of sector, improved efficiency of utility/company, improved quality and reliability of service, energy efficiency benefits, widened access, public participation/inclusion, improved, more efficient public

service corporations with public accountability; lower costs for consumers, cross-subsidies for the poor, environmental benefits.

Necessary steps before reform process

Information from focused interviews with key respondents e.g., national regulator, utility, and power producers.

Effective, transparent and independent regulatory system, removal of barriers inhibiting reform, e.g., sub-economic tariffs, subsidies, and public pressure against privatization.

What are the stages of reform?

Information from focused interviews with key respondents, e.g., cabinet ministers.

Type of unbundling or restructuring, e.g., corporitization, commercialisation, privatisation, IPPs, independent regional power suppliers and how they are arranged. For example, the nature of privatisation may differ from country to country and their impacts may also differ.

Which stages of reform have been partially or fully completed?

Policies, laws, directives passed by political authority, degree of implementation of policies, laws, directives by whom? Intensity of public discussion, debate, participation?

Impact of implemented or partially implemented reforms

Information from focused interviews with key respondents, e.g., labor organizations, consumer organisations, relevant NGOs.

Evaluate against initial objectives, impact on cost, prices, access and tariffs.
Impact on employment, consumer response.

Have there been any price changes? At which link in the supply chain has the price gone up or down? E.g., look at fuel price (including price of gas bottles), appliances and transport costs. Who bears the cost of change?

Renewable energy technologies (RET)

How far are renewable energy technologies part of the reform?

Prospects and environmental impact. Impacts of liberalisation on the participation of the private sector in servicing remote off-grid areas at reduced costs through RETs.
Who finances their development and monitoring?

What is the impact on the poor?

This question should be answered from the data collated or gathered under B.

B. HOUSEHOLD SURVEY INFORMATION

1. How could the social impact particularly on the poor be measured?

2. What surveys exist that contain questions relevant for measuring impact?

3. Are the surveys done before and a reasonable time after the intervention/reform?

3. Are the survey data available?

5. What type of analysis can be done with these survey data? (Compare with what has been done in the Guatemala study. Any other ideas?).

6. Can you measure the impact on the poor? How do you measure the impact on the poor? What criteria should we use? Income/expenditure, better access to energy, affordable use of energy, energy price change. Total energy cost for household? Changes in HH energy use?

7. Have the poor greater access to affordable energy sources than before the intervention? Has the distribution system been improved? Have poor household more energy choices? Are gas bottles, gas, kerosene and SHS available in remote areas? Have consumption rates increased? Has any business or income generating activity benefited from easier access and availability of energy sources?

8. How do you take care of other factors affecting the poor, e.g., increased employment or unemployment, HIV/AIDS epidemic, old-age or child support pensions?

9. What additional data need to be collected?

10. Does the HH energy questionnaire adequately gather information on the impact of the intervention? Which questions should be added, changed or dropped?

11. How do we determine the 'benefits' to HHs, which by definition live with multiple hardships and various survival strategies (multiple fuel use, large HHs, tight intergeneration support links). Who benefits most in HH? Women, children, the sick, the aged?

List of key informants

Government/energy ministry
Major power/energy producers, utilities
Distributors
National regulator
Labour organisations
NGOs in energy fields
Municipal, local government
Consumer organisations

Appendix 3: Household Fuel Use and Supply

Questionnaire 2003

Interview details

Name of interviewer……..

Date of interview …… Starting time ….....…….. Ending time ….....……..

Questionnaire number……

Cluster identification number……

Name of country: Senegal [1] Ghana [2] Botswana [3] Honduras [4]

Information on household obtained in advance

Surname of household……..

Site or house number ……..

Physical address……..

Section / sub village, locality name: ……..

Type of area / settlement

Urban informal planned [1] Urban informal unplanned [2] Peri – urban informal planned [3]
Peri-urban informal unplanned [4] Traditional (remote) rural village [5]
Rural settlement [9] Other (specify)……

Electricity meter number:……

Instructions to interviewer

Interviewers will have read the guidelines for interviewers and attended the briefing session, prior to the interview.

Interview a member of the household who knows most about the fuels used by the household for different purposes and has knowledge of household income from all sources and the expenses of the household.

Introduce yourself and explain that this study is part of a study being undertaken by a large international organisation in three African countries and Honduras. The study aims to better understand how households use different fuels, how easy or difficult it is for households to access various fuels according to where they live and their income resources. This is done so that government can design policies to make access and use of energy more useful to people like you. We will also be asking you a few questions on household income and expenses.

Please remember that all the information you give us is **confidential.** It will not be communicated to anyone outside the research team.

We would like you to answer the questions for your household as a whole not just for yourself.

SECTION A: HOUSEHOLD ROSTER

In this first set of questions, we will ask about your household and household members

A01 What is your first name?…….

TABLE 1: Members of Household

A02 First name *Write name of respondent in row a.*	**A03** Sex Male (1) Female (2)	**A04** Age at last birthday ?	**A05** What is the highest level of education she/he has completed? Choose from the list below: *No schooling [0]* *Literacy courses [1]* *Completed primary school [2]* *Some primary school [3]* *Completed secondary school [4]* *Some secondary school [5]* *Vocational (eg. Technical) [6]* *Some vocational [7]* *Completed Tertiary [8]* *Some tertiary [9]* *Other (specify)……*	**A06** What is her/his employment circumstances? Choose from the list below: *Employment fulltime [1]* *Employment part time [2]* *Employment casually (piece jobs) [3]* *Self-employed [4]* *Pensioner/retired [5]* *Disabled [6]* *Student (including school children) [7]* *Housewife/home maker [8]* *Unemployed [9]* *Unemployed, in training [10]* *Unemployed, looking for work [11]* *Preschool child [18]* *Other [19] (specify)……..*	**A07** Where does he/she live most of the time? Choose from the list below: *Always in this house [1]* *Same locality but in another house [2]* *Neighbouring town or village [3]* *Neighbouring city [4]* *Capital city [5]* *Provincial city [6]* *Another town/village [7]* *Boarding school in another town or village [8]* *Other (specify)* ……	**A08** In the last 12 months has any member of your household required treatment for an episode (s) of: *If No*, GOTO A10, *if Yes*, which of the following ones: *Asthma [1]* *Bronchitis [2]* *Pneumonia [3]* *Burns [4]* *Kerosene poisoning [5]* *Eye problems [6]* *Tuberculosis (TB) [7]*
Example: Priscilla	*F*	*35*	*22*	*4*	*1*	
a.						
b.						
c.						
d.						
e.						
f.						
g						
h.						
i.						
j.						
k.						
l.						
m.						
n.						
o.						

Household income

We would like to ask about all the sources of income for your household. Do any members of your household earn money from regular employment, own businesses (self-employed), pensions and grants, informal selling of any kind, piece jobs, part-time or occasional employment?

A02 First name *Write name of respondent in row a.* *Same as for page 2*	**A09** What type of work do they do? Include part-time, informal selling of any kind and piece jobs. *Officials/Administrators [1]* *Professionals [2]* *Technicians [3]* *Sales workers [4]* *Office & clerical [5]* *Craft (trade) workers [6]* *Operatives [7]* *Labourers [8]* *Service workers [9].* *Other (specify)……*	**A10** If household member/s have own business (self-employed), what type of business do they have? *store/shop [1]* *Neighbourhood store selling from home [2]* *Hawker in nearby town [4]* *Sewing [6]* *Baking [7]* *Brewing beer/alcohol [8]* *Carpentry [10]* *Cell phone service (pay phones) [13]* *Collecting water or firewood for other people [16]* *Don't know [99]* *Other (specify)……*	**A11** If household member/s receive a pension/grant, what type of pensions / grants does the persons receive? *govt old age [1]* *private employer/work pension [2]* *govt. disability grant [3]* *govt. unemployment benefit [4]* *retrenchment payment [5]* *child support grant [6]* *foster child grant [7]* *pension received by dependants from deceased person's employer [8]* *other (specify)……*	**A12** How much do they earn per month net? (*net income is income after deductions)*	**A13** How often do they contribute money to this household?(Write the code number which corresponds.) *Every day [1]* *Every week [2]* *every two weeks [3]* *every month [4]* *every 2-3 months [5]* *every six months [6]* *once a year [7]* *infrequently [8]* *never [9]*	**A14** How much do they contribute to this household each time? (*Amount in local money*.)	**A15** Which of the following items does he or she contribute to the household? *Fill in nature of any contribution* *Everything [1]* *No / Nothing [2]* *Money [3]* *Groceries [4]* *Money and groceries [5]* *Tools [6]* *Rent [7]* *Transport cost [8]* *Clothing [9]* *Furniture [10]* *Appliances [11]* *Labour [12]* *Pay loans [13]* *Medical expenses [14]* *Other (specify)* ……	**A16** Give the monthly value of these contributions in local money
Example: Priscilla								
a.								
b.								
c.								
d.								
e.								
f.								
g								
h.								
i.								
j.								
k.								
l.								
m.								
n.								
o.								

A17 Does the household get money/remittances from members or persons living elsewhere? (e.g., child support, rent)?

Yes [1] No [2] ☐

If no, GOTO A 20.

If yes, **A18** How often does the household get money/remittances from elsewhere? ☐
At least once a month [1] Twice a year [3] Never [5]
Four times a year [2] Infrequently [4] Other (specify) ..……

A 19 How much is received each month? *Amount in local money.*……..

A 20 Does the household get money from selling agricultural produce? (e.g., cattle, milk, goats, vegetables, mealies)

Yes [1] No [2] ☐

If no, GOTO A 23
If yes, **A 21** How often?
Every day [1] Once a week [3] Once a month [5]
Twice a year [2] Once a year [4] ☐

A 22 How much does the household obtain per month by selling? *Amount in local money.*……

A23 Give us your ***best estimate*** of the total monthly or yearly **INCOME** of your household**:**

Monthly: *Amount in local money.*……..

Yearly: *Amount in local money*……

Household expenditure

A24 Every household has to buy / pay for a large variety of things. Please tell us how much your household spends in total per month or per year on each of the following items.

Use the box below for calculations. Where there is no expenditure, write "none" *Items you buy*	Value of items bought by household in local money. Indicate average monthly or yearly.	
	Monthly	*Yearly*
a. Food and groceries (***excluding fuels***)		
b. Clothes		
c. House rent		
d. Personal transport (car /van): fuel, maintenance, etc		
e. Public transport (bus, taxi, air, rail etc)		
f. Entertainment (e.g., TV license, sport activities), Lotto		
g. Repayment of bank loans		
h. Repayment of cash loans		
i. Bond (housing) repayment		
j. Savings including saving clubs, including stokvel		
k. Burial society		
l. Hire purchase payments		
m. Water		
n. Furniture, appliances		
o. Medical expenses		
p. School / tertiary education fees		
q. Remittances to members of the family living elsewhere (child support, second family, alimony etc)		
r. Building materials		
s. Telephone (landline and mobile)		
t. Labour (home help, gardeners, cooks etc)		
u. Eating / drinking outside the home		
Other (specify)……..		

A25 Give us your ***best estimate*** of the total monthly or yearly EXPENDITURE of your household**:**

Monthly: *Amount in local money*…….

Yearly: *Amount in local money*……

SECTION B
INFORMATION ABOUT YOUR HOUSE / DWELLING

Structure of the house

B01 Do you own or rent your house or are you provided with accommodation? ☐

Own [1] Rent [2] Home provided [3]

B01a If renting or paying nominal fee – how much are you paying per month? *Amount in local money*……

B02 How many separate buildings make up your house/dwelling excluding separate toilet(s) but including separate kitchen(s)? ☐

B03 How many habitable rooms in total are there in your house/homestead? Excluding farm buildings, buildings used for work, and buildings that form part of another household's homestead. ☐

B04 Does the household use a coal and or wood stove for cooking? Yes [1] No [2] ☐

If no, GOTO B06

B05 *If yes,* is this stove connected to a chimney? Yes [1] No [2] ☐

Electric lighting

B06 How many electric lights are there all together inside your house/dwelling? *If no electric lighting in house GOTO B10* ☐

B07 How many outside electric lights are connected to your dwelling? ☐

B08 How many sockets are there to plug in appliances inside the house? ☐

Household amenities

B09 What is the household's most common source of drinking water? ☐

Tap in house [1] Tap in yard [2] Tank [3] Shared tap [4] Hand pump [5]

Tube well [6] Surface well [7] Spring [8] River [9] Other (specify)…….

B10 If your household is not using an inside tap or tap in the yard, what is the distance to the nearest tap? ☐

Less than 100m [1] 100m to 199m [2] 200m – 500m [3]

If more than 500m, specify the distance in kilometres [4]…….km

B11 If no access to tap water, what is the distance to the nearest protected water source (well, borehole etc)? ☐

Less than 100m [1] 100m to 199m [2] 200m – 500m [3]

If more than 500m, specify the distance in kilometres [4]…….km

B12 Does your house have a separate bathroom? Yes [1] No [2] ☐

B13 Does your house have an inside toilet? Yes [1] No [2] ☐

B14 What type of sewerage system does your house/homestead have? ☐

Water-borne sewerage [1] Pit-latrine [2] No sanitation facility [3]

Other (specify)……

SECTION C
FUELS USED FOR DIFFERENT PURPOSES IN THIS HOUSE

Now we would like to know what type of fuels are used by the household.

C01 What is the main fuel, second and third fuels the household uses for **lighting, cooking, heating water and ironing**? (*If household does have not have a third fuel, write* 0)

End-use	What is the main fuel, second and third fuels the household uses for lighting, cooking, water heating and ironing? *Electricity [1] Candles [2] Kerosene (paraffin) [3] Gas [4]* *Wood [5] Dung/crop residues [6] Coal [7] Charcoal [8] Solar 9]]* *Other (specify)……*		
	Main fuel	Second fuel	Third fuel
A. Lighting			
B. Cooking			
C. Water heating			
D. Ironing			

C02 What are the most important reasons the household uses this as the main fuel for **lighting and cooking**? (Put the code in the1st column in the box, which most closely reflects the respondent's first answer. If there is more than one response do the same for the 2nd and 3rd choices.)

A. LIGHTING **B. COOKING**

Reasons	1 st	2 nd	3 rd	Reasons	1 st	2 nd	3 rd
Affordable/ cheap [1]				Affordable/ cheap [1]			
Easily available [2]				Easily available [2]			
Bright light [3]				Easy to use [4]			
Easy to use [4]				Safe [5]			
Safe [5]				Other (specify)……			
Other (specify)……							

C03 If you had a choice and all fuels were available in your area, which fuels would the household like to use most for **lighting, cooking**, **heating** and **ironing?** What are the reason (s)?

End-use	Which fuel would the household like to use most if it had a choice? *Electricity [1] Candles [2]* *Kerosene (paraffin) [3] Gas [4]* *Wood [5] Dung/crop residues [6]* *Coal [7] Charcoal [8] Solar [9]* *Other (specify)……*	If the fuel of your choice is not used regularly, what are the reason(s) for this? *Too expensive to use [1]* *Fuel/electricity not available in the area [2]* *Have no electricity connection [3]* *Don't have appliances [4]* *Other (specify)……*
A) Lighting		
B) Cooking		
C) Heating		
D) Ironing		

SECTION D
ELECTRICITY SUPPLY, PURCHASE, USE AND APPLIANCES

Electricity supply

D01 Is your area electrified? Yes [1] No [2] ☐

D01 Does the household have an electricity connection? Yes [1] No [2] ☐

If yes, GOTO D04

*If no***, D03** why not?

Connection fee/deposit is too expensive [1] Monthly bills for electricity are too expensive [2] ☐

Connection fee/deposit and monthly bills are too expensive [3] Household can't afford electrical appliances [4]

Household does not like electricity [5] Other (specify)……

D04 Does the household have its own electricity meter or is it shared? Own [1] Shared [2] ☐

D05 In which way does the household pay for electricity?
Pre-payment meter [1] Credit meter (pay monthly bill) [2] Pay private person [3] ☐
Other (specify) ……

D06 When did the household get electricity in this house?

As long as I know/ since we moved in [1] Year (not month) [2] (specify) ..... ☐

Legal electricity connection

*For those who have an electricity connection less than 2 years***.**

D07 How long did it take before you got the connection? ☐
1 month or less [1] 2 to 6 months [2] 7 to 12 months [3] More than 1 year (4) Don't know [5]

D08 How much did the household pay to get a connection, including deposit and connection fee? *Amount in local money*
……

D09 Did the household experience any problems in obtaining a connection? Yes [1] No [2]

If no, GOTO D10. *If yes*, which of the following problems did you experience?

Had to pay extra [1]		Had to bribe someone [2]		Had to obtain support of community leader(s) [3]	
Other (specify) ……					

Strength of electricity supply

D10 How powerful was the electric supply the household got then? ☐
2.5A [1] 5A [2] 8A [3] 2X5A [4] 20A [5]
60A [6] Don't know [7] Other (specify).....……

D11 Is the level of supply the same as when it was connected? ☐
Same [1] Has changed [2] Don't know [3]
If the level of supply has changed (*answer D12 – D15*)

D12 How powerful is the electric supply the household has now? ☐
2.5A [1] 5A [2] 8A [3] 2X5A [4] 20A [5]
60A [6] Don't know [7] Other (specify).....……

D13 In which year did the level of supply change? Year .....

D14 How much did the household pay to change the level of supply? *Amount in local currency* .....

D15 Why has the level of supply changed? (*One answer only*)
Changed by supplier [1] Was too weak [2] Has acquired more appliances [3]
Was too strong [4] Has extended the house/homestead [5]
Runs own business from home [6] Other (specify)……

Power failures

D16 During the last year, how often has there been there been power failures in your area?
Every day [1] Several times a week [2] Once a week [3]
Several times a month [4] Seldom / occasionally [5] Every two to three months [6]
Never [7] Other (specify) .....

D17 How long do power failures generally last in your area?
Few hours [1] 1 to 3 days [2] 4 to 7 days [3]
1 to 2 weeks [4] 3 to 4 weeks [5] 1 to 4 months [6]
Other (specify) …….

