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Energy Usage and Socio-economic Conditions in Mozambique

Evidence from GTZ Electrification Project Regions

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Executive Summary

In mid 2008, the research institute RWI Essen conducted baseline surveys for two electrification projects implemented by GTZ in Mozambique. They are sub-components of "Access to modern energy services - Mozambique (AMES-M)", an energy facilitation programme under the umbrella of the Dutch-German energy partnership "Energising Development" (EnDev) currently being implemented in 22 different countries.

Within the electricity densification project "Household Service Connections at Matola Area (HHSC-M)", households in certain peri-urban neighbourhoods of Matola located around 25 kilometres west of the country's capital Maputo could apply for a subsidized connection at a roughly 95 percent discount. All 6,670 benefiting households have already been connected to the existing low-voltage grid of the government-owned energy corporation "Electricidade de Moçambique" (EdM). These household have been connected by a contractor in the three months preceding the survey. The second intervention is a, yet ongoing pico-hydro power project in rural Manica Province. Four existent corn mills powered by hydro power are being rehabilitated such that they function as multifunctional platforms that allow for the generation of electricity as well. 265 households shall benefit from this development measure either through electricity connections or through the provision of car batteries in combination with battery charging stations.

While the densification component HHSC-M explicitly targets private households, it is the low power output of the installed multifunctional platforms that restricts the pico-hydro project to prioritarily connect households. Accordingly, only private households have been sampled. In total 650 interviews with structured questionnaires have been conducted. A junior researcher has been on the ground during the whole survey implementation and collected additional, qualitative information apart from supervising the survey and data entry.

In addition to households living in the target areas of HHSC-M, households that had benefited from comparable electrification interventions in the past have been interviewed as well. This control group has been included in the baseline approach in order to allow cross-sectional comparisons. It shall as well serve to assess how project households will perform in the wake of electrification. This delivers insights concerning the project design and provides first insights concerning the impact to be expected even before project implementation.

Instead of including ordinary electrified households that are in general better-off than the project's target group of non-electrified households, the control group is a representative draw from the population. Baseline data revealed that these households are nevertheless living under better conditions than beneficiary

households even apart from better energy access. The main conclusion that can drawn from this is that the targeting of 'late connectors' as presumably poorer households proved successful. While this is a positive survey outcome, it goes along with the methodological drawback that the control group can not perfectly serve its purpose, as it is not fully comparable. Since poorer households are actually overrepresented among beneficiary households, differences to the representative households in the control group do not properly mimic the impact that is to be expected from the electrification intervention. Probably, the project impact will be slightly less than this, since beneficiary households on average have less financial and educational means to benefit effectively from electricity. Target group oriented sensitization material might compensate for this disadvantage. EdM should provide for this. For the microhydro site at Chua, no such control group has been included in the survey and the present document therefore principally serves as a baseline.

Table 1

AMES-M Beneficiary Outcomes

	HHSC-Matola (Grid Densification)		AKSM-Chua (Pico-Hydro)	
Number of people provided with...	achieved in 1-2009	expected for 2010	achieved in 1-2009	expected for 2010
lighting/ household energy	29,135	29,135	370	1,628
energy in social infrastructure	–	–	101	203
energy for productive use	–	–	270	540
Total	**29,135**	**29,135**	**741**	**2,371**

In terms of the project outcome of 'new access to modern energy', the figures given in Table 1 have been calculated based on survey data. This 'new access' concept of EnDev has been accommodated by subtracting pre-electrified households that already possess alternative modern energy access, e.g. via a solar panel. While the amount of households who disposed of an alternative to grid electricity amounted to 47 percent in Chua, further assessment revealed that less than half of the sources proved functional and reliable. The corresponding 20 percent of households have been declared as pre-electrified. For Matola, this share is 16 percent. For further projects, it is recommended to account more rigorously for pre-electrification rates. In addition, it shall be noted that – as been done by the project – these households should neither be privileged nor put at a disadvantage in comparison to their non-electrified counterparts. In total, the figures in the table show that

outcome targets will be fulfilled and that the attempt to combine a 'low-hanging fruits' project component with an innovative, smaller and more sophisticated one seems to work out. By means of the random sample of some 400 households in Matola, the correctness of the figure for the densification component provided by EdM could be corroborated – all visited households were correctly provided with electricity. More than two-thirds of them were very satisfied with the project intervention while no one expressed his dissatisfaction.

Some generalities that can be drawn from this baseline report are the following: The two project sites each feature typical characteristics of an urban and rural agglomeration respectively. For example, the labour market in Matola is far more diversified and services such as banking are used more. Rates of hypertension are far higher and those of Malaria are far lower than in Chua. The more diversified labour market does, however, not translate into more job opportunities. Actually, a significant amount of fathers in Matola households left their family to work in bordering South Africa. In addition, the lack of own fields leaves especially the young at the surveyed sites in Matola without occupation resulting in an unemployment rate among people between 18 and 30 of 31 percent. Although the local economy in Chua is dominated by subsistence farming, every third male adult is exerting gold mining as his primary occupation. This makes this activity among males even more common than subsistence farming and implies a strong dependency on the depletable resource gold in the local community. A higher diversification in local labour markets would be especially beneficial considering the very young population at Chua with many of them entering the mostly informal job market soon. Against this background, the support of the productive energy use initiatives planned in the community is highly recommended.

While purchasing power is generally low, baseline data indicates that sufficient discretionary income is available to pay for both electricity consumption and basic electric appliances. In Matola, already today two-thirds of households have a TV and appliances on the 'shopping list' are most frequently freezers and fridges. In Chua, already a fourth of households – the ones with already existing alternative electricity sources – call a TV set their own. Since the electrification intervention has taken place, almost all project households in Matola have installed light bulbs in their dwelling. These are predominantly incandescent light bulbs, since energy saving lamps are only modestly promoted. Lighting is as well perceived as its most significant positive impact. In fact, significant improvements in terms of lighting hours and light consumed (measured in Lumen hours) same as cheaper lighting can be observed. The combination of increased energy consumption and unit cost reductions, though, leaves the overall impact on energy expenditures unclear. Grid electricity cannot be expected to entirely substitute traditional energy sour-

ces – even in households that are electrified for years. Significant reductions in the use of traditional energy sources can be expected for kerosene for lighting devices and, to some extent, batteries for radio use. Reductions in the consumption of cooking fuels (wood, charcoal and gas), on the other hand, will probably be negligible. At present, cooking stoves can only be found in less than ten percent of control households. For the same reason, health-related impacts are limited. An alternative step towards resource savings and health improvements would be the dissemination of improved stoves. Currently, they can be found in less than ten percent of the households in both intervention areas.

The last chapter of this report includes suggestions concerning upcoming monitoring activities. A companion paper to this baseline study, furthermore, analyses in more detail the intervention design and potential complementary activities.

The pico-hydro project is still ongoing with a successful beginning. The grid densification intervention at Matola, on its side, is already completed and the customer service is fully incumbent on EdM. While impacts to be expected of the densification component turned out to be limited, the Matola project efficiently provided a considerable amount of yet non-electrified households with modern energy. The intervention proved to make up a justifiable part in EnDev's electrification portfolio. The pico-hydro project seems quite promising in producing community-wide impacts. Effective capacity development is provided on the micro level incorporating prudently local knowledge, institutions and material. The approach is deemed to be replicable at least in other remote off-grid villages in the mountainous regions of Mozambique that lack options to get connected to the national grid.

1. Introduction

This chapter provides a concentrated description of the national, sectoral and technical cooperation environment in which the development intervention AMES-M has been established.

1.1 Country's State of Affairs

After 30 years of armed conflicts and of war, Mozambique has now experienced a peaceful decade with steady economic growth at a high level. Post-conflict recovery began with the first Mozambican multiparty presidential and parliamentary elections in October 1994. The government was formed by the former communistic liberation movement FRELIMO ("Liberation Front of Mozambique") with RENAMO, the "Mozambican National Resistance", being the main opposition party. Apart from political stability and economic recovery, the government succeeded in the following years in administering what became the largest repatriation witnessed in Sub-Saharan Africa with over 1.7 million Mozambican refugees and a further estimated 4 million internally displaced people (USCRI 1997).

Table 2
Synthesis of Main Socio-economic Indicators

Year	2000	2006
Land Surface (km2)	799,380	
Population (millions)	18,2	21,0
Population Density (per km2)	23	27
Ann. Pop. Growth Rate (%)	2,5	2,1
Urban Population (%)	30.7	35.4
Real GDP Growth Rate (%)	1.9	8.0
GDP per capita, Atlas method (current US$)	230	310
Life Expectancy at Birth (y.)	45	42
Net Enrolment in 1ary Schools (%)	n/k	69.1
HDI* Rank among 177 countries	170	172
"GDI-HDI Ratio"-Rank* among 156 countries	144	150

*Blue colourisation specifies values that are higher than the average for Sub-Saharan Countries, red ones those that are lower while grey represents values that are identical with the Sub-Saharan average. – * The UN Human Development Index (HDI) is comparative measure of life expectancy, literacy, education, and standard of living for countries. The UN Gender-related Development Index (GDI) represents the same measure for women. – Sources: AfDB 2008; UNDP 2002, 2008; WB 2002, 2008*

Energy Usage and Socio-economic Conditions in Mozambique

The current president is Armando Guebuza. As his two predecessors he is a candidate of FRELIMO. The Republic of Mozambique is divided in 10 provinces (províncias) and Maputo, the capital city with provincial status. The provinces are subdivided in 128 districts (distritos) and 43 urban municipalities (municípios) at present. The districts are further subdivided into town and city districts (postos administrativos) and finally localities (localidades). While Mozambique gained independence from Portugal only in 1975, it still exhibits the complex and bureaucratically structured administration inherited from its former colonial ruler. The presidential system is organized in a centralistic manner: the president appoints the governors and district administrators are delegated by the ministries.

Fiscal reforms, including the introduction of a value-added tax and reform of the customs service, have improved the government's revenue collection abilities. In spite of these gains, Mozambique remains dependent upon foreign assistance for much of its annual budget. With a growth rate of GDP of over 7 percent annually during the past 10 years, Mozambique is the best-performing African non-oil country. Its economy is relatively diversified, with agriculture, transport, manufacturing, energy, fisheries, tourism, and wage remittances all making important contributions. The contribution of agriculture, at 22 percent of GDP in 2005, underestimates its overall importance, as some 80 percent of the population is involved in the sector (EIU 2008). Meanwhile, Mozambique is still among the poorest countries in the world being ranked 172 out of 177 countries listed in the UN Human Development Index (UNDP 2008). Moreover, primarily "mega projects" such as the MOZAL aluminium smelter opened in 2000 contributed to the increasing economic growth and incomes. While Mozambique does well in terms of investor protection, local small and medium firms throughout the country are still struggling.

In 2007 the best performing exports were energy, electricity and natural gas. Four out of every five units of electricity from the Cahora Bassa Dam were exported to South Africa and Zimbabwe. In the agricultural sector main export products are cotton and prawns. However, most of capital goods are imported, while raw materials are exported – also because of a poorly performing manufacturing industry. Consequently, the Mozambican economy has a large trade deficit (cf. Standard Bank 2008).

Its governance priorities defined the Mozambican government in the so-called Action for the Eradication of Absolute Poverty (PARPA). It intends to focus on the promotion of economic and social development in terms of (i) education, (ii) health, (iii) agriculture and rural development, (iv) basic infrastructure, (v) good governance, and (vi) macro-economic and financial management. The new Poverty Reduction Strategy Paper, known as PARPA II (RoM 2006) and agreed in May 2006, sets out targets which put Mozambique on track for reaching the

majority of the Millennium Development Goals (MDGs) by 2015. Main non-political sticking points concerning progress are the extremely high HIV/AIDS-prevalence rate (12.5 percent among people aged between 15 and 49 (UNAIDS 2008)) and the high-risk disposition for natural disasters (floods and cyclones).

1.2 Energy Sector

Power generation is dominated by the hydroelectric facility Cahora Bassa, located on the Zambezi River in western Mozambique. It contributes to 87 percent of the 2.4 gW installed capacity in the country and exports two-thirds of its output to the South African state electricity company Eskom. Largest domestic customer is the Mozal aluminium smelter, accounting by itself for 84 percent of domestic electricity consumption in 2006. Hydropower is also most important in terms of resources – it disposes of an estimated potential of 12.5 gW, 80 percent of which is concentrated in the Zambezi basin. Many smaller or remote towns rely on diesel-powered generators or solar panels.

Furthermore, considerable proven natural gas reserves have been identified in commercially exploitable quantities, with further exploration being under way. Main proven fields are between the Pande and Temane natural gas fields in Inhambane province and in the Rovuma Basin, a 60,000 km2 onshore and offshore area located in the far north of the country. A major coal deposit is located in the Moatize area, which is going to be exploited by the Brazilian mining and logistics company Companhia Vale do Rio Doce. The production, which is scheduled to start ion 2010, would transform Mozambique into a significant international coal producer with exports worth over US$500m per year (EIU 2008). The second major renewable energy potential lies in solar energy, since Mozambique is located in the so-called “sunbelt” with a relatively high but yet unused solar radiation capacity. For the near future, new power generation will, though, come from hydroelectric and gas- and coal-fired power stations, including seven mega-projects with combined generating capacity of 6.5 gW (EIU 2008).

Mozambique is self-sufficient in energy with the exception of liquid fuels. Despite the extensive modern resources, biomass is by far the country’s predominant energy source. Firewood and charcoal (wood fuels) cover 91 percent of domestic energy demand. On the other hand, less than 8 percent of the population had access to electricity in 2006. Significant expansion of the national grid is under way. However, Mozambique is a vast country with a low population density of 27 per square kilometre. It is therefore expensive to distribute any commercial form of energy. Considering grid connection fees of 3,500 Meticais (US$146) and

an income per capita of US$310 in 2008 (WB 2008), electricity is unaffordable for most part of the population especially due to the prohibitive up-front costs (cf. Scanteam 2005).

The most relevant institution in the energy sector is Electricidade de Moçambique (EdM) which is responsible for the transport, distribution and commercialisation of electricity in Mozambique. EdM is not strictly a government organisation, but a government owned corporation. Transmission of power is still the monopoly of EdM. Hence, it has been the primary partner for the present intervention "Access to modern energy services – Mozambique (AMES-M)" (see below)

Table 3
EdM Electricity Tariffs by Monthly Consumption Levels
(Mt/kWh)

Consumption (kWh)	Social Tariff	Domestic Customers	Agricultural Consumers	General Tariff
From 0 to 100	1.07	–	–	–
101 to 200	–	2.34	2.36	2.61
201 to 500	–	3.11	3.36	3.74
Above 500	–	3.27	3.68	4.09
Pre-Paid	1.07	2.98	3.27	3.75

Source: EdM, 2007

EdM applies a uniform tariff structure throughout the country (Table 3), which implies cross-subsidisation from the much more lucrative Southern region to the poor and remote regions in Central Mozambique and especially the North. There, electricity supply and distribution is more expensive than the tariff charged due to long distances and low customer density combined with low consumption per customer. In addition the tariff structure across users is progressive and therefore pro-poor: the greater the domestic consumption – indicating greater income and hence higher capacity to pay – the higher is the unit rate (GTZ 2006).

1.3 Access to modern energy services – Mozambique (AMES-M)

"Access to modern energy services – Mozambique (AMES-M)" is one component under the umbrella of the Dutch-German energy partnership Energising Development (EnDev) (see Box 1 below) implemented by the German Technical Cooperation (GTZ). The objective is providing five million people in developing countries with sustainable access to modern energy, i. e. reliable grid electricity, improved cooking stoves, solar panels, generators or – to a limited extent – car batteries.

1. Introduction

AMES-M comprises the following components: (i) Electricity grid densification; (ii) Pico Hydro; and (iii) small solar photovoltaic (PV) systems. The present baseline survey has been conducted for both the grid densification component and the Pico Hydro project, which will be outlined in the following.

1.3.1 Household Service Connections at Matola Area (HHSC-M)

The primary aim of the grid densification component called "Household Service Connections at Matola Area (HHSC-M)" is to facilitate the access to electricity services to poor households in the peri-urban region of Matola Municipality, Maputo Province. A final number of 6,670 households is provided with service connections to the existing low-voltage distribution grid (220 V). EdM Matola has been responsible for the control of household connections supplied as well as the standards and quality provided on a turnkey basis by the contractor Electroredes.

Box 1: Energising Development (EnDev)

Energising Development (EnDev) is a Dutch-German partnership on access to energy implemented by the GTZ. Its goal is to actively promote and realise sustainable access to modern energy services for 5 million people in developing countries and thereby contributing to the achievement of the Millennium Development Goals (MDGs), as energy is seen as a prerequisite to the achievement of all eight MDGs (cf. DFID 2002). In this context, the Directorate-General for International Cooperation (DGIS) at the Dutch Ministry of Foreign Affairs and the German Federal Ministry for Economic Cooperation and Development (BMZ) have been first-movers in setting specific, quantified targets to measure the provision of "sustainable access to modern energy".

Every project under EnDev is required to report reliable, trustworthy and comparable figures about the number of people provided with modern energy. Therefore, standardised rules for calculating the number of people reached, the "EnDev beneficiaries", have been developed. The types of energy services included in EnDev are modern energy for:

(i) Lighting and household applications,
(ii) cooking,
(iii) social infrastructure, and
(iv) productive use,
while only (i) is relevant for HHSC-M. Further details can be found in Box 2.

The grant has been designed to be output-based and amounted to 24 EUR per capita. It should serve to reduce the household's connection fee for the single phase service connection between the distribution grid and the house, including the costs of a pre-paid meter and a ready board. The lump-sum fee has been

set at 150 Mt (4.30 EUR) compared to some 3,500 Mt (100 EUR) for conventional connections. After being connected to the electricity grid, the households will furthermore profit from a cross-subsidized social tariff for low-volume electricity consumers (under 100 kWh per month).

The rationale behind this development measure is that the up-front connection charge is a hurdle that prevents the poor in electrified regions from connecting to the grid, even though the benefits they would derive – and so their willingness to pay – would exceed the cost of supply. Since households generally tend to connect to the electricity grid once they achieved a certain income level, yet unconnected households (so-called "late connectors") can be credibly assumed to belong to the poorer in the region. 6,020 household connections were accomplished from March till June 2008, while another 650 connections were realized until end of 2008 in order to fulfil the grant agreement.

1.3.2 Pico Hydro Power Project in Chua by AKSM (AKSM-Chua)

The core measure of the Pico Hydro project is the rehabilitation of four existent corn mills powered by hydro power in the community of Chua. Chua is a small village in the Mozambican Province of Manica, located close to Manica City. The rehabilitation shall serve the purpose to augment the capacity of the mills such that they function as multifunctional platforms that allow for the generation of electricity as well. 265 households shall benefit from this development measure either directly through electricity connections or indirectly through the provision of car batteries and battery charging stations. The project is implemented by the local NGO "Associação Kwaedza Simukai Manica" (AKSM).

2. Baseline Approach

This chapter offers background information on why, how and which data has been gathered.

2.1 Objectives

The baseline study was designed according to the following aims:

1. Portray the socio-economic conditions in the project areas.
   The accountability of socio-economic change to the provision of electricity access is a matter of complex investigation. It is therefore required to document conditions at the beginning of a programme in order to provide a baseline from which to measure progress.

2. Serve as a data basis for monitoring activities, accounting for all relevant aspects of EnDev Monitoring (cf. GTZ 2007).
   Of specific interest are estimates of the probable number of beneficiaries in 2010 according to EnDev counting guidelines (cf. Box 2).

3. Provide benchmark data for a potential Impact Evaluation of the project components.

4. Assess some of the anticipated impacts of the development measure, specifically related to energy.
   In order to inform stakeholders of the expected consequences of interventions, international development organisations set out to implement ex ante poverty impact assessment processes (cf. OECD 2007). In this case, both descriptive and econometric analysis of the basic linkages between energy availability, energy use and economic development is conducted based on development impact hypotheses delineated in the EnDev Impact Monitoring Guide (GTZ 2007). This is done for HHSC-M by investigating as well another group of households in the project area, which show similar basic characteristics but are already electrified for some years.

5. Additional information and, if appropriate, recommendations shall be gathered concerning
   - the needs and wants of the population;
   - the appropriateness of the intervention;
   - potential complementary activities;
   - the satisfaction with the implementation of the household connections under way (only HHSC-M);
   - random verification of connections already realized (only HHSC-M).

