



Alleviation of Poverty Through the Provision of Local Energy Services (APPLES)

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Abstract

This document is part of the COOPENER project "Alleviation of Poverty Through the Provision of Local Energy Services" (APPLES). The report covers project Work Package 7.

The APPLES project is implemented by the Energy Centre of the Netherlands (ECN) as project coordinator, in collaboration with Risø National Laboratory (Technical University of Denmark – DTU), Denmark, and as local South African partners the Energy Research Centre (ERC) at the University of Cape Town and Parallax Ltd South Africa.

The objectives of the APPLES project were to understand the energy needs and energy priorities within targeted poor South African communities, to determine and demonstrate the best practices for energy service provision to meet the needs of these communities, and to strengthen the embryonic networks of existing energy centres that will supply energy information, products and services to the poor communities. In the longer term, it is hoped that job creation and income generation from business development within these communities, based upon energy efficient use and access to new secure energy supplies, will represent a contribution to poverty alleviation. This document aims to facilitate the evaluation of the extent to which project objectives have been reached.

Given the very special circumstances under which the APPLES project has been implemented, very few if any development impacts of the project have materialized by the project' end date. This document is therefore restricted to an outline of the logic behind expected development impacts and provides contextual as well as baseline information for a selection of relevant indicators.

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From 1 January 2007, Risø National Laboratory, the Danish Institute for Food and Veterinary Research, the Danish Institute for Fisheries Research, the Danish National Space Center and the Danish Transport Research Institute have been merged with the Technical University of Denmark (DTU) with DTU as the continuing unit.

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Preface

Alleviation of Poverty through the Provision of Local Energy Services (APPLES) is a project under the European Commission's Intelligent Energy-Europe programme COOPENER. After an extensive and successful household electrification program and several years of high economic growth, South Africa has been confronted with severe electricity supply constraints. At the same time, a considerable fraction of the population, predominantly in remote rural areas but also in peri-urban areas, remains un-serviced. The APPLES project ambitions to understand and meeting the energy needs of those communities are especially pertinent in face of the current, challenging situation in South Africa's energy sector.

The more specific, ultimate objectives of the APPLES are to understand the energy needs and energy priorities within the target communities, to determine and demonstrate the best practices for energy service provision to meet the needs of these communities, and to strengthen an embryonic network of existing energy centres that will supply energy information, products and services to poor communities. In the longer term, it is hoped that job creation and income generation from business development within these communities, based upon energy efficient use and access to new secure energy supplies, will represent a contribution to poverty alleviation.

The APPLES project initially intended to undertake activities in two peri-urban and two rural areas over two and half years. Due to unexpected complications with respect to co-funding of the South African partners, the APPLES project has had to delimit its activities to in total two sites, with implementation restricted to effectively six months, and a halved budget for the South African partners. Despite these severe restrictions the project has – in close cooperation with the communities in question and based on thorough needs assessments – launched an Integrated Energy Centre in the rural community Ubuhlebezwe, in KwaZulu-Natal, and undertaken several efforts towards reducing shack fire hazards and promoting households' energy-expenditure savings in the peri-urban settlement Imizamo Yethu in Hout Bay, near Cape Town.

At the time of writing this report, the Highflats Energy Centre is awaiting the outcome on the application for additional funding from the South African National Development Agency. Key experiences and advice from the Imizamo Yethu activities have been collected and are being printed for wider distribution in the illustrated "Imizamo Yethu Energy Cookbook".

Acknowledgements

Several sections of this document draw to varying extent on other APPLES project documents. In order of this document's contents the current author thankfully acknowledges the authors and co-authors as follows: The second and third sections in this document draw on the "Assessment Procedure Guideline" developed for the COOPENER sister project "Development and Energy in Africa" (DEA), which was co-authored by Gordon Mackenzie and Emiel J.W. van Sambeek. Section four builds on the APPLES project's "Establishing energy-related priorities in Urban and Peri-Urban areas", the bulk of which was produced by the co-author Bill Cowan. Section five draws on the market-assessment section of the APPLES project's "Highflats Energy Centre business plan", which was compiled by Tjasa Bole and Dean Cooper. Many thanks to Gordon Mackenzie for very helpful contributions to the finalization of this document.