D18 In the event of power failures, what is the most common fuel the household uses for lighting *(One only)*
Diesel/petrol generator [10] Candles [2] Kerosene (Paraffin) [3]
Torch batteries [7] Car batteries [8] Gas [4]
Solar [9] Other (specify) .....

D19 In the event of power failures, what is the most common fuel the household uses for cooking? (*One only)*
Diesel / petrol generator [10] Kerosene (Paraffin) [3] Firewood [5]
Dung / crop residues [6] Gas [4] Charcoal [8]
Solar [9] Other (specify) .....

"Brown-outs"

D20 During the last year, has there been 'brown-outs' (dimmed lights) in your community? Yes [1] No [2]

If no, GOTO D22.
If yes, how often has there been there been brown-outs in your area?
Every day [1] Several times a week [2] Once a week [3]
Several times a month [4] Once a month [5] Every two to three months [6]
Several times a year [7] Seldom / occasionally [8] Never [9]
Other (specify) .....

D21 How long do the brown-outs generally last?
Few hours [1] 1 to 3 days [2] 4 to 7 days [3]
Other (specify) .....

Buying electricity: Houses with credit meters
Households with pre-payment meters go to D 31

D22 How much does the household pay for electricity in a typical month? *Amount in local money*…… .....

D23 Has the electricity supply ever been suspended because the household did not pay the bill? Yes [1] No [2]
If no, GOTO D27
If yes, **D24** How many times has your supply been cut off (suspended) for non-payment in the last one year?

D25 What was the reason the electricity supply was cut off (suspended) for non-payment of the bill? (*One reason only*)
We did not have money to pay the bill. [1]
We did not receive any bill before being disconnected [2]
No one came to read the meter [3]
The bill did not reflect what electricity we had used [4]

We forgot to pay the bill [5]
Other (specify) …….

D26 How much did you pay to get reconnected? *Amount in local money.……*
Customer relations

D27 Does your household buy electricity from a local or national electricity supplier? ☐
Local supplier [1] National supplier [2]
D28 Does the local / national electricity supplier have a customer relations service? ☐
Yes [1] No [2] Don't know [3]
If no or don't know, GOTO D41.

If yes, **D29** How satisfied are you with the service provided? ☐
Totally ineffective / non-existent [1] Adequate, but could be improved [2]
Provides good service [3] Provides excellent service [4]

D30 If you have had any contact / interaction with your electricity supplier, tell us more about this

.....

.....

Buying electricity: Houses with pre-payment meters
Houses with credit meters go to D 22

D31 How many times did the household buy electricity in the last month? **.....☐.....**

D31a During the last month, when the household bought electricity, how much did you spend each time?

Money (local) spent

First time .....
Second time .....
Third time .....
Fourth time .....
Fifth time .....
Sixth time .....
Seventh time .....
Eight time .....

D32 How much did the household spend on electricity in total in **one** month? *Amount in local money*
.....

D33 Has the household ever stayed without any electricity in the house? (excluding power failures) Yes [1] ☐
No [2] .....

If yes, **D34** How long does the household stay without any electricity before buying more? ☐
A few hours [1] 1 to 3 days [2] 4to 7 days [3]
1 to 2 weeks [4] 3 to 4 weeks [5] 1 to 4 months [6]
Other (specify) .....

D35 Excluding power failures, what are the reasons for staying without electricity? (*One reason only*) ☐
Insufficient money to buy units [1] We had lost the bill / card or receipt [2]
The electricity suppliers are not honest [3] Faulty meter [4]
Meter removed [5] Other (specify) .....
D36 If the household cannot generally afford electricity for the whole month, for how many days per month is the household without electricity? ☐
Customer relations

D37 Where does the household obtain more electricity units (kWh)? : ☐
From local business [1] Vending machine [2] Other (specify) ….....

D38 Does the local / national electricity supplier have a customer relations service?
Yes [1] No [2] Don't know [3]
*If no or don't know***,** GOTO D39.
if yes, D39 How satisfied are you with the service provided?
Totally inadequate / non-existent [1] Adequate, but could be improved [2]
Provides good service [3] Provides excellent service [4]

D40 If you have had any contact / interaction with your local supplier, tell us more about this

……

……

……

Household electrical appliances

D41 What electrical appliances do the household use ? Fill in across the table for each.	Code	**D42** Number of each appliance WORKING	**D43** Number of each appliance BROKEN
Example Electric Toaster	*12*	*1*	*1*
Radio/cassette with electric plug [1]			
Music centre / hi-fi system [2]			
Colour TV [3]			
Black and white TV [4]			
Cell phone charger [5]			
Kettle [6]			
Hotplate – One-plate [7]			
Hotplate – Two-plate [8]			
Two plate stove with oven [9]			
Electric stove with oven [10]			
Electric fridge / freezer[11]			
Electric toaster [12]			
Electric iron [13]			
Electric heater [14]			
Electric fan [15]			
Grooming equipment (Electric hairdryer / Electric hair tongs, Electric hair clipper, Electric razor) [16]			
Other (specify)…….			

SECTION E
KEROSENE (PARAFFIN) SUPPLY, PURCHASE, USE AND APPLIANCES

Kerosene (paraffin) supply and use

E01 Is kerosene (paraffin) generally available in your immediate area? Yes [1] No [2] Don't know ☐

E02 Does the household use kerosene (paraffin) at any time of the year? Yes [1] No [2] ☐

If no, GOTO section F.

If yes, **E03** What are all the things the household does with kerosene (paraffin)? *Indicate Yes [1] or No [2]*

A. Lighting		E. Heat water		I. Heat water for ceremonies	
B. Make polish		F. Run a fridge/freezer		J. Selling for profit	
C. Cooking		G. Heat the house		K. Brewing beer	
D. Ironing		H. Baking		L. Other (specify)……	

E04 Fill in the table below of prices for quantities of kerosene (paraffin) bought.

	Frequency	For 1 bottle (0.75 L)	For 1L or ¼ Gallon	For 2L or ½ Gallon	For 4 L or 1 Gallon	For 5L	For 10L	For 20 L or 5 Gallon	For 25 L	Other (specify) …… ……
A	Every day									
B	3 times/ week									
C	4 times/ week									
D	Twice a week									
E	Once a week									
F	3 times /month									
G	Twice/month									
H	Once/month									
I	Less often/irregularly									
J	During power failures									
K	When no electricity units									
L	Other (specify)……									

E05 How much kerosene (paraffin) does the household use for making floor polish in a month? *If the household does not make floor polish indicate with 0.*
Amount in local money……

E06 Does the household sell kerosene (paraffin)? Yes [1] No [2] ☐
If no, GOTO E08.
*If yes***, E07** How much kerosene (paraffin) does the household sell per month? ☐
Litres/Gallons……

E07 How much income does the household get per month from selling kerosene (paraffin)? *Amount in local money*……

E08 How much does the household spend on kerosene (paraffin**)** for all purposes (including making polish and selling) in one month? *Amount in local money*……

E09 Where do you buy your kerosene (paraffin) usually? *Indicate Yes [1] or No [2]*

A. Petrol (filling) station		B. Local neighbourhood Shop		C. Specialist kerosene (paraffin) dealer		D. Other (specify)……	

E10 How far from home are your usual suppliers?
Less than 1 km [1] 1 to 5 km [2] 6 to 10 km [3]
More than 10 km [4]

E11 Do you generally pay for transport to get to your usual kerosene (paraffin) suppliers? Yes [1] No [2]

If yes, **E12** How much does the household pay for the return journey to buy kerosene (paraffin)?

Amount in local money .....

Kerosene (paraffin) appliances

E13 Does the household have any kerosene (paraffin) appliances? Yes [1] No [2]
If no, GOTO section F.
If yes, **E14** Which ones do you have? *Indicate Yes [1] or No [2]*

A. Kerosene (paraffin) wick lamps		D. Kerosene (paraffin) lanterns	
B. Kerosene (paraffin) flame stove		E. Kerosene (paraffin) primus stove	
C. Kerosene (paraffin) heater		F. Kerosene (paraffin) fridge	
G. Others (specify)…….			

SECTION F
BOTTLED GAS SUPPLY, PURCHASE, USE AND APPLIANCES

Here we distinguish the gas cylinder,e.g., the cost of the gas cylinder from the gas to fill or refill the cylinder,e.g., the cost of bottled gas.

Bottled gas supply and use

F01 Is bottled gas generally available in your immediate area? Yes [1] No [2] Don't know [3]

F02 Does the household use any bottled gas at any time of the year? Yes [1] No [2]
If no, GOTO section G
If yes, ask questions below:

F03 What are all the things the household does with bottled gas? *Indicate Yes [1] or No [2]*

A. Lighting		E. Cooking		H. Ironing	
B. Heat water		F. Run a fridge/freezer		I. Heat the house	
C. Baking		G. Heat water for ceremonies		J. Selling for profit	
D. Brewing beer		K. Other (specify)……			

F04 How often does the household generally buy bottled gas from their main supplier?
Every day [1] 3 to 4 times per week [2] 2 times per week [3]
once per week [4]3 times per month [5] 2 times per month [6]
once per month [7] less often/irregularly [8] during power failures [9]
when no electricity units [10] Other (specify) ……..

F05 Does the household buy bottled gas cylinders from the same suppliers who sell gas? Yes [1] No [2]

If no, **F06** Who are your usual suppliers of bottled gas cylinders? *Indicate* Yes [1] or No [2]

A. Petrol (filling) station		B. Shop		C. Specialist gas dealer		D. Other (specify)……	

Fill in the table below for quantities of bottled gas bought.

F07 How much bottled gas does the household buy typically at one time? *Quantity and unit (kg or pounds)*	**F08** How much does the household pay typically for the bottled gas it buys at one time? *Amount in local money*	**F09** How many of these units of bottled gas does the household buy in a typical month? *Quantity and unit (kg or pounds)*	**F10** How much does the household spend on bottled gas in a typical month? *Amount in local money*

F11 Who are your usual suppliers of bottled gas? *Indicate* Yes [1] or No [2]

A. Petrol (filling) station		B. Local neighbourhood Shop		C. Specialist gas dealer		D. Other (specify)……	

F12 Is your bottled gas delivered free of charge? Yes [1] or No [2]
If no, **F13**, how much do you pay for delivery? *Amount in local money*……

F14 How far from home are your usual suppliers?
Less than 1 km [1] 2 to 5 km [2] 6 to 10 km [3] More than 10 km [4]

F15 Does the household pay for transport to get to their usual supplier? Yes [1] No [2] ☐

If no, GOTO F17

If yes, **F16** How much does the household pay for the return journey including the transport of the cylinders?

Amount in local money……..……

Gas appliances

F17 Does the household have any gas appliances? Yes [1] No [2] ☐

If no, go to section G

If yes, **F18** Which ones does the household have? *Indicate* Yes [1] or No [2]

A. Gas lamps		C. Gas bottle with burner		E. Gas stove without oven		G. Other (specify) …… ……	
B. Gas stove with oven		D. Gas heater		F. Gas fridge			

SECTION G
COAL AND ANTHRACITE SUPPLY, PURCHASE, USE AND APPLIANCES

Coal and anthracite supply and use

G01 Are coal and / or anthracite generally available in your area?

Anthracite Yes [1] No [2] Don't know [3] ☐
Briquettes Yes [1] No [2] Don't know [3] ☐
Coal Yes [1] No [2] Don't know [3] ☐
Other (specify).....

G02 Does the household use any coal products at any time of the year? Yes [1] No [2]
If no, GOTO section H.
If yes , **G03** What are the main things the household does with coal products? *Indicate Yes [1] or No [2]*

A. Cooking		D. Ironing		F. Heat water	
B. Heating the home		E. Baking		G. Heating water for ceremonies	
C. Brewing beer		H. Other (specify).....…… .			

G04 How often does the household use coal products?
Every day [1] 3 to 4 times per week [2] 2 times per week [3]
once per week [4]3 times per month [5] 2 times per month [6]
once per month [7] less often/irregularly [8] during power failures [9]
when no electricity units [10] Other (specify) ..... ☐

G05 How often does the household generally buy coal products?
Every day [1] 3 to 4 times per week [2] 2 times per week [3]
once per week [4]3 times per month [5] 2 times per month [6]
once per month [7] less often/irregularly [8] during power failures [9]
when no electricity units [10] Other (specify) ..... ☐

G06 How much coal products does the household buy at one time? (*number of sacks and weight in kg or pounds)*

Number of sacks.…… *Weight.……..kg or pounds*

G07 How much does the household pay for this coal? *Amount in local money*……..

G08 How much does the household spend in total on coal per month? *Amount in local money*…….

G09 Does the household sell any coal products? Yes [1] No [2] ☐

If no, GOTO G12

If yes, **G10** How much coal does the household sell per month? *Quantity and unit (kg or pounds).*……

G11 How much income does the household get from selling coal per month? *Amount in local money*……

G12 Who are your usual suppliers of coal products? *Indicate Yes [1] or No [2]*

A. Members of the community		C. Specialist coal/anthracite dealer	
B. Shop		D. Other (specify)……	

G13 How far from home are your usual suppliers?
Less than 1 km [1] 2 to 5 km [2] 6 to 10 km [3] More than 10 km [4] ☐

G14 Does the household pay for transport to get to coal suppliers? Yes [1] No [2]
If yes, **G15** How much does the household pay for the return journey including the transport of coal?
Amount in local money……

Appliances for burning coal

G16 Does the household have appliances for burning coal? Yes [1] No [2] [ ]

If no, GOTO Section H
If yes, **G17** Which ones does the household have? *Indicate Yes [1] or No [2]*

A. Coal stove		B. Mbawula (local stove)		C. Other (specify)……	…

SECTION H
CHARCOAL SUPPLY, PURCHASE, USE AND APPLIANCES

Charcoal supply and use

H01 Is charcoal generally available in your area? Yes [1] No [2] Don't know [3] ☐

H02 Does the household use any charcoal at any time of the year? Yes [1] No [2] ☐

If no, GOTO section I.

If yes, **H03** What are the main things the household does with charcoal? *Indicate Yes [1] or No [2]*

A. Cooking		D. Ironing		F. Heat water	
B. Heating the home		E. Baking		G. Heating water for ceremonies	
C. Brewing beer		H. Other (specify).....			

H04 How often does your household use charcoal? ☐

Every day [1] 3 to 4 times per week [5] 2 times per week [8]
Once per week [2] 3 times per month [6] 2 times per month [9]
Once per month [3] Less often/irregularly [7] During power failures [10]
When no electricity units [4] Other (specify) .....

H05 Does the household make charcoal or buy or do both? ☐

Make charcoal [1] Buy charcoal [2] Make and buy charcoal [3]

If they do not make charcoal, GOTO H10

*If they **make** charcoal, ask the following questions:*

H06 How often does the household make charcoal? ☐

Once per week [1] Once a month [2] Two times per month [3]
Other (specify)……

H07 How much charcoal does your household usually make at one time? ☐

Three bags (*include weight in kg/ pounds)* [1] Five bags (*include weight in kg/ pounds)* [2]
Other (specify) .....

H08 How long does this charcoal last? ☐

Less than 1 week [1] 1 week [2] 2 weeks [3]
1 month [4] Other (specify) ……

H09 Who in the household usually makes charcoal? ……

If they buy charcoal, ask the following questions. If the household does not buy charcoal, GOTO H14.

H10 How often does the household buy charcoal? ☐

Every day [1] 3 to 4 times per week [2] 2 times per week [3]
Once per week [4] 3 times per month [5] 2 times per month [6]
Once per month [7] Less often/irregularly [8] During power failures [9] When no electricity units [10]
Other (specify) .....

H11 How much charcoal is generally bought at one time? (*number of sacks and weight in kg or pounds)*

Number of sacks.…… *Weight.……..kg or pounds*

H12 How much does the household pay for this charcoal? *Amount in local money*……

H13 How much does your household spend on charcoal per month? *(Calculate with respondent)*

Amount in local money……

H14 Does your household sell charcoal? Yes [1] No [2]

If no, GOTO H17

If yes, **H15** How much charcoal does your household sell per month? *Quantity and weight (kilogram or pound).……*

H16 How much income does the household get per month from selling charcoal? *Amount in local money*……

H17 Who are your usual suppliers? *Indicate Yes [1] or No [2]*

A. Members of the community		C. Specialist charcoal dealer	
B. Shop		D. Other (specify)……	

Appliances for burning charcoal

H18 Does your household have appliances for burning charcoal? Yes [1] No [2]

If no, GOTO section I.

If yes, **H19** Which ones does the household have? *Indicate Yes [1] or No [2]*

A. Charcoal stove (specify)……		B. Other …….	

SECTION I
FIREWOOD SUPPLY, PURCHASE, USE AND APPLIANCES

Firewood supply and use

I01 Is firewood generally available in your area? Yes [1] No [2] Don't know [3]

I02 Does the household use any firewood at any time of the year? Yes [1] No [2]
If no, GOTO section J
If yes, **I03** What are the main things your household does with firewood? *Indicate Yes [1] or No [2]*

A. Cooking		D. Ironing		F. Heat water	
B. Heating the home		E. Baking		G. Heating water for ceremonies	
C. Brewing beer		Other (specify).....……			

I04 How often does your household use firewood?
Every day [1] 3 to 4 times per week [5] 2 times per week [8]
once per week [2]3 times per month [6] 2 times per month [9]
once per month [3] less often/irregularly [7] during power failures [10]
when no electricity units [4] Other (specify) .....

I05 Does the household collect firewood or buy or do both?
Collect firewood [1] Buy firewood [2] Collect and buy firewood [3]
*If they say they **buy** firewood,* GOTO question I10.
*If they **collect** firewood, ask the following questions:*

I06 How often does the household collect firewood?
Every day [1] Every second day [2] Once a week [3]
Other (specify) ……
I07 How much firewood does the household generally collect at one time?
One head load collected by one person [1] Two head loads collected by two people [2]
One truck/ bakkie load [3] One cart load [4] Other (specify)…….