According to these aims, data and complementary information both on the pre-intervention status quo and on already executed household connections were required for HHSC-M. The baseline study was therefore designed to take place during project implementation. Hence, it was scheduled for June 2008, since it was planned that households get connected between April and September 2008. The subcontractor in charge of the connections in fact finished his works already in June, i.e. at the beginning of the baseline survey. For this reason, some questions in the questionnaire referring to the situation without connection to the electricity grid were adapted. In these cases, households were asked to give additional information about the corresponding situation before project implementation.

Box 2: EnDev Counting

Due to its output-based commitment (cf. Box 1, page 4) and to support planning and monitoring, reliable estimates of EnDev's beneficiaries are indispensable. In order to account for the heterogeneity among potential beneficiaries and to achieve comparability among the different EnDev projects, standardised rules for calculating the number of "EnDev beneficiaries" have been developed. While the only beneficiary category applicable for HHSC-M is "People provided with modern energy for lighting and household applications", AKSM also provides some microenterprises and churches with electricity. The corresponding numbers of beneficiaries will be presented in the concluding chapter 6. They are calculated in Annex A4 according to calculation formulas developed in Bensch and Peters (2008) that are based on EnDev guidelines (GTZ 2005).

Moreover, the baseline is crucial for determining, whether the further EnDev criteria are fulfilled: The access is (i) newly provided, and (ii) additional, i.e. it would not be realized without EnDev intervention. Furthermore, (iii) EnDev can be held accountable for the access. As will be seen in the Chua data analysis, even the satisfaction of the first criterion can be problematic where alternative electricity sources such as solar panels existed already beforehand in the benefiting households.

2.2 With-without Comparison

Statistical comparison can be longitudinal (over time, e.g. comparing today's income in Mozambique with the income in Mozambique in five years) or cross-sectional (at the same time, e.g. comparing today's income in Northern Mozambique with today's income in Southern Mozambique). The usual approach for measuring the impact of an intervention is longitudinal by before-after comparison. One weakness in longitudinal evaluation designs of rural electrification projects has been that the time interval was too short to measure certain benefits of rural electrification. For instance, education of children takes between ten and twelve years. Sustainable effects of electrification probably only materialize in the long term and will therefore be difficult to capture within a period of three to four years from receiving access (cf. WB et al. 2003).

Modern studies therefore make use of cross-sectional comparison. In the form of ex ante poverty impact assessments, international development organisations such as World Bank or OECD include these studies more and more as an integral part of the preparatory stage of their programmes. The cross-sectional approach has been applied in this survey as well. It allows drawing conclusions on the investigated issue in the same way as before-after comparison, while, of course,

not ruling out a follow-up survey for evaluating the concrete impact of the development measure. The research design includes a "with"-group and a "without"-group. The project sites that will be electrified as the "treatment group" and the comparison or "control group" of sites that are already electrified.[1] In order to identify causal relationships, the project and control sites have to show similar socio-economic characteristics.

In the present case, the control sites even correspond to two of the project sites. Part of the population in these neighbourhoods has been relocated there after floods in 2000 had devastated their former dwellings. The relocation has been sponsored and EdM offered these families low-cost grid connections for 150 Mt, which equals the fee demanded by HHSC-M. These households therefore create a viable control group, since they are (i) living in the same place and are therefore affected by the same influence factors. (ii) Due to the random character of becoming a victim of a natural disaster such as a flood and their – according to available information – relatively unstratified neighbourhoods of provenance, one can credibly expect these households to be randomly drawn from a rather poor subpopulation same as the households that benefited from HHSC-M. They are, furthermore, (iii) already electrified for several years, which makes it possible to assess main impacts from electricity access. For more detail on the sites, confer chapter 3.

The availability of data for comparable electrified and non-electrified neighbourhoods forms the foundations for applying robust evaluation techniques as outlined in Frondel & Schmidt 2005 or Ravallion 2008.

2.3 Questionnaire Design

The questionnaire (see Electronic Annex E2) was designed including both quantitative and qualitative approaches. In order to find an appropriate balance between the two ways, among households a mainly quantitative survey is applied using a formalised questionnaire to gain a distinct picture of the people's living situation in the target area, including a small range of qualitative indicators. In addition, key informants were interviewed in order to verify specific responses.

1 The denomination might be confusing, since in an ordinary quasi-experimental set-up one would refer to the electrified region as the treatment group (the group that underwent an intervention) and to the non-electrified as the comparison group (the group that will undergo an intervention). Yet, in our case the terms "treatment" refers to the target households of HHSC-M, i.e. a kind of an inverted scientific control is applied. Moreover, it is acknowledged that the term "control group" should be reserved for experimental settings. For reasons of convenience, it is, though, referred to "control sites" instead of "comparison sites".

Of particular importance concerning the topics included in the questionnaire is the availability of socio-economic and energy-related information. This has been done, since profound statements on interrelations between energy and development issues can only be made if data is available on both topics. To provide the required basic data, the following topics had to be considered in the questionnaire for household data collection:

Component 1: Household structure
- e.g. household size and composition

Component 2: Economic situation
- e.g. occupation, household income sources and expenditures

- Component 3: Social life

- e.g. time use, work load, including children's studying, TV and radio use, health issues, migration

Component 4: Energy
- Energy sources used in the household
- Energy consumption, expenditures and problems
- Energy for Lighting, respective consumption and appraisal
- Productive activities in the household
- Electricity sources and respective use, expenditures
- Electric appliance ownership and use
- Expectations, plans and preferences concerning electricity

2.4 The Wealth Indicator

In addition, a group of questions was included in the questionnaire intended to elicit the view on and satisfaction with the design and course of action of the interventions. The questionnaire was developed to be applicable without fundamental modifications in future impact assessment and monitoring surveys. Household interviews lasted around 40 minutes.

Various variables listed in Annex E3 have been created stemming from the questionnaire information. Most of them are self-explanatory and constructed according to common methodologies. Somehow innovative is the "wealth indicator" generated for the poverty/wealth analysis. Data gathered in rural areas in developing countries typically suffers – in addition to the general shortcomings of quantitative data referred to above – from sporadic inaccuracies due to a lack of recording systems and limited intellectual abilities. Data on income and wealth is further biased, because people tend to state lower values in order not to give rise to jealousy. Therefore, a combined indicator has been created to reduce bia-

ses inherent in single variables and to incorporate different facets and proxies of wealth. These comprise assets, expenditure and income elements (cf. Table 4). Income has been defined as shown in Box 3, following the definition of World Bank Living Standard Surveys (WB 1992). The indicator takes on values between 0 and 39, which are categorized into "poor", "middle" and "rich". It is described in more detail in Appendix A1.

Table 4
Wealth Indicator Components

Criterion	Subindicator
Assets	
Dwelling Conditions	Construction Material of Outside Walls Flooring Material
Animals	Quantity and Type of Animals Owned
Savings	Ownership of a Bank Account Savings
Mobility	Type of Means of Transportation
Electric Appliances	Electric Appliances Owned Electricity Source
Education	Education Level of Head of Household
Expenditure	
Nutrition	Food Expenditure per Adult Equivalent* Existence of Food Shortages
Telecommunication	Telecommunication Expenditure Ownership of Mobile Phones
Energy	Expenditure on Energy Sources per Adult Equivalent*
Health	Health Expenditure
Income	
Income	HH Income per HH Member Able to Work excl. Consumption of Home Prod

** For a description of the Adult Equivalent see Appendix A2.*

Box 3: Income Definition

Income =
Wage Income
+ Non-Farm Self-Employment Income
+ Net Income from Remittances
+ Farm Income

(Farm Income = Revenue from Sale of Crops, Transformed Crop Products, and Animal Products - Total Expenditure on Inputs for Growing Crops (Seeds, etc.), Expenditure on Renting Land)

2.5 Representativity and Sample

Altogether, 510 households have been visited in six project neighbourhoods and two control neighbourhoods (Table 5). The 398 project site households represent seven percent of the total of 6,670 households that benefited from HHSC-M. Households were selected in a simple random sampling (Warwick & Lininger 1975). Based on customer lists of EdM, households living in a certain project neighbourhood were screened with the help of local authorities and then randomly selected.

Since no listings of potential control households (households that benefited from former subsidized electrification projects for flood victims (cf. chapter 2.2)) existed, they underwent a nearly complete sampling. If possible non-present households were revisited. In part, people were visited at their working place, e.g. a shop or school.

Table 5

Surveyed Entities

	HHSC-M Project Sites	HHSC-M Control Sites	AKSM-Chua
Households	398	112	140

2.6 Baseline Schedule

The Baseline Study includes the following eight phases. Phases 2 to 6 were realised in Mozambique during the period of 01 June until 11 July 2008.

2. Baseline Approach

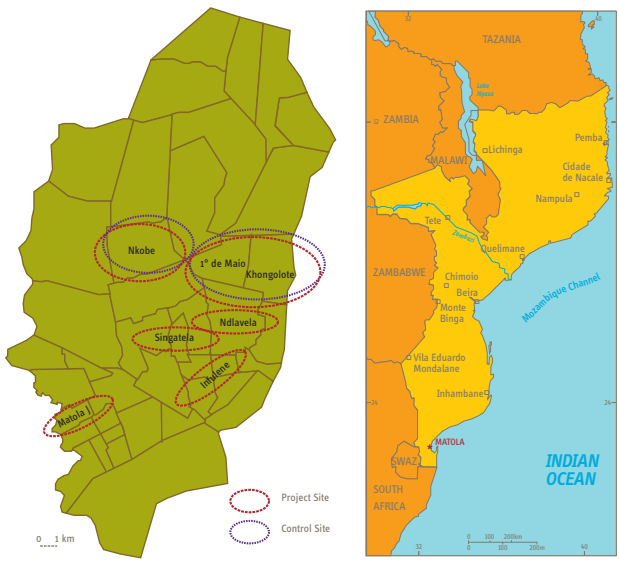
1. Preparatory desk study of AMES-M Programme Reports, setup of a survey team, uestionnaire preparation in Portuguese, structurally based on a questionnaire used for a GTZ baseline study in Rwanda.
2. Desk study of relevant documents, like EdM material and results of National Surveys used for the baseline preparation and the later data analysis.
3. Site visits to the Matola project area and potential control neighbourhoods in order to prepare the baseline schedule and sampling and furthermore to inform and interview local authorities.
4. Five-day enumerator training workshop. After discussing and concluding the questionnaire and data entry, pre-tests have been conducted on-site.
5. During the survey, 510 household interviews were conducted in six project neighbourhoods and two control neighbourhoods. At least one family member, mostly the head of household was interviewed.
6. Presentation and discussion of first results with programme stakeholders.
7. Data processing in Excel and data analysis in STATA.
8. Final report and feeding results back into the planning and monitoring of the development measure.

3. Site Profiles

This chapter offers background information on the project and control neighbourhoods where data has been gathered.

Figure 1

The Six Beneficiary Neighbourhoods at Matola Area



3.1 HHSC-M Sites

An overview of the sites that have benefited from the GTZ development measure "Household Service Connections at Matola Area (HHSC-M)" is given in Figure 1. The 6,670 beneficiary households live in six neighbourhoods (bairros), each of them being composed of several blocks (quarterões): (i) Nkobe [in the following partly abbreviated by NK], (ii) Singatela [SI], (iii) 1° de Maio and Khongolote [1M], (iv) Ndlavela [ND], (v) Infulene [IN] and (vi) Matola J [MJ].

The two neighbourhoods that served as control sites as well are Nkobe [NKC] and 1° de Maio/ Khongolote [1MC] (red colourisation in Figure 1). As mentioned in chapter 2.2, victims of floods in Mozambique in 2000 have been resettled there. The projects were financed by foreign embassies (1° de Maio/ Khongolote) and by a private road construction company (Nkobe). People have been provided with houses and EdM connected the corresponding households to the electricity grid at low costs.

Table 6
Data on Household Connections and Survey Interviews by Neighbourhood

Project Site	Number of Household Connections	% of Total Number of Household Connections	Number of Interviews	Percentage of Interviewed Households
Matola J	2 137	35	111	5
Ndlavela	1 516	25	69	5
1º de Maio/ Khongolote	537	9	58	11
Infulene	1 036	17	64	6
Singatela	672	11	70	10
Nkobe	122	2	26	21
TOTAL	**6 020**	**100**	**398**	**7**
Control Site				
Nkobe			48	
Khongolote			64	
TOTAL			**112**	

An overview of the household connections and interviews in each of the neighbourhoods can be taken from Table 6. Most part – almost two-thirds – of the 6,020 household connections that had been realized until the time of the baseline survey have taken place at Matola J (35 percent) and Ndlavela (25 percent). Only two percent have been carried out at Nkobe and about nine to 17 percent at 1°de Maio/ Khongolote, Singatela and Infulene.

Since Ndlavela and 1°de Maio/ Khongolote as well as Infulene and Singatela are located very closely and are very similar in the social structure of the neighbourhood, they have been treated as single sampling units. Accordingly, 5 to 8 percent of the connected households have been interviewed on average per neighbourhood. This holds except for Nkobe, where connected household have been oversampled due to the little number of connected households.

3.1.1 Matola City

All neighbourhoods covered by the development measure HHSC-M belong to Matola City. Matola is a city in the South of Mozambique, some 25 kilometres west of the country's capital Maputo. Matola is also the capital of Maputo Province (one of the ten Mozambican provinces) and has its own elected municipal

government since 1998. It is an industry centre with an important harbour, e.g. for imports from and exports to South Africa and Swaziland. In addition it has diverse industry, dominated by the aluminium smelter MOZAL and its suppliers. With a population of 675,422 (census from 2007; 53 percent more than in 1997), Matola is the second-largest city in Mozambique.

The majority of people are working at Matola centre or in the capital Maputo. Due to the geographic proximity, a lot of people from Matola work in the neighbouring country South Africa as well. One consequence of this is that a lot of households lack their male head of household. Being the second biggest city in Mozambique and only few kilometres from Maputo, Matola is very much affected by urban structures. Households mostly do not practice agriculture or have domestic animals. People are working in the city centers and the neighbourhoods in the centre of Matola area are well organized and parcelled.

Hence, regarding their social structure, the six neighbourhoods that will be presented in the following have some characteristics in common. However, they had very different preconditions concerning the household's connections to the electricity grid: (i) Some neighbourhoods such as 1º de Maio are still not entirely covered by the EdM grid. Part of the population was therefore excluded from being able to benefit from HHSC-M. (ii) Some neighbourhoods have still been in their expansion phase at the time of HHSC-M (such as Nkobe). Consequently, part of

Photos 1 – 4: Panorama of Matola J

Matola J is close to the urban centre of Matola – the expansion of the neighbourhood has already finished.

Almost every neighbourhood has public street lighting. But some people mourn that it is often not functioning.

Some Households – most of them in Matola J – have also been equipped with a ready-board, a so-called „Quadrolec".

Household an in-house installation in Matola J.

Photos 5 – 10: Panorama of Infulene, Singatela and Ndlavela

Infulene Neighbourhood.

View on a road in Singatela.

3. Site Profiles

People fetching water at the well in Ndlavela.

Typical cooking place.

Energy Usage and Socio-economic Conditions in Mozambique

Beneficiary household in Ndlavela.

Apart from the female jail of Mozambique, EdM electricity facilities are located at Ndlavela.

Photos 11 – 14: Panorama of 1° de Maio/Khongolete and Nkobe

The – so far – less densely populated Nkobe neighbourhood.

Like Nkobe, 1° de Maio/Khongolete is located at the preiphery of Matola area and in state of expansion.

The both neighbourhoods served also as control sites. At the two pictures on this page the corresponding houses can be seen that have been sponsored by foreign embassies and by a private road construction company.

the households that only recently took up residence in these areas might probably have been solvent enough to afford the regular connection without subsidy. (iii) Some neighbourhoods already benefited from subsidized household connections executed by EdM.

Apart from these projects implemented by EdM, donor-supported electrification programmes in Matola area are limited to grid expansion financed by World Bank and African Development Bank.

3.1.2 Matola J

Most beneficiaries of HHSC-M live at Matola J. Over 2,000 households have been connected there. Among the beneficiary neighbourhoods, Matola J is the closest to Matola centre and Maputo. Therefore Matola J disposes of the best infrastructure among the analysed neighbourhoods, including a water canal system that covers most part of the area. In addition it is mostly parcelled – as Singatela, Ndlavela and Infulene as well.

3.1.3 Infulene, Singatela and Ndlavela

The three neighbourhoods Infulene, Singatela and Ndlavela are located next to each other and are very similarly structured. All of them are well organized regarding the division in streets, public places and private property. Main part of the area is parcelled; most people live here for many years already. The neighbourhoods present themselves relatively established. They are very green and seem to be much more fertile than Nkobe and 1° de Maio/ Khongolote. As can be gleaned from the pictures water is provided by wells. Before the present development measure was implemented, only Ndlavela had benefited from another project of subsidized connections. Many households at this area are still not connected to the electricity grid.

3.1.4 1° de Maio/ Khongolote and Nkobe

1°de Maio/ Khongolote and Nkobe are located at the periphery of Matola area. For that reason the two neighbourhoods are still in the state of expansion and many houses are under construction. Both seem to be more spacious, less fertile and green as well as less organized in terms of public space and streets than the other project neighbourhoods. As they are the areas the most distant from the urban centre Matola and Maputo they seem to be more rurally structured than the neighbourhoods described above. The first houses have been connected in 2002 (Nkobe) and 2003 (1°de Maio/ Khongolote). Part of the population that benefited in 2000 from flood victim resettlement programmes constitute a viable control group and has therefore also been interviewed (cf. chapter 2.2). Despite these projects

of subsidized connections and the HSSC-M intervention a lot of households remain without connections to the grid – more than half of all households at 1° de Maio/ Khongolote are not connected.

3.2 AKSM-Chua Site

Chua is a small village close to Manica City in the District and Province of Manica. Manica is the gateway for trade between Beira, Mozambique's second largest city with one of the most important harbours in Southern Africa, and its westerly neighbour Zimbabwe. Integral to its formation, this trade route, generally referred to as the 'Beira Corridor', remains a great influence on the province. Manica city is located directly on this road to Zimbabwe.

Besides its very central commercial position, Manica is characterized by its very fertile ground and good weather conditions for farming and agriculture. The search for precious metal (such as gold and diamonds) in this mountainous landscape is an important income generating activity in the Province as well. A working gold mine at Penha Longa and the water filling of the famous "Vumba" water is located here. It is also home to the Chimanimani mountains with the highest peaks in Mozambique. The mountainous region with its pleasing landscape offers tourism potential with various sites such as Cabeça de Velho, Montanhas de Penhalonga, Paintings of Chinhamapere and Serra de Vumba. Until now, however, the necessary infrastructure lacks (RoM 2005).

Photos 15 – 20: Panorama of Chua Site

Families live at homesteads generally remote from each other.

3. Site Profiles

A homestead and its inhabitants in Chua.

A maize mill before its refurbishment made of junk metal pieces.

A second maize mill, already after its rehabilitation.

A chicken house at a homestead in Chua – many households are active in livestock breeding.

4. Analysis of HHSC-M Survey Results

Chua is located at the mountains that border Zimbabwe. People speak Chitwe, while only half the population older than 5 years can speak Portuguese. 51 percent of the population is illiterate – while more men than women are illiterate, more men than women are able to speak Portuguese due to their higher involvement in economic and social activities (RoM 2005). Chitwe is a language that integrated some English vocabulary such as numbers. The Zimbabwean influence on Chua is quite strong in other aspects as well. Many Zimbabweans have immigrated to Mozambique, and their concentration is particularly high at this border village. They share the same culture with Zimbabweans and are from the same ethnicity "Shona", sharing a common history and used to have strong commercial relationships.

Chua is stretched out over two valleys and the surrounding mountains. The families live very distant from each other, dispersed in the mountains. The most prevalent cultural aspect is polygamy that is very widespread in Chua and surrounding areas. Often the father has two or even more wives. Women mostly get married at the age of 12. The wives live in separated huts with their children. Each woman usually has one kitchen to cook for her children.

Chua is divided in two different zones: Marondo and Chihururu. 260 families live at Chua, of which 130 families will receive power generated directly from hydroelectric turbines. There are three turbines at Marondo and one at Chihururu. Each turbine can provide electricity to the connected households within a radius of 500 meters. Households that are located outside this radius will be electrified via car batteries.

Figure 2
Location of Chua in Manica Province

The climate at Chua is humid and temperate. In comparison to other Mozambican regions there is more rainfall on average. Agriculture and farming is due to the comparatively high rain falls and to the fertile ground the first economic activity (RoM 2005).