1 Introduction

The intention of the APPLES project's work package 7 was to monitor and evaluate (M&E) the impacts of the APPLES project, both successes and short-comings. One criterion for the selection of the two project sites, the Highflats and Imizamo Yethu was "close links to the nationally-determined poverty nodes". The project's poverty-alleviating impacts would be on the user side, where poverty is manifested. The user-side of energy services in developing countries is complex and characterised by a high degree of diversity. For the evaluation of such diverse impacts, the intention was to apply an assessment procedure tailor-made for energy intervention impacts. The framework was developed and applied in course of the "Development and Energy in Africa" (DEA) COOPENER project, in which the European partners in the APPLES project collaborated with six African partners and GVEP International. The methodological content of this document draws heavily on the experiences, the assessment- procedure guideline, and the literature study of the DEA project.

According to DAC-OECD (2002), project evaluation is defined as "the systematic and objective assessment of an on-going or completed project, programme or policy, its design, implementation and results". The aim of an evaluation is to "determine the relevance and fulfilments of objectives, development efficiency, effectiveness, impact and sustainability". The information provided from an evaluation should be credible, useful and enable the incorporation of lessons learnt into decision-making processes. Furthermore, assessment and monitoring should be distinguished by the impact assessment's wider focus and once-off data collection occasion, while impact monitoring (IM) has a narrower focus and involves repeated collection of smaller amounts of data (Simanovitz, 2001).

A first step in the evaluation procedure is to identify and associate indicators with each of the energy intervention's "elements", i.e. with the intervention's "inputs" (into the energy intervention), "outputs", "outcomes" and "impacts". In terms of distance from the assumed causal trigger mechanisms – inputs – each of the latter three elements are found further away and subject to increasing influence from time and outside factors. The consecutive, implied steps of an APPLES impact evaluation would be summarized as:

1. Develop indicators that allow an evaluation of the extent to which the desired impacts of APPLES has been achieved.
2. Establish the baseline values of those indicators
3. Evaluate the project's impacts based on the changes in the indicator values at the conclusion of the project.

The APPLES project has however, suffered severe delays and heavily reduced funding for the South African partners. Consequently, the project's time span for implementation was shortened considerably, to eight months, with the availability of local partners practically halved. These circumstances have had serious implications for the Monitoring and Evaluation work package;

Firstly, in general the outcomes or impacts of energy projects, which typically need considerable time to materialize, could not realistically be expected before the project's conclusion.

Secondly, the severely reduced time budgets have necessitated a high prioritization, also by European partners, of planning and participation in the implementation of on-the-ground activities, in the absence of which no "inputs" would materialize to cause the consecutive results. The description of the M&E work package refers e.g. to the organisation of before and after surveys by local partners. Surveys for M&E purposes require a predetermined focus (on specified indicators) and are typically very time consuming. Under the prevailing circumstances the prioritization of surveys was therefore deemed inappropriate.

Thirdly, with increasing vulnerability to external developments – such as the prospects of synergizing with other projects – the APPLES project ambitions continually had to be revised and reduced, often unexpectedly. The adequate planning, focus, and conduction of M&E activities under those circumstances became excessively challenging, as expected results (and conceivable) impacts remained uncertain.

Last, but not least serious from an M&E perspective, many "outputs" from which to expect measurable "outcomes" or "impacts" have yet to materialize.

It follows from the above that any ambition to capture "outputs" or "impacts" empirically, at the project's end-date would have been fruitless. Hopes exist however, that when sufficient time has passed the project "inputs" and "outputs" will render highly interesting and empirically measurable results. Measuring those results is, however, beyond the scope of the APPLES project's time frame. We proceed therefore to prepare a document to encourage and facilitate future evaluations, by:

- introducing a proposed assessment framework
- assembling the most relevant contextual information about the project sites in one document,
- modelling expected household level impacts for which baselines can currently be drawn
- and calculating baseline indicator values from existing statistical data

This document should not be seen as a manual for the assessment of (expected) impacts from the APPLES project. For such purposes we refer to the DEA "Assessment procedure guideline", downloadable from <http://www.deafrica.net>. The methodological sections 2 and 3 are provided as a coarse guideline to the logic that implicitly underlies the content of the following sections. The following two sections will allude to the importance of contextual factors. Therefore the site-specific sections, 4 and 5 for Imizamo Yethu and the Highflats respectively, both include subsections that describe the locations, before introducing the relevant project activities on each site, the expected impacts of those activities, the choice of indicators, and their estimated baseline values. In the brief section 6 we provide some concluding remarks.