I08 How long does this firewood last?
Less than one week [1] 1 week [2] 2 weeks [3]
1 month [4] Other (specify)…… ……

I09 Who in the household usually collects firewood?
Women [1] Men [2] Female children [3] Male children [4] Other (specify)……
*If they **buy** firewood, ask the following questions:*

I10 How often does your household buy firewood?
Every day [1] 3 to 4 times per week [2] 2 times per week [3]
once per week [4]3 times per month [5] 2 times per month [6]
once per month [7] less often/irregularly [8] during power failures [9]
when no electricity units [10] Other (specify) .....

I11 How much firewood does your household generally buy at one time? (*Weight in kilograms or pounds)*
……kg
I12 How long does this firewood last?
Less than one week [1] 1 week [2] 2 weeks [3]
1 month [4] Other (specify)……
I13 How much does the household pay for this firewood? *Amount in local money*…….

I14 How much does your household spend on firewood per month? *Amount in local money*……

I15 Does the household sell firewood? Yes [1] No [2]

If no, GOTO I18

If yes, **I16** How much firewood does the household sell per month? *Weight in kilograms or pounds*…….

I17 How much income does the household get per month from selling firewood? *Amount in local money*……

I18 Who are your usual suppliers for firewood? *Indicate Yes [1] or No [2]*

A. Member/s of the community		B. Shop		Other (specify)……	

I19 How far from home are your usual suppliers?
Less than 1 km [1] 2 to 5 km [2] 6 to 10 km [3] ☐
More than 10 km [4]

I20 Does your household pay for transport to get to your suppliers? Yes [1] No [2] ☐

If yes , **I21** How much does the household pay for the return journey including the transport of firewood? *Amount in local money*……

Type of woodfire place

I22 Does your household have any woodfire place / stove? Yes [1] No [2] ☐

If no, GOTO Section J

If yes, **I23** What type of fireplace / stove does your household have? *Indicate Yes [1] or No [2]*

A. Outside fireplace		B. Inside fireplace		C. Special wood stove		D. Other (specify)……	

SECTION J
OTHER ENERGY SOURCES

CAR BATTERY SUPPLY, PURCHASE, USE AND APPLIANCES

The car battery in this section refers to the exclusive use for operating household appliances – not for motor vehicles, motor cycles etc.

J01 Are car batteries generally available in your area? Yes [1] No [2] Don't know [3] ☐

J02 Does the household use car batteries at any time of the year? Yes [1] No [2] ☐

If no, GOTO J16.

If yes, **J03** How often does your household use a car battery?

Every day [30] One or two days per week [6] One or two days per month [1] ☐

Other (specify) …….

J04 Does your household operate any appliances from a car battery? Yes [1] No [☐

If no, GOTO J16

If yes, **J05** Which ones do you have? *Indicate Yes [1] or No [2]*

A. Lights		C. TV	
B. Radio/music centre		D. Others (specify). ……	

J06 How much did your household pay for a car battery? *Amount in local money*……..

☐

J07 How many car batteries does your household own?

J08 Does your household buy the car battery from the same suppliers who charges your battery? Yes [1] No [2] ☐

If no , J**09** How much does your household pay for the return journey to your car battery suppliers? (*Including the transport of the battery*) *Amount in local money* ……..

J10 Is there a place to recharge car batteries in your immediate area? Yes [1] No [2] ☐

J11 How many batteries does your household generally charge at one time? ☐

J12 How much does the household pay for charging one battery? *Amount in local money*……

J13 How much does your household spend on charging car batteries per month?

Amount in local money ……

J14 How often does your household charge the car battery? ☐

Every day [1] 3 to 4 times per week [4] 2 times per week [7]

once per week [2]3 times per month [5] 2 times per month [8]

once per month [3] less often/irregularly [6]

Other (specify) …….

J15 How much does your household pay for travelling to and from the place where you charge the car battery

including the transport of the car battery? *Amount in local money*

……

CANDLES SUPPLY, PURCHASE AND USE

J16 Are candles generally available in your immediate area? Yes [1] No [2] Don't know [3] ☐

J17 Does your household use any candles at any time of the year? Yes [1] No [2] ☐

If no, GOTO J29

If yes, **J18** What are the main things your household does with candles? *Indicate Yes [1] or No [2]*

A. Lighting		C. Make polish		D. Ceremonial purposes	
B. Selling for a profit		E. Other (specify) …… ……			

J19 How often does your household use candles for lighting?
Every day [1] 3 to 4 times per week [5] 2 times per week [8]
once per week [2]3 times per month [6] 2 times per month [9]
once per month [3] less often/irregularly [7] during power failures [10]
when no electricity units [4] Other (specify) .....

J20 How many candles of standard size or other size does your household buy in one month *(Calculate with respondent)*

Number of candles: Standard size…… Other size (specify) …….

(*A standard size candle burns for 8-9 hours. If the household uses other sized candles indicate how long they burn*)

J21 How many of these are used for making things to sell (e.g. polish)?

Number of candles: Standard size…… Other size ……..

J22 How many of these are used for lighting?.....

Number of candles: Standard size…… Other size ……..

J23 Does the household sell candles? Yes [1] No [2]

If no GOTO J26

If yes, **J24** How many of these are sold? .....

Number of candles: Standard size…… Other size ……..

J25 How much income does the household get from selling candles and or polish made from candles? *Amount in local money*…….

J26 How much does the household pay for the candles you buy? *Amount in local money*

For one candle: Standard size……. Other size (specify)…….……

For a packet of six: Standard size……. Other size (specify)……

For a packet of twelve: Standard size…… Other (specify)……

J27 How far from home are your usual suppliers?
Less than 1 km [1] 2 to 5 km [2] 6 to 10 km [3]
More than 10 km [4]

J28 How much does your household spend on candles for all purposes in one month in total? *(Calculate with respondent)*
Amount in local money ……..

APPLIANCES WORKING FROM A GENERATOR

J29 Are generators available in your immediate area? Yes [1] No [2] Don't know [3]

J30 Does your household own a generator? Yes [1] No [2]
If yes, **J30a** How much per month do you pay for diesel ? *Amount in local currency*……

J31 Do you get power from a generator of a neighbour? Yes [1] No [2]

J32 How much per month do you pay for using the generator? *Amount in local money*……..

J33 Does your household operate any appliances from a generator? Yes [1] No [2]
If yes, **J31a** Which ones do you have?
Specify.....
Specify.....
Specify.....

DRY CELL BATTERIES SUPPLY, PURCHASE, USE AND APPLIANCES

J34 Are dry cell batteries (not car batteries) available in your immediate area? Yes [1] No [2] Don't know [3] ☐

J35 Does your household use any dry cell batteries (e.g. PM or PP) at anytime of the year? Yes [1] No [2] ☐

If no, GOTO J47

*If yes,***J36** How often does your household use batteries?

Every day [30] One or two days per week [6] One or two days per month [1]

Other (specify) …… ☐

Fill in the table below.

J37 What type of appliances do you use batteries for?	**J38** What size (type) of batteries does the household buy? *PM9 [1] PM10 [2]* *PP9 [3] PP10 [4]* *R20PP [5] AA [6]* *AAA [7]* *Other (specify)……*	**J39** How many does the household buy at one time?	**J40** How much does your household pay for each? *(Amount in local money)*	**J41** How often does the household buy them?
Radio [1]				
Torch [2]				
Clock [3]				
Television [4]				
Remote [5]				
Other (specify)…… …….				

J42 How much in total does your household spend on batteries per month? *Amount in local money.*……

J43 Who are your usual suppliers? *Indicate Yes [1] or No [2]*

A. Shop		B. Other (specify)……	

J44 How far from home are your usual suppliers?

Less than 1 km [1] 2 to 5 km [2] 6 to 10 km [3] More than 10 km [4] ☐

J45 Does your household pay for transport to get to your suppliers? Yes [1] No [2] ☐

If yes, **J46**How much does your household pay for the return journey? *Amount in local money.*……

SOLAR SYSTEMS

J47 Does your household have any solar systems? Yes [1] No [2] ☐

If no, GOTO **J50**

If yes, **J48** Which ones do you have? *Indicate yes [1] or No [2]*

A. Solar home system		B. Solar water heater		C. Solar stove		D. Other (specify)……	

J49 For houses using solar voltaic systems, what is the strength of their panel in Watt?……

BENZINE, METHS, CROP RESIDUE, ETC

J50 Are other fuels, such as benzine generally available in your immediate area? Yes [1] No [2] Don't know [3] ☐

J51 Does your household use any other fuels at any time of the year? Yes [1] No [2] ☐

If no, GOTO section K.

If yes, **J52** which ones do you use? *Indicate Yes [1] or No [2]*

A. Cow dung		C. Crop residues		E. Dry aloe	
B. Benzine		D. Meths		F. Other (specify) ……	

J53 How often does the household use these fuels? *Indicate Yes [1] or No [2]*

A. Every day [1]		E. 3 to 4 times per week [2]		H. 2 times per week [3]	
B. 3 times per month [4]		F. 2 times per month [5]		I. During power failures [6]	
C. Once per month [7]		G. Less often/irregularly [8]		J. Once per week [9]	
D. When no money for electricity [10]		K. Other (specify)……			

J54 Does the household buy any of these other fuels (benzine, meths. Etc)? Yes [1] No [2] ☐

If no, GOTO J56

If yes, **J55** How much does the household spend per month in total? *Amount in local money*……

J56 Does your household sell any of these fuels? Yes [1] No [2] ☐

If no, GOTO section k.

If yes, **J57** How much income does the household get per month from selling these fuels? *Amount in local money*

FOR THE INTERVIEWER:
PLEASE ANSWER THESE QUESTIONS AS SOON AS POSSIBLE AFTER LEAVING THE HOUSEHOLD

(i) How well were you received by the person interviewed?
Excellent [1] Good [2] Not very well [3]
With hostility [4]
Other (Specify).....
.....

(ii) Overall, how well did the interview go?
Excellent [1] Good [2] Not very well [3] Badly [4]
Other (Please add your comments) .....
.....

(iii) Was an interpreter used during the interview? Yes [1] No [2]

(iv) *If yes*, who was this person?
Professional translator [1] member of household [2] neighbour/friend [3]
Stranger [4] other (specify)…….

(v) How well did the interpreter appear to translate the questions and answers?
Very well [1] not very well [2] with great difficulty [3] other [19]
(specify)……

(vi) How well do you think the person interviewed understood the questions?
Very well [1] Not very well [2] With great difficulty [3]
Other (Specify)..... .....

(vii) Please add any other comments you think are relevant to the study.
.....
.....
.....
.....
.....

Appendix 4: Instruction Manual for Interviewers: Household Fuel Use & Supply Questionnaire 2003

INTRODUCTION

This document is designed to guide field workers and interviewers in undertaking the survey on Household Fuel Use and Supply, to help them understand the prime objectives of the survey, the rational for each section of the questionnaire, and the meaning of specific questions so as to maximise the accuracy of the answers provided by individual households. The manual is designed to highlight the most important aspects of interviewing and the interview, on which the accuracy and the quality of the data depend entirely.

The Objectives of the Survey

The object of the study (which is being undertaken in four countries) is to gather detailed information from a fairly representative sample of all households in the country) concerning the fuels which households buy and use to meet their energy needs. Needs will vary according to the availability of fuels, the composition of the households, their income, their living conditions and the household budget. Buying and using various energy resources in the home, whether it is for lighting, cooking, water heating, indoor heating or entertainment consumes a large part of any household's available income. The poorer the household the greater is this proportion.

The survey aims to provide data from which the following questions can be answered:

- How does the household combine and choose between different fuels for different purposes?
- In terms of choice of fuels and their use in the home, what differences are there between households according to their income?
- To which fuels does the household have ready access and at what price?
- What proportion of the total household budget goes towards the purchase of fuels?

METHODOLOGY

A representative sample of communities and areas will be drawn up so as to reflect the geographic and socio economic characteristics of the country. Each representative area both rural and urban, will be divided into "clusters" and the addresses of households will be selected which represent the cluster. (The sampling procedures and selection of the list of households to be interviewed are the responsibility of the Research Centre in each country and the field staff. Sampling notes will be provided.)

Wherever possible, all of the (randomly selected) households on the list will be interviewed.
The chief field worker or a local community member selected will be responsible for helping interviewers locate the specific address they are looking for.

There are special procedures for "replacing" a household that the interviewer is unable to locate and the chief field worker will provide the interviewer with a substitute address.

The study will contain a Community questionnaire answered by key representatives of communities in both rural and urban areas that will be administered by the chief field worker.

The Household Questionnaire described in detail here will be filled out during face-to-face interviews with households and by qualified interviewers**.**

The briefing session

The chief field worker will convene a meeting for all interviewers.

For this survey, it is essential that interviewers have received full training for their work and that they have several years of experience. They will attend a "briefing session" at the outset of the survey during which the points below will be discussed and the purpose of each and every question will be carefully explained.

Interviewers must have read the questionnaire several times, in conjunction with the Manual and be thoroughly familiar with both before the briefing session. Any queries about the meaning of questions should be brought up during this session.

Immediately following all the household interviews in a community or area, supervisors will organize a "de-briefing" session. The purpose of this meeting is to allow each interviewer to report on how each section of the questionnaire and specific questions were responded to by respondents and to describe situations or circumstances that might have made some interviews more difficult than others or where the accuracy of the information could be called into question.

Finding the Household and the person to be interviewed

Should a pre-selected household be absent or not possible to find, the chief field worker will advise interviewers on the substitute household to be interviewed.

It is essential that when ever possible, the household head is interviewed, or an adult (preferably female) who is knowledgeable about all aspects of the household: the composition of the household, the use and purchase of different fuels, the sources of income of members and the budget/expenditure of the household.

Using interpreters

Interviewers will probably not be aware of the need to obtain the help of an interpreter until they enter the home. Ideally the team of field staff should include someone proficient in several local languages who could be called upon to translate. Failing this, the interviewer should ask the household to choose someone (a friend, neighbour or relative) to interpret for the interviewer. This person must be someone who speaks fluently the language of the respondent and the language used in the questionnaire.

Remember that there are certain problems that can arise from using an interpreter:

1) The information given by the respondent is confidential. The interpreter must be a trusted and trustworthy person.

2) It is difficult to know how well the person chosen as interpreter is translating the questions. They may be simply paraphrasing rather than providing a word-by-word translation of the questions. Nor is it possible to know how faithfully the person is translating the words of the respondent.
3) A serious bias can be introduced when the interpreter is a neighbour or friend. The respondent may be withholding information he/she does not want the friend or neighbour to know. Similarly, the interpreter may be consciously or unconsciously transforming responses in order to impress the interviewer. Worse, the interpreter may think he/she knows the household well enough to reply in their place. Should the interviewer sense that any of these is happening, it is important that he remind the translator to translate faithfully what the respondent has said. Direct your attention always to the respondent and it may be necessary to change the seating position of the interpreter.

Where an interpreter has been used the interviewer **must** fill in the section on the last page relating to the evaluation of the interview.

THE NATURE OF FACE-TO-FACE INTERVIEWS

Interviewing requires the establishment of a special type of relationship, one in which the interviewer's own personality and behaviour play an important part. An interview is essentially a relationship between two strangers in which one party, the respondent, must have sufficient trust in the other to accurately answer a large number of questions, some of which may be private or even painful in nature. Questions relating to household members may involve recalling someone who has died or has lost his/her job.
The attitude, even the body language of the interviewer has an impact on how readily or willingly and accurately the respondent answers the questions.

Introductions and providing the objectives of the study

In the first moments, as the interviewer greets his/her respondent (and all other household members who may be present), the tone and quality of the interview will have been determined. The interviewer must be able to put the respondent and the household at ease, provide them with clear information about the purpose of the study and who is responsible for it.
Don't use complicated sentences to describe the study. Interviewers can say very simply that the questions are part of a national survey aimed at understanding how households from all areas use different fuels for different purposes in the home. The information provided by all the households to be interviewed will be used to increase the availability of fuels to all households.

Reassurance of the respondent concerning confidentiality

It is very important to give respondents assurance as to the confidentiality of their replies. Assuring the household that the questions have nothing to do with paying taxes may be essential. It is important to reassure the respondent that the information contained in the questionnaire is confidential, will be treated anonymously and will not be communicated to any one outside the survey team. The interviewer must be courteous, and attentive of any particular situation in the household. Once the interviewer has identified the person to be interviewed, (which should whenever

possible be the head of the household or a person who can answer for all members of the household as a whole) it may be necessary that the interview takes place in an area of the house or outside where the person can reply without interruptions.

Remember that a demonstration of interest in what the respondent is saying works as catalyst. It should not be forgotten however, that there is a tendency for all persons interviewed to reply in a way that pleases the interlocutor. It is essential that the interviewer remains objective and absolutely neutral through-out The delicate balance has to be sought between allowing the respondent to mention other subjects during the interview, (which may be a key to understanding the answers) and keeping the interview on track.

On many occasions, the respondent learns things in the course of the interview that he/she was previously unaware of, such as the amounts of what the household is spending monthly on the various fuels they are using.

Questions must be asked that is, read out to the respondent in a clear voice, in the **exact** way in which they are written on the questionnaire. The interviewer must make sure his/her voice does not become monotonous which guarantees that the respondent will stop listening. It is also essential to allow the respondent time to think and to reply. The question can be repeated in its exact form if necessary. Paraphrasing the question should be used only as a last resort. When a reply does not seem to match the question, proceed by asking the respondent to explain what he/she means by his answer that can in some cases, reveal that the respondent has misunderstood the question.

It cannot be stressed enough that the quality and accuracy of the data on which the study is based depends on the skills of the interviewers. Interviewers will be asked by the chief field staff to return to the household should there be inconsistencies, missing data or errors but if a good relationship was established between the interviewer and the household in the interview, a follow up for more information should not present any difficulty

THE QUESTIONNAIRE AND ITS SECTIONS

The household questionnaire is divided into 13 sections (A-M) as follows:
A. The Household Roster
B. Information about the House/Dwelling
C. Fuels used for different purposes in the home
D. Electricity Supply, Purchase, Use and Appliances
E. Kerosene (Paraffin) Supply, Purchase, Use and Appliances
F. Bottled Gas Supply Purchase, Use and Appliances
G. Coal and Anthracite Supply Purchase, Use and Appliances
H. Charcoal Supply Purchase, Use and Appliances
I. Fuel wood Supply Purchase, Use and Appliances
J. Other Energy Sources
K. Income
L. Household Expenditure
M. Family Heath

The final page of the questionnaire (an evaluation of the interview) must be filled out for all interviews as soon as possible after the interview has been completed.