Commerce is the second most important economic activity in this region. Traders come from all central and southern Provinces to buy agricultural products. On the other hand, traders from Manica District use to import products from Zimbabwe (RoM 2005). Hunting, fishing, livestock breeding, deforesting and collecting wood are additional household income generating activities. Many families at Chua attempt to generate some income by searching for gold. The access to banking services and credit is very limited in this region, too. The only existing bank branch is BIM at Manica town.

According to the population census in 1997, six percent of the Manica District population have access to electricity. In Manica town, this percentage amounts to 14. In Chua, no electricity grid existed before AMES-M (RoM 2005).

4. Analysis of HHSC-M Survey Results

In this fourth chapter the processed survey data from Matola is presented and discussed. The household data is divided according to the questionnaire components outlined in chapter 2.3. The structure thereby reflects the impact to be expected in each of these fields: While the household structure is unlikely to change substantially due to the project intervention, the expected impact on household energy is the highest. Of course, the analysis focuses on the results of the project sites. Data on control sites enriches and qualifies this analysis as well as the examination of specific subgroups like individual project sites, different socio-economic classes.

4.1 Household Structure

This paragraph presents a basic profile of the surveyed households including household sizes, composition and information on the head of household. Up-to-date official data representative for whole Mozambique to be used for comparative reasons is, unfortunately, not at hand. The second and latest wave of the National Household Survey of Living Conditions IAF2 has been carried out in 2002 and 2003 (INE 2004, see also Fox et al. 2005). For the recent 2007 Population and Housing Census, so far only elementary data as the one given in Table 7 is available. Instead, now and then in subsequent paragraphs it will be referred to data from a comparable impact survey in Magoanine commissioned by the Danish International Development Agency (DANIDA) – confer Box 4.

4. Analysis of HHSC-M Survey Results

Table 7
Summary of Data on Household Composition

	Average Household (HH) Size				Children per HH (per Adult)	Adults per HH	Share of Female Population	Share of Male Heads of HH
	Total	poor	middle	rich				
Project Sites	5.2	5.6	5.0	4.8	2.2 (0.74)	3.0	51.0	70.1
Control Sites	5.0	5.6	4.7	4.5	2.2 (0.81)	2.7	55.0	68.8
Census 2007 Matola City	4.6	–	–	–	– (–)	–	52.4	–
HLCS 2002/3 Mozambique	4.8	5.8	4.8	4.2	2.2 (0.81)	2.7	–	75.0

Table 7 summarizes the basic data on household composition. In Matola, the average number of household members in the 398 households of the four project neighbourhoods is 5.2. Interestingly, the most urbanized one, Matola J [MJ], exhibits the highest value with 6.0, while in the most remote one, 1° de Maio/ Khongolote [1M], households on average count only 4.3 members. The value for the urban area of Magoanine for example is only 4.4, that for whole Matola City is 4.6 (cf. Table 7). Rather in line with expectations is the negative correlation between the household size and the different wealth categories that are derived from the wealth indicator (cf. chapter 2.4 or appendix A1): Poorer households tend to be the biggest with the largest household including 17 household members.

Box 4: DANIDA Magoanine Survey

A Socio-Economic Impact study has been carried out as well for a subcomponent of a Danish sponsored Energy Sector Programme. The impact of the extension of the distribution system in the administrative area of Magoanine, one of Maputo's most extensive quarters, was analyzed by means of two successive surveys in 2004 and 2007 (Sustém 2004, Sustém 2008). Both surveys were realized in the project area Magoanine A and a control or reference area, Magoanine B and C.

Different from the approach applied in the present study, the basic idea of a difference-in-differences approach (cf. Frondel & Schmidt 2005) was followed with Magoanine A as the treated object (to be electrified) and Magoanine B and C as the untreated (unelectrified) one. Contrary to expectations, Magoanine B and C have also been electrified in 2007, thus, rendering difference-in-differences comparisons impractical. Nevertheless, due to the similar study focus, part of the descriptive survey findings will serve to supplement the analysis of the present survey results.

According to a classification by the International Labour Organization (ILO), household members of 15 years or older were considered adults, while members younger than 15 years were considered children. The corresponding average numbers of children per adult are 0.74 and 0.81 for project and control neighbourhoods respectively. This means that a proportion of 42.5 percent of the population is younger than 15 years, which is not extraordinary for Sub-Saharan Africa.

In total, the considerable amount of 36 percent of project site households lacks one parent. This is primarily due to fathers who have left the household as foreign workers in the bordering South Africa. Although they may in fact embody the head of household, in the present analysis their wives being present in the household are considered heads of household. Accordingly, across all neighbourhoods, three out of ten heads of households are female. Again, there seem to exist differences between more remote neighbourhoods [NK, 1M and ND] and more centrally located ones [MJ, IN, SI] with the latter including significantly more foreign workers. One reason might be that relatively more among the households in the more remote neighbourhoods have settled only recently while the more centrally located ones are already more established and may therefore have a higher propensity to leave the family for working abroad.

Households that lack both parents only amount to two percent. Although opportunities to earn money in South Africa are relatively well, the wealth indicator values of the corresponding households are worse than those of the two-parent households.

The urban, non-farm orientation in the project region becomes apparent when looking at the main occupation of heads of households, which is in only ten percent of the cases subsistence farming. The occupations and income-generating activities of the working population will be analyzed in more detail in the following chapter.

4.2 Household Economy

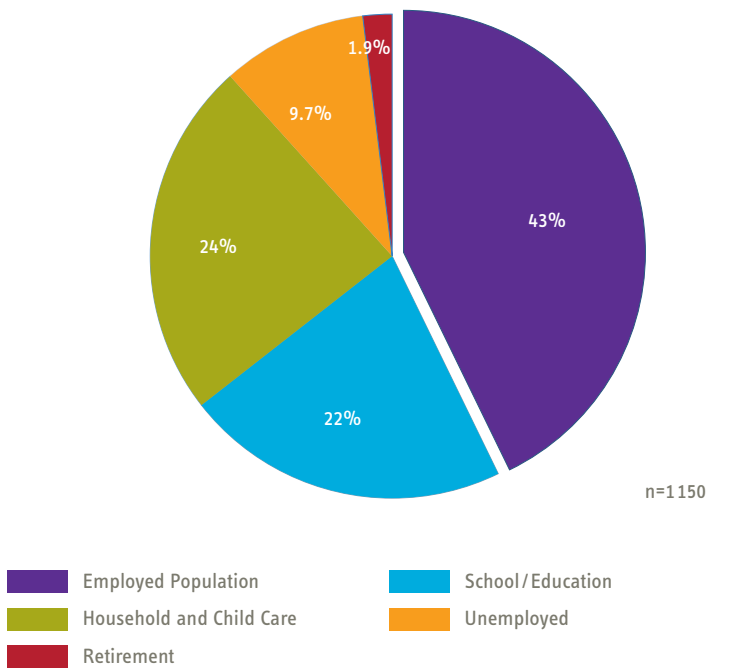
4.2.1 Main Occupation

Chart 1 depicts the occupational situation of the adult population in the project neighbourhoods. The non-employed population makes up a high share of 57 percent of the total. This is not only due to the young population with many (22 percent) still attending school other educational institutions, but also to a high share of people occupied with household and child care and many unemployed persons. The percentage of almost 10 percent for the latter implies that the rate of unemployment among the labour force, i.e. the sum of people of working age employed and those looking for work, is 18 percent. Looking at the age structure

for unemployment, the picture becomes even worse. The median age is 23 with an unemployment rate among people between 18 and 30 of 31 percent. This means that every third young person does not succeed in entering the job market.

Chart 1

Adult Population's Occupation at Project Sites



Unfortunately, this data cannot be backed by data from IAF2, since it does not contain information on this topic. Neither the DANIDA report provided for reliable data, since it suggests that 85 percent of the adult population "can be considered unemployed". One reason for the high unemployment rate can be found by considering that only 30 percent of the households do possess fields. The plot sizes are, in addition, often so small that at most one person is needed to till them. Hence, in contrast to rural areas with a higher share of subsistence agriculture, the analyzed peri-urban region exhibits more people without occupation, especially among young adults still living at their parents' homestead.

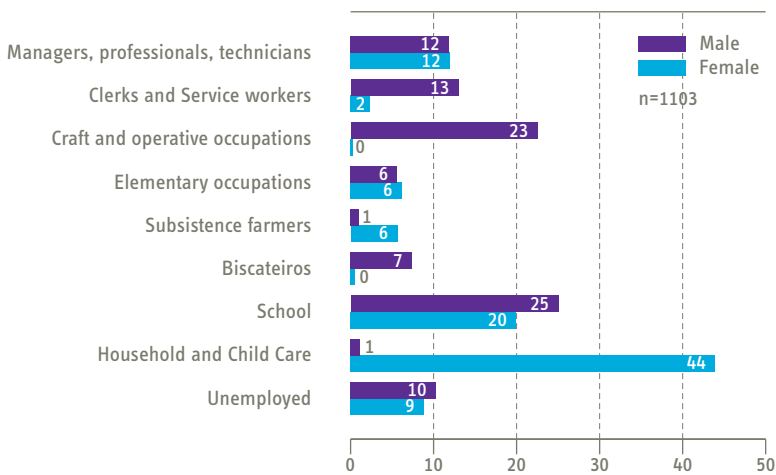
While many people in rural areas such as Chua exert a second activity, this is quite uncommon in Matola: In the project neighbourhoods, 11.5 of males and 4.3 percent of females do so. No typical combination of primary and secondary activities exists. Values for the control sites are similar.

Since the regions covered by the intervention and the survey are predominantly residential areas, home businesses are very uncommon. Only two percent of the project households indicate a productive use at home, while the percentage among control households reaches a reasonable level of eight percent. Main income-generating activities at home are sewing and selling chilled drinks and other foodstuffs.

Chart 2

Adult Population's Primary Occupation at Project Sites by Sex

Shares in percent among adult population under 65; only working population, including students



The mentioned high share of people occupied with household and child care are unsurprisingly almost entirely women as can be gleaned from Chart 2. The chart gives reference to primary occupations of the adult population under 65 at project sites by sex. The grouping into the top four categories is based on an adaptation of the ILO occupation classification ISCO-88 by Elias & Birch (1994) according to so-called skill levels. While managers & Co. tend to be best skilled, elementary occupations can be executed without any specialisation. The chart also makes clear that household chores do not crowd out unemployment: There are as many male as female unemployed individuals.

Chart 3

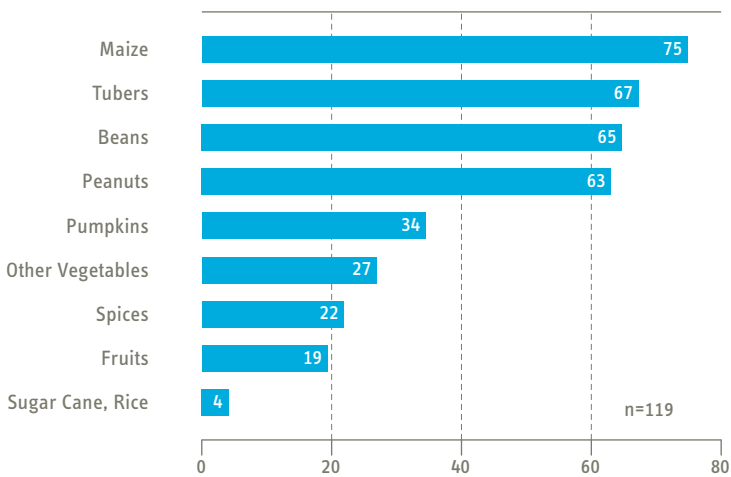
Employed Population by Site Type

Shares in percent

Chart 4

Main Cultivated Crops at Project Sites

Shares in percent among cultivating households



Coming in detail to the other half of the adult population illustrated in Chart 1, Chart 3 depicts the situation among the employed population for both project and control sites. Due to the peri-urban location of the project sites, the adult population is occupied with diverse non-farm activities. Only ten percent are actually subsistence farmers. Biscateiros, people with only casual employment, are slightly less. The other four occupation groups, the same as in Chart 2, suggest a relatively developed and heterogeneous job market with only every sixth employed person exerting unskilled labour. The comparison between project and control households reveals that the latter exercise more sophisticated labour though the attribution of this to electricity access would be too speculative at this point.

4.2.2 Cultivation and Livestock Breeding

It has become clear already in the preceding paragraph that agricultural activity in the surveyed region is low with plots often having rather the dimension of a front garden. Market-oriented agriculture is almost non-existent. Only five percent of the project site households that possess fields did sell any agricultural product last year, transformed agricultural products such as flour have not been sold at all. Accordingly, farmers who rent plots amount to less than ten percent and those who have agricultural expenditures, e.g. for seeds or fertilizers, to only 30 percent. In the same way, electric machines are rarely used for food procession – while less than ten percent utilize motorised mills, crop transformation is usually done at home by hand and/ or with a pestle. Transformation outputs are – in order of importance – maize, peanut and cassava flour. Main cultivated crops are given in Chart 4. As in whole Mozambique, the most important staple crop for households is maize.

For cattle breeding, the picture is quite similar: One third of the households engages in this activity, while only a fraction of three percent did sell animal products last year. Animals apart from poultry are very rare, e.g. only one household possesses a cow. Table 8 gives reference to agricultural activity in a broader sense also including animal husbandry. While half the project site households do neither cultivate crops nor raise animals, a sixth of them does both with the rest being evenly distributed to one or the other activity.

Another implication of the low proportion of subsistence farmers is that food shortages do fluctuate less in the course of the year. For a given month, on average every fourth household stated not have enough to eat at that time. Altogether less than 30 percent of the households stated not to suffer from any food shortage. For the majority of the other households, food shortages do not persist more than a week per month, while for ten percent they last more than half a month each.

Photo 21

A yard and front garden in Singatela

Table 8

Agricultural Activity of Project Site Households

Shares in percent; n = 398

		Livestock Breeding	
		No	Yes
Crop Cultivation	No	48	22
	Yes	17	13

4.2.3 Savings and Credits

Though people were permitted to refuse any answer and some actually made use of this option in relation to financial statements, data on savings and credits may still suffer from misinformation and shall accordingly be treated with reserve. A reasonable proportion of 22 percent of the project site population declared to possess a bank account – three fourths of these at BIM, the biggest Mozambican bank with a minority stake of the government of Mozambique, or Barclay's, former Austral Bank. The figure for actual savings is slightly lower, as can be retrieved from Table 9 (14 percent). The table gives an account of credits taken in the last five years, too. While savings average 6,200 Mt (180 EUR), average credits amount to 9,500 Mt (275 EUR) (in both cases, the averages are taken from those households

that actually dispose of savings and/ or credits). Credit lenders are half private and half institutional. One third of the credit takers stated to face real problems with repaying the credit.

Table 9
Savings and Credits

	Percentage of Households in Possession of...				Average Amount of ... in Mt				Main Purposes (% of Households)
	PN	PN_p	PN_m	PN_r	PN*	PN_p*	PN_m*	PN_r*	PN*
Savings [last year]	14	4	17	67	few observations				–
Credits [last 5 years]	20	17	20	43	9,500	3,100	11,200	25,100	Commerce (36), Construction (21), Ceremonies (12)

*PN = Project Neighbourhoods; PN_p = poor households in PN_s; PN_m = middle households in PN_s; PN_r = rich households in PN_s (for the classification into poor, middle and rich, see 2.4 and appendix A1); * Among those households which dispose of Savings and/ or Credits.*

4.2.4 Assets, Expenses, Income

Main assets that are observed in households in Matola are listed in Chart 5. A surprising outcome is that two-thirds of them already possess a television set although grid connection has only been achieved thanks to the development measure. According to the responses provided by the households, only 30 percent of them have been purchased after the connection, i.e. not more than three months before the survey. Nevertheless, this group of households, amounting to 20 percent of all households, indicate the existence of discretionary savings, which households are willing to spend on electric (entertainment) appliances. The question why such a high amount of TV sets already existed before grid electrification will be further scrutinized in chapter 4.4.1, which also analyses electrical appliances.

Due to the peri-urban location, households in Matola are more intensely involved in the market economy, such that the calculation of household income can be easier executed than in rural areas such as Chua. The resulting income values can be categorized according to Table 10.

The Wealth Indicator presented in chapter 2.4 draws on a wider range of information on the socio-economic status of a family. Apart from income, different indicators concerning assets and expenses have been included. Its distribution is illustrated in Chart 7. As for income itself, it can be observed that control households are on average better off. Chart 8 splits these values on neighbourhood type level up into the individual neighbourhoods. The values for the project

neighbourhoods indicate a certain degree of homogeneity in terms of the median values (represented by the horizontal line in the box) and the gap between the poor and the rich (represented by the box and whisker sizes). Surprisingly, the values of control households in 1° de Maio [1M] and Nkobe [NK] are not only higher on average but also a lot more heterogeneous than those of project households in the same neighbourhood.

Chart 5

Ownership of Assets

Shares in percent among project site households

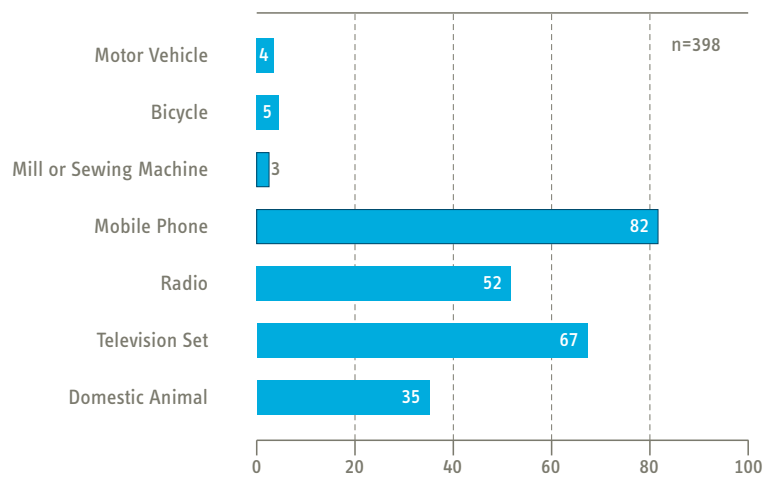


Table 10

Household Income per Year

Shares in percent; n=470

	less than 500 EUR	between 500 and 1000 EUR	between 1000 and 2000 EUR	more than 2000 EUR
Project Sites	29	36	28	7
Control Sites	26	28	27	19

Chart 6

Expenditures

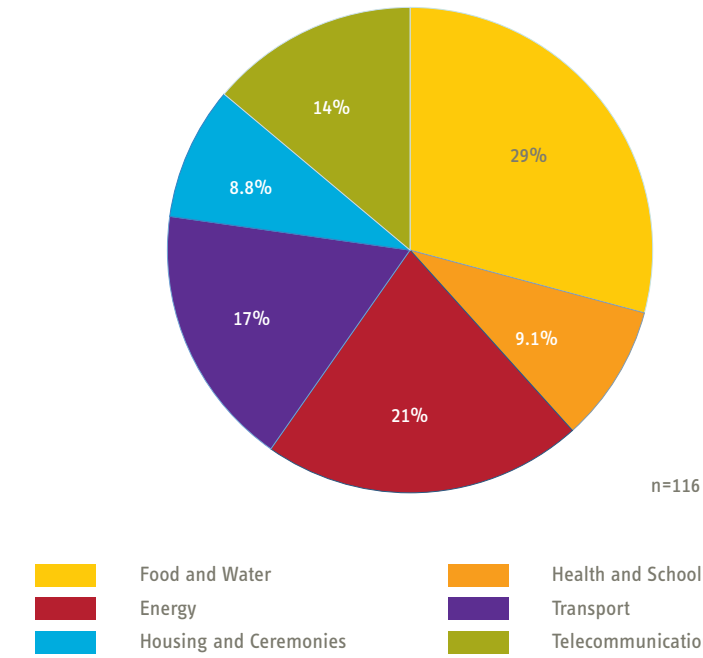


Chart 7

Wealth Indicator

Shares in percent

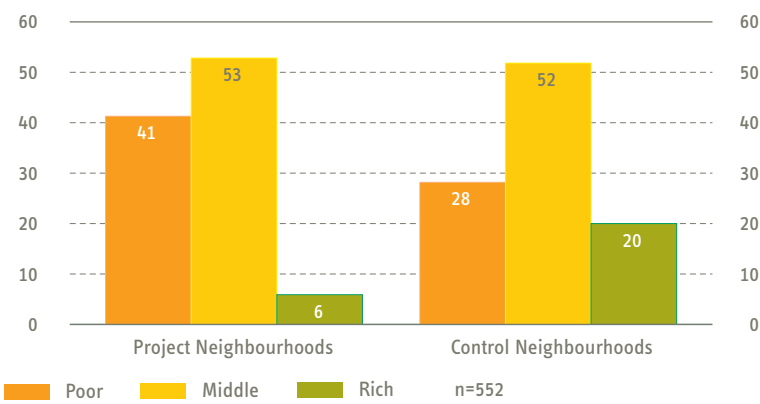
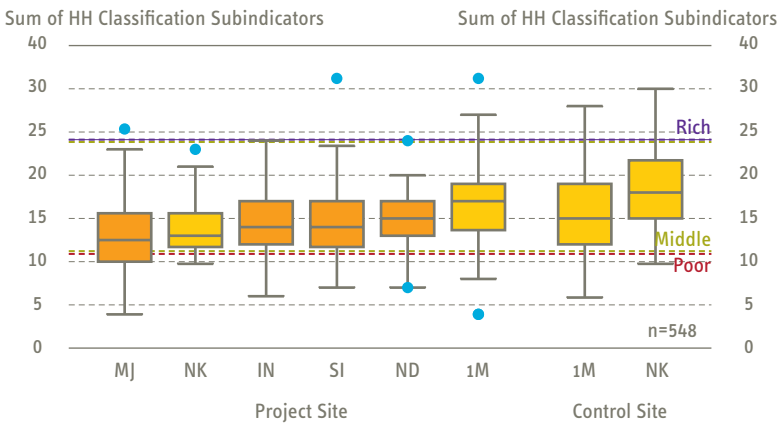


Chart 8

Wealth Indicator by Neighbourhood



While the wealth indicator values are presented in the left chart at the aggregate level, the right chart gives the sum of the subindicators. The horizontal line in the box represents the median, the lower bands of the boxes are the 25% percentiles, the upper bands are the 75% percentiles. Including the whiskers, which show the range of the observations, an illustrative picture of the conditions in the individual neighbourhood is being drawn.