2 Evaluating energy interventions and the basic theoretical framework

The APPLES project aimed to provide or facilitate access to local energy services for the alleviation of poverty, with expected impacts therefore most prominent on the user side. The complexity of the energy user-side in developing countries originates in the varying availabilities and costs of energy from various sources. This variation manifests itself not only in differing end-uses, but also in differing mixes and levels of fuel consumption for similar purposes. Households also differ in their abilities and willingness to invest in new technologies, as well as in their energy-related preferences, traditions and behaviours. Consequently, energy demand (and supply) patterns are often specific to regions, districts, settlements within districts, and to users within settlements. Energy impacts on poverty and livelihoods should thus be considered within this total context (Leach and Gowen (1987), Hulme (2000)). Both the complexity of the links between energy and development impacts and the influence of contextual factors, make empirical verification of causal linkages of energy interventions a demanding task. It is therefore highly recommendable to model such links, prior to any attempt of empirical substantiation. Some guidance for the latter purposes is therefore well warranted and follows below.

2.1 Considerations in the evaluation of impacts from energy interventions

The identification and attribution of impacts of energy projects present a number of significant challenges, as compared to projects in sectors such as water, agriculture, health or education. If one accepts a wider definition of poverty, that encompasses factors beyond mere monetary income or expenditures levels, one must consider the following issues in assessing energy impacts:

- Energy does not in itself quench, feed, house or clothe people. Rather, energy services facilitate and improve the provision of water, food, houses or clothing. Consequently, the hypothetical chain of causality, leading from energy to poverty alleviation, is often more complex than for other projects.
- Energy services often bring about improvements in many aspects of life. Electricity, for instance, can be applied in activities such as pumping water, refrigeration of vaccines and/or welding of metals. Thus, evaluation of energy projects faces the challenge of measuring improvements in more than one area.
- End-users' choices of energy sources for specific services are subject to many considerations, such as prices, traditions, the sustainability of provision and end user's income. Hence, the attribution of impacts to energy provision requires awareness of the factors that affect choices, and how those factors vary over time.
- The positive impacts of access to energy may often become manifest many years after the project ends. Thus, reliable evaluations for energy interventions would measure impacts beyond the project life cycle. This makes the documentation of conditions at the beginning of the project important, since it provides both a picture of the baseline from which to measure progress as well as insight into how energy is or would be used among the project's potential beneficiaries.

Hence, any attempt to assess impacts on poverty at several locations requires frameworks that are tailor-made to location-specific circumstances.

2.2 A basic conceptual framework

Behind virtually all development interventions lies an assumption that the intervention will affect the behaviour among target “agents” towards an achievement of some objective, such as more efficient agricultural production or improved health statuses to name two examples. The targeted agents will have been subject to – or experienced – the intervention in question, while other agents have not. We assume that some kind of “variables” exist which can be used to relate both targeted and non-targeted agents to the project’s intended outcome. Such variables would be key characteristic of the agents, their behaviour, or their circumstances. The objective of impact evaluation is to capture difference in the values of those key characteristics, between the outcomes on agents that have experienced the intervention and those that have not. The logic is illustrated in the “impact chain” in Figure 2.1.