Detailed explanations concerning questions in each section of the questionnaire follow in Section 6.

GENERAL INSTRUCTIONS FOR FILLING OUT THE QUESTIONNAIRE

On the cover page of the questionnaire, some information about the household should be obtained in advance wherever possible. Interviewers should note the duration of the interview and insert it on the first page.
Use a ballpoint pen to fill out the questionnaire.

The interview must be conducted in the local language. See Section 2.4 on using interpreters.

Codes and their purpose

Codes are used to stand for specific responses so that they can be recorded in the database. Great care is needed from the interviewer to make sure that the right code has been selected that faithfully translated the respondent's reply and that it is accurately written in the 'code box'. For most questions, a box has been provided on the right hand side of the page in which the code number corresponding to the answer given by the respondent should be written. Please first circle the code number, then write the code number in the box. For example, for the question 'Does the kitchen have a chimney?' Yes[1] No[2], the interviewer will circle the code of the appropriate reply (that is, 1 or 2) then write it in the box provided.
Should interviewers make a mistake, they should make sure that the figure to be corrected is crossed out and the correct figure written clearly next to it.

"Open-ended" questions

A few questions are "open-ended". For one kind of "open-ended questions, a number of likely replies are given and coded.

B11 in Section B for example, asks "How does your household feel about not having electricity"?……, This requires that the interviewer waits for the reply, without prompting the respondent, then chooses from the possible replies given on the questionnaire which corresponds the closest to what the respondent has said. Notice that for B11, the interviewer must circle and note the code numbers of all responses given, in other words, more than one reply is likely and each one is to be circled and the code number recorded in the box.

A few "open-ended" questions are asked and no pre-coded replies are given.
When asking, D41, no suggestions are given. The interviewer must write as faithfully as possible each of the reply(s) that the respondent gives.

Where necessary on the questionnaire, specific instructions for interviewers are written in italics in brackets, immediately after the question. An example of such an instruction is *(Mark one option only).*

"*Other (specify)……..*" is provided for situations where the reply of the respondent does not fit any of the possible replies provided. If the interviewer uses this category, he/she must write out fully what the respondent has said.

Skipping procedures

There are many contingency questions in the questionnaire. These have special procedures. The response to a question may be "Yes" or "No". "Yes" to a question will be followed by one or more subsidiary questions that have to be asked. A response of "No" will require skipping to the next set of questions. (The number of the next questions to be skipped to will be indicated on the questionnaire).

Missing data must be avoided

Questionnaires should be filled out as completely as possible. It is very important to obtain answers to all questions. For questions such as the frequency of contributions to the household income, (K07) note that without the frequency, the amount contributed per month to the household cannot be calculated,
If the amount earned or contributed by one member of the household is "missing", the total income of the household cannot be calculated. This will mean that that household's income cannot be used in the calculations.

GUIDE LINES FOR FILLING OUT THE QUESTIONNAIRE

Questions specific to each Section

SECTION A: The Household Roster

This first section has two main purposes:
1) to identify every person who is a member of the household. This will include all members who live, eat and sleep in this house and all members who live elsewhere and who benefit from or contribute to the household resources.
2) to provide basic household demographic information such as gender, age, relationship to the head of the household, education, employment status or situation of members and the membership of the household.

Members are defined as persons living, eating and sleeping in the same home. Members living away from home are to be included in the Roster if they contribute financially or in kind to the household or are benefiting from the household resources.

The interviewer must fill in Table 1 **completely,** making sure that all questions (A06 - A13) are asked for each and every member including for members living elsewhere.

Filling out the Roster

Filling out the roster is a sensitive task, which will require tact and patience. It is extremely important to avoid leaving out members. (This may sometimes happen with female members).

First write the first name of the household head and ask A06 - A13. Information concerning the household head is always filled in on line 'a'. Note that this line is used exclusively for the household head. Proceed across the Table 1.

If the respondent is not the household head, line 'b' should be filled in. This line is reserved exclusively for respondents. Ask the respondent to first provide the information concerning the head of the household (A06 - A13), to be filled in on line 'a' then ask these questions of the respondent.

Age (A08) refers to age at last birthday. If the person does not know his/her age, refer to one or more landmark events in the country and ask if the person was born before or after that date until you have the most probable age of the person. Note that the supervisors will supply the information about major historical events.

A09 requires you to fill in for all household members (except the head), the person's relationship to the head of the household.

A fairly exhaustive list of possible relationships to the household head (A09) is provided for A05, page 2. Consult this list if you are in doubt as to the appropriate relationship code.

Should lodgers, servants or other non-household members be living in the house, these persons must be included if they take their meals with the household. The code '31' has been provided for such a person living and sharing meals with the household whether they are servants or lodgers. Non-members (friends, visitors, neighbours etc.) would be coded as '70'.

A10. Education level, asks for the highest level completed. Use the codes provided. If a person dropped out of high school and the respondent does not know which was the highest grade completed, then the response would be 'some high school completed' [27]. If the person has had no schooling then write [0].

A11 asks about 'employment or other circumstances' but includes a wide range of situations, for example housewife, student, pre-school children, unemployed, unemployed in training etc. Interviewers must be familiar with this list so as to be able to write the description of the situation in the appropriate line and space. Circle the code number and write the code number corresponding to that situation in the column below in the row that has the person's name.

A12 asks where the member lives most of the time. 'Most of the time' refers to more than 4 days per week or more than 6 months in the year.

If the member lives permanently with the household write the code "1" in the column below. If the member lives elsewhere, write the place name, ask where this is and write the appropriate code from the list. Remember that for members living elsewhere, they must only be included in the Table **IF** they are contributing to the household (in money or in kind) or are being supported by the household, (money is sent to them). This information must corroborate with the information on household expenditure, Section L, "remittances sent to members living elsewhere" (q) and K11 Section K, on sources of income "remittances from household members living

elsewhere." Note that each member living elsewhere and 'counted' in the total remittances (Section K, K13,) **must** be listed in the household Roster. If one or more of the children are away for schooling (living in hostels or boarding schools) they receive the code '8'.

A14 Asks how many people who live in the house are not members of the household. These people could be servants, lodgers etc. They should be included in Table 1 if they take their meals with the household. Write down the status of these people in A14a.

A15 Asks if there are household members living elsewhere. If the answer is "yes" or "no", make sure that it corresponds with the information in Table 1.

A16 Asks for the total number of people belonging to the household. This should be the same number as the number of entries on Table 1 Household Roster.

Section B: **About your House/Dwelling**

The purpose of this section is to obtain information about the main features of the house/dwelling where the interview is taking place
"Dwelling" means the structure or group of structures (rooms or buildings) separate or contiguous, occupied by members of the household.
B01 asks whether the household owns or rents their house/dwelling or whether the house is provided by an employer. B01a asks for the amount of rent paid per month.

B02 asks for the number of separate buildings that make up the dwelling. This figure should exclude separate toilets but include separate kitchens. Farm buildings or those used for work purposes should also be excluded as well as buildings that form part of another household's dwelling except if this is rented out.

Remember that if a building is rented out, or if someone living in the house pays rent, the amount paid per month **must** be included in the household income under K11.

It is possible to find several separate households occupying the same dwelling, (B03). If the households cook, and eat separately, then they are to be counted as another household.
B03 asks how many separate households occupy the house/dwelling.

B04 asks for the number of habitable rooms in the dwelling. Toilets should be excluded but kitchen(s) included.

B08 - B09 deal with the number of indoor and outdoor electric lights. 'Lights' would include all fittings in working order even if there is no light bulb. For households without any electricity connection, that is they never had a connection, the interviewer should skip to B11. If there are several buildings that make up the dwelling, B8 refers to the total number of lights in all buildings (excluding farm buildings, work buildings and rooms rented out).

B10 asks about the number of sockets in the house. Sockets refer to the points at which electric appliances can be plugged in. Multiple plugs, added to a socket are counted as a single socket.

B11 is to be asked of all households including those who have no electricity connection. Possible responses are given with the question. Do not read the list to the respondent, but choose the reply(s) and circle the code that best fits what the respondent replied. Write all of the codes in the box provided. Other responses must be written down in the space provided.

B12 - B17 concern amenities such as inside taps, inside toilet, and type of sewerage system.
B12 refers to access to a clean drinking water source. Clean drinking water implies that some precautions are taken to maintain the source (avoidance of pollution from animals or waste).

Section C: **Fuels Used for Different Purposes in the House**

The purpose of Section C is to gather information on all fuels used by the household for different purposes.
C01 asks for the main, second and third fuels used by the household **for lighting, cooking, heating and ironing**.

C02 asks for the reasons for the first choice of fuel for **lighting**. Do not read the list of possible answers but select from the possible answers according to their first reply. Here from the 5 possible replies, interviewers must write "1st" in the box corresponding to the first reason, "2nd" in the box corresponding to the second reason, and 3rd in the box corresponding to the third reason.

The three corresponding codes are then to be written in the boxes provided in the order 1st, 2nd, 3rd.

C03 asks what is the most important reason why the household uses this fuel as the main fuel for **cooking**. Do the same as for C02.

C04 asks if the household had a choice of fuel for lighting, cooking, heating and ironing, which fuel they would use and if the fuel of their choice is not used regularly, what the reason(s) for that were. The respondent should select only one fuel. Note that heating water for tea, or hot drinks is to be included in cooking.

C05 – C08 concerns the person(s) in the household doing the cooking. More than one member may be involved in cooking. For each member, the interviewer should write their relationship(s) to the household head (See codes page 2) or refer to the household Roster, Table 1 for their relationship.

Section D: **Electricity Supply, Purchase, Use and Appliances**

The purpose of this section is to obtain information concerning the electricity supply, power failures, 'brown-outs', meter types, customer relations, ownership and use of electrical appliances.

Note: If the household has never had a connection to a supply of electricity, the interviewer should skip to Section E. If the meter is currently faulty or has been removed, all questions in this section should be asked.

The questions are organised according to whether the household has a credit meter, a prepayment meter or some other system.

D02 asks in what ways the household pays for electricity each month. With a credit meter, the household will be consuming electricity before they are billed at the end of the month. For those with pre- payment meters, the household will be buying tokens or have cards with which they charge their meters prior to consuming.

D03 concerns the household electricity tariff which may be one of several: a standard general tariff, a subsidized tariff for the poor (such as a lifeline tariff), a flat rate tariff which remains the same regardless of consumption or may be supplied by a neighbour.

D06 – D14 concerns the electricity connection, how this was arranged, the cost, and who in the household paid for the connection fee. Write the first name of that household member and his/her relationship to the head. Refer to the household roster for this information.

D15 - D20 asks questions about the "strength" of the electricity supply which is measured in Ampere (A). An amp refers to the strength of the electric current. A 2.5A supply is not as strong as an 8A supply so the household will not be able to use a powerful appliance. Note that volts (V) refer to the "force" that pushes the current. The voltage is generally 220 V throughout the country. Amperes (A) refers to the rate at which electricity is delivered and consumed. The number of Watts is generally written on a small plaque at the back of an appliance. Volts multiplied by the Watts gives the number of Watts that can be used. If a household has an 8Amp supply, they can use a maximum of 1760 Watts, (220x8) This would mean that they would not be able to use an electric kettle which requires 2000 Watts.

QD21 - D24 concern power failures, their frequency, duration and the fuels used by the household in the event of a power failure.

D25 and D26 ask about "Brown outs". The interviewer may have to explain that these are generally experienced as "dimmed lights".

D27 - D41 are to be asked only of households with credit meters. Skip to D42 for household with pre-payment meters.

For credit meter customers, the interviewer should ask to see the households last **two** electricity bills.

Remember, when writing in the total spent on electricity for each month, (D27 and D28), that charges for other services (e.g. water or refuse collection) should be deducted from the total bill.

For D29, the average cost per month over the two-month period must be calculated with the respondent. (This is the total amount for the first month plus the total amount for the second

month divided by 2). Do this calculation with the respondent slowly enough for him/her to understand what you are doing.

When asking, D41, no pre-coded suggestions are given. The interviewer must write as faithfully as possible each and all of the reply(s) that the respondent gives.

D42 to D50 apply to households with pre-payment meters.
For those with pre-payment meters, the household will be buying tokens or have cards with which they charge their meters prior to consuming.

D42 asks how many times the household has bought electricity in the last **two months.** Always ask to see the payment receipts for electricity purchases for the last two months.
The answer to D42 may vary considerably, for instance it may be only twice, that is, the household buys electricity units only once a month. (In other words, the household has bought electricity twice in the last two months). The household therefore buys electricity units only **once** a month.

In D42a the interviewer will write down how much the household spent each time they bought electricity units during the last two months. **Remember this is for a TWO month supply.** The average cost per month over the two-month period must be calculated with the respondent. This is the total amount adding up the amount spent the first time, the second time, and up to the eighth time (if appropriate) for the two month period. This figure must be divided by 2 to obtain the amount spent per month. This is the amount you will write in D43.
Do this calculation with the respondent slowly enough for them to understand what you are doing.

For D44 - D50 interviewers should refer to the comments relating to households with credit meters (D27 - D41).

D51- D54 should be asked of all households with an electricity connection.D51 asks which electric appliances (on the list of appliances) the household owns. D51a asks which appliances they actually use. It is possible that a household owns an appliance, but does not use it. D52 asks if the appliance in question is working or is broken.

D54 asks how much the appliance cost. If the appliance was bought on hire purchase the cost will be the quoted hire purchase cost or the amount of each instalment multiplied by the number of instalments. As you read down the list, encircle the code number of the appliance owned and ask the questions across the table (D51a – D54) before continuing with the list of appliances.

Should the household have more than one of the same appliance, e.g. two television sets, then the second TV must be listed at the end of the Table and D51a - D54 should be asked for this appliance. Any other electric appliances not found on the list should be added at the end of the list and D51a - D54 should be asked.

Section E: Kerosene Supply, Purchase, Use and Appliances

The purpose of this section is to obtain information on the Kerosene (Paraffin) supply, purchase, use and appliances. The interviewer must ask E01, E02, and E03 to ascertain

whether the household uses kerosene as a fuel at all or for just a part of the year. If no Kerosene is ever used, the interviewer should go to Section F.

Note that from Section E to Section J, (one section per fuel type) the wording and procedure for filling out the questions are the same and the comments given for section E will apply.

E04 refers to all possible uses of kerosene and multiple replies are possible. The interviewer should read all of the possible uses to the respondent. Circle the appropriate codes and write the code(s) in the box.

Interviewers should fill in the table by asking E05 and E06.

E05 asks for the amount paid for the quantities of kerosene bought by the household as well as for the frequency with which kerosene (paraffin) is bought.. If they buy in different quantities write down the amount paid for each quantity. Suppose the household usually buys kerosene in 5 Litre quantities, the price of which is R20 once a week. The figure '20' is to be written in the column 'for 5 litres' and in the row for 'Once per week'. Make absolutely sure that the figures are entered in the right place on the table. The household buys once a week, that is, they are buying 20 litres per month. The total amount spent per month on kerosene will be 4 multiplied by the price paid for 5 litres. This amount is to be filled in the total for the frequency 'once a week'. The same household might once a month buy an extra two litres at R8. 1x the cost of those two litres is filled in the last column. Notice that the grand total (adding the amount written in the final column) for each row is the amount that the household is spending per month.

The (E06) total amount per month that the household spends on kerosene is to be calculated with the respondent. Where the respondent cannot provide the amount used for a month, the interviewer should ask how much is used per day or per week and from that information, calculate the amount used per month. A month should be calculated as thirty days.

E11 asks who are the usual suppliers of kerosene (paraffin), interviewers should write down the code where kerosene is bought e.g. "local spaza", "supermarket", "petrol station" etc.

E12 asks the distance from the dwelling to the kerosene supplier. This is to be expressed in kilometres. Should the respondent be able to provide only the time it takes to walk the distance, this should be converted into kilometres. One hour on foot would convert to between 3 and 4 kilometres. Fifteen minutes would be just less than 1 kilometre.

E15 - E16 ask for the kerosene appliances used by the household. (From a fairly exhaustive list)

Section F: **Bottled Gas Supply, Purchase, Use and Appliances.**

Here interviewers should be aware of the difference between the cost of obtaining the gas cylinder that has generally to be paid for separately from or in addition to its contents. The questions F06 - F08 refer to the gas cylinder. F09 – F15 refer to the cost of refilling the gas cylinder.

Section G: Coal and Anthracite Supply, Purchase, Use and Appliances.

The general instructions for questions about Kerosene use and purchase also apply to Coal and Anthracite. If 'no' is the answer to G02, and G03 then the interviewer should skip to Section H.

Note that coal is generally bought by weight. If the respondent can only provide information on the number of sacks used, then ask to see the sack and try to estimate the weight of sacks of that size.

G07 asks how much coal is bought each time. The amount is to be given in both the number of sacks and the weight of each sack.

Section H: Charcoal Supply, Purchase, Use and Appliances

Where the answer is 'no' to H02 and H03 interviewers will skip to Section I

H06 asks if the household makes charcoal, buys charcoal or both. A separate set of questions, (H07 - H10) apply to households that make their own charcoal. H11 - H14 should be asked of all households buying charcoal including households who also make it.

H12 asks how much charcoal is bought each time. The amount is to be given in both the number of sacks and the weight of each sack.

Should the weight of the sack not be known, you should ask to see the sack and try to estimate its weight.

Section I: Firewood Supply, Purchase, Use and Appliances.

Where the answer is 'no' to I02 and I03 interviewers will skip to Section J
I06 asks if the household collects, buys or collects and buys firewood. Where the household only buys firewood (does not collect it) skip to I11.

Collected firewood is often measured in head loads. Where this is the case, it is important to obtain the weight of head loads collected by the household. I08 ask for information as to the amount that is collected.

Section J: covers all other energy sources: Supply, Purchase, Use and Appliances.

Car batteries (J01- J016).

Where the answer is "no" to J02 and J03 skip to J17 (Candles)

Candles (J17 - J27)

Where the answer is "no" to J18 and J19 you will skip to J28 (Generators).