4.3 Social Life of Households

4.3.1 Education

Since 40 percent of the surveyed population is between 6 and 17 years old, almost half the population is still in school, vocational training or university. Among the adult population, i.e. those of age 15 and above, still 22 percent have not yet completed their education. Chart 9 presents also the figures of the highest educational degree for those adults who already finalized their studies, with the two control neighbourhoods as a comparison group. Again, these exhibit better results, with significantly more people having finished secondary education. Among the project neighbourhoods, only 1° de Maio/ Khongolote [1M] comes up with a reasonable percentage of people having completed secondary school of 23 percent secondary. In the other project neighbourhoods, this value ranges between nine and 14 percent.

People not having visited or finished primary school are the other extreme and bring about the most pronounced differences between males and females as well (Chart 10). Both vocational training and university are among all investigated subgroups only very rarely observed.

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People not having visited or finished primary school are the other extreme and bring about the most pronounced differences between males and females as well (Chart 10). Both vocational training and university are among all investigated subgroups only very rarely observed.

The observations made on the highest educational degree are supported by data on years of schooling. The comparison at site level given in Chart 11 reveals very similar results for Matola J [MJ], Infulene [IN] Singatela [SI] and Ndlavela [ND], whereas the two neighbourhoods with both project and control households, 1° de Maio/ Khongolote [1M] and Nkobe [NK], diverge to both ends. The average values are 5.6 years for project sites and 7.1 for control sites.

Chart 9

Adults' Highest Educational Degree Completed by Neighbourhood Type

Shares in percent

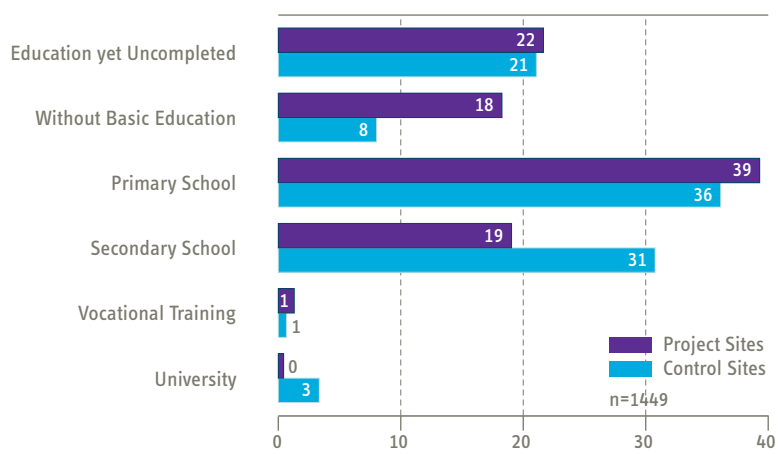


Chart 10

Adults' Highest Educational Degree Completed of Project Site Population by Sex

Shares in percent

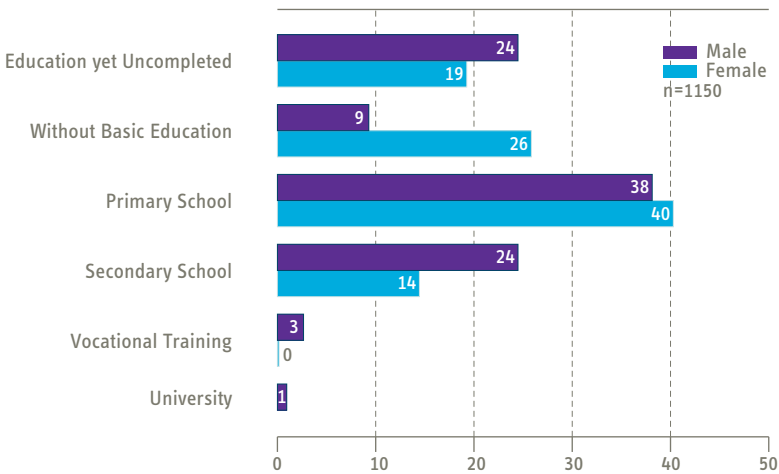
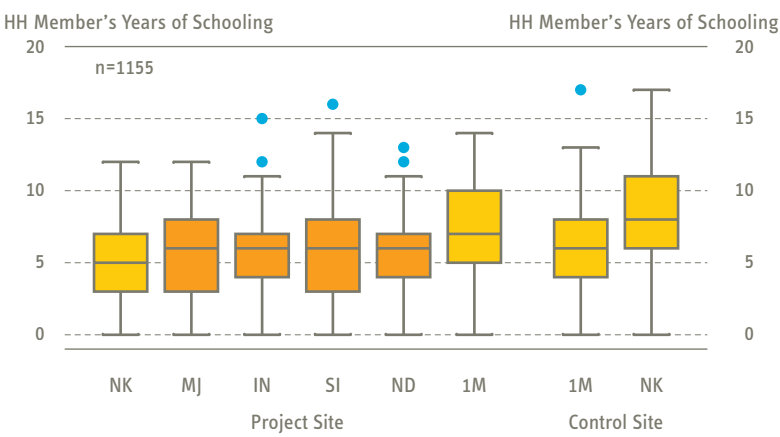


Chart 11

Average Years of Schooling at the Site Level



Those 80 percent of households who have children of school age, were furthermore asked, whether their children have missed school during the month preceding the interview. Though such information is bound to be biased, the information provi-

ded suggests that school absenteeism is less a problem. In less than ten percent of the households, a child did miss school at all implying an attendance rate of almost 100 percent. Asked for the reason of absence, the frankly appearing "lack of interest, will, energy" was express second most behind "illness and injuries". A negative aspect, however, is the relatively high share of pupils, who missed the whole month.

4.3.2 Health

Health insurance is virtually inexistent. Less than three percent enjoy being insured, mainly through their employer. While half the population does not make use of health services, the rest pays on average 320 Mt (9 EUR) per month in health expenditures for consultations and medicine, while this value goes up in individual cases up to 6,000 Mt (170 EUR). A correlation between health expenditures and the wealth status of the family can be observed though only weak probably due to the erratic nature of illnesses and injuries.

Table 11
Prevalence of Chronic Diseases among Households

Shares in percent; n = 510

	Neighbourhood Type	
Disease	Project	Control
Malaria	18	22
Hypertension	19	21
Respiratory System Disease	34	29
Eye Problems	27	23

Taking a look at the recurrent diseases, differences between project and control sites are limited (Table 11). While the prevalence of other diseases is lower, diseases affecting the respiratory system and those concerning eyesight are higher among the project households. One might be tempted to impute this effect to electrification, since the latter two groups of diseases are of highest interest for electrification programmes as they should be tackled by means of electric lighting and stoves replacing smoke-producing kerosene lamps and firewood. In the present sample, this effect is, however, questionable. On the one hand, households mainly cook outside or under a (roof) overhang with steady supply air. On the other hand, the use of electric stoves is quite limited. Among control households, only ten percent possess an electric stove, which is why an impact of electricity in

this regard is not to be expected in the short term perspective. Furthermore, even among electrified households 30 percent still use traditional, smoke-inducing lighting sources.

Gender-related data, however, reveals a strikingly higher prevalence of respiratory system diseases and eye problems among women than men (cf. Table 12). Whether this is related to the fact that women are the persons primarily responsible for cooking and therefore more exposed to indoor cooking smoke, remains speculative, especially against the background of the aspects mentioned in the preceding paragraph.

Table 12
Prevalence of Relevant Diseases among Household Members by Sex

Shares in percent; n =1 483

	Neighbourhood Type	
	Project	Control
Respiratory System Disease		
male adults	6.9	6.4
female adults	10	12
total population	10	10
Eye Problems		
male adults	7.1	4.3
female adults	9.7	10
total population	5.8	5.9

4.3.3 Housing

Although the agglomeration process is at different stages in the various neighbourhoods of Matola (cf. chapter 3), the dwelling are almost uniformly modern, i.e. normally featuring a rectangular construction style, air-dried bricks, several rooms, a cement floor, a corrugated iron roof and possibly glass windows. 85 percent of houses at project sites exhibit all these characteristics (apart from glass windows). Table 13 refers to information concerning housing conditions. Since the houses are mostly in parcelled areas, the dimensions of the households' estates are of homogeneous size of on average some 500 m2. In almost all cases, the house's residents are also the owners of the estate.

4.3.4 Access to Infrastructure and Information

Only half the population in Matola has access to information via a radio. With 60 percent, this ratio is not much higher in the already electrified control households. Even though the latter do have to pay fewer for radio use (cf. chapter 4.4.1), they switch on this information and entertainment device for less time (6 hours per day) than non-electrified project households, where the radios play on average for 6 hours and 25 min a day (all averages refer to households who are in possession of a radio). Instead of with costs, listening hours correlate negatively with wealth. Households of both project and control neighbourhoods falling under the "poor" category listen during 7.5 hours a day, "middle" ones for 5 h and 45 minutes, while the richer ones only arrive at 5 hours 20 minutes time. Since control households are on average slightly better off, they were accordingly expected to listen slightly more to the radio.

Table 13
Physical Housing Information

		Neighbourhood Type	
		Project	Control
Outside Walls (%)	Brick	90	100
	Reed	6	0
Roofing Material (%)	Corrugated Iron (Zinco)	95	63
	Corrug. Iron (Lusalite)	3	32
Flooring Material (%)	Cement	93	97
	Soil	7	1
Windows Fitted with Glass (%)	Yes	51	92
	No	49	8
Estate is Own Property (%)		93	89
Dimension of Estate (in m²)	Average	510	475
	Median	450	450
Housing Investments Last Year (in Mt)*	Average	11,300	8,800
	Median	1,500	2,000

** Of those 20 percent of households which carried out any home maintenance, extension or repair last year.*

As already pointed out in 4.2.4, the extension of TV possession is unexpectedly high. Already two-thirds do possess a TV set in the only lately electrified project households. In control households, television achieved with 85 percent almost total pervasion.

Finally, studying telecommunication it was found that a proportion of 84 percent uses telephones in the project neighbourhoods (89 percent at control sites). The use patterns of those households that use any telephone regularly are represented in Table 14. The predominance of mobile phones becomes evident. More than 85 percent of these households solely utilize these devices for telecommunication. There is only a single case, where a landline telephone is in use. The figures in general do not differ substantially between the two neighbourhood types. Noteworthy is only the less frequent use of telecommunication for work in the project. The frequency of use of telephones strongly depends on the economic situation of the household. Telephone expenditures among poor households amount to 39 Mt (1.1 EUR), while middle tend to spend three times more (105 Mt) and rich households even 235 Mt (6.75 EUR) per week on telephony.

Table 14
Telephony

	Neighbourhood Type	
	Project	Control
Type of Telephone Used in %		
only mobile phone	85	89
mobile phone	97	100
public phone	15	11
Main Purpose in %		
only work	2	3
work and private	29	42
only private	69	55
Telecommunication Expenditures per Week in Mt	**95**	**185**

n=436

4.3.5 Time Usage

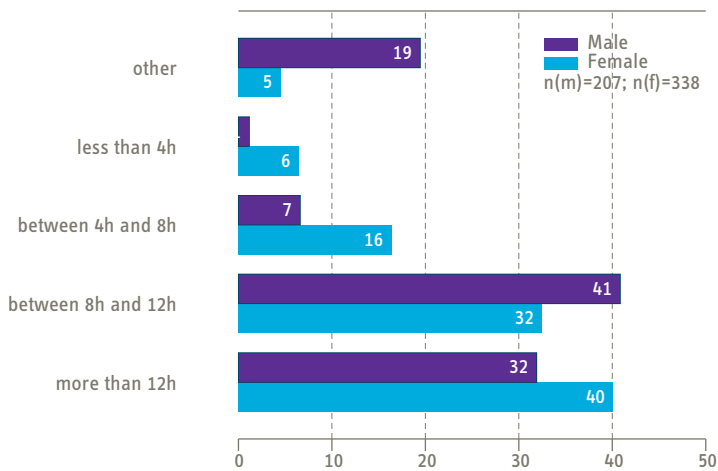
A general working day counts on average less than 12 hours in the Matola project neighbourhoods. Although household chores are included, the average for women of 11 hours is lower than for male adults, which amounts to 11 hours and

50 minutes (cf. also Chart 12). A normal male working day, accordingly, covers the time span from 6.10 a.m. till 18.00 p.m. Since 58 percent of interviewees have been female adults compared to 28 percent male adults, a gender-specific bias at the disadvantage of females in this information provided is less probable.

Chart 12

Duration of Working Days by Sex

Shares in percent



The category "other" mainly comprises "biscateiros" (day labourer) or in general people who work infrequently.

In case women are employed, they, however, tend to work more. In the four non-agricultural ILO occupation categories introduced in chapter 4.2.1 ranging from technicians to elementary occupations, working hours per week average between 47 and 51 for males, whereas for females the average is 56 hours per week. People of both sexes, whose primary activity is subsistence farming, have a lower workload of less than 40 hours. As pointed out in 4.2.1 as well, secondary activities are untypical and shall therefore not be further investigated here.

Data on hours spent on household duties has been gathered in the baseline only for the case of energy source procurement. It was enquired how much time it takes per week to buy the different energy sources such as batteries, kerosene and firewood – without differentiating between males and females. Since only a third of the project households collect their firewood, the corresponding average is only 35 minutes. For energy sources but firewood, the average is even higher

(45 minutes). The assignment of tasks in the family concerning collecting firewood is (almost) identical to that for fetching water, which is represented in Table 15. Same as for cooking, it was asked, whose responsibility the specific duty is. The strongest electricity-induced time saving would stem from electric cooking, which would reduce both the time for cooking and for collecting firewood. As already mentioned in chapter 4.3.2, widespread use of electric stoves is, however, not to be expected. Therefore, significant time savings will not materialize.

Table 15

Responsibility for Household Duties

Shares in percent; multiple answers possible

	Fetching Water	Cooking
Male Adult	10	6
Female Adult	80	86
Male Children	10	5
Female Children	15	11
Maid, Domestic	10	10
Children under 12 (among HH with children under 12)	20	8

Primary school children usually go to school for four, otherwise three or five hours. The regular school duration for pupils at secondary schools is five hours. Although studying at home is eased by electric lighting, this improvement does not materialize in terms of higher learning hours at home for already electrified households.

4.4 Household Energy

4.4.1 Energy Sources and Uses

Energy can be subdivided into modern and traditional energy. Traditional energy comprises primarily candles, kerosene, petrol, diesel, batteries, wood, charcoal and dung. Modern energy forms on their part are reliable and functional grid electricity, generators, solar panels, and car batteries. These have advantages in terms of versatility, power and rather lower prices. The proportions of households that possessed one of these sources before the electrification measure are depicted in the left column of Table 16. Among these, the share of households having disposed of what can actually be considered a modern (functional and reliable) electricity source has to be calculated, in order to extrapolate the total number of pre-electrified households from the sample. Generators can be in general credibly assumed as modern in this sense, while grid connection through a neighbour can

not, since the national electricity utility EdM outlaws this practice and rigorously traces and punishes it. For solar panels and car batteries, however, this assessment is less straightforward if one can not rely on technical inspections. Nevertheless, certain indicators may be used to estimate this proportion.

Table 16
Electricity Sources at Household's Disposal

Shares in percent; n=398

all values in %	Total	Modern*
Solar Panel (+ Car Battery)	4.0	3.0
Grid Connection via Neighbour	2.0	0
Generator	0.5	0.5
Car Battery	17.6	12.8
Total	**24**	**16**

**Electricity sources are considered modern if they represent a reliable source for modern energy services such as electric lighting. The values are derived in the continuous text.*

Table 17
Data on the Use of Specific Energy Sources

		Candles	Kerosene*	Batteries for Torches	Batteries for Radios	Wood	Charcoal	Gas	Grid Electricity
% among all PN/ CN Households	PN	43	92	2	13	51	84	4.5	2
	CN	60	53	2	7	28	82	20	100
Average Monthly Consumption	PN	19.2 pieces	3.4 l	7.3 pieces	10.6 pieces	14.5 bunches	1 bag	10 l	-
	CN	13.6 pieces	2.3 l	3 pieces	5.8 pieces	17.5 bunches	1.1 bags	11 l	- **
Average Monthly Expenditures in Mt***	PN	90	95	40	55	180	365	440	-
	CN	60	180	15	30	155	425	495	315

*PN = Project Neighbourhoods; CN = Control Neighbourhoods; * Kerosene is meant here as lighting fuel. ** Since most households possess prepaid meters, consumption in kWh is often unknown. *** This average is calculated for those households which do consume the corresponding energy source.*

On the one hand, three-forth of households with a solar panel made effective use of it by actually using electric light or a television set before the intervention. On the other hand, three-forth of car batteries used for solar panels have been at

most three years old, indicating that they still have been operable. Hence, it seems most sensible to conclude that two-thirds of the solar panels that already existed before the intervention can be appraised as modern energy sources. Running the same analysis for households that only possessed a car battery, one arrives as well at a fraction of three-fourths of car batteries that can be declared as modern. In consequence, when counting the actual beneficiaries of the electrification intervention, 16 percent of households have to be subtracted for being pre-electrified (cf. the right column in Table 16).

Most energy in project households was nonetheless provided by traditional energy sources listed in Table 17. The data allows for the following conclusions: Firstly, it becomes evident that grid electricity does not entirely substitute traditional energy sources – even in households that are electrified for years. Significant reductions in the use of traditional energy sources can be expected for kerosene for lighting devices and, to some extent, batteries for radio use. How candle consumption will react to electrification is yet unclear, both in terms of the quantity of households still using this lighting source and of the intensity of its use. Batteries for torches are not affected by electrification. The impact on cooking and therefore on the use of cooking fuels (wood, charcoal and gas) will probably be negligible, too. A first step towards resource savings in this regard are improved stoves, which can yet be found in only three among the 398 project neighbourhood households.

The low rate of substitution of cooking fuels to be expected from electrification can also be gleaned from Table 18, which enumerates electric stoves together with other electrical appliances. These other main domestic appliances can all be found in significant quantities in the control neighbourhoods. Even in the (until very recently) non-electrified project neighbourhoods, appliances in need of electric energy are already numerous. Of these, surprisingly, only 25 to 50 percent have been acquired after grid electrification. Some households, hence, possessed appliances already during pre-electrification stage. It can only be hypothesized on the reason for that, e.g. on the existence of TV sets in 30 percent of beneficiary households, which did not possess a modern energy source at the time before the intervention. For example, some of these households have been created by people who moved house coming from electrified regions. These can, nevertheless, not be such numerous that they account for almost half the surveyed population.

Households were also asked, which electrical appliances they would be most tempted to purchase in case of grid connection. Favourites have been a freezer (51 percent), followed by a fridge (34 percent). Accounting for those households that already possess electrical appliances, TV sets are most popular with 91 percent of households either already have or willing to acquire them. Electric appliances for productive uses are less a topic.

Table 18

Electrical Appliances

Shares in percent

	Project Sites (n=398)	Control Sites (n=112)
Iron	13	44
Electric Stove	5	10
Refrigerator	5	28
Freezer	9	46
Cassette Recorder	17	25
Fan	3	13
Radio	52	61
Television Set	67	85
DVD	26	47
Telephone*	83	89
Electric Sewing M.	0	1

** More information on telecommunication can be found in 4.3.4.*

4.4.2 Lighting

Lighting as probably the most relevant service delivered by electricity for poor people shall be further illuminated in this paragraph. In combination with the use data of traditional energy sources in Table 17, the data on lighting devices used in the project neighbourhood households shown in Table 19 gives a larger picture of lighting patterns in the households. Kerosene consumption obviously primarily stems from hurricane lamps that are used in modest quantities but for relatively many hours. Since public lighting is reasonably available, only very few torches can be found in Matola.

The data of electrified control households in both Table 19 and Table 20 mirrors what has already been mentioned in chapter 4.3.2: 30 percent of electrified households did not switch totally to modern lighting sources, thus still relying in part on traditional lighting devices. On average, two light bulbs are lit for four and a half hours in electrified houses, while one is used outside for seven hours. Both fluorescent tubes and energy saving bulbs are used by only very few households.

Since the electrification intervention, almost all (98 percent) of project households have installed light bulbs in their dwelling. Their illuminaire choice falls predominantly to incandescent light bulbs. 12 times more households are now lit by this

type of light bulb than by fluorescent tubes and 15 times more than by CFL bulbs. The low prevalence of energy saving bulbs can be ascribed to the fact that electricity is – especially for Sub-Saharan-African circumstances – abundantly available and sold at low costs. Therefore, energy saving efforts are neither pursued from the side of EdM nor from consumers. Basic information about energy saving potentials through CFL bulbs is, nevertheless, existent. Half the population stated to be aware of energy saving light bulbs, of which 85 percent consider these to be beneficial, mostly since energy and money can be saved. On the other hand, only 10 percent see them as disadvantageous, with "too expensive" and "worse quality of light" being the most frequent reasoning.

Table 19

Traditional Lighting Devices

		Project N.	Control N.
Traditional Tin Lamps	#	0.15	0.03
	h	4	4
Hurricane Lamps	#	1.3	0.5
	h	5	3.6
Torch	#	0.02	0
	h	-	-

Table 20

Modern Lighting Devices in Electrified Households

		Exterior	Interior
Incandescent Light Bulbs	#	0.8	2.0
	h	7.1	4.5
Fluorescent Tubes	#	0.2	0.2
	h	7.8	4.2
Energy Saving Bulbs	#	0.04	0.06
	h	7.3	4.4

 # = quantity per household; h = hours lit per day

4.4.3 Energy Expenditures

The total average energy expenditures for all households in the project neighbourhoods are given in Table 21, including the different energy types listed in Table 17 plus generator fuel. In order to relate these expenditures to total spending of the household, the share of energy expenditures in total expenditures is presented as well. Same as in another, similarly designed baseline survey in Rwanda (Bensch & Peters 2008), the hypothesis that energy spending rises less than proportionately with income (cf. Albouy & Nadifi 1999) can not be supported by the baseline data. For both project and control households (and – as will be seen later – also for the Chua site), the relationship has rather a U-shape with poor people spending less of their income than "middle" households, which, on their side, spend relatively more than richer households. It should be borne in mind that the data might slightly converge to the values cited for preceding investigations when other expenditure classes than those investigated in 4.2.4 are considered as well; an

example would be luxury goods like furniture, which wealthier households tend to consume more. Nevertheless, this will unlikely change the interpretations made in this paragraph.

Another outcome similar to Bensch & Peters 2008 is that the increased use of energy makes electrified households in the end pay more on energy than comparable non-electrified households. This contrasts with the view of respondents in project households, who in two-thirds of the cases suppose that they have to spend less on energy due to electricity and in only seven percent the opposite. Financial saving potentials originating from electrification primarily exist with regard to kerosene for lighting devices and batteries for radio use. Total cost calculations reveal that kerosene hurricane lanterns cause annual costs of 22 EUR. Considering the same amount of lighting hours and applying the social electricity tariff of 1.07 Mt/ kWh (3 ct/ kWh), incandescent light bulbs induce costs of 3.70 EUR and energy saving (compact fluorescent) bulbs of only 1.08 EUR (this total cost calculation is demonstrated in Annex A3). This cost decrease is even more pronounced when quality of lighting is accounted for, since lighting output (measured in Lumen) of light bulbs is much higher than that of lanterns.

As can be taken from Table 17, battery consumption for radios in the electrified control households is only half as high as that for non-electrified project households. The corresponding savings of plug-in radios instead of battery-run ones can be best assessed in terms of costs per listening hour. Thanks to the low electricity price, cost savings in this regard can be expected to amount to more than 90 percent.

Table 21

Energy Expenditures

		Total	poor	middle	rich
Monthly Energy Expenditures in Mt	PN	500	390	490	1210
Share of Energy Expenditures in Total Expenditures*	PN	21	22	20	23
Monthly Energy Expenditures in Mt	CN	900	550	800	1750
Share of Energy Expenditures in Total Expenditures*	CN	24.5	30	22	29.5

4.4.4 Attitude towards Electricity

The general perception of the development measure is very positive so far. 97 percent of the population consider the project to have positive impacts. These are seen to materialize in the form of specific improvements as presented in Table 22. Four percent also see negative effects. These are mainly aspects that can not be influenced by the project: frequent power cuts, expenses for garbage collection which are tied to electricity payments, lack of street lighting, and that not the whole neighbourhood benefited from the project.

Table 22

Perception of Positive Impacts of the Electrification Intervention

Shares in percent; multiple answers possible; n =385

1. Lighting	42
2. Energy at accessible price, for the poor	34
3. Spending less money	6
4. Community development	5

Table 23

Purposes Electricity shall Serve or actually Serves for

Shares in percent; n = 390

	Project Neighbourhoods	
	1st	2nd
1. Lighting	61	14
2. TV	8	25
3. Commerce	11	14
4. Fridge/ Freezer	7	15
5. Radio, Music	3	10
6. Housework	2	4

People were also asked for the three main purposes they themselves plan to use electricity for – or in the case of control neighbourhoods, electricity actually serves for. The results can be retrieved from Table 23. Since the surveyed regions are residential areas, purposes are predominantly of consumptive nature. Commerce is also quite often quoted. Apart from improving working conditions in general (being able to work easier, faster or at night, prepare work for the following day at night), productive uses most often cited are hairdressing and then poultry farming

and welding/ locksmithery. Single cases of people intending to use electricity for a photo studio, selling ice and a mill exist as well. In all, 63 percent of project neighbourhood households expect to work faster and more efficient with electricity.

Chart 13

Willingness to Pay for Electricity among Project Households

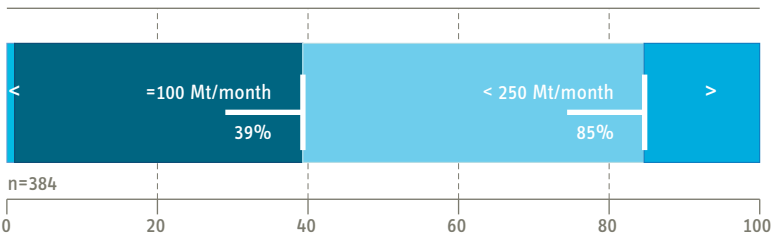
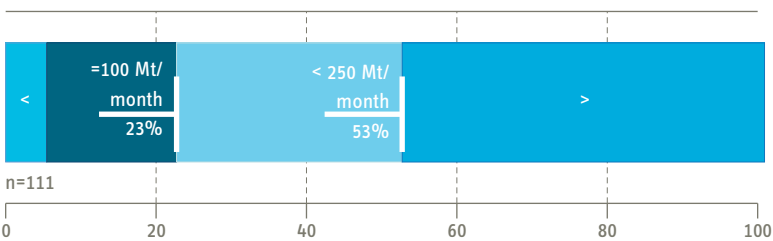


Chart 14

Electricity Expenditures in Control Households



The population's valuation of electricity was, furthermore, elicited in the form of willingness to pay. Most people actually had an idea of how much money electricity is worth to them. The corresponding values are depicted in Chart 13. The graph shows the values in relation to the two thresholds 100 Mt (3 EUR) and 250 Mt (7.50 EUR). On the other side, Chart 14 picks up these thresholds and represents them in relation to the concrete electricity expenditures incurred by the electrified control households. It becomes evident that most electrified households pay more on electricity than project households are willing to expend. This observation, however, has to be qualified. (i) Since two-thirds of control households have prepaid meters they might find it difficult to specify their monthly electricity expenditures; (ii) if finally using electricity continuously, people in project households might become willing to spend more than assumed at present; (iii) if people are

- as announced – charged the social electricity tariff of 1.07 Mt/ kWh, even those willing to spend 100 Mt/ months will be permitted to use almost 100 kWh, which allows for the use of illumination and several other electrical appliances.

To conclude, some project-related facts shall be itemized:

- 80 percent of benefiting households have been informed about the intervention by a village representative, 10 percent by their neighbour and in only one case through the radio;
- 80 percent of project households had the idea to connect to the electricity grid already before the intervention; among them 83 percent lacked the money do realise this idea and eight percent stated to wait for connection subsidies;
- 93 percent do not know who the donor of the intervention was; four percent have been correctly informed;
- 69 percent of the households have been very satisfied with the project intervention; no one has not been satisfied;
- six percent experienced problems with the in-house installation.

5. Analysis of AKSM-Chua Survey Results

Data analysis for the development measure in Chua has been conducted analogously to the analysis of the HHSC-M data in the preceding chapter.

Table 24

Summary of Data on Household Composition

	Average Household (HH) Size				Children per HH (per Adult)	Adults per HH	Share of Female Population	Share of Male Heads of HH
	Total	poor	middle	rich				
Chua	5.5	4.8	6.0	6.3	3.0 (1.2)	2.5	48.0	81
HLCS 2002/3 Manica Province	5.7	–	–	–	2.7 (0.9)	3.0	–	–
HLCS 2002/3 Mozambique	4.8	5.8	4.8	4.2	2.2 (0.81)	2.7	–	75

5.1 Household Structure

Household composition in Chua shows some distinct features from that observed in Matola (Table 24). While the average household size of 5.5 is only slightly higher than the one in Matola, contrary to Matola, household size and wealth are positively correlated in Chua. This is most probably due to the fact that children are seen as status symbols in the area. The same holds for wives. Every fifth surveyed household is polygamic. Polygamy is also a main reason for a lacking parent in the household. Fathers living outside the household but still at another house at the same plot make up more than a third of those 24 percent of households, where either the father or the mother is not present.

Another difference to Matola and many other regions in the country is that there are more children under 15 years than adults. The ratio between children and adults is 1.2 compared to values between 0.74 and 0.9 in Matola, Manica Province or Mozambique. The average age among the surveyed population is under 18, which underpins the very young population at Chua.

5.2 Household Economy

5.2.1 Main Occupation

Rural-urban differences are also reflected in the occupational situation. The main difference to Manica that can be deducted from Chart 15 is that the employment ratio is quite higher. 59 percent of the population state to be occupied. The two main reasons are that (i) more women are employed and (ii) less people are unemployed. As can be taken from Chart 16 this is primarily due to the fact that more people carry out subsistence farming on their proper land.

Same as in chapter 4.2.1, Chart 16 gives reference to primary occupations of the adult population under 65 by sex. Again the grouping into the top three categories is based on an adaptation of the ILO occupation classification ISCO-88 by Elias & Birch (1994) according to so-called skill levels. The fourth group defined by Elias and Birch, clerks and service workers that represent the second highest skill level group, is not specified since it is not applicable to any employment among the surveyed population. Instead, another activity has been added that is very widespread – at least among the male population: As many as every third male adult is exerting gold mining as his primary occupation, which makes this activity even more common than subsistence farming.

Chart 15

Adult Population's Occupation

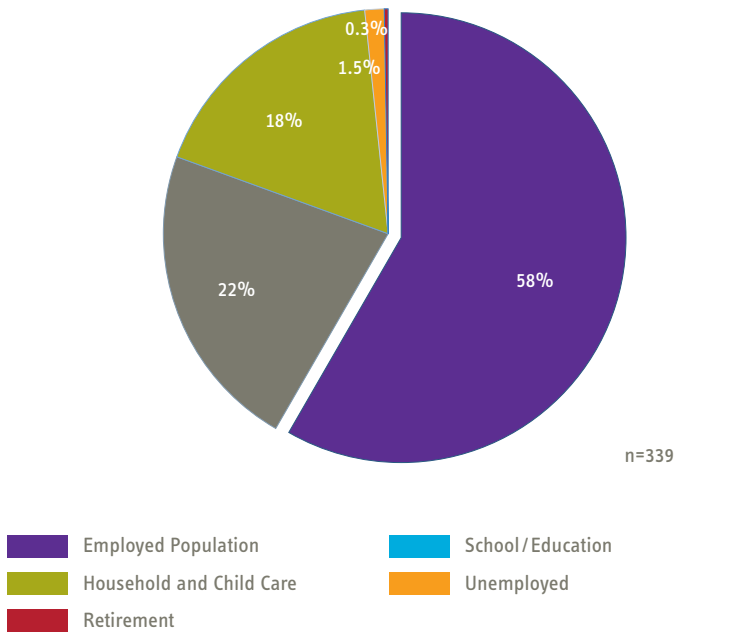


Chart 16

Adult Population's Primary Occupation by Sex

Shares in percent among adult population under 65

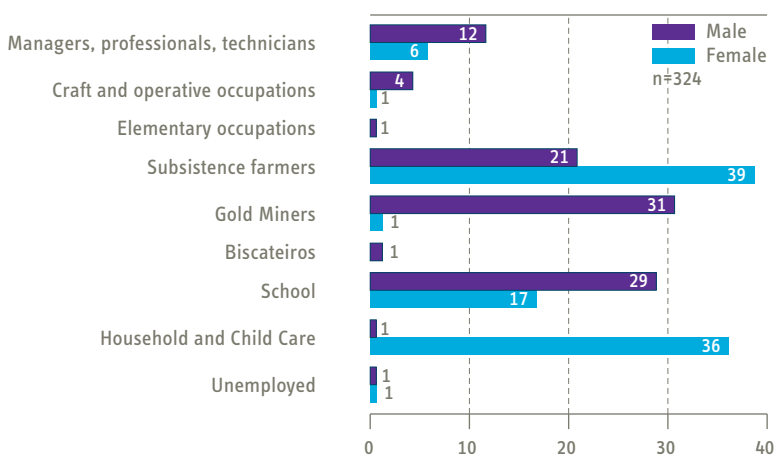
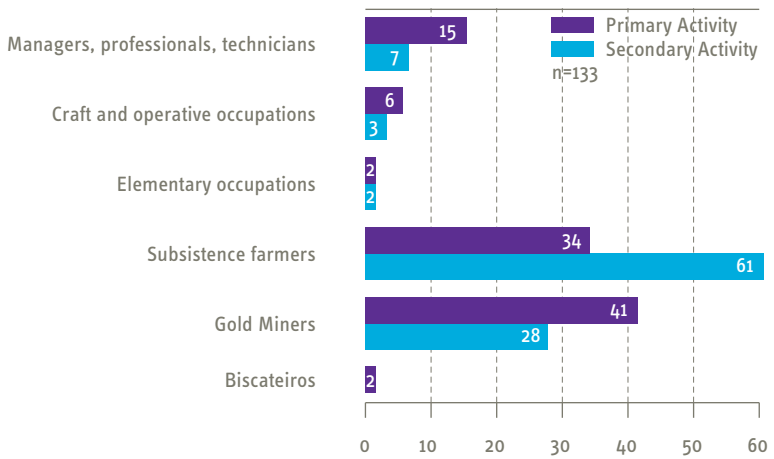


Chart 17

Male Primary and Secondary Occupations

Shares in percent among occupied male adults



Half the employed people have a second activity as well. For females, this is in most of the cases (84 percent) agriculture. The picture among men given in Chart 17 is more similar to that of their primary activities. Although subsistence farming is now more common for secondary activities, gold mining again surpasses by far any other occupation. In total, 90 among 129 male employed people are somehow occupied in gold mining.

Home businesses are relatively uncommon. Seven percent of the households indicate a non-farming productive use at home. These include milling, sewing and selling chilled drinks and other foodstuffs.

5.2.2 Cultivation

Crop cultivation is universal in the Chua region. 98 percent of the households possess fields. There is only a single household with a rented plot and a handful of cases where the fields are used free of charge. In all other cases, the households themselves are the owners. The plots seem to be of sufficient size (cf. Chart 18). The crops planted on these plots are depicted in Chart 19. Again, the importance of maize as a staple food in Mozambican households becomes clear. In contrast to Matola, bananas, sugar cane and rice are planted in significant quantities, while tubers (sweet potato, potato, yam, and cassava) are less frequently cultivated.

71 percent of crop planting households sell part of their production. Apart from sugar cane, no specific "cash crops" seem to exist, i.e. crops that tend to be sold instead of being used for autoconsumption of the household. Being asked why they do not sell more of their agricultural output, households gave reasons according to the percentages presented in Table 25.

Figures for crop transformation are also relatively high. Two-thirds of the households engage in crop transformation. This is probably due to the good transformation facilities offered by the hydropower maize mills. They perform 87 percent of all cases of crop transformations. The rest is done at home by hand and/or with a pestle. Main transformed crops are listed in Table 26. Among these crop transforming households 30 percent sell their transformation output. The average monetary values related to agricultural activity are given in Table 27. Although agricultural inputs such as seeds and fertilizers are not intensively utilized, they already make up half the revenue stemming from agricultural activity.

Animals are almost as frequent as farming plots. Households raising animals amount to 92 percent. Accordingly as many as 91 percent of the households are active both in crop cultivation and livestock breeding. Poultry is most important, followed by cows and goats. It is noteworthy at this point that households in Chua tend to have more cows than goats: The median number of cows is 4 while it is 3 for goats. Households selling animal products (including eggs, milk, fur, meat, etc.) make revenues of on average 4100 Mt, while individual revenues range from 60 to 62,000 Mt (2 and 1800 EUR).

More than half the households that sell agricultural products do so exclusively at home or in front of it. Consequently, only forty percent use markets to sell their products at all, while only five percent use regional or national markets as selling points.

The hypothesis set up in chapter 4.2.2 that a higher amount of subsistence farmers results in higher food shortage fluctuations in the course of the year seems to be supported by the data from Chua (cf. Chart 20). Although this data is based on the individual, subjective perception of the respondent and is therefore not indubitable, the chart, furthermore, shows that the level of food shortages is lower in Chua than in Matola. Altogether almost 60 percent of the households, i.e. twice as many as in Matola, stated not to suffer from any food shortage. The persistence of food shortages per moth is, however, similar to Matola. Food shortages mostly do not exceed a week per month.