It is possible that the household buys both the standard size of candle and another size.
Make sure that the quantity bought and the prices are given for both sizes. (J22). A standard size candle or household candle burns for 8 – 9 hours. If the standard size in your country is different indicate under ' other size' and specify for how many hours a candle burns. .....

Generators (J28 - J32)

The household may own their own generator, or get electricity from a neighbour's.
In the first case, you should ask J29a on how much per month they pay for the diesel or petrol used. If they get electricity from a neighbour's generator, ask J30a how much do they pay the neighbour per month for the electricity used.

Dry Cell Batteries (J33 - J47)

Where the answer is "no" to J34 and J35 you will skip to J48 (Solar systems)

Solar Systems (J48-J50)

Where the answer is "no" to J48, you will skip to J51 (Benzine, Meths, Crop residues)

For households using solar power, J50 asks for the "strength" of the solar system(s). This is usually expressed in watts. If necessary, ask the respondent to show you the documentation leaflet supplied with the system.

Benzine, meths, crop residues, dung (J51 - J55)

If the household uses none of the listed fuels you will skip to Section K (Income)

J52 asks if the household uses any other fuels such as cow dung, crop residues, benzine etc. Circle the code corresponding to the fuel(s) used and write the code number(s) in the box provided.

J53 Asks for the frequency of use of these fuels. It is possible that different fuels are used with different frequencies. The code box provided therefore gives a place for the frequency of use for each specific fuel. Code 1 is for the frequency of use of cow dung, code 2 is for the frequency of use of crop residues, code 3 is for the frequency of use of dry aloe and so forth.

Section K: Household Income

The purpose of this important section is to ascertain the amount of income from **all sources** that is earned and contributed to the household. It may be again necessary to reassure the respondent that these questions have nothing to do with taxes.

Always write the first name of the person obtaining the income in the space provided. Remember, this person will be listed on Table 1 Household Roster.

Income from earnings, wages, piece jobs etc.

If the answer to K01 is "no" (that is no one in the household gets an income from regular employment, own business, pensions and grants, informal selling, piece jobs, casual work etc.) then skip to K11.

K03 asks for the type of work the person does. Work may be full time, part-time, casual, piece jobs or informal selling. For each household member, the interviewer should write the first name and what the person does to earn the money.

K04 concern self-employed household members or persons owning their own businesses.
Note that the distinction between "own business" and "informal selling" is not clear-cut. In answer to K04 (the list is not exhaustive) write the type of business and code adjacent to the first name of the person.

K05 relates to all persons receiving pensions or grants.
Write the first names of receivers (K02) and write the type of pension received (K05), select the appropriate code and complete the table remembering again that the frequency (K07) is a vital piece of information for the calculations and analysis which will be made.

K06 asks for the amount earned per month. This should be **net earnings** after any deductions which the employer might make e.g. deductions for pension fund, transport etc.

Remember that :
i) respondents may be reluctant to state the earnings of members. Always be prepared to suggest a range of income that might be appropriate according to the type of work mentioned. One can say: "Would that be between xx amount and yy amount?" which usually helps the respondent provide the figure.

ii) the respondent may simply not know the income of a particular household member. If you are sure that no one in the household knows the persons income, write "don't know".

iii) money obtained from selling fuels, (questions which have already been asked earlier in the questionnaire in relation to the use of different fuels): kerosene, (E10) bottled gas, (F13), coal (G10), charcoal, (H15), firewood, (I16) and other fuels, (J55) the monthly amount to be included here in household income.

K07 asks for the frequency of contributions made to the household. Remember that it is very important to obtain this frequency in order to be able to calculate the amount contributed monthly.

K09 provides a list of what could be contributed by members to the household: e.g. Food and groceries, money and groceries, money, clothing, labour such as child minding, 'everything' etc. Write the answer and its code in the column below.

K10 requires that the respondent (with the help of the interviewer) calculates the monetary value per month of the contribution. Should the contribution be in kind, e.g. groceries, it is important that a reasonable estimate is made of the value per month of the what is contributed.

Income from remittances

K11 asks about money and/or remittances that are contributed to the household by members living elsewhere. This could be money from renting out a room or a building, money for supporting a child, money for schooling, alimony for a spouse etc. Note that the contribution of wages from earners living elsewhere should be included in the Table K02 - K10.

Income from the sale of agricultural produce

K14 covers income gained from the selling of any kind of farm produce (cattle, milk, vegetables etc.) and anything sold informally that was not previously included as informal income in the Table K02 - K10.

In kind contributions

K17 relates to the monetary value of all contributions made in kind by household members.
The contributions in kind might be food and groceries, electricity and/or telephone cards, clothes, appliances etc. With the help of the respondent, the interviewer should calculate the total monthly monetary value of all in-kind contributions.

Section L: **Household Expenditure**

The household expenditure questions require the careful reading of each item on the table and frequent reminders to the respondent that you are asking for monthly expenditure (or yearly expenditure if this is appropriate).

Respondents may need some help in arriving at an amount spent per month on food if the frequency varies which is often the case for the purchase of food and groceries where some items are bought daily, some weekly or fortnightly.

Suppose the household buys groceries every 5 days for R50, interviewers will first calculate the amount spent per day (that is, R10) then multiply this by 30 (we can assume that a month has 30 days) to arrive at the amount spent per month, which in this case would be R300. Suppose the same household also buys bread every day for R1 (as well as the groceries every 5 days), the total monthly expenditure on bread will be 30xR1, (R30) for bread, plus R300 for other groceries which is a monthly total on food and groceries of R330.

Please note that monthly expenditure on food and groceries **must exclude whatever fuels, including electricity that are paid for together with the groceries.**

The interviewer should ask if any of the following fuels are included in the food and grocery bills: electricity, kerosene (paraffin), gas, coal and anthracite, charcoal, firewood, candles or dry cell batteries). If the answer is "yes" for all or some fuels, the interviewer must check the answers to the questions on monthly amount spent on each fuel and follow the procedure given in the box below. The monthly totals of expenditure for each of nine possible fuels have already been given by the respondent and are to be found in the following sections and questions numbers:

Electricity: Section D: D29 (for households with credit meters) **or** Section D D43 (for households with pre-payment meters). Pages 10 and 11

Kerosene /paraffin Section E: E06 Page 15

Gas Section F: F12 Page 17

Coal and Anthracite Section G: G09 Page 19

Charcoal Section H: H14 Page 20

Firewood Section I: I 15 Page 23

Candles Section J: J27 Page 25

Diesel/petrol for a Generator Section J: J29a Page 25

Dry cell batteries Section J: J43 Page 26

The monthly expenditure for each fuel 'included' with the groceries **should be added together** and this total should be **subtracted** from the monthly amount spent on food and groceries. To facilitate the calculations necessary here, an example is given below. Please study this carefully.

For your own calculations, during an interview, use the box labelled "food and groceries minus fuels" provided on the questionnaire (on page 36 following the Table on HH expenditure).

This box helps you to calculate the amount spent per month on food and groceries *excluding* the cost of fuels(s) if they have been included in the food bill.

Example of a calculation

Electricity and **kerosene** are purchased together with food and groceries.

Step 1:
For monthly spending on electricity,
go to Section D, D29 (credit meters) or Section D, D43 (pre-payment meters) and copy here:

Total expenditure on electricity/month……

Step 2
For monthly spending on kerosene (paraffin),
go to Section E, E06 and copy here:

Total expenditure on kerosene/month……

Step 3
Add monthly total for electricity and kerosene.

Monthly total for fuel(s) purchased with food and groceries *Amount (b)…….*

Step 4
Total monthly food and groceries expenditure (given by respondent)
Amount (a)……

Step 5

Deduct the amount (b) from the amount (a)

Amount (a)……
Amount (b)……
Amount spent on food and groceries excluding fuels ……..
This is the amount to be written on line 'a' of the Expenditure Table for the monthly expenditure on food and groceries.

Some items such as furniture, appliances, school or tertiary education fees are generally yearly expenses**.** The amounts should be written under 'yearly'.

Other expenses may occur more irregularly such as expenses on medical care. Interviewers should probe as to how much the household has been spending over say two years and divide this amount by 2. Write the amount under amount per year.

Section M: Family Health

The last section concerns the health of the household members.

M3 asks if anyone in the household has needed medical treatment in the last 12 months.

M11 concerns children under the age of 14 years who have been treated (at home, or in hospital) for one or more of five illnesses. To fill in the Table, write the first name of each child and fill in under the relevant illness, the word “Home” if the child was treated at home and “Hosp”. if the child was treated in hospital. Should a child have died of one of the five illnesses, write the first name of that child in the space provided and tick the space under the illness that caused the death.

M17 - M24 Asks if other members of the household of whatever age have suffered from respiratory diseases in the last 12 months. You should fill in the first name(s) of household members and their relationship to the head of the household.

M25 asks how well in terms of health the household is at the moment. Read all four possible replies before the respondent answers.

CLOSING THE INTERVIEW

Closing the interview is as important as beginning it. Your respondent has given up his/her time for the interview and their answers provide an important part of the study. The respondent and the household should be thanked appropriately. Remember that you may have to return to the household should there be gaps or inconsistencies in the answers.

AFTER THE INTERVIEW.

As soon as possible after the interview, please fill out the final page that asks for your comments and evaluation of the interview. Remember that your comments concerning unusual or difficult situations in the household are invaluable in understanding and interpreting responses to the questions. It is important that you fill in the question on the use of an interpreter.

It is extremely important that interviewers thoroughly check the completeness of answers and obvious inconsistencies whilst the interview is still fresh in their mind. If necessary, the interviewer should return to the household for the missing or inconsistent information.

Your own efforts and patience in conducting the interview are of course invaluable. The research would not be possible without your skills and expertise.

Appendix 5: Community Questionnaire 2003

Energy Use and Supply Survey

Country: Senegal [1] Ghana [2] Botswana [3] Honduras [4]

Name of community……

Region…….

Date of interview……

Cluster……

Name of interviewer/enumerator…….. **Code**……..

GUIDELINES
Introduce yourself and explain that this research is part of a study being undertaken by a large international organisation in three African countries and Honduras. The study aims to gather information about the shared environment in which households operate from community members who are particularly knowledgeable about key subjects rather than from each household individually. Data collected at the community level enhances the usefulness of data collected at the household level. Please share the information below with the informants.

1. Defining "Community:" The cluster in which the survey is being undertaken should be regarded as the "community."

However, it may not be possible in some instances to separate out a specific cluster from the broader community or a group of clusters or enumerated areas. In these cases it may be necessary to define the community as consisting of a group of clusters or enumerated areas, village, groups of areas controlled by a chief or induna, a whole suburb or neighbourhood in a city.

What is your full name?	Gender *Male* [1] *Female* [2]	How old are you? (last birthday) *Years*	If you have an occupation and position in this community, give both.	What is the highest level of education you have attained?	How long have you lived in this community? *Less than 1 year* [1] *1 to 3 years* [2] *4 to 5 years* [3] *More than 5 years* [4]

2. Explain to the respondents that they have been invited to this meeting so that they can tell us about their community. We would like to know how they live in the community, what the characteristics, public services, the type of energy fuels members of the community use, what are the problems they have in the community and what can be done to resolve them.

3. Only one questionnaire is to be filled in for a cluster. Where clusters are adjacent, one community questionnaire may
be adequate for more than one cluster.

4. The community questionnaire must be completed by a field supervisor or field manager. The informants will be
6 to 8 informed people in the community, e.g. town clerks, community leaders, energy service personnel, shopkeepers, farmers, teachers, doctors/nurses, indunas and chiefs, ministers of religion etc.

Participants/List of people interviewed/Respondents

Section1: Characteristics of the community

1. Type of area / settlement
Urban informal planned [1] Urban informal unplanned [2] Peri – urban informal planned [3] ☐
Peri-urban informal unplanned [4] Traditional (remote) rural village [5]
Rural settlement [9] Other (specify)……

2. How long has the community been in existence?
More than 20 years [1]
Between 10 and 20 years [2] ☐
Less than 10 years [3]

3. What are the principal population groups represented in this community? (*List the largest group first*)

a	
b	
c	

4. What is the number of households in this community? ☐

5. How many people live in this community? ☐

6. Since 1998 (the last 5 years), the inhabitants of this community
Have increased [1]
Have decreased [2]
Have stayed the same [3] ☐

7. For you, what are the 2 principal reasons that the number of people in the community (response to Q 6)

a)……
……
b)……
……

8. Now lets talk about living conditions of the households in the community.
Since 1998 (last 5 years) would you say that the living conditions of the households:

Take into account opportunities to work, security of the people etc.

Have improved? [1]
Have gotten worse? [2]
Stayed the same? [3] ☐

9. What are the principle reasons that the living conditions of the community have (response from Q8)

a)……
……
b)……
……

Section 2: Infrastructure in the community

We would like to know what physical infrastructure the community has. Furthermore, we would like to know about transportation and services in this community to places that community residents sometimes use, such as post offices etc.

	10.In this community is there a […]? *Yes [1]* *No [2]*	**11**.For those facilities/services outside the community, indicate how far from the community is the closest [….]? **UNITS** *Meters [1]* *Kilometers [2]* *Miles [3]* *Does not exist [4]*	**12**.To go to […] what mode of transport is being used by the majority of people in the community? *On foot [1]* *Horse [2]* *Boat [3]* *Bicycle [4]* *Motor cycle [5]* *Private Car /van / truck/ [6]* *Ambulance [7]* *Bus/ van / taxi [8]*

			Ambulance [9] *Don't know [10]* *Other (specify)……*
	Code	Distance Unit	
Grocery store/supermarket			
Telephone service			
Post office			
Police station			
Place of worship			
Bank			
Adult education/skills training facility			
Nurse/Doctor			
Clinic			
Hospital			
Petrol station			
Cafés, restaurants, places of entertainment			
Sports facilities			
Fire brigade/house			
Pharmacy			
Regular market			
Railway station			
Other (specify)			

13. What in your opinion are the two principal problems with public transport service? Mark the two most serious problems

Insufficient buses [1]

The routes are far away [2]

Don't keep to the schedules [3]

Buses in bad condition [4]

Taxis are in bad condition [5]

Other (specify)……

14. Which specialists are found in your community?

Professionals and technicians	**Are located in the community** Yes [1] No [2]
Plumbers	
Electricians	
Builders	
General handyman	
Other (specify)…….	
…….	

15.What type of road serves the largest or central village/part of city in the cluster?

Paved……[1]
Tarred…..[2]
Dirt or unpaved…[3
No road…..[4]

Social networks

Which of the following organizations are in the community? What portion of the community is a member of the different groups?

	16.[……] exist in the community. *Yes [1]* *No [2]*	**17**.What portion of the community belongs to each of these groups that exist in the community? *Majority [1]* *More than half [2]* *Half [3]* *Less than half [4]* *Negligible [5]*	**18**. List the three most influential (in order of influence) of these groups. *Most influential [1]* *Influential [2]* *Less influential [3]*
Women's group			
Farmers group			
Environmental group			
Scouts/girl guides			
Youth group			
Health committee			
Electricity action group			

Cooperative (agricultural)			
Savings group			
Others (specify)			

Section 3: Community services

Let's continue this interview talking about the public services that are found in the community. We'd like to know what type of services you have, what is the quality of the services, what are the principal problems**.**

Electricity services

19.Does this community have electricity inside their dwellings/houses? ☐

Yes [1] No [2]

***If yes,* 20** How many years has it been since electricity was installed?

More than 20 years [1]
10 to 19 years [2]
5 to 9 years [3]
1 to 4 years 4] ☐
Less than 1 year [5]

21.What portion of the community has electrical energy in their dwellings/houses?
All of the community [1]
More than half [2] ☐
Half [3]
Less than half [4]

22 As a result of the electrification of this community, the general welfare of the community

Has improved significantly [1] ☐
Has improved [2]
Has remained the same [3]
Has deteriorated [4]

23.For what reason has the welfare (Response from Q22)
…….
…….
…….

24.Is the main electricity supplier to this community a
National public supplier? [1] ☐
Municipal/local supplier? [2]
Private supplier? [3]
Other (specify)……..

25.Does the community have public lighting in the streets? ☐
Yes [1] No [2]

If no, GOTO **29**. ***If yes,* 26** How many years has there been public lighting?

More than 20 years [1]
10 to 19 years [2]
5 to 9 years [3] ☐
1 to 4 years 4]
Less than 1 year [5]

27.What is your opinion about the quality of public lighting?
Good [1]

Satisfactory [2]
Bad [3]

28.The public lighting covers
All of the community [1]
More than half [2]
Half [3]
Less than half [4]

Strength of electricity supply

29.What is the level of electric supply the majority of households have?
2.5 A [1] 5A [2] 8A [3] 2X5 A [4] 20 A [5] 60 A [6] Other (specify)…….

Legal Electricity connection
30. How much do the households pay to get an electricity connection?
Amount in local money……..

31.What are the conditions to get a connection?
Must be employed? [1] Must own a house? [2] Must have bank account [3]
Must make a down payment [5] Other (specify)……..

Power failures
32.How often are there power failures in your area?
Every day [1] Several times a week [2] Once a week [3] Several times a month [4]
Every 2 to 3 months [5] Seldom/occasionally [6] Never [7] Other (specify)…….

33.How long do power failures generally last?
Few hours [1] 1 to 3 days [2] 4 to 7 days [3] 1 to 2 weeks [4] 3 to 4 weeks [5]
1 to 4 months [6] Other (specify)…….

34.In the event of power failures, what other fuels do the households use for **lighting** and **cooking**?
Complete the table below.

	Lighting	**Cooking**
Diesel/petrol generator [1]		
Candles [2]		
Kerosene (paraffin) [3]		
Torch batteries [4]		
Car batteries [5]		
Gas [6]		
Solar [7]		
Dung/crop residues [8]		
Fire wood [9]		
Charcoal [10]		
Other (specify)		

"Brown-outs"

35. Does this community experience 'brown-outs' (dimmed lights)? Yes [1] No [2]

36. *If yes*, how often are there brown-outs in your area?
Every day [1] Several times a week [2] Once a week [3] Several times a month [4]
Every 2 to 3 months [5] Seldom/occasionally [6] Never [7] Other (specify)…….