Chart 18

Farming Plot Sizes

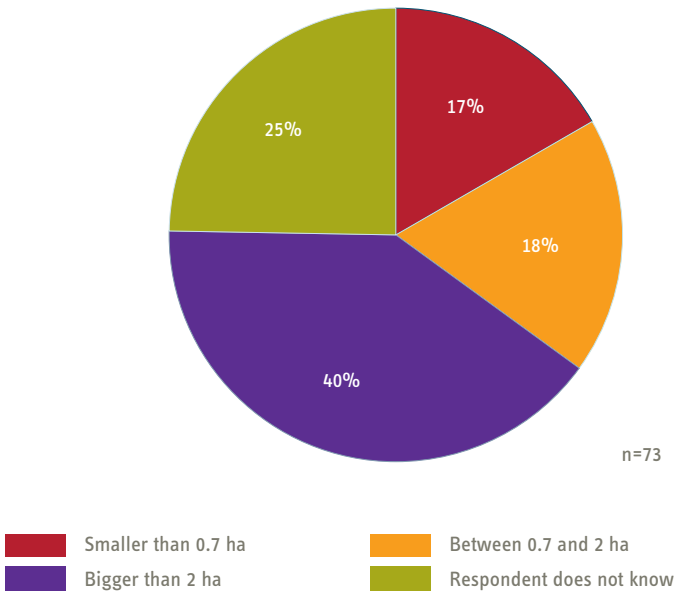


Chart 19

Main Cultivated Crops

Shares in percent among cultivating households

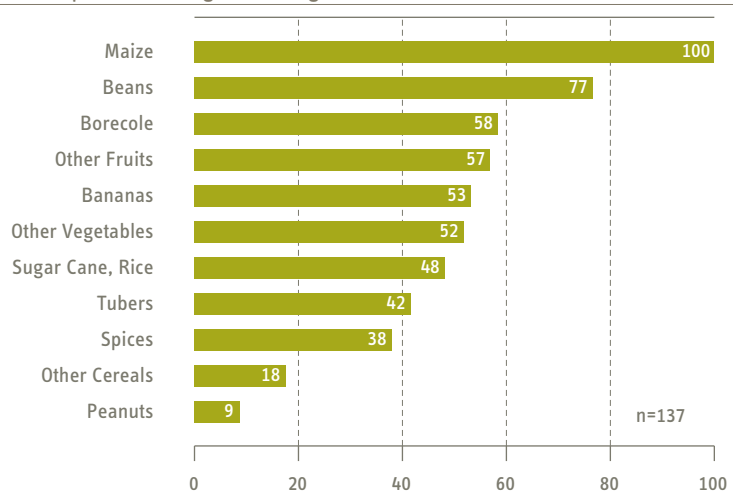


Table 25

Declared Reason Why Household does not Sell More

	%	% (selling households only)
Harvest is Sufficient only/ mainly for Autoconsumption	31	21
Poor Harvest	25	34
Lack of Inputs (Dung, Fertilizer, Seeds, Machines)	14	14
Size of Fields is Insufficient	12	11
Lack of Water, Irrigation System	7	10
Lack of Financial Means	5	5
No Demand for the Products	4	5

n=132; 80

Chart 20

Comparison of Food Shortages on Household Level in Chua and Matola

Shares of households suffering from food shortages in the respective month in percent

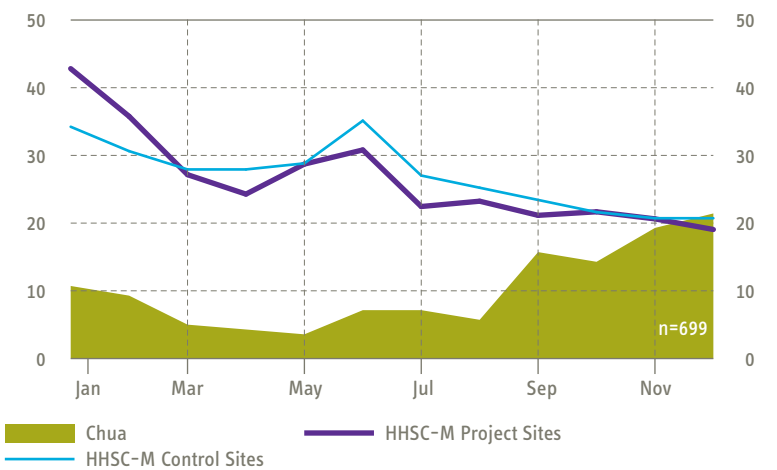


Table 26

Main Transformed Crops

Shares in percent; n = 136

Maize Flour	67
Pearl Millet Beer (Mexoeira)	10
Sorghum/Millet Flour (Mapira)	4

Table 27

Income Components of Agricultural Activity

Annual values in Mt; n=121

Revenue from Sold Cultivated Crops	1,700
Revenue from Transformed Agricultural Products	260
Expenditures on Agricultural Inputs	970

Table 28

Savings and Credits

	Percentage of Households in Possession of...				Average Amount of ... in Mt				Main Purposes (% of Households)
	PN	PN_p	PN_m	PN_r	PN*	PN_p*	PN_m*	PN_r*	PN*
Savings [last year]	42	28	58	58	4,200	1,700	4,500	9,300	-
Credits [last 5 years]	23	12	32	33	5,500	500	4,300	21,400	Commerce (28), Construction (13), Health (13)

*PN = Project Neighbourhoods; PN_p = poor Households in PN_s; PN_m = middle households in PN_s; PN_r = rich households in PN_s (for the classification into poor, middle and rich, see 2.4 and appendix A1); * Among those households which dispose of Savings and/or Credits.*

5.2.3 Savings and Credits

Analyzing the data for savings and credits the poorly developed rural financial market can be pinpointed. Less than 10 percent of the project site population declared to possess a bank account. However, the considerable proportion of 42 percent of households that actually do save money indicates that household budgets allow for surpluses. Hence, in contrast to Matola, the figure for actual savings is higher than that of bank accounts. As can be retrieved from Table 28, savings average 4,200 Mt (120 EUR). The table, moreover, gives an account of credits taken in the last five years. Here, the extreme differences between the wealth groups become apparent. While these credits average 5,500 Mt (160 EUR), they average 500 Mt (15 EUR) for poor households while richer ones credited on average 40 times more

(again, averages are taken from those households that actually dispose of savings and/ or credits). Also for credits, informal financial arrangements dominate. In 88 percent of the cases, the lender is an individual. Meanwhile, credit repayment problems are rare and only occur in 10 percent of the cases.

5.2.4 Assets, Expenses, Income

The set of assets that can be found in households in Chua given in Chart 21 is quite distinct from that of households in Matola. Due to low mobile phone grid coverage, mobile phones are quite rare. On the other hand, the more pronounced orientation towards agriculture is reflected in higher occurrence of bicycle (often purchased as a means of transport for agricultural products), mills and cows. Even in Chua, a fourth of the households already possesses a television set although grid connection was not yet accomplished at the time of the survey. The reason for this is, however, easy to find: As will be shown in chapter 5.4.1, a lot of households already dispose of alternative electricity sources (mainly solar panels and car batteries). Chart 21 also shows values for rural Mozambique stemming from the National Household Living Conditions Survey IAF2 of 2002/ 2003. While the high amount of television sets in Chua is probably in fact exceptional, the low level of mobile phones seems to be rather due to the date of the survey, which dates back five years.

Chart 21

Ownership of Assets

Shares in percent among households

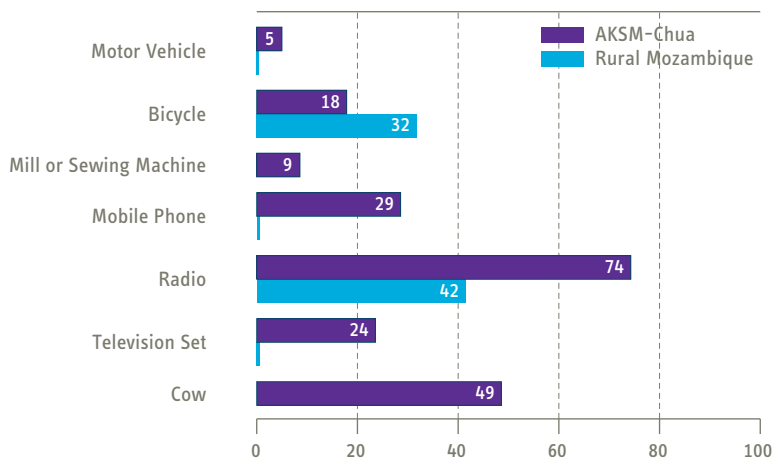
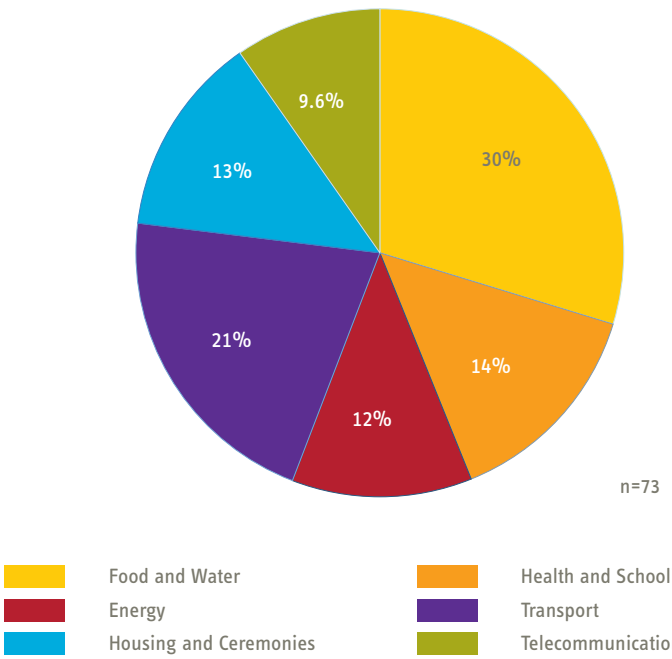


Chart 22

Expenditures



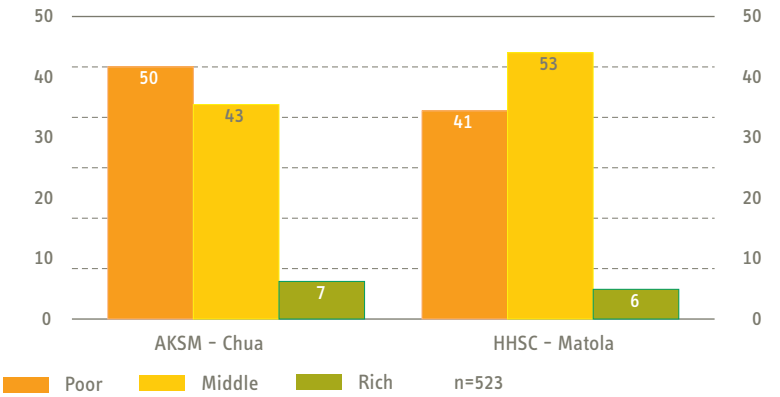
Concerning remittances, households are net donors, which is not typical for rural households either. With 24 percent, the amount of households sending frequent remittances is three times higher than the one for receiving households. The reason for this probably lies in the favourable geo-physical conditions with intensive gold mining activities. The absolute values of remittances are, however much lower than in Matola and amount on average to 3,800 Mt (110 EUR) for senders and 2,400 Mt (69 EUR) for receivers.

Table 29

Household Income per Year

n=108	less than 500 EUR	between 500 and 1000 EUR	between 1000 and 2000 EUR	more than 2000 EUR
Chua	51	30	15	5
Matola	28	34	28	10

Chart 23
Wealth Indicator
Shares in percent



Main expenditure categories, on the other hand, are depicted in Chart 22. While the individual categories will be scrutinized in more detail in the following two chapters if not already dealt with above, the comparison with the values of Matola is illuminating at this point. For obvious reasons, telecommunication expenditures are lower. Compared to 21 percent, energy expenditures are also substantially lower. This can probably be reasoned by the high level of free of charge firewood collection and the already significant amount of solar panels and car batteries. A deeper analysis of energy consumption will follow in chapter 5.4.

Since household income per year is calculated excluding any home consumption and more people in Chua are engaged in subsistence farming, values turn out to be lower here than in Matola (cf. Table 29). The Wealth Indicator drawing on a wider range of information on the socio-economic status of a family gives a different picture. According to this measure, households are better of in the Chua project region than in the project neighbourhoods of Matola (cf. Chart 23).

5.3 Social Life of Households

5.3.1 Education

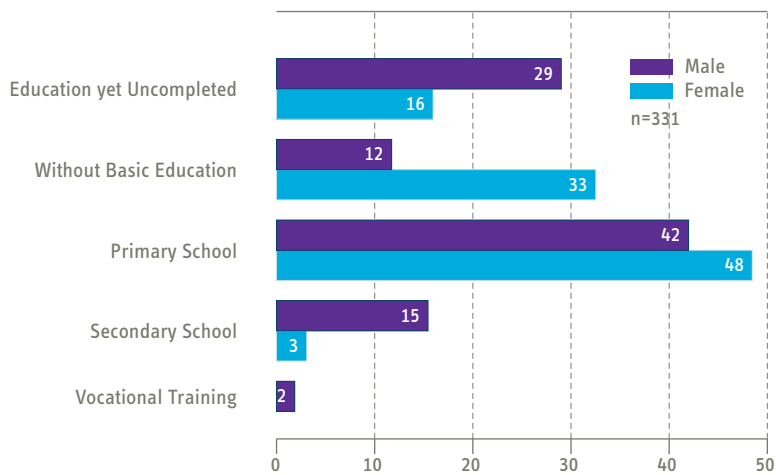
Chua is inhabited by a younger population which is why more than half of the surveyed population aged between 6 and 17 years is still in school, vocational training or university. The latter two, vocational training and university, are, how-

ever, complete exceptions with only one among 268 cases each. Education, hence, seems to improve in terms of more children entering school rather than in terms of higher education.

Chart 24

Adults' Highest Educational Degree Completed by Sex

Shares in percent



Taking only the adult population into account, still 22 percent have not yet completed their education. Chart 24 presents also the figures of the highest educational degree for those adults who already finalized their studies, subdivided by sex. Differences between men and women are very comparable to Matola, though the educational background is at a lower level in Chua. This is as well mirrored in the average years of schooling of 5.1, which are lower than in any neighbourhood of Matola.

School absenteeism is more pronounced in Chua. Every fourth household stated that at least one of the children did miss school in the month preceding the interview. The absence reason is predominantly health-related.

5.3.2 Health

There is only a single case of a health insured survey respondent through the support to former combatants. While half the population does not make use of health services, the rest pays on average 260 Mt (7.5 EUR) per month, while this value goes up in individual cases up to 5,000 Mt (150 EUR).

5. Analysis of AKSM-Chua Survey Results

Comparing recurrent diseases from Chua to those of Matola, rural/ peri-urban differences become clear (Table 30). While the prevalence of malaria is substantially higher, the one of hypertension is negligible in Chua in contrast to Matola. Diseases concerning eyesight occur substantially less in Chua indicating that other regional factors might play a role. Furthermore, they are not more prevalent among women than men (cf. Table 31).

Table 30

Prevalence of Chronic Diseases among Households

Shares in percent; n = 140

	Village	
Disease	Chua	Matola
Malaria	38	19
Hypertension	2	20
Respiratory System Disease	32	33
Eye Problems	14	26

Table 31

Prevalence of Relevant Diseases among Household Members by Sex

Shares in percent; n = 339

	Respiratory System Disease	Eye Problems
male adults	6.8	5.1
female adults	15	4.3
total population	7.6	3.0

Table 32

Physical Housing Information

		AKSM-Chua	HHSC-Matola			AKSM-Chua	HHSC-Matola
Outside Walls (%)	Brick	90	90	Estate is Own Property (%)		97	93
	Adobe	6	0				
Roofing Material (%)	Corrugated Iron (Zinco)	75	95	Dimension of Estate in m²	Average	4,350	510
	Straw	19	0		Median	500	450
Flooring Material (%)	Cement	50	93	Housing Investments Last Year in Mt *	Average	2,550	11,300
	Soil	47	7		Median	1,500	1,500
Windows Fitted with Glass (%)	Yes	52	51				
	No	48	49				

** Of those 50 (Chua) and 20 (Matola) percent of households which carried out any home maintenance, extension or repair last year.*

5.3.3 Housing

In spite of the very rural setting in Chua, the existence of modern dwellings is quite high. Especially corrugated iron roofs are widespread, probably continuing to replace straw roofs that are yet covering every fifth hut. Table 32, furthermore, underlines the higher level of subsistence farming with much more heterogeneous plot sizes that are on average eight times bigger.

5.3.4 Access to Infrastructure and Information

Figures for radio and television possession are three-fourths and one fourth respectively and thereby more in line with expectations than in Matola. People in Chua are, moreover, tilted far more toward radio than TV use. Radios are switched on for more than eight hours a day. The reason, why the television is switched on for less than three hours a day (compared to 5 hours 45 minutes in Matola area) most probably lies in the temporal restriction of electricity supply, since most of those households watching TV are able to do so owing to solar panels, which only provide limited power output. It will therefore depend on the availability of the new grid electricity, whether this figure can be expected to increase due to the development measure.

Table 33
Telephony

	AKSM-Chua	HHSC-Matola
Type of Telephone Used in %		
only mobile phone	81	85
mobile phone	83	97
public phone	19	15
Main Purpose in %		
only work	6	2
work and private	77	29
only private	17	69
Telecommunication Expenditures per Week in Mt	**93**	**95**

n=389

Finally, studying telecommunication it was found that a proportion of only 39 percent uses telephones at all. The reason for this relatively low percentage also lies in the low mobile phone network coverage – only a third of households stated that their homestead is actually covered. The use patterns of those households that use any telephone regularly are represented in Table 33. The figures are very similar to those in the project neighbourhoods in Matola. Same as in chapter 4.3.4, the main difference exists in the proportion of households that, at least partially, use their phone for working purposes. In Chua, so far less people possess a mobile phone at all, and these seem to have acquired the phone more often due to its usefulness for work.

5.3.5 Time Usage

While the labour market in Matola is quite heterogeneous, it can be subdivided into three main blocks in Chua: Agriculture, gold mining and others, of which the mean hours worked, differentiated by sex, are summarized in Table 34. The table furthermore shows the high percentage of people with a second occupation. For men, combining hours worked of first and – if existing – second occupation results in total working hours of on average 47.5 hours per week. For women, this average can not be provided, since more than half the women with a second occupation stated to be occupied in housework, about which no hours work are available. It can, though, be expected that is similar to the one for males.

Table 34
Data on Workload by Sex

	Male	Female
Mean Hours Worked per Week in...		
Agriculture	30.5	37
	n=36	n=55
Gold Mining	43.5	-
	n=47	n=2
Other Occupation	36	41
	n=27	n=9
Total	37.3	37.7
	n=111	n=66
Percentage of People with a Second Occupation	59	51
Mean Total Daily Workload	9 h 30 min	8 h 10 min

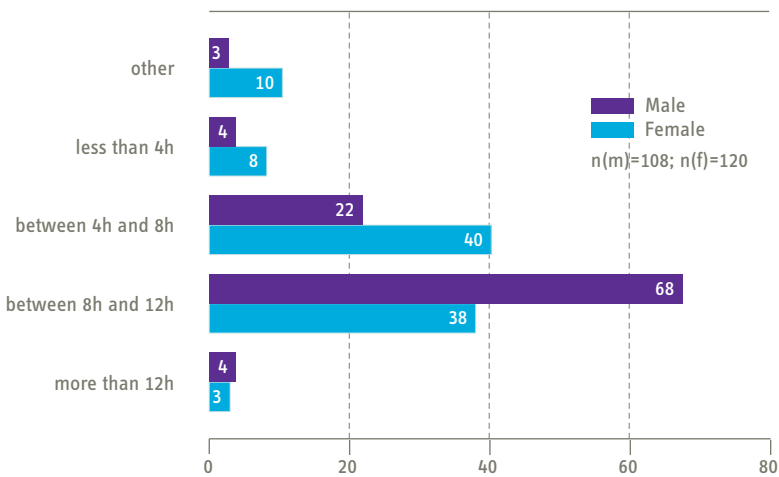
Asked for the general working day, including all kinds of work- and housework-related duties, people in Chua stated to be occupied for a relatively short period per day. It stars on average at 6.40 a.m. and lasts for 9 hours 30 minutes (male adults) and 8 hours 10 minutes (female adults). Chart 25 depicts this aspect graphically.

Table 35 portrays the assignment of tasks in families in Chua. It is not referred to collecting firewood, since this is (almost) identical to fetching water. Comparing these values and those for cooking with the ones from Matola, difference are observed in terms of (i) female adults being even more often the (single) responsible person for household duties; (ii) Chua households having less domestics; (iii) children under 12 are far more often involved in household duties.

Chart 25

Duration of Working Days by Sex

Hours per day



The category "other" mainly comprises "biscateiros" (day labourer) or in general people who work infrequently.

For energy sources, information is, furthermore, available, how much time it takes per week to buy the different energy sources such as batteries, kerosene and firewood – without differentiating between males and females. For collecting firewood, the average is 110 minutes for the whole family per week, and one hour for energy sources but firewood.

Table 35

Responsibility for Household Duties

Shares in percent; multiple answers possible

	Fetching Water	Cooking
Male Adult	3	1
Female Adult	94	94
Male Children	15	3
Female Children	22	19
Maid, Domestic	5	4
Children under 12 (among HH with children under 12)	41	24

5.4 Household Energy

5.4.1 Energy Sources and Uses

An important finding of the baseline is the high rate of pre-intervention electricity access. The considerable share of one-third of households already possesses a solar panel or a generator (cf. Table 36). Further 13 percent, at least benefit from a car battery. Same as for Matola, these electricity sources are to be assessed in detail in order to estimate the proportion of functional solar panels and car batteries that can be considered as "modern" energy sources. This assessment is of special importance for the intervention, since these households can not be counted as being newly provided with modern energy. Running the same analysis as in section 4.4.1 yields that only half the households with a solar panel can make effective use of it. Hence, only half of the existing solar panels are appraised as modern energy sources. Among households that only possess a car battery, for the case of Chua, one arrives at a fraction of one-third that possessed already before the intervention an energy source which can be called modern. In sum, only every fifth household in Chua can be considered as pre-electrified (cf. the right column in Table 36).

Main energy sources used are still traditional as listed in Table 37. For lighting, households in Chua use candles and kerosene in inverted frequencies in comparison to Matola (for Matola, the values are 43 percent for candles and 92 for kerosene). A reason for this might be the lower availability of kerosene in Chua, or at least the higher prices – kerosene is on average 60 percent more expensive here than in Matola, while candles are only slightly cheaper there. For cooking, the Chua population only utilizes firewood, which is still abundant with over 98 percent collecting their firewood themselves. For that reason the average expenditure on

firewood is almost zero. With only 10 percent of households possessing improved stoves, their diffusion is not satisfactory, however, higher than in Matola, which already suffers from wood scarcity.

The appliances, which consume the energy provided, are listed in Table 38. Comparative values in this case are delivered by the latest household living conditions survey, which, though, provides for relatively outdated data from 2002/ 2003 (INE 2004). This becomes evident especially when looking at mobile phone possession. Due to the high amount of already available alternative electricity sources (cf. Table 36), the significant existence of TV sets does not astonish.

When asked, which electrical appliances they would be most tempted to purchase in case of grid connection, households favour TV sets (53 percent), followed by fridges and video recorders (35 percent).

Table 36

Electricity Sources at Household's Disposal

Shares in percent

	Total	Modern*
Solar Panel (+ Car Battery)	31	14
Solar Panel and Generator	1	1
Generator	2	2
Car Battery	13	3
Total	47	20

*n=138 – * Electricity sources are considered modern if they represent a reliable source for modern energy services such as electric lighting. The values are derived in the continuous text on the left.*

Table 37

Data on the Use of Traditional Energy Sources

	Candles	Kerosene*	Batteries for		Wood	Charcoal	Gas
			Torches	Radios			
% among all Households	82	51	11	45	92	0	0
Average Monthly Consumption	19 pieces	1.9 l	7.3 pieces	12.9 pieces	11.8 bunches	-	-
Average Monthly Expenditures in Mt**	110	80	55	90	3	-	-

Table 38
Electrical Applicanes

Shares in percent

	AKSM-Chua	Rural Mozambique*
Iron	8	0.4
Electric Stove	0	0.3
Refrigerator	1	0.2
Freezer	0	0.3
Cassette Recorder	4	5.3
Fan	0	0.5
Radio	75	41.5
Television Set	24	0.7
DVD	5	-
Mobile Phone	29	0.5
Electric Sewing M.	0	0

** These values stem from the last household living conditions survey (INE 2004).*

Table 39
Traditional Lighting Devices

		AKSM-Chua	HHSC-Matola
Traditional Tin Lamps	#	0.6	0.15
	h	3.7	4
Hurricane Lamps	#	0.3	1.3
	h	2.7	5
Torch	#	0.07	0.02
	h	–	–

Table 40
Modern Lighting Devices in Households with Alternative Electricity Source

		Exterior	Interior
Incandescent Light Bulbs	#	0.05	0.35
	h	3	2.7
Fluorescent Tubes	#	0	0.02
	h	–	–
Energy Saving Bulbs	#	0.04	0.06
	h	0.8	2.6

 # = quantity per electrified household; h = hours lit per day

5.4.2 Lighting

Although almost half the households in Chua already have an electricity source at their disposal that allows them to use electric lighting, only a fourth of these (i.e. one eight of all households) actually do so. Simple traditional tin lamps therefore

remained the dominant lighting source in Chua households (cf. Table 39 and Table 40). Also in terms of lighting hours, households seem to economize kerosene consumption. Although no public lighting exists in Chua, torches are only rarely in use.

Data given in Table 40 does not yet allow making inferences on the use pattern of electric lighting appliances in Chua, since it is based on less than twenty households. Furthermore, the promotion of energy saving light bulbs on the part of the AMES-M project might help to sensitize for the superiority of these light bulbs. This promotion has been put into practice by offering a "starter package" of items necessary for a basic in-house installation that contained a set of compact fluorescent light (CFL) bulbs (cf. Photo 22). Anyhow, the sensitization for energy saving opportunities provided by CFL bulbs in Chua is even higher than in Matola, since even cognition of energy saving lamps is scarce. The share of respondents who are acquainted with them amounts to meagre 20 percent. A further problem is, of course, their availability. Only a third of the latter respondent group regards CFL bulbs as easily available in the region.

Photo 22
Electricity Installation Package Provided by the Project

5.4.3 Energy Expenditures

The level of energy expenditures is quite low, although unit prices are higher due to the remoteness of the site. Two reasons can be determined: self-collected firewood serves for almost all households as cooking fuel and a significant amount of households already disposes of a solar panel and/ or car batteries. (cf. chapter 5.4.1). The weight of energy expenditures in total expenditures (as defined in chapter 5.2.4) across wealth classes is analogous to the findings in the energy expenditure chapter for Matola, 0: "middle" households spend least on energy in relative terms, while the richer households' share of expenditures on energy is the highest. Energy has, hence, both characteristics of a necessary good (for basic cooking and lighting – poor spend more than middle) and of a luxury good (like for entertainment and locomotion – richer spend more than middle).

Table 41
Energy Expenditures

	Total	poor	middle	rich
Monthly Energy Expenditures in Mt	170	90	110	980
Share of Energy Expenditures in Total Expenditures*	12	12.5	7.5	18.5

5.4.4 Attitude towards Electricity

In Chua, the general perception of the development measure is very positive as well. 95 percent of the population consider the project to have positive impacts according to Table 42. Negative effects are perceived by 11 percent of the people. Like in Matola, it was criticized that not the whole neighbourhood benefited from the project. Furthermore, concerns about the safety risks that go along with electricity have been expressed.

Table 42
Perception of Positive Impacts of the Electrification Intervention
Shares in percent; multiple answers possible; n =129

1. Lighting	46
2. Community development	12
3. A better life/ satisfying basic needs	9
4. Makes work easier	6

The main purposes households in Chua plan to use electricity for are named in Table 43. They do not differ substantially from the preferences observed in Matola. The household's willingness to pay is depicted in Chart 26. The diagram shows

the values in relation to the two thresholds 100 Mt (3 EUR) and 250 Mt (7.50 EUR). The corresponding amount of electricity that they will be allowed to consume will depend on decisions of the operator of the multifunctional platform. These are, however, not yet taken, since the project is not fully executed. That is also the reason why no information concerning the project realisation can be provided in this baseline.

Table 43

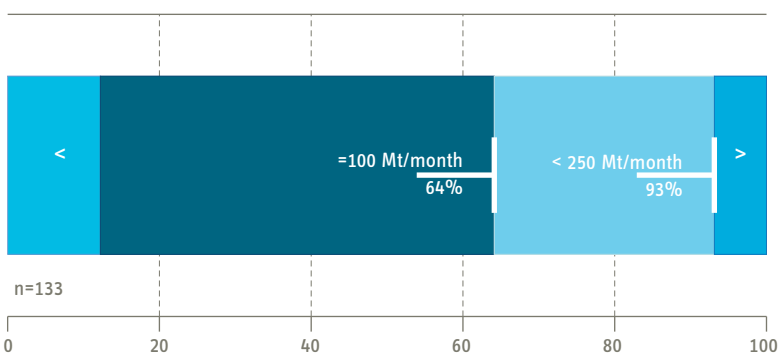
Purposes Electricity shall Serve or actually Serves for

Shares in percent; n =111

all values in %	1st	2nd	3rd
1. Lighting	80	12	6
2. TV	11	32	26
3. Fridge/ Freezer	2	15	12
4. Radio, Music	1	12	12
5. Commerce	1	12	5
6. Studying at night	1	2	12

Chart 26

Willingness to Pay for Electricity



6. Conclusions and Recommendations

The present study brings about the following compilation of conclusions and recommendations, which are presented according to the study objectives described in chapter 2.1.

Objective 1. **Portray the socio-economic conditions in the project areas.**

- This primary objective of the study has been accomplished by presenting the results of a representative sample population for both project sites in the chapters 4 and 5.
- In a second step the data and results will be utilized for accomplishing the following objectives.

Objective 2. **Serve as a data basis for monitoring activities, accounting for all relevant aspects of EnDev Monitoring.**

- The processed data collected through structured questionnaires in 398 (HHSC-M) and 140 (AKSM-Chua) project neighbourhood and 112 (HHSC-M) control neighbourhood households constitutes a profound and reliable basis for future monitoring activities.
- The calculation of people the energy facilitation programme Energising Development can be held accountable for ("EnDev beneficiaries") is quite straightforward. Within the framework of "Household Service Connections at Matola Area" (HHSC-M), only private households have been connected – in order to reach the total number, the household average, which is 5.2 according to the baseline data, has to be multiplied by the number of connections, which is 6,670. With a random survey sample of 398 households, the correctness of this figure could be sufficiently verified (cf. objective 5). Yet, those households that already possessed a reliable electricity source before the intervention can not be counted as being newly provided with modern energy in the EnDev sense (cf. Box 2 on page 20) and, consequently, have to be subtracted. According to the analysis conducted in section 4.4.1, 16 percent of the beneficiary households fall under this category, mainly due to having used a car battery as former electricity source but also because of functional solar panels or a genset at their disposal. The resulting figures are presented in Table 44.
- Table 44 also delivers EnDev beneficiary data for Chua. Here, the situation is more complicated. Connections have not yet been executed at the time of the survey, a considerable amount of households possessed alternative electricity sources before the intervention (mainly solar panels) and beneficiaries are as well countable in the social infrastructure and productive use categories.

- Based on the explanations given in section 5.4.1, 20 percent of the households can not be counted, since they already possessed a functional solar panel or generator before the intervention. With an average household size of 5.5 and a planned number of 265 connected families one arrives at 1,160 "EnDev beneficiaries".

- According to the experience gained when the first of the four maize mills has been rehabilitated shortly after the baseline survey, the targeted number of households has been raised by the community authorities to the total population of Chua comprising 489 households. This was mainly due to the increased willingness of households to get provided with electricity by means of car batteries. While the proportion of directly and indirectly connected households in the original proposal has been 95 to 170, the revised figures are 129 and 360. Accordingly, the EnDev beneficiaries would augment to 2,150. At the current stage of implementation, a more conservative figure of 370 connections (120+250) shall be applied for the EnDev beneficiary projection for 2010 in Table 44.

Table 44

Summary on EnDev Beneficiaries

	HHSC-Matola		AKSM-Chua	
	achieved in 1-2009	expected for 2010	achieved in 1-2009	expected for 2010
Number of people provided with lighting/ household energy	29,135	29,135	370	1,628 [1,166 - 2,152]
Number of people provided with energy for cooking	–	–	–	–
Number of people provided with energy in social infrastructure	–	–	101	203
Number of people provided with energy for productive use	–	–	270	540
Total	**29,135**	**29,135**	**741**	**2,371**

A detailed derivation of these figures is given in Annex A4.

- For Chua, there is the potential to connect and, hence, count micro and small enterprises (MSE) and churches as social infrastructure in the third and fourth category of Table 44 as well. According to current information and counting rules applicable to these beneficiary categories that are each outlined in Annex A4, further 740 people are countable for two churches and twelve kiosks. The

Annex document, furthermore, describes how to proceed with the EnDev counting, if further interventions – potentially targeting other social infrastructure services such as hospitals or street lighting – are implemented.

- Table 44 lists the already achieved beneficiary figures up to January 2009 as well. HHSC-M is already concluded, which is why the figures for Matola are identical. In Chua, the first of the four rehabilitated maize mills provides electricity to 84 households (directly and indirectly, while also here the 20 percent of pre-electrified households have to be subtracted) and half the targeted enterprises and churches.

- Both for Matola and Chua, homebusiness activities will very likely not contribute to the outcome in terms of people provided with energy for productive use. This holds for Chua, because the project is a pico-hydro intervention, i.e. with a very limited capacity and scope that will only allow for few regular businesses to use electricity. Data from the control sites suggests that homebusinesses will not play a role in Matola either. The seven percent of homebusinesses there are – apart from one case – people using a fridge and/ or freezer to sell beverages. Since they would be counted as one-person enterprises with limited additional income and small catchment areas, the resulting figure would be too insignificant and questionable to be included here.

- Although the figures for Chua are yet uncertain and so far only one of the four mills has been rehabilitated, reliable figures will be easily available after all rehabilitation and construction works are finished due to the intensive inclusion and supervision of local authorities. It, nevertheless, has to be monitored, whether the vast majority of benefiting households are actually able to use electricity continuously. For that purpose, the electricity consumption and production patterns should be randomly verified at least once in the time period until 2010. For Chua, aspects of electricity production refer in particular to (i) the frequency and nature of outages due to problems with the multifunctional platforms, (ii) the duration of electricity availability per day and (iii) the performance of the battery charging station. Easily collectable indicators concerning electricity consumption are figures concerning the payment behaviour of the electricity clients at the different mills and the battery charging station. If available in an updated version, the lists of existing household and lighting applications may complement this information same as random household visits in the community. These visits should at best include some ten households each that are (i) directly connected (ii) indirectly connected thanks to the battery charging station or – if still existent – (iii) non-electrified.

- Concerning the monitoring within the Matola intervention it is recommended to first of all assess the customer data processing capacities at EdM Matola. It should be as a minimum feasible to once produce a separate record of basic indicators for the 6,670 beneficiary households. Taking into account the irregular electricity purchasing behaviour of households using prepaid meters, the time period under investigation should cover three months. The indicators should at least include mean and median electricity consumed in this period in kWh and the percentage of households having consumed in the total of these three month less than or equal (i) 30 kWh, (ii) 90 kWh, i.e. 1 kWh per day, and (iii) 300 kWh, i.e. on average falling under the social tariff category of less than 100 kWh consumed per month.
- Since EnDev beneficiaries will be eventually counted in 2010, one might extrapolate the figures collected in 2008 with the expected population growth. However, as explained in Annex A4, neither the average household size nor the figures for churches or MSEs are expected to become significantly affected by population growth.

Objective 3. **Provide benchmark data for a potential Impact Evaluation of the project components.**

- The design of comparing electrified and non-electrified households already allowed for predicting the most relevant development impacts of electrification. It can, however, not replace an endline or ex-post study of the actual programme impact. Since parts of the benefits of rural electrification will materialize only in the log term, it would be worthwhile to contemplate postponing an ex-post study of the impact of the development measure until after 2010. It is recommended to design this study based on the present baseline in order to guarantee useful comparability of the here presented and future results.
- When assessing ex-post the impact of the development measure, possible changes in decisive factors for the people's living conditions but not related to the intervention always have to be taken into consideration. For the case of Chua, especially the development of gold mining should be closely followed, since this activity is the main income source in the village, while its sustainability is questionable.

Objective 4. **Assess some of the anticipated impacts of the development measure, specifically related to energy.**

- For the densification intervention in Matola, already electrified households in the peri-urban target region that have benefited from subsidised connections in the past have been included in the survey design as a control group. They

have been selected in a way to be a representative draw from the population in order to circumvent biases inherent to the analysis of common electrified households that are typically better-off and thereby structurally different (cf. section 2.2). Baseline data of the household composition and wealth indicator revealed that even households among the control group tend to be better-off than beneficiary households. There are two main conclusions to be drawn from this: (i) The targeting of 'late connectors' as presumably poorer households proved to be successful. (ii) Since poorer households are actually overrepresented among the beneficiary households, the findings among the representative control households will not perfectly characterize the impact that is to be expected of the electrification intervention. Probably, the impact among the concrete group of beneficiary households will be slightly less, since they on average have less financial and intellectual means to benefit from the provided modern energy.

- At the household level, the most considerable benefit can be expected in terms of lighting. Costs of lighting per hour can drop by 95 percent if kerosene is substituted by energy saving bulbs and if households are charged the subsidised electricity tariff. Since on the other hand more lighting and electricity for new appliances is consumed, the effect on the total energy expenditures is unclear. The use of energy saving bulbs can, however, not be taken for granted. While they have been provided by the project in Chua, in Matola this was not the case. Eventually, 15 times more households bought incandescent light bulbs than compact fluorescent ones.
- Apart from kerosene for lighting, resource savings can be expected due to the substitution of batteries for radio use and generator fuel, while the consumption of cooking fuels will not be affected by the intervention.
- Appliances that will be most probably purchased and in use are entertainment devices (TV, radio, DVD), and, to a less extent, freezers and irons.
- Since the project region in Matola is a residential area, the productive use of electricity is of little relevance there. In Chua, the limited power provided by the future pico-hydro power plants is the restricting factor.
- A substantial impact on women's workload triggered by the electrification intervention is not foreseeable in the short and medium term, especially since cooking will not be significantly affected. In Matola, purchased charcoal and firewood are mainly used for cooking and electric stoves will commonly not be acquired. In Chua, again, the limited kW of the hydro power plants will hinder the use of this appliance. Furthermore, it should be mentioned that – even

taking household chores into account – women have a lower workload (in terms of time) than men; at least according to the interviewee's disclosure, who have been at both sites women by the majority.

Objective 5. **Gather additional information and, if appropriate, recommendations concerning…**

…the needs and wants of the population; the satisfaction with the implementation of the household connections under way and a random verification of connections already realized (only HHSC-M).

It was originally planned that findings of the survey would be fed back into the project design, since the survey had been planned for a time when part of the household connections has already been carried out. Yet, this has been rendered impossible, as the implementing contractor worked more efficiently than anticipated and finished his tasks at the beginning of the survey – in half the time planned. Consequently, the whole random sample of 398 project households in Matola could serve to verify that connections have been effectively implemented and to the household's satisfaction. Actually, all visited households were correctly provided with electricity and more than two-thirds of the households have been very satisfied with the project intervention while no one has been unsatisfied. Six percent experienced any problems with the in-house installation.

…the appropriateness of the intervention and potential complementary activities.

A companion paper to this baseline study deals in more detail with this question. At this point, the following shall be noted: While expected impacts turned out to be limited, the grid densification component in Matola efficiently provided a considerable amount of yet non-electrified households with modern energy. The intervention proved to make up a justifiable part in an electrification portfolio. The pico-hydro project, on the other hand, seems quite promising in producing community-wide impacts and for horizontal scaling up at least in other remote off-grid villages in the mountainous regions of Mozambique. By incorporating prudently local knowledge, institutions and material, effective capacity development has been provided on the micro level.