37.How long do brown-outs generally last?
Few hours [1] 1 to 3 days [2] 4 to 7 days [3] Other (specify)…….

Customer relations

38.Does the local /national electricity supplier have a customer relations service?
Yes [1] No [2] Don't know [3]

39.*If yes*, is the customer relations service
Totally ineffective/non-existent [1] Adequate, but could be improved [2]
Provides good service [3] Provides excellent service? [4]

40.If you have had any contact/interaction with your electricity supplier, tell us more about this
……
……

Piped and non-piped water

From what source does the majority of households get their water? What is the quality?

Source	**41**. From [……] the majority of households get their water.	**42**. What is the quality? *Good [1]* *Satisfactory [2]* *Bad [3]* *Not applicable [4]*
	Code	Code
Piped in house [1]		
Public tap [2]		
Tank/rain water[3]		
Hand pump [4]		
River/stream [5]		
Well [6]		
Spring [7]		
Other (specify)		

43. In this community are there households that carry water to the dwelling?
Yes [1] No [2]

44. *If yes*, which members of the household carry the water most of the time? *One answer only*.

Female children [1]
Male children [2]
Adult women [3]
Adult men [4]
Old men [5]
Old women [6]
Other (specify)…….

Drainage – sewers

45.What is the principal method used by residents of the community to dispose of sewerage?
Water-borne sewage system [1] Septic tank [2] No particular methods [3]

Education

We'd like to know if the community has pre-schools, primary schools and secondary/high schools, how many youngsters attend and what are the principal problems these schools experience.

Type of school	**46**. Number Private	**47**. Number Public	**48**. Total Number
Pre-primary/crèches			
Primary school			
Secondary/high school			

49. How many boys and girls under 7 years attend pre-school (s)/ /crèches?
All attend [1]
The majority attend [2]
Half attend [3]
Few attend [4]
Very few / almost none attend [5]

50. How many boys and girls of school age attend primary school (s)?
All attend [1]
The majority attend [2]
Half attend [3]
Few attend [4]
Very few / almost none attend [5]

51 .How many young people of secondary/high school age attend secondary school (s)?
All attend [1]
The majority attend [2]
Half attend [3]
Few attend [4]
Very few / almost none attend [5]

52. What are the TWO principal problems with each of these public educational institutions?

Pre-primary school//crèches	Primary school	Secondary/high school
a)	a)	a)
b)	b)	b)

Irrigation system
53 Is there an irrigation system for the land? Yes [1] No [2]
If no, GOTO Section 4.

If yes, **54** What energy resource is most commonly used to power the irrigation system?
Electricity [1]
Diesel/petrol [2]
Kerosene [3]
Solar energy [4]
Battery system [5]
Wind energy [6]
Manual/mechanical [7]

55. What portion of farmers has access to an irrigation system?
All the farmers [1]
More than half [2]
About half [3]
Less than half [4]
Very few [5]

56. What are the two principal problems with irrigation?
a)……
b)……

Section 4: Fuels

Now we would like to ask you about the most commonly used fuels the households in your community use.

Sources	**57**. What portion of the households uses this source as their **first** most commonly used fuel?
	All of the community [1] *More than half [2]* *Half [3]* *Less than half [4]* *None [5]* **Code**
A. Electricity	
B. Charcoal	
C. Gas	
D. Kerosene (paraffin)	
E. Firewood for collection	
F. Firewood for purchase	
G. Coal	
H. Other (specify)	
…….	
……	

58. How has the introduction of electricity in the community influenced the sale of the following fuels?

Fuel	**Increased**	**Stayed the same**	**Decreased**
Kerosene (paraffin) [1]			
Batteries [2]			
Candles [3]			
Firewood [4]			
Coal [5]			
Gas [6]			
Other (specify)……..			

59. Do members of your community experience barriers to using electricity? Yes [1] No [2] ☐

60. *If yes*, what are the barriers?

……
……
……

61. Do members of your community experience barriers to using gas? Yes [1] No [2]

62. *If yes*, what are the barriers?

……
……
……

Section 5: Health

We are going to talk about the illnesses that affect the community, medical service at the health center and the major health problems affecting the community.

63. What is the infant mortality rate in your community?
High [1]
Low [2]

64. Does the health centre or clinic usually have SUFFICIENT (……) to attend to the needs of the residents?

CODES : Yes [1] No [2] There are none [3]

Medicines		Hospital beds	
Equipment or instruments		Ambulances	
Medical personnel		Other (specify)	

65. Since the households in your community have had electricity connections, has the health of the community improved? Yes [1] No [2]

66. *If yes*, please explain in what way……
……
……
……

67. What is the level of malnutrition in this community?
Very widespread [1]
More than half [2]
Half [3]
Less than half [4]
Very rarely [5]
Not at all [6]

68. What are the major health problems in this community? *List in order of importance*.
a)……..
b)…….
c)…….

Section 6: Work

In this part of the interview we are going to talk about the work that residents of this community do and
the opportunities people have to find work.

What are the TWO principal jobs/occupations/professions that are done by the Men and Women of the community?

	69. Work category 1	**70. Work category 2**
Men		
Women		

71. In you're opinion, how many men and women work (fulltime, part-time and piece-jobs) in this community?
The majority [1]
More than half [2]
About half [3]
Less than half [4]
Very few [5]

Section 7: Current problems in the community

72.What are the 2 principal problems or needs of the community that you consider require solutions most urgently?

a)……
……
b)……
……

73. Is there any government agency /institution or organization (NGOs) that are helping with any specific programme
or are giving assistance to the community? Yes [1] No [2] ☐

74..*If yes*, please explain in which way……
……
……

Section 8: Poverty

Now let's talk about the theme of poverty. We'd like to know what you think of poverty and what are its causes.

75. In your opinion, what are the main types of poverty your community experiences?…….
……
……
……
……

76.What would you say are the TWO principal causes of poverty in your community?

a)……
……

b)……
……

77. If you had to rate your community as a non-poor community, a poor community or a very poor community, what would you rate your community?

Not poor [1]
Poor [2] ☐
Extremely poor [3]

78.Why do you say this?……..
……
……
……
……
……
……

79. In this community are some people poorer than others? Yes [1] No [2] ☐

80. How many [proportion] poor people are there in this community?

All [1]
More than half [2] ☐
About half [3]
Less than half [4]
Few [5]
None [6]

Section 9: Fuel price list

Now we would like to know the price members of this community pay for the following fuels. Use two different shops most commonly used by the community to obtain prices of fuels. For example, in some rural areas the first source could be the "local", which includes a local shop and local vendors; the second source could be the "closest urban area" that is most often used by the people in the community. *Give the amount in local money*.

Fuels	**81. Shop 1 (*local money*)**	**82. Shop 2 (*local money*)**
Electricity/kWh		
Coal/kg		
Charcoal/kg		
Kerosene (paraffin)/litre		
Firewood for purchase (indicate unit i.e. head load)……		
Gas cylinder only – without gas. (Indicate cylinder size in kg) ……kg ……kg ……kg	 …… …… ……	 …… …… ……
Refill of Gas - cylinder with gas. (Indicate cylinder size in kg)…….. kg ……kg ……... kg	 …… …… ……	 …….. …….. ……
Candles (single)…… Candles (packet of six)……	…….. ……	…….. ……..
Other (specify)		

General comments

83. Under general comments you might include how the respondents received you and tell us about any difficulties/problems experienced by that particular community.

……
……
……
……
……
……
……
……
……

Appendix 6: Notes for Supervisors

Community Questionnaire

Energy use and supply survey

Introduction
Collecting community data is desirable for two reasons. First, the government programmes and services that affect individuals are often implemented and provided at community level. Thus household surveys that collect information both at household and community level yield more policy-relevant data than those that only collect household data. Second, it is efficient to collect information about the shared environment in which households operate from community leaders or community members who are particularly knowledgeable about key subjects rather than from each household individually.

These additional data are collected in a community questionnaire that is administered separately from the household questionnaire. The informants (called 'informants to distinguish them from the 'respondents' to the household questionnaire) include community members, market traders, and staff at relevant facilities and institutions such as nurses and teachers.

The community-level information collected in this survey includes information on infrastructure, employment opportunities and access and use of fuels. The community-level data enhance the usefulness of data collected at the household level.

Policy issues analysed using community-level data
Government programmes often aim to provide services within a specific geographical area on the assumption that the services benefit individuals and families living in the area. Because the community is the level to which governments often target interventions, it is sensible to collect data on how government programmes work by measuring the extent to which the services they provide actually exist at the community level.

Data on access to facilities and services can be combined with data on individual characteristics such as age, sex, education, and income level to evaluate whether the relationships between access and use differ among individuals. These relationships may be of particular interest if programmes are intended to benefit certain groups. For example a community energy centre supported by government, was set up to give access to less expensive fuel to the poor. The energy centre sells kerosene for 25% less than the local shop but many of the poorest households continue to buy the more expensive kerosene at the local shop. (We are still investigating. Our hypothesis is that the local shop gives people credit and will refuse to do that if customers take their fuel purchases elsewhere).

It is also possible to use data on labour in conjunction with community-level information on infrastructure to explore how activities in the labour force vary

depending on how much of what kind of infrastructure is available to the community. Vijerberg [1] (1998) found that in rural Vietnamese communities, important determinants of the decision to start up a nonfarm enterprise include the availability of electricity and piped water at the community level, the availability of a market that is frequently open, and the presence of a secondary school.

Defining a community

Defining the term "community" is difficult because even within countries communities are extremely heterogeneous. In the context of our survey the term "community" refers to a spatial unit that contains the households included in the survey sample, that has characteristics common to its residents, and that is of social, economic, or physical significance to its residence.

For our purpose it appears useful to define the community as the most appropriate low-level administrative unit. The reason being:

- An administrative unit is a well defined geographical area to which informants can easily relate.
- Measuring access to programmes is an important goal and the benefits of programmes are often allocated by administrative units.
- Administrative units are usually run by people whose responsibilities imply that they are knowledgeable about many of the topics dealt with in the community questionnaire.
- Some data broken down by administrative unit may already exist at the central government level.

To define a community in urban areas is more difficult. It is argued that urban residents have access to such a wide range of resources that the location of a household is an insignificant determinant of the opportunities and constraints faced by its members. However, there is no conclusive evidence that urban residents are unaffected by measurable aspects of their environment. Also, the urban/rural divide is a continuum rather than a clear cut distinction.

In defining an urban community the structure of local government may be a good guide in some countries, while elementary school catchment areas or postal zones (with accompanying maps) might be appropriate in others.

Administering the community questionnaire

The supervisor will be responsible for administering the community-level questionnaire. One questionnaire will be completed for each of the Primary Sampling Units (PSU) visited by the field teams.

Identifying information and description of the community

The first page of the questionnaire contains identifying information for the PSU and details on those questionnaires which have been filled out: the date each was completed, and the names and occupations of the people providing information.

[1] Vijerberg, W. 1998. "Nonfarm enterprises in Vietnam" In david Dollar, Paul Glewwe, and Jennie Litvack, eds., *Household Welfare and Vietnam's Transition to aMmarket Economy.* Washington, D.C.: World Bank.

Write the name of the province and community in the space provided in the top left-hand corner of the front page of the questionnaire. In addition, write your own name and code number in the space provided.

Write the date each questionnaire was administered in the space provided on the front page, and the name, title and position of the person(s) providing information.

Informants

Rural areas

Information for this questionnaire is typically obtained from one or more interviews with a small group of local villagers, who may include farmers, local officials, the school teachers, the health worker, and other senior members of the village.

Your discussion with the group of villagers should take an estimated one hour to complete. When completing the questionnaire, the pattern of discussion should be maintained. Familiarity with the questionnaire is very important. You may either take notes and later fill in the questionnaire, or fill in the questionnaire in front of the respondents.

Urban areas

This questionnaire should be filled in for all urban PSUs in the survey.
As these are typically smaller than rural PSUs, most of the questions can be taken to refer to the entire PSU. The major difficulty in completing this questionnaire for urban areas lies with the definition of "the community." For convenience, attempt to equate the community with the physical boundary of the PSU.

It will be more difficult to find respondents in urban communities than in rural areas. You should attempt to contact knowledgeable people, such as community leaders, or shopkeepers and teachers. The information is likely to be obtained in a number of brief interviews and conversations rather than a single interview with a group of knowledgeable individuals.

As for rural areas, the information abtained will reflect opinions of respondents, and you must be careful to resolve inconsistencies in the information without giving offence to the respondents.

Most of the questions are self-explanatory. Below are specific instructions for selected questions.

Instructions

Questions 1 and 2. Obtain information on the population of the PSU and number of household residing in the PSU from local residents. *Do not use the information provided on the household listing forms, which may be a number of years out of date.* If necessary ask the local official for his estimate of the number of persons and households residing in the PSU.

Question 5 If the respondents say that the community has always been there, write as long as people remember.

Question 6 This would be an urban centre where people sometimes travel for specialised services or shopping.

Question 8 The economic activities have to be determined for each country. If they are not known before the survey is administered, they have to be coded after the questionnaire is filled in.

Question 9 and 10 If there were any particular national or local events to which the change in the condition of the community can be related, try to probe further and write the answers under question 10.

Question 12 and 13 Have new factories been opened, have existing ones been closed, have public works programmes started, have new subsidies or new marketing strategies in agriculture been introduced? Is increased unemployment due to many young people, eg., school leavers, entering the job market?

Question 14. Include the beginning and duration of the project and the name of the organisation which supported and/or financed the project.

Question 15 to 20 are questions about access facilities to services. They are straight forward and intend to give a picture of how well or poorly infrastructure is developed in the community.

Questions 26 to 42 ask about access to fuels and barriers to access. Add any further remarks for which there is no space provided here under comments at the end of the questionnaire.

Question 26 to 29. When asking about gas it is important to make a distinction between the gas cylinder or gas bottle and the gas refill.

Comments and description of important characteristics of the community.

This part gives very important background information for analysis of the data and it will be reviewed very carefully by the analyst. Under comments you might include, how you were received and any difficulties in that particular community.

Under the important characteristics you might include such things as the village store selling gas cylinders since a few months, improvements to the water system, any widespread illnesses, or a propensity for residents to travel away from the village for work. If, for example, the PSU is located some 20 km outside a major town and residents often travel to the town for work, please make note of it on this page. The more information you provide on this page, the better.

Appendix 7 Sampling Notes for Household Fuel Use and Supply Survey 2003

Introduction
The main objective of this survey is to understand household fuel use and supply. The sample is small in size about 300 households. The sample should be so designed as to give a fair representation of the population of the country as a whole as well as that of the subgroup this study is particularly interested, the poor population.

Selecting a sample to represent some larger population is the most common data production task, the one that lies behind opinion polls, government economic statistics, and much social science research. Human choice, either by the selector or by respondents who volunteer their voices, often produces samples that systematically misrepresent the population.

A data analysis is a journey of discovery. At each step we try to learn more about the data. The essence of data analysis is 'to let the data speak', to look for patterns in the data.

Confidence intervals

Classical inference attaches to its conclusions a probability statement that expresses our confidence in the method used to draw the conclusion. The reasoning is clearest for confidence intervals. We wish to estimate from data some unknown parameter[2], let us call it Θ (theta) for convenience, of the underlying population. The data produce an estimate of the unknown Θ, call it T. It is never satisfactory to report simply that T is our estimate of Θ, for we have given no indication of the uncertainty in our result. A confidence interval has two parts: a recipe for computing an interval from the sample data, and a confidence level, the proportion of all samples for which the interval will cover the true value of Θ.

In these notes we have covered some important aspects of sampling without letting it become too mathematical.

Some basic ideas of sampling

Probability sampling uses a random device, like the toss of a coin or a table of random numbers, rather than human judgement, to decide which members of the population are to be included in the sample.

When the sample is drawn by probability methods, the theory of statistical inference can be brought to bear on the analyses of the results. Another crucial reason to use a probability sample is to avoid bias.

[2] A parameter is a numerical characteristic of the population. It is a fixed number, but we usually do not know its value.
A statistic is a numerical characteristic of the sample. The value of a statistic is known when we take a sample, it changes from sample to sample.

Samples are to be drawn in two stages. In the first stage, a certain number of area units, primary sampling units (or PSUs) are selected. In the second stage, a certain number of households are selected in each of the designated PSUs. Both stages are random selections.

Ideally, the first stage of sampling requires developing a sample frame (list of all PSUs) from census files. The second stage requires listing all households in the selected PSUs and then choosing a random sample of these households for the final sample.

To derive unbiased estimates from the survey, the values observed in the sample may need to be weighted. To compute the needed raising factors and correct the sampling errors, all stages of sampling must be carefully recorded and made available to the survey analysts, both in written documents and in the data sets.

ISSUES IN SAMPLING DESIGN

Methods of Probability Sampling

The simplest kind of probability sampling is simple random sampling (SRS). SRS gives every unit in the sample frame an equal chance of being included in the sample, and it also has the property that all samples of a given size are equally probable.

SRS is thus equivalent to writing the name of each unit, eg., households, in the sample frame on a slip of paper, mixing the slips of paper very thoroughly, and then drawing a sample containing the required number of slips of paper. The crucial step in this procedure is the mixing, and ample evidence indicates that physical mixing, although often dramatic and quite convincing, is exceedingly difficult and usually fraught with failure. Hence tables of random numbers which are widely available, can be used to choose a sample; each unit in the frame is given a serial number, and the sample consists of those units with serial numbers corresponding to the numbers drawn from the table.

Inference from an SRS is straightforward. Let us assume that we are interested in the average income in the South African population, μ, and that we can draw a SRS of 1500 individuals, that every individual chosen for the sample responds, and that all the respondents report their income accurately and honestly. These two assumptions are often violated. We know that the distribution of incomes in the population is highly skewed – many poor and middle income people and a few very rich one – but that fact need not trouble us here.