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7. Appendices

A1 Wealth Indicator

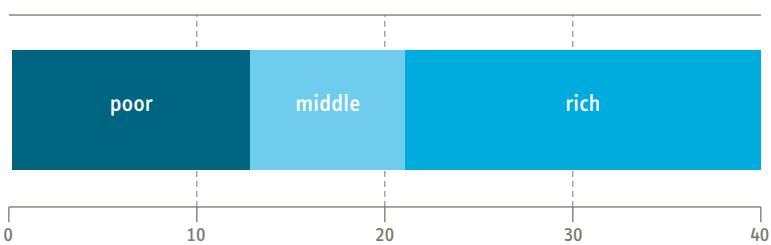
Subindicators	Variable Names		Subindicator Values					
Assets								**20**
Dwelling Conditions								2
Construction Material of Outside Walls	hind_walls1	h5	0	1				
Flooring Material	hind_floor	h6	0	1				
Windows Fitted with Glass	hind_wind	h8	*dwellings of control HH were all fitted with glass wind. by sponsors*					
Domestic Animals								4
Quantity and Type of Animals Owned	hind_anim	h61_x/h62_x	0	1	2	3	4	
Savings								2
Savings	hind_sav	h74	0	1				
Ownership of a Bank Account	hind_bankacc	h72	0	1				
Means of Transportation								3
Type of Means of Transportation	hind_mot	h90_x	0	1		3		
Electric Appliances								5
Type of Electric Appliances	hind_elap	h157_x/ h156_11	0	1	2	3		
Electricity Source	hind_els	h141	0		2			
Education								4
Education Level of Head of Household	hind_hohedu	h19 / h12_1x	0		2	3	4	
Expenditure								**13**
Nutrition								
Food Expenditure per AEQ1	hind_foodpe	h66 / h21t	0	1	2			4
Existence of Food Shortages	hind_foodsh	h68 / h69	0	1	2			
Telecommunication								4
Telecommunication Expenditure	hind_tel	h107	0		2	3	4	
Ownership of Mobile Phones		h108_2						
Energy								2
Expenditure on Energy Sources per AEQ[1]	hind_enpe	[2]	0	1	2			

7. Appendices

Subindicators	Variable Names		Subindicator Values						
Education									0
Schooling Expenditure	hind_school		*too many families could not estimate their schooling expenditures*						
Ability to Send Children to secondary School	hind_sec		*too many families for whom this indicator would not apply*						
Health									3
Health Expenditure	hind_health	h98	0	1	2	3			
Income									**6**
Household (HH) Income									6
HH Income excl. Consumption of Home Production	hind_inc		*hind_incpw is considered a better indicator*						
HH Income per HH Member Able to Work3 excl. Consumption of Home Production	hind_incpw	[4]		1	2		4	6	
					13[5]		21[6]		39

[1]abbreviations: hind = Household Indicator; AEQ = Adult Equivalent. – [2]h143b_x/ h136/ h144_x. – [3]„Able to Work" is defined as being older than 14 and not older than 65, neither studying, working in the household or being retired. For those being older than 65, the same classification applies with an inclusion factor of 0.5. – [4]hind_incpw is composed of a variety of variables to calculate wage and farm income (minus farm expenditures) and income from remittances, adapted to HH Member Able to Work (see 3.). – [5]The values highlighted in orange represent (one possible) upper boundary of the categorization as „poor" - they sum up to 13, the maximum value for being classified as poor. They have been chosen among the different parameter value of each subindicator such that at least two-thirds of the households classified as poor do not exceed this value. – [6]Similar to the values highlighted in orange, the values highlighted in yellow represent (one possible) upper boundary of the categorization as „middle" - they sum up to 21, the maximum value for being classified as middle. They have been chosen among the different parameter value of each subindicator such that at least two-thirds of the households classified as middle do not exceed this value.

The resulting Wealth Indicator looks as follows:



Variable Name	Unit	Codes for Subindicator Values						
		0	1	2	3	4	5	6
hind_walls	-	other	brick					
hind_floor	-	other	cement or clinker					
hind_wind	-	no	–	yes				
hind_anim	-	none	<15 poultry, rabbits	1 cow; < 5 pigs, goats; >= 15 poultry and rabbits	2-4 cows; >= 5 pigs, goats	>= 5 cows		
hind_bankacc	-	no	–	yes				
hind_mot	-	none	bicycle	–	vehicle			
hind_elap	-	none	only radio	other	electric stove, fridge, air cond. and similar			
hind_els	-	no		yes				
hind_hohedu	-	none	–	basic education/ still attending school	2ary school finished/ vocational training	tertiary education/ university		
hind_foodpe	€/ week	< 2	< 4	>= 4				
hind_foodsh	days	> 30	other	no				
hind_tel	€/ week	none	–	< 2	< 4	>= 4		
„	# mobile phones	–	–	1	2	>2		
hind_enpe	€/ month	< 2	< 4	>= 4				
hind_health	€/ month	none	< 4	< 10	>= 10			
hind_incpw	€/ year	< 30	–	< 500	–	< 1000	–	>= 1000

A2 Adult Equivalent Scale

When comparing consumption levels between households, and using them to assess poverty and inequality, investigators face the situation that households differ in the number of members they have and in the age of these members. Larger households or those with a higher proportion of prime age adults are likely

to have higher consumption needs. This is taken into account for by means of an adult equivalent scale, which allows household size to be measured in terms of "adult equivalents", recognising that the consumption needs of younger children for instance will be less than those of prime age adults. The scale used in this survey is the same that is traditionally used in Rwanda. The scale is reproduced in the table below.

Table A1

Rwandan Adult Equivalent Scale

Age range	Sex	
	Male	Female
Less than 1 year		0.41
1 to 3 years		0.56
4 to 6 years		0.76
7 to 9 years		0.91
10 to 12 years	0.97	1.08
13 to 15 years	0.97	1.13
16 to 19 years	1.02	1.05
20 to 39 years		1.00
40 to 49 years		0.95
50 to 59 years		0.90
60 to 69 years		0.90
More than 70 years		0.70

Source: A. McKay & Greenwell, G. 2007. Methods Used for Poverty Analysis in Rwanda Poverty Update Note.

A3 Cost Calculation for Different Lighting Devices

Table A2

Cost Calculation for Different Lighting Devices

	Lamp costs						fuel costs			cost indicators	
	A	B	C	D	E	F	G	H	I	J	K
	luminous flux	life	annual utilisation[4]	unit price[2]	annual unit costs	annual maintenance costs3	consumption	unit price	annual fuel costs	annual operating costs	unit price per kilolumenhour
	Lm	h	h	€	€	€	ltr/ h or kWh	€/ ltr or €/ kWh	€	€	€
					C/B * D				C * G * H	E + F + I	(1000/A) * G * H
I	32[1]	5500[3]	1500	3	0,82	3,2	0,020	0,75	22,00	26,02	0,46
II	730[1]	1000[2]	1500	0,7	1,05	0	0,06	0,03	2,69	3,71	0,0025
III	600[2]	7000[2]	1500	2,2	0,47	0	0,011	0,03	0,56	1,08	0,0006

[1]Source: Nieuwenhout, F., P. Van de Rijt, and E. Wiggelinkhuizen. 1998. Rural Lighting Services. Paper prepared for the World Bank, Netherlands Energy Research Foundation, Petten. – [2]own research. – [3]Source: Schwarz, Dishna et al. 2005. Lighting Technologies. Paper prepared for gate Information Service / gtz, Eschborn. – [4]The actual values for the different lighting devices range around this value. For comparative reason, this same value is applied to all three lighting devices. [I]Kerosene Hurricane Lantern. – [II]Incandescent Light Bulb (60W). – [III]Compact Florescent Bulb(11W)

A4 Calculation of EnDev Beneficiaries

AMES-M exclusively targeted households in Matola, while it can be held accountable in Chua for people provided with modern energy in households, churches and microenterprises. Accordingly, the relevant EnDev outcome categories are (i) lighting and household applications, (ii) social infrastructure, and (iii) productive use. Table A3 depicts the outcome figures for the respective categories.

In the following, the underlying formulas, assumptions and relevant background information are presented. Calculation formulas for different beneficiary groups are displayed in the table below. They have been specified according to EnDev guidelines outlined in EnDev Annual Planning 2006. In consideration of future AMES-M interventions, the table includes formulas on all potential beneficiaries.

Some aspects of these calculation formulas represent substantial innovations to the formulas proposed by EnDev. These will be explained later on. Before that the variables used shall be concretized and explained for the specific case of AMES-M

in Table A5. The table not only refers to the interventions presented in this baseline, but also considers data needs of potential future development measures of AMES-M.

At the time of concluding this baseline report in January 2009, the Matola grid densification intervention has already been finalized. In Chua, the first of four maize mills to be rehabilitated has been upgraded to a multifunctional platform and already provides electricity to its vicinity.

While the calculation of the number of people provided with modern energy for lighting and household applications in households is straightforward and identical to the formula proposed by EnDev, the other formulas in Table A4 are innovative in some aspects.

A person is counted as having access to modern energy for social infrastructure if he or she is supplied with electrified schools, health institutions and communal services. If only part of this social infrastructure is electrified, accounting shares for the respective institution type depicted in Table A6 have to be applied in order to determine the accountable EnDev outcome. Four potential communal services have been determined in Chua: Administrative offices, community centers, street lighting and churches. Since the benefit for the population that can be expected from the electrification does not differ substantially among these services, it seems most adequate to weight them equally with 0.075. A similar reasoning applies to primary and secondary schools that are both weighted with 0.175.

Table A3
EnDev Beneficiaries of AMES-M

Number of people provided with...	HHSC-Matola (Grid Densification)		AKSM-Chua (Pico-Hydro)	
	achieved in 1-2009	expected for 2010	achieved in 1-2009	expected for 2010
lighting/ household energy	29,135	29,135	370	1,628
energy in social infrastructure	-	-	101	203
energy for productive use	-	-	270	540
Total	**29,135**	**29,135**	**741**	**2,371**

Table A4
Calculation Formulas for EnDev Beneficiaries

Beneficiary Group	Calculation Formulas					
Households	SF ×	$(1\text{-}SPE_H)$ *(Share of Households that have not been Pre-electrified)*	×	N_H *(Number of all Electrified Households)*	×	HS *(Average Household Size)*
Social Infrastructure						
Health Institutions	SF ×	N_{HI} *(Population Living in the Service Areas of the Health Institutions)*			×	0.35 *(Accounting Share of Health Institutions)*
Primary and Secondary Schools	SF ×	$\Sigma_t (N_{Pt}$ *(Number of Pupils of School Type t)* *t = Primary or Secondary*	×	$\frac{SP}{SP_{Pt}}$ *SP = (Surveyed Population)* *SP_{Pt} = (Number of Pupils of School Type t among Surveyed Population)*	×	0.175) *(Accounting Share of School Type t)*
Administrative Offices	SF ×			N_A *(Population of Local Administrative Units)*	×	0.075 *(Accounting Share of Communal Services)*
Community Centers	SF ×			NC_0 *(Community Population)*	×	0.075
Street Lighting	SF ×	SL_V *(Estimated Share of Main Roads in the Villages provided with Street Lighting)*	×	N_V *(Village Population)*	×	0.075

Beneficiary Group	Calculation Formulas					
Churches (incl. Mosques)	SF ×	$\frac{N_{CE}}{N_C}$ *N_{CE} = (Number of Churches Served with Electricity)* *N_C = (Number of Churches in the Village)*	×	N_V *(Village Population)*	×	0.075
Micro and Small Enterprises (MSE)	SF ×	$\sum_t \left(\frac{N_{BEt}}{N_{Bt}} \right)$ *N_{BEt} = (Number of Businesses of Business Type t Served with Electricity)* *N_{Bt} = (Number of Businesses of Business Type t in Need of Electricity in the Village)* *t = Tailor, Bar, ...*	×	$\frac{1}{T}$ *$T = \sum t$*	×	N_V) *(Village Population)*

Table A5
Details on the Variables used in the Calculation Formulas for EnDev Beneficiaries

		HHSC-Matola	AKSM-Chua 1-2009 end 2010	General Remarks	Remarks on Outcomes of Matola and Chua
HS	Average Household Size	5.2	5.5	The figures refer to individual households, even in the case of homesteads. They are retrieved from the baseline survey and can be applied to interventions in similar regions (peri-urban; rural Western Mozambique).	–

		HHSC-Matola	AKSM-Chua 1-2009	AKSM-Chua end 2010	General Remarks	Remarks on Outcomes of Matola and Chua
N_A	Population of Local Administrative Units	–	–	–	–	–
N_{BEt}	Number of Businesses of Business Type t Served with Electricity	–	t = Kiosks/ Bars: 6	12	These are only businesses that are newly provided with electricity.	Among the microenterprises that are in principal in need of modern energy in Chua, only kiosks/ bars are expected to actually get connected. All 12 kiosks/ bars will receive connections, of which half have already been implemented.
N_{Bt}	Number of Businesses of Business Type t in Need of Electricity in the Village	–	t = Kiosks/ Bars: 12		–	
N_{CE} / N_C	Number of Churches Served with Electricity among all Churches in the Village	–	1 / 2	2 / 2 = 1	If individual churches differ substantially in size, they may be weighted with their number of worshippers.	One of the two churches in Chua has already been connected by the project. The second will follow soon. Both count 30 worshippers, which substantiates the equal weighting.
N_{CO}	Community Population	–	–	–	In the normal case, this figure equals NV.	
N_H	Number of all Electrified Households	6,670	84	370	These households include pre-electrified households.	It was intended to connect 265 households in Chua – 95 directly to one of the four micro-grids and further 170 indirectly via car batteries. This outcome figure is, however, expected to be higher due to an increased interest in the car battery solution among the population, which could be observed after the first multifunctional platform serving 84

		HHSC-Matola	AKSM-Chua 1-2009	AKSM-Chua end 2010	General Remarks	Remarks on Outcomes of Matola and Chua
						households has been installed. At the current stage of implementation, it is, though, unclear, how many of the 489 households in Chua can actually be served. 370 (120+250) connections can be deemed feasible and shall therefore be assumed for the EnDev beneficiary projection for 2010.
N_{HI}	Population Living in the Service Areas of the Health Institutions	–	–	–	If a health institution (HI) can not provide a reliable figure on NHI, an estimate shall be made reflecting best the population living within a radius of 8 km, implying that the HI can be reached by foot in one and a half hours.	–
N_{Pt}	Number of Pupils of School Type t	–	–	–	–	–
N_v	Village Population	–	2,700		–	–
SF	Sustainability Factor	0	0		Population growth, migration, disconnections and outages may influence outcome figures both positively and negatively over the course of time. Extrapolating with the population growth for Mozambique, which the National Statistics Institute INE predicts to	Since Matola has been a connection and not an access project, migration does not apply here. Population growth does not apply due to the general observations made in the left column. Disconnections and outages are neither to be expected. This assessment is based on the experience gained in Mozambique

		HHSC-Matola	AKSM-Chua 1-2009	AKSM-Chua end 2010	General Remarks	Remarks on Outcomes of Matola and Chua
					amount to 4.8 percent for the time span from 2008 to 2010, would only be valid for catchment areas. For households this is not the case since adult children move out to create their own household that have to be provided with electricity again. Hence, population growth does not necessarily correspond to growth of the number of people provided with electricity. In addition, it remains unclear for rural communities if the population grows at the end of the day. Rural-urban migration might countervail the positive effect of high birth rates.	with pre-paid metering in relation to Matola and on the project setup in Chua. Therefore, it is advisable to leave out any assumption on adjustment factors and to rely on the current figures provided in this baseline.
SL_V	Estimated Share of Main Roads in the Villages provided with Street Lighting	–	–	–	This factor shall be applied, if a substantial part of the village remains without street lighting.	–
SP / SP_{Pt}	Surveyed Population/ Number of Surveyed Pupils of School Type t	2084/555 = 3.75	770/213 = 3.62		According to expectations, this ratio is very similar across the two survey regions. A value of 3.5 can therefore be applied to any other regions as well.	–

		HHSC-Matola	AKSM-Chua 1-2009	AKSM-Chua end 2010	General Remarks	Remarks on Outcomes of Matola and Chua
SPE_H	Share of Pre-Electrified Households	0.16	0.20		According to the EnDev principle that beneficiaries have to be newly provided with modern energy in order to be countable, households that already possessed functional and reliable, i.e. "modern" electricity sources before the intervention have to be subtracted. Generators can in general be considered modern in this sense. For solar panels and car batteries this is less clear, since they are inferior in terms of reliability, lifetime and power output. Contrary to standard procedure, grid connections via neighbours should not be considered as pre-electrified in Mozambique, since the national electricity utility EdM outlaws this practice and rigorously traces and punishes it.	In lack of direct observability of functionality and reliability, baseline data has been analysed, whether solar panels or car batteries were actually used for electric light or a television set at the time before the intervention. Those households that made effective use of the solar panel or car battery were as well regarded as pre-electrified. Their proportion among the total of households possessing a solar panel or car battery respectively is given in the following table.
	Solar Panel	0.03	0.14			
	Grid Connection via Neighbour	0.00*	–			
	Solar Panel and Generator	–	0.01			
	Generator	0.005	0.02			
	Car Battery	0.128	0.03			
		* The two percent of beneficiaries who had disposed of connections through a neighbour before the intervention are not counted as pre-electrified (see general observation column).				
T	Number of Different Business Types in Need of Electricity	–	5	5	In case new businesses types are established when having electricity (e.g. welding), this value has to be adapted accordingly.	The 5 microenterprise types that are in principal in need of modern energy are chicken breeding, carpentry, tailoring, bakeries and kiosks/ bars.

	HHSC-Matola	AKSM-Chua
Solar panel (+ Car battery)	3/4	1/2
Car Battery	3/4	1/3

Table A6
Accounting Shares of Institution Types

Health Institutions	0.35
Schools	0.35
Communal Services	0.30
Social Infrastructure	**1.00**

As a general rule, these accounting shares have to be multiplied by the total population living in the service area, or in EnDev terminology "catchment area", of the respective social infrastructure in order to reach at a credible figure of people that have access to newly electrified services. Since these catchment areas are usually not identical, they have to be determined individually. Furthermore, a reliable catchment area definition often lacks. Concerning schools for example, a fraction of pupils often comes from rather remote areas and school representatives are typically overstrained by estimating the number of people living in the core areas of pupils' provenience. Anyway, at least for schools this figure can be relatively easily imputed: If one credibly assumes that the proportion of pupils among the catchment area population is the same as the proportion of pupils among the population surveyed by the baseline, baseline survey data yields a plausible catchment area value. It corresponds to multiplying the number of pupils of a school by the total number of people divided by the number of pupils among the surveyed population (cf. Table A4).

Analogously to social infrastructure, a person is counted as having access to microenterprises with modern energy if all microenterprises in need of modern energy are electrified. If only some of them are electrified, these shall be counted according to their contribution to the local economy. Concretely, it is proposed in EnDev Annual Planning 2006 to multiply the catchment area population by the share of workers in the MSEs served among the total number of workers in enterprises in need of modern energy. Since this is a rather monitoring-intensive approach, we propose an alternative procedure that has already been applied in Rwanda. It encompasses the generalisation based upon survey findings that the village offers a limited range of T specific businesses that are relatively homogenous in terms of size and the number of employees. The catchment area of these businesses, i.e. the area where workers essentially come from, is the village (NV). Apart from its easy applicability, the resulting calculation formula presented in Table A4 has the advantage that businesses are in fact weighted according to their contribution to the local economy.

The following table sums up all the presented information on the identification of a reliable and transparent figure concerning the beneficiaries of the intervention:

Table A7

Summarizing Calculation of EnDev Beneficiaries

	HHSC-Matola achieved in 1-2009	expected for 2010	AKSM-Chua achieved in 1-2009	expected for 2010
Number of people provided with lighting/ household energy	(1-0.16)×6,670× 5.2 = 29,135	(1-0.16)×6,670× 5.2= 29,135	(1-0.20)×84× 5.5 = 370	(1-0.20)×370× 5.5 = 1,628
Number of people provided with energy in social infrastructure	–	–	1/2×2700× 0.075 = 101	2/2×2700× 0.075 = 203
Number of people provided with energy for productive use	–	–	6/12×1/5× 2700 = 270	12/12×1/5× 2700 = 540
Total	**29,135**	**29,135**	**741**	**2,371**

8. Electronic Annex

Soft copies of the following documents are available on request.

E1 Photographs

E2 Household Questionnaires (Portuguese)

Annotations on the Household Questionnaires of the AMES-M Baseline for future baseline surveys can be found in the electronic annex E4.

E3 STATA Codes

E4 Annotations on the Household Questionnaires

E5 Terms of Reference RWI Essen, AMES – Mozambique Baseline Study

Abbreviations

1M	1° de Maio and Khongolote, project households
$1M_C$	1° de Maio and Khongolote, control households
AMES-M	Access to modern energy services – Mozambique, energy sector programme of GTZ
CFL	compact fluorescent light
CN	Control Neighbourhood
DANIDA	Danish International Development Agency
EdM	Electricidade de Moçambique
EnDev	Energising Development
EUR	Euro (average exchange rate of EUR/Mt in September 2008 = 1:34.8)
GDP	Gross Domestic Product
GTZ	Gesellschaft für Technische Zusammenarbeit (German Technical Cooperation)
gW	giga Watt
IAF2	Inquérito aos Agregados Familiares sobre Orçamento Familiar 2002/3 (2nd National Household Survey of Living Conditions conduted in Mozambique in 2002 and 2003)
ha	hectare = 10,000 m2
HHSC-M	Household Service Connections at Matola Area, subcomponent of AMES-M
HS	Household size
IN	Infulene, project neighboourhood
kW	kilo Watt
kWh	kilo Watt hours
MDG	Millennium Development Goal
MJ	Matola J, project neighbourhood
MSE	Micro and Small Enterprises
Mt	Metical, currency of Mozambique
NH	Number of electrified households
ND	Ndlavela, project neighbourhood
NK	Nkobe, project households
NK_C	1° de Maio and Khongolote, control households

Abbreviations

n/k	not known
PN	Project Neighbourhood
SI	Singatela, project neighbourhood
TCF	Trillion Cubic Feet
US$	US Dollar (exchange rate of $/Mt in September 2008: 1:24 Metical)
V	Volts