Central limit theorem tells us that, if we draw repeated samples of the same size

$$(y_{11}, y_{12}, \ldots, y_{1n}),\ (y_{21}, y_{22}, \ldots, y_{2n}), \ldots$$

from this population, calculate the average ($\bar{y}$)of the incomes of the individuals in each sample, and from the distribution of these averages, the resulting sampling distribution of the sample mean will be approximately normal. Moreover, the mean of that sampling distribution, $\bar{y}$, equals the population mean μ. Thus we can use $\bar{y}$ as an estimator of μ. Furthermore the standard deviation of the sampling distribution is

$$\sigma_{\bar{y}} = \frac{\sigma}{\sqrt{n}}\sqrt{1-\frac{n}{N}}$$

Where n is the size of the sample, N is the size of the population, and σ is the standard deviation of the original population.

The standard deviation of the sampling distribution of the sample mean is known as the standard error of the mean.

For a large sample, a particular sample mean, $\bar{y}$, can be considered an observation from a normal distribution with known standard deviation. We can then make probability statements based on the normal distribution, from which we can derive, for example, the usual 95% confidence interval.

$$\bar{y} \pm 1.96\frac{\sigma}{\sqrt{n}}\sqrt{1-\frac{n}{N}}$$

We have here tacitly assumed that we know σ, the population standard deviation. In practice we would seldom know σ when μ is unknown. Nevertheless we need to know σ in order to derive the standard error of the mean to construct confidence intervals based on the normal distribution. When σ is unknown, it is customary to use the sample standard deviation,

$$s = \Sigma\sqrt{\frac{\sum_{i=1}^{n}(y_i-\bar{y})^2}{n-1}}$$ as an estimate of σ.

Then we base confidence intervals and other inferences on student's "t" distribution with n – 1 degrees of freedom. For the sample sizes usual in surveys, however, student's "t" distributions are practically indistinguishable from the normal distribution.

As the most easily understood method of sampling SRS often serves as a touchstone to evaluate other method of sampling. Because SRSs are sometimes difficult and expensive to draw, samplers often use two convenient variations on SRS instead:

i Systematic random sampling
ii Probability sampling with quotas

Further, when an investigator needs to make comparisons among subgroups of the population, an SRS may not ensure coverage of some subgroups to support inferences. In such a case an investigator can turn to stratified sampling, which often has the additional advantage of reducing the standard error of $\bar{y}$. Still further, SRSs take no account of the geographic location of the units chosen for the sample. If telephone interviewing is to be done, the geographic scattering of the units does not matter much; but if interviewers must visit every household in person, scattering

incurs large travelling costs. The device of cluster sampling reduces such costs. Finally, SRS requires a complete listing of the population in the frame, but for many populations such as the adult population no listing exists. Multistage probability sampling, which combines both stratification and clustering, reduces the need for such listings to a fraction of the population.

Systematic Random Sampling

Systematic random sampling uses an interval I (interval) = $\frac{N}{n}$, rounded down to the nearest integer for convenience. Then a single random number, $r \leq i$ is drawn; the sample consists of units with serial numbers r, r + i, r + 2i, ... This method entails less effort than drawing a SRS; and unless the ordering of the frame involves periodicity (a rare situation in practice), it gives results comparable to SRS.

Old fashioned quota sampling allowed interviewers to choose their own respondents as long as they met quotas for each sex, age group, race, etc. Professional survey takers currently use probability sampling with quotas with multistage area probability sampling down to the block level and then controls on such variable as gender, age, and employment status. This technique more often produces usable results.

Stratified Sampling

Stratified sampling divides the population into the subgroups of interest or into other homogenous groupings (on the basis of some variable that is easily measured a priori and that is thought to be related to the major variable under consideration).

Thus, if we were trying to estimate the average income of the South African population we might stratify by race, by marital status, or by geographic area. We would then draw an independent probability sample from each of the specified strata.

If N is the total number of units in the population and N_j is the number of units in the j^{th} stratum, we can define $\omega = N_j/N$ as the proportion of the population in the j^{th} stratum. Then we can estimate the population mean by the weighted mean of the stratum means $\bar{y}_j$

$$\bar{y}_{strat} = \Sigma \omega_j \bar{y}_j$$

Similarly, the standard error of $\bar{y}_{strat}$ is given by

$$\sqrt{\Sigma \omega_j^{\,2}}\ \mathrm{var}(\bar{y}_j)$$

Note that var ($\bar{y}$) is computed using deviations around the stratum mean. If the strata are very different from one another, the standard error attached to a mean calculated from a stratified sample is likely to be much smaller than the corresponding error for an SRS.

Statisticians have proposed several schemes, to help investigators, decide the size of the sample (n_j) to be drawn from each stratum. The simplest of these is proportional

allocation, where $n_j/N_j = f$ for all j, and we can speak of a sampling fraction of f = 0.1 or 0.01, say across strata. Such a sample is called self-weighting, because we can calculate the overall sample mean as the simple mean of the observations y_{ik}

$$\frac{1}{n}\Sigma y_{ik} = \bar{y}_{stratprop} \quad \text{where } n = \Sigma n_j$$

If however the strata differ in variability, an allocation that samples more heavily from more variable strata can reduce the standard error of the overall estimate, at the cost of requiring weighting calculations. An intuitive feel for this idea derives from considering two strata, one in which all the units are identical on the variable of interest and the other in which the units differ over a wide range. A single observation of the non-varying stratum is sufficient to estimate the stratum mean, whereas the more variable the units in the varying stratum, the more observations we need to locate the mean. Cost considerations also affect allocation. Other things being equal, it makes sense to draw fewer units from strata where observations are expensive than strata were observations are cheaper. In practice the design balances variability against cost.

Stratified sampling aims to divide the population into strata that are as different from one another as possible and as internally homogenous as possible. Cluster sampling does the opposite. Here a sampler divides the population into subgroups that are typically compact geographically but as diverse as possible internally – ideally each cluster should mirror the entire population. Then the sampler uses a probability sampling method to choose several of the clusters to constitute the final sample. Cluster samples often reduce travel cost for the interviewer. Most large sample surveys combine clustering, stratification and systematic sampling in a complex procedure known as multistage area probability sampling.

Non-sampling errors

We have assumed here an ideal world. Among other things we assumed that the sampling frame is an accurate representation of the population to which we want to generalise, that everyone chosen provides the information requested, that the researcher and respondent share the same definition of all the concepts involved, that respondents remember correctly and tell the truth, and no one makes a mistake in copying down the answer. Violations of the assumptions – non-sampling errors – have attracted much interest, for in some ways non-sampling errors are harder to understand and control than sampling errors.

Some non-sampling errors are essentially random, and they tend to cancel as the sample size increases, though they will increase the variance of the estimates. Other non-sampling errors tend to accumulate and cannot be decreased just by increasing the sample size.

Non-sampling errors can be subdivided into i) non response errors, people are left out of the frame, left out of the sample, or do not answer some specific questions, ii) response or measurement questions, answers are obtained but are in some sense wrong.

Response errors have a long history in survey research. Some of the issues explored include the following

i the tendency of respondents to give socially or otherwise desirable answers
ii failures of memory
iii differences in interviewer behaviour across respondents or different respondent reactions to interviewers by such variables as gender, race, and social class.
iv mismatch between the meaning of the question as intended by the researcher and the meaning understood by the respondent
v differences in answers related to the mode of administering the interview (by mail, by phone, or person)
vi characteristics of the question itself, long or short, open-ended or with explicit response alternatives, presented in a positive or negative manner, and so on)
vii the context of other questions in which a particular question is embedded and the ordering of questions in an interview or questionnaire
viii whether the answer is given by the person directly concerned or by a proxy respondent

Without substantial efforts to curb non-response, lowered response rates in major national data collection programs may render survey results practically and scientifically useless.

Picking the sample size

How many observations should we take? If three things are specified;

i The confidence level, $1 - \alpha$, which determines z (determines it to be $z_{\frac{\alpha}{2}}$). For example, a 0.95 (or 95%) confidence interval determines z to be $z_{0.025} = 1.96$.
ii σ, which defines the variability affecting individual observations.
iii d, which defines how small an allowance is desired. In other words it's absolute difference between the estimate and the true value.

Then n, the sample size, corresponding to the above condition, is defined by the following equation

$$\text{n (the sample size)} = \left(\frac{z\sigma}{d} \right)^2 \ldots .$$

Note that n must grow as z grows, that is, as the desired confidence is increased. It must also grow with σ that is natural – greater variability will need to be offset by more observations. Finally, n must grow if d, the desired allowance, is reduced. Note that n varies as the square of σ and 1/d.

An example: An industrial engineer wants to know the average number of defective connections made in the production of computer chipps of a new design. In particular, he would like to be 95 percent confident the sample, he finds in within 10 (defective connections) of the population mean. It is known from previous research that the standard deviation of the defectives per chip 40.

Using equation for ‘n’ above

$$N = \left(\frac{z\sigma}{d}\right)^2 = \left(\frac{1.96 \cdot 40}{10}\right)^2 = 61.4656 \approx 62$$

$$(z_{0.025} = 1.96)$$

The industrial engineer should take a sample of at least 62 chips.

If instead he wanted to be 99 percent confident that the sample mean is within 10 of the population mean, he should have taken a sample of size

$$N = \left(\frac{z\sigma}{d}\right)^2 = \left(\frac{2.58 \cdot 40}{10}\right) = 106.5024 \approx 107$$

$$(z_{0.0025} = 2.58)$$

Sampling error and non-sampling error

Sampling error is the error inherent in making inferences for a whole population from observing only some of its members. Sampling theory studies the behaviour of sampling error for different design options. It is usually assumed that one of the variables to be observed is of particular interest, household income, energy use or unemployment, and that the sample design should maximise the precisions of the estimates of this variable, given cost constraints. Several good textbooks explore this complex issue and it does not need to be specified in detail here. It is important, however, to bear in mind two general conclusions of sampling theory.

1. The law of diminishing returns underlies the relationship between sample size and sampling error. Roughly speaking, and other things being equal, the sampling error is inversely proportional to the square root of the sample size. This means that, even with the best design, to reduce the error of a particular sample by half, the number of households visited must be quadrupled.
2. The sample size needed for a given level of precision is almost independent of the total population. For instance, a 500-household sample would give essentially the same sampling precision whether it is extracted from a population of 10 000 or 1 000 000 households, or indeed from an infinite population. Some people find it hard to believe that the sample size does not depend very much on the size of the population; they feel that the relationship should be more or less proportional. An intuitive grasp of this seemingly

Box 1: How wrong will our estimate be?

Reports in the press of opinion polls often say something like, “Forty-two percent of those polled said they would vote for candidate Jones; the margin of error on this poll is plus minus two percent.”

The reason for the margin of error is that in doing sample surveys we observe only some members of a population rather than the whole population. Any conclusions we draw from studying the members of the sample may be a little different than what we would learn if we could study the whole population.

It is desirable to know how far from the ‘truth’ (what we would know if we studied the whole population) our estimate (what we do know from studying only the sample of the population) may be. Of course we cannot calculate this precisely, because to calculate it precisely would require knowing the ‘truth’. Statistical theory can help us establish boundaries on how large our errors might be, and therefore how much confidence we can put into our estimates.

Suppose we want to estimate the proportion of people who smoke, using data of a sample of the population. We want some predetermined level of certainty that our estimate is not too far from the true value of the proportion. This range is called the confidence interval. The formula used in calculating the confidence interval is

$$CI = \dot{\rho} \pm e \bullet Z_{\alpha}$$

where ρ is the estimate from the sample, e is the estimate of the standard error, and z_{α} is a constant that depends on the degree of certainty, α, we want the proportion of. If we want to be 95 percent certain that the true value lies within the confidence interval, z_{α} would be 1.96. For 99 percent confidence, z_{α} would be 2.58.

Suppose that 28 percent of our sample smokes ($\rho = 0.28$), we have an estimated standard error of 1.5 percent and we want to be 95 percent certain that the true value lies within our estimated interval. The interval in which we have 95 percent confidence that the true value lies would be from about 25 to 31 percent of the population (that is, 28 +- 1.5 ・1.96).

Obviously, we want to have the smallest practical confidence interval. The confidence interval will be smaller, the smaller is the estimate of the standard error. The following boxes discus factors that influence the size of the standard error. To simplify the presentation, the following boxes discuss the true standard error,e, rather than our estimate of it, e. But the intuition is the same for both.

striking statistical fact can be obtained by noticing that, in order to test if the soup is salty enough, an army cook does not need to take a larger sip from the regimental pot than a housewife needs to take from the family saucepan. This does not necessarily mean that the size of a sample is independent of the size of the country. Large countries generally require larger samples, not because they are large but because large countries tend to demand for a larger number

of internal subdivisions. India, for example, would require state-level data from any survey.

Box 2: Sampling error and sample size: a case of diminishing returns

For a simple illustration of the diminishing returns relationship between sample size and sampling errors, consider the case where a proportion (for instance, the proportion of households with pre-school children) is estimated from a simple random sample of n households, extracted from an infinite population. The standard error is:

$$e = \sqrt{\frac{p(1-p)}{n}}$$

The table below gives the values of e for different sample sizes and p = 50%:

Sample size (n):	100	200	500	1000	2000	5000	10000
Standard error (e):	5.00%	3.54%	2.24%	1.58%	1.12%	0.71%	0.50%

Notice that in order to reduce the error from 5.00% to).50% (a tenfold reduction), the sample must be increased hundredfold, from 100 to 10 000 households.

Non-sampling errors

Beside sampling errors, data from a household survey are vulnerable to other inaccuracies from causes as diverse as refusals, respondent fatigue, interviewer errors, or the lack of an adequate sampling frame. These are collectively known as non-sampling errors. Non-sampling errors are harder to predict and quantify than sampling errors, but it is well accepted that good planning, management and supervision of field operations are the most effective ways to keep them under control. Moreover, it is likely that management and supervision will be more difficult for larger samples than for smaller ones. Thus one would expect non-sampling error to increase with sample size.

Cluster effect

If the sample of n households is not selected by simple random sampling but in two stages (m households in each of c PSUs, with n = cm) and without stratification, the formula for the standard error should be corrected (see Box 4).

Sampling practice

The Basic Sample Design. The sample size for the Household Fuel Use and Supply survey is small, 300 households. The Primary Sampling Units are area units selected with probability proportionate to size. The second stage units are households with a fixed number of households per PSU, 10 to 15 in this survey. When a partition into differently weighted domains has been defined, the two-stage sampling procedure is conducted within each of them. If the quantitative sampling formula cannot be applied

for good reason then a qualitative judgement should be made and a higher sampling error may be accepted if the non-sampling error could be kept at the desired standard.

Box 3: Sample size and population size

The formula in Box 2 is valid for simple random sampling from infinite population. For a finite population of N households, it should be corrected as follows:

$$E = \sqrt{1-\frac{n}{N}}\sqrt{\frac{p(1-p)}{n}}$$

The term:

$$\sqrt{1-\frac{n}{N}}$$

Is called *the finite population correction*, which essentially depends on the sampling fraction n/N. The table below shows the sample size n that is needed to achieve a 5% standard error for a proportion p = 50% and different population sizes N:

Population size (N)	500	1000	5000	10000	50000	Infinite
Sample size (n)	83	91	98	99	100	100
Sampling fraction (n/N)	0.166	0.091	0.020	0.010	0.005	0.000

A *dwelling* is a structure or group of structures (rooms or buildings), separate or contiguous, occupied by members of the household. It can be:

* a single family house/hut
* a flat/apartment (self-contained)
* rooms (compound house)
* several huts/buildings (same compound)
* several huts/buildings (different compound)

Although the second stage of sampling requires “household listing”, in practice, dwellings are listed instead of households. Strictly speaking, therefore, the samples are samples of dwellings rather than of households, though the listing operation is called “household listing” rather than “dwelling listing”. Some dwellings may be unoccupied and some may be occupied by two households or more, but the large majority of dwellings are occupied by one single household. (The average number of households per dwelling ranges from 0.9 to 1.1 in most countries). If a dwelling with two households is selected in the sample, both are interviewed separately.

Non-Responde and Household Replacement. Some households selected will not be interviewed for one of the following reasons: the interviewer cannot locate the dwelling; the dwelling is uninhabited; the dwelling’s residents are away from home

and expected to remain so until after the end of the survey; or the residents refuse to be interviewed.

Box 4: Cluster effects

If the sample of n households referred to in Box 1 is not selected by simple random sampling but in two stages, (m households in each of c PSUs, with n = cm) and without stratification, the formula for the standard error should be corrected as follows:

$$e^2_{(\text{corrected})} = e^2 [1 + \rho (m-1)]$$

The term in brackets is called the design effect. It represents how much larger the squared standard error of a two-stage sample is when compared with the standard error of a simple random sample of the same size. ρ is the so-called *intra-cluster correlation coefficient* – a number that measures the tendency of households within the same PSU to behave a like in regard to the variable of interest (for example in Box 1, this would be the tendency of households with pre-school children to be clumped in the same PSUs). ρ is almost always positive, normally ranging from 0 (no intra-cluster correlation) to 1 (when all households in the same PSU are exactly alike). For many variables in 'Living Standard Measurement Surveys', ρ ranges from 0.01 0.10, but it can be 0.5 or larger for variables such as access of the household to running water. The table below gives the design effects due to clustering for various values of ρ and m:

Number of households	Intra-cluster correlation (ρ)						
Per PSU (m)	0.00	0.01	0.02	0.05	0.10	0.20	0.50
			Design effect				
5	1.00	1.04	1.08	1.20	1.40	1.80	3.00
10	1.00	1.09	1.18	1.45	1.90	2.80	5.50
20	1.00	1.19	1.38	1.95	2.90	4.80	10.50
50	1.00	1.49	1.98	3.45	5.90	10.80	25.50

Non-responding households cannot be considered to be a random sample of all households. Non-response rates are always higher in urban than in rural areas and higher in rich households than in poor households. They also have a clear tendency to decrease as the survey proceeds and field staff becomes more experienced and persuasive. Surprisingly enough, refusal does not seem to be related to the length of the questionnaire but to the unwillingness of certain people to be interviewed at all.

Non-responding households are replaced by other randomly selected households by means of an explicit procedure that is explained below. All the details of this process (including the codes of the replaced and replacing household and the reasons for replacement) are properly documented, both in the questionnaires and in the computer files, to let each analyst decide individually whether or not to include the replacement households in the data sets being analysed.

The survey managers should carefully monitor all replacements, especially those determined by refusal. Many surveys have demonstrated that refusal rates can be

reduced to a minimum, since refusals often depend on the interviewers' attitude and experience. There is empirical evidence that individual interviewers usually have very different refusal rates. It is useful to stress this to interviewers while monitoring the refusal rate for each interviewer.

IMPLEMENTING A SAMPLE DESIGN

Determining the basic sample design parameters

The decisions about the basic sample design parameters (the number of households in total, per PSU, and per analytical domain) are based on qualitative judgements based on past experience and estimates of cost and manageability. The decisions about the basic sample for a survey of this nature generally follow the steps below:

1. A preliminary estimate of the total sample size is established. The sample is about 500 households, but may be smaller if a single analytical domain is required.
2. Using data from the most recent census, this sample is distributed in proportion to the total number of households in the major regions, urban and rural locations. In other words, the option of using a constant sampling fraction throughout the country (i.e. a self-weighted national sample) is taken as a starting point.
3. If the sample seems insufficient for some particular analytical domains, the sample size may be increased in these domains and decreased in other domains.

As a general guideline it is better to reduce the number of partitions imposed in this way to a minimum and to keep their sampling fractions as close as possible so that the total sample does not differ too much from a self-weighted national sample. The more complicated the sample design, the more often the sampler will make mistakes in executing the sampling and the less often others will be able to detect them. There is also a long history of sampling weights being lost, incorrectly calculated, or omitted or misused in analysis. Self-weighted samples are much more robust to this kind of error than more complicated designs.

In a self-weighted sample, the proportions and averages obtained from the sample are unbiased estimates for the proportions and averages in the population. However, when adjustments are made in step 3, the sampling fractions will become different across analytical domains, and the sample will no longer be self-weighted. The households will need to be weighted differently to get unbiased estimates. Calling N_k the total number of households in the population of domain k and n_k the number of households sampled in domain k, the weight w_k to be applied to the values from that domain is

$$w_k = \frac{N_k}{n_k}$$

Note that w_k is the inverse of the selection probability of each household in domain k. As with all sampling information, the basic set of weights (also known as expansion factors or raising factors) resulting from this step of sample design should be carefully documented and made available to the survey analysts.

The number of PSUs to be sampled is determined by the total sample size and the number of households to be interviewed in each PSU. The latter depends both on theoretical and practical considerations. On the one hand, the number of households per PSU affects the precision of the sample, as explained above when discussing cluster effects. On the other hand, the number of households per PSU is a function of the length of interviews, the number of interviewers in each team, and the time each team spends in the PSU. It is suggested that between 10 and 15 households are selected in each PSU.

Two-stage sampling

Samplers usually do not have a single complete list of households from which to draw a random sample. Even if such a list were available, a sample taken from it would entail high travel costs because selected households would be spread thinly over the entire country.

Both these problems can be diminished by using two or more stage sampling. In this survey we are using two-stage sampling. A certain number of small area units are selected with probability proportional to size (PPS), then a fixed number of households are taken from each selected area, giving to each household in the area the same chance of being chosen.

The area units are the smallest recognizable geographic units in the national census. These are usually census enumeration areas (EAs), which are aggregates of 50 to 200 households. If census enumeration areas are not available the first stage sampling may use administrative units such as wards, sectors, etc.

The two-stage procedure has several advantages. It provides an approximately self-weighted sample (i.e., each household has roughly the same chance of being selected), which simplifies analysis. It also reduces the travel time of the field teams relative to a single-stage sample, because the households to be visited are clumped together in the PSUs rather than spread out evenly over the whole country. An additional advantage of selecting a fixed number of households in each PSU at the second stage is that this makes it easy to distribute the workload among field teams.

A two-stage sample will yield larger errors than a simple random sample with the same number of households because neighbouring households tend to have similar characteristics. A sample of households drawn in two stages will therefore reflect less of a population's diversity than a simple random sample of the same size. The influence of the two-stage sampling on the precision of the estimates is called the cluster effect. As would be expected, the cluster effect grows with the number of households selected in each PSU. In other words, for a fixed total sample size, a design with more PSUs and fewer households in each PSU will provide more precise estimates of sample statistics than a design with fewer PSUs and more households in each PSU.

Analytical domains

For this survey the subgroup of the poor population is important and the survey is expected to provide separate, reliable results for them. The design will have to ensure a minimum sample size within this subgroup which can be called analytical domain. If the poor make up a large part of the population this may occur automatically if not, it may be necessary to oversample this analytical domain and to modify the expansion factor (also called "sampling weights") accordingly. The two stage sampling procedure is applied independently within each of those differently weighted domains.

Implementation of the first sampling stage

The Sampling Frame. Implementation of the sample begins with the sample frame – the complete list or file of units from which the sample units are selected. A sample frame can be developed from census data. In this case it is important to obtain a computer-readable list of all PSUs, with a measure of size such as the number of households, the number of dwellings or the population, recorded in order to obtain the classic census tabulations for larger geographic aggregates. When this list is not available, ideally the data should be compiled, but this may take too long for this study and other sources for a PSU list such as electoral lists may be considered.

Though only the total number of households or dwellings in each PSU is really needed, the list will probably include the total population of each PSU, broken down by sex. This information should be entered into a spreadsheet like the one shown in Figure 4.1. If the sample considers differently weighted domains, the procedure described here should be applied independently within each of them (i.e. the sample frame data should be entered in a separate spreadsheet for each domain). The spreadsheet contains one line for each PSU and columns for descriptive information such as province, district (or whatever administrative hierarchies are used locally), PSU number, population, number of males, number of females, and number of households or dwellings.

Figure 1: List of first stage sampling units

	A	B	C	D	E	F	G
1 2	Pro- vince	Dis- trict	PSU	Popu- lation	No of Males	No of Females	No of Hholds
3							
4	1	1	1	365	180	185	62
5	1	1	2	262	143	119	43
6	1	1	3	357	172	185	58
7	1	1	4	503	267	236	71
…	…	…	…	…	…	…	…

After all the data have been entered and before proceeding any further, a series of checks should be carried out to ensure that no PSUs have been omitted from the listings and that all data are correct. These tests are relatively easy to implement within the spreadsheet, and may include the following: (i) The total population in each

PSU should equal the number of males plus the number of females in each PSU. (ii) The masculinity rate (number of males as a percent of the number of females) in each PSU should be within reasonable limits (e.g., between 80 and 120 percent). (iii) The average household size within each PSU should be within reasonable limits (e.g., between 3 and 10 persons per household). (iv) The total number of PSUs and households, as well as the totals by sex in each administrative unit, should be consistent with the other information available from the statistical agency.

Also, the list should be scanned to make sure that the PSUs are not too small. Small PSUs may be too homogenous. PSUs smaller than 30 households should be appended to some of the neighbouring PSUs. This is facilitated by the fact that statistical agencies generally number the PSUs according to a geographical pattern, so that two PSUs with sequential codes will be neighbours.

Selecting PSUs. After the sample frame has been reviewed, the actual selection of the sample of the PSUs to be visited by the survey can proceed. The method for making this random selection with PPS will be explained below. Here we assume that the number of households is used as a measure of PSU size. The same method would apply if some other reasonable measure of PSU size were used.

Another column must be added to the spreadsheet for the cumulative number of households. This column will contain the total number of households up to and including the corresponding PSU on each line, as in column "H" in Figure 4.2. The last line in column H will contain the total number of households.

Figure 2: Cumulative totals in the list of first stage sampling units

	A	B	C	D	E	F	G	H
1 2	Pro-vince	Dis-trict	PSU	Popu-lation	No of Males	No of Females	No of Hholds	Cumulative No of Hholds
3								
4	1	1	1	365	180	185	62	62
5	1	1	2	262	143	119	43	105
6	1	1	3	357	172	185	58	163
7	1	1	4	503	267	236	71	234
…	…	…	…	…	…	…	…	

The complete spreadsheet should be printed and kept for reference. Selecting PSUs with PPS can be done manually on the printout or automatically with the spreadsheet. For the sake of simplicity the manual procedure is described here.

1. Divide the total number of households by the number of PSUs to be selected and round it to the nearest whole number. Call this number "SI" (the sampling interval).

$$SI = \frac{Numberofhouseholds}{NumberofPSUstobeselected}$$

For instance, if the number of households is 200 000, and 52 PSUs are to be selected, the SI = 200 000 : 52 = 3846

2. Using a table of random numbers or a scientific pocket calculator, obtain a random number between 1 and SI (if a calculator is used, obtain a random number between 0 and 1, multiply it by SI, add 1, and drop the decimals). Call this number "RS" (the random start). Assume, for instance, that RS turns out to be 127.
3. Write a sequence of 52 numbers obtained by starting with RS, and repeatedly adding SI. With the above values of RS and SI, this sequence would start like this:

127
127 + 3846 = 3973
3973 + 3846 = 7819
7819 + 3846 = 11667
… ….

4. Starting with the first number in the sequence, scan the printout of the PSU list for the first PSU where the "Cumulative Number of Households" is equal to or larger than this number. This PSU is selected for the sample.

Continuing with the example above, the first number in the sequence is 127. Scanning the PSU list, the first and second PSUs should be skipped, because the respective cumulative numbers of households are 62 and 105, which are less than 127. However, the cumulative number for the third PSU is 163, which is greater than 127. PSU number 3 in District 1 of Province 1 would therefore become the first PSU selected in the sample (see Figure 3).

Figure 3: Selecting the First Stage Sampling Units

	A	B	C	D	E	F	G	H
1	Pro-	Dis-	PSU	Popu-	No of	No of	No of	Cumulative
2	vince	trict		lation	Males	Females	Hholds	No of Hholds
3								
4	1	1	1	365	180	185	62	62
5	1	1	2	262	143	119	43	105
6	1	1	3	357	172	185	58	163
7	1	1	4	503	267	236	71	234
…	…	…	…	…	…	…	…	

Finally, repeat the above procedure for the remaining 51 numbers in the sequence and create a separate list of the province, district and numbers of PSUs thus selected.

Sorting the Sample Frame. The selection procedure described above will almost certainly result in a sample of households that conserves the overall characteristics of the sample frame. In other words, the proportion of urban households in the sample,

the distribution of the sample by province, and so forth, will all be statistically similar to those in the general population. However, since the selection is random some slight deviations may occur. For instance, by sheer bad luck the sample may contain a larger proportion of northern households than the sample frame.

There is a simple way of making sure that one particular distributional criterion of the households is reproduced in the sample in the best possible way. All that is needed is to sort the PSUs in the sample frame according to that criterion (north to south, for instance) before the selection. In many cases, the "natural" order of the sample frame – according to encoding of administrative units – will be adequate and no further sorting will be necessary.

Segmenting Large PSUs. The household listing operation becomes too burdensome in PSUs larger than 300 households. This problem is aggravated by the PPS procedure, which tends to bring disproportionately many of the large PSUs into the sample. One possible solution is just to accept that the household listing operation will be harder and longer than usual in those cases, but if they are very large or if many of them are selected in the sample, it may become necessary to split them into smaller units, called segments. This need only be done for the large PSUs actually selected in the sample. Segments should have clearly defined boundaries, and a rough estimate of the number of households in each segment should be made, either using recent maps or aerial photographs or by means of a "quick count" of dwellings in the field. The original PSU in the list is replaced by the segments (each with their size measures adding up to the original). Then listing only the segment that is selected need be done.

Implementation of the second sampling stage

Household Listing. A list of all dwellings in each selected PSU is needed to determine which dwelling on the list will be visited in the survey. This list will have to be created or updated for the survey, though in some cases it can be borrowed from a census or from another survey. The option of borrowing an existing list should be examined critically, to ensure that the existing lists are recent, complete, and have good addresses. In particular, demographic mobility makes it dangerous to use lists that will be more than one or two years old by the time of the actual field work. The standard for completeness is difficult to set, but under-enumeration in the census of five percent would be worrisome. The information on the list should make it easy to locate the households once they are selected. In areas with good street address systems, addresses may be sufficient. Alternately, grid codes on census maps may be used, or references to landmarks and the name of the household head.

Household listing can be carried out by the survey teams when they first arrive in each PSU. Household listing may also be carried out as a separate field operation conducted in all PSUs before the survey starts. This option is more expensive. The expense is incurred because each locality must be visited twice, once during the listing and then again during the survey. If the survey team does the listing they are more likely to bias the sample by excluding the dwellings that are harder to reach. These dwellings are usually inhabited by poorer households who have arrived in the area recently. The survey teams, working under pressure to start interviewing quickly are more prone to make mistakes in this regard.

The two most important characteristic of the list are that all dwellings in each PSU be included on it and that it allows the selected dwellings to be located easily. Some practical guidelines can help to attain these objectives:

- Field work should always start with a cartographic reconnaissance. The maps do not need to be very precise in terms of scale or the locations of the dwellings, but they should show the PSU boundaries and the landmarks used to split it into smaller areas. This helps to organise the daily work of the enumerators.

- Each enumerator should scan the assigned area in a systematic way, striving to keep neighbouring dwellings close to each other in the list.

- As a rule of thumb, the time needed to list a PSU can be estimated from standard daily yield of 80 dwellings per enumerator in urban areas to 50 in rural areas.

- The list should reflect the proper concepts of dwellings and households. Enumerators should be trained to tell the difference between the two (see page 2 for definitions).

- Dwellings should be clearly listed with appropriate addresses so that interviewers can find them easily during the survey. Some imagination should be used where street names and house numbers are not well established. In many national surveys dwellings are numbered as part of the listing operation, either by affixing a numbered sticker to the outside of the home or by painting a number on the wall or door. Some surveys may have used a Global Positioning System (GPS) to locate dwellings. If lists with GPS readings exist interviewers should be provided with GPSs to locate the dwellings.
- The complete list should always be recorded in a standard form with one line per dwelling. The list can be several pages long, depending on the size of the PSU and the number of enumerators. The precise layout of the list form depends on local conditions. A typical list form is shown below.

Figure 4: Typical listing form

Region:…….. Province:…… Locality:…….. PSU Code: ☐☐

Date of listing:…….Enumerator:……Page:

Serial number	Address of the dwelling	Head of Household	Household size		
			M	F	total
01					
02					
..	…	…	…	…	…
nn					

- Supervision of the listing is crucial. Listers have an obvious incentive not to be too diligent in locating hard-to-find or remote dwellings. Supervisory staff (or

other listers) must check a subset of listed areas, especially the difficult parts of them, to verify the listing. In some areas lists from other sources may be used. For example, the PSUs can be identified with electoral areas, voting lists might be used. Although not every resident of the PSU will be on the voting list, any address on the voting list should be listed in the PSU listing.

Columns may be added to this model for key landmarks, the occupation of the head of household, or whatever other information could help in finding the dwelling.

Selecting Dwellings. The dwellings to be visited are selected by systematic sampling from the PSU listings. A few extra dwellings are also selected to be used if replacements are needed in the field.

Figure 5: List of selected dwellings

Region:…….. Province:…… Locality:…….. PSU Code:

Total number of dwellings:…….Random start:……Interval:…….

Serial number in sample	Page and Serial number in the list		Address of the dwelling	Head of Household	Household size		
					men	women	total
01							
02							
03							
04							
05							
06							
07							
08							
09							
10							
11							
12							
13							
14							
15							

1. Count the total number of dwellings in the PSU and record it in the space on top of the form. Assume that there are 86 dwellings in the PSU.
2. Divide the total number of dwellings by the number of dwellings to be selected and keep the first decimal place. The result is called the sampling interval (SI) and also is recorded on top of the form. In this example, if the number of dwellings to be selected is 15, SI would be 5.7 because 86:15=5.7.
3. Select a one-decimal random number from 0.0 to 5.7; it can be obtained by selecting a random integer from 00 to 57 and inserting a decimal point before the last digit. Add 1 to the random number. The result is called the random start (RS) and is also recorded on top pf the form. In this example RS is 3.2. Write the numbers obtained by starting with RS and repeatedly adding SI. With the above values of RS and SI, the 15 numbers would be:

= 3.2	26.0 + 5.7 = 31.7	54.5 + 5.7 = 60.2
3.2 + 5.7 = 8.9	31.7 + 5.7 = 37.4	60.2 + 5.7 = 65.9
8.9 + 5.7 = 14.6	37.4 + 5.7 = 43.1	65.9 + 5.7 = 71.6
14.6 + 5.7 = 20.3	43.1 + 5.7 = 48.8	71.6 + 5.7 = 77.3
20.3 + 5.7 = 26.0	48.8 + 5.7 = 54.5	77.3 + 5.7 = 83.0

4. Take the integer part of each number. The 15 numbers obtained in this way (3, 8, 14, 20, 26, 31, 37, 43, 48, 54, 60, 65, 71, 77 and 83) are the sequence number of the dwellings to be visited in the survey. The corresponding lines in the listing should be transferred to another form, called the *List of Selected Dwellings*.

The households to be visited during the survey are those listed on the unshaded lines in the form. The dwellings on the shaded lines are kept as reserve for possible replacements.

Both the full listing form with all the dwellings and the list of selected dwellings will be needed by the field team responsible for the PSU during the survey (the former will help them locate the selected dwellings by referring to their neighbours). It is recommended to provide the field teams with photo copies and file the original lists securely.

Replacing Households. The above selection procedure implicitly assumes that it may be impossible to interview the households in some of the selected dwellings and that a standard procedure for replacing them has to be implemented. The most frequent reasons for replacement are:

The dwelling is unoccupied and is likely to remain unoccupied for the full survey period.

The dwelling has disappeared or is not being used for housing.

The dwelling cannot be located because the information in the listing is bad or insufficient (for example, illegible names or addresses).

The household refuses to be interviewed.

These cases should be carefully studied by the team supervisor. Only when the supervisor is convinced that the interview is impossible should the dwelling be replaced with the one on the nearest shaded line in the form.

If the dwelling is occupied by a household different from the one recorded during the listing operation, the new household is interviewed. Such cases should not be counted as non-response.

Joint UNDP/World Bank

ENERGY SECTOR MANAGEMENT ASSISTANCE PROGRAMME (ESMAP)

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