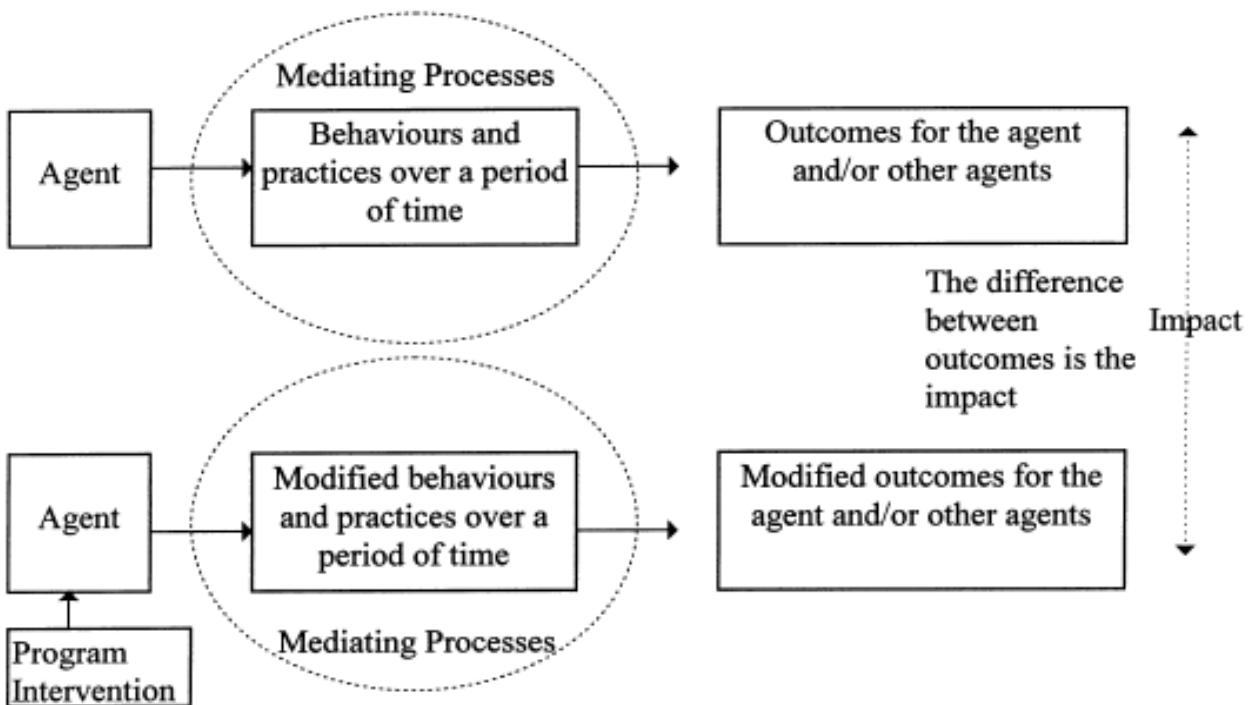


Figure 2.1 The impact chain [source Hulme(2000)]

It is generally accepted that the further “downstream” an intervention’s consequences are found, the more difficult it becomes to attribute the consequences empirically to the input factors (GTZ (2004)). By definition “downstream” implies greater prospects for influence from characteristics of the agent and his or her specific economic, physical, social and political context. Hence, other factors enter the arena of causation. In Figure 2.1 these factors are represented by “mediating processes”, the variation in which may affect outcomes among both categories of agents.

The “results chain” is another, relatively elementary, but rather powerful modelling tool. A results chain can be thought of as a set of hypotheses about the linkages between an energy intervention

and its possible impacts. The chain makes explicit our assumptions about those linkages. It begins with 'inputs', moving through the other "strategic elements", 'activities' and 'outputs', and culminates in 'outcomes', 'impacts'. (In some versions, 'feedback' and 'reach' is part of the results chain.) Related to a development intervention, the strategic elements of the results chain are individually defined as:

- Inputs: the financial, human, and material resources used
- Activities: actions taken - or work performed for the mobilization of resources - in order to produce specific outputs
- Outputs: resultant products, capital goods and services, as well as resultant changes relevant to the achievement of outcomes.
- Outcome: The likely or achieved short-term and medium-term effects of an intervention's outputs. Not a strategic element itself, an effect is a "change intended or unintended due directly or indirectly to an intervention"
- Impacts: produced long-term effects that may be positive and/or negative, primary and secondary, direct or indirect, intended or unintended.

The chain can be visualized conveniently with its "strategic elements" as a set of arrows arranged in a direction of causality from left to right or from above to below. By deconstructing the chain into several levels and gathering proof of the linkages between each level, the plausibility can be assessed of a proposed link between energy interventions and observed social, economic and environmental changes ((GTZ, 2004), Hulme (2000), DAC-OECD (2002)).

Outputs, outcomes, and impact are also jointly referred to as "results", which give rise to the related term "results monitoring". Such monitoring signifies "a continuing function that uses systematic collection of data on specified "indicators" to provide [...] indications of the extent of progress and achievement of objectives and progress in the use of allocated funds." In Chapter 3 we will discuss the selection of indicators. For our current purposes, the formal definition of an indicator is "a quantitative or qualitative factor or variable that provides a simple and reliable means to (i) measure achievement, (ii) reflect the changes connected to an intervention, or to (iii) help assess the performance of a development actor" (DAC-OECD (2002)). In terms of the impact chain model above, an indicator would be a measurable key characteristic of the agents, their behaviour, or their circumstances, that can be related to the intervention's desired outcome. The operational objective of the assessment thus becomes to capture differences in indicator values between agents that have experienced the intervention and agents that have not.

For the purposes of modelling effects from energy interventions, a first useful step is to draw a visual diagram of a results chain. Projects need not be very complex in order for a given link of the causal chain to give rise to several causal relationships. In addition to the above five levels, a commonly applicable level is the "Use of Outputs", which describes the usage of Outputs by target groups or intermediaries. An example of a simple results chain for a solar home system project is illustrated in Figure 2.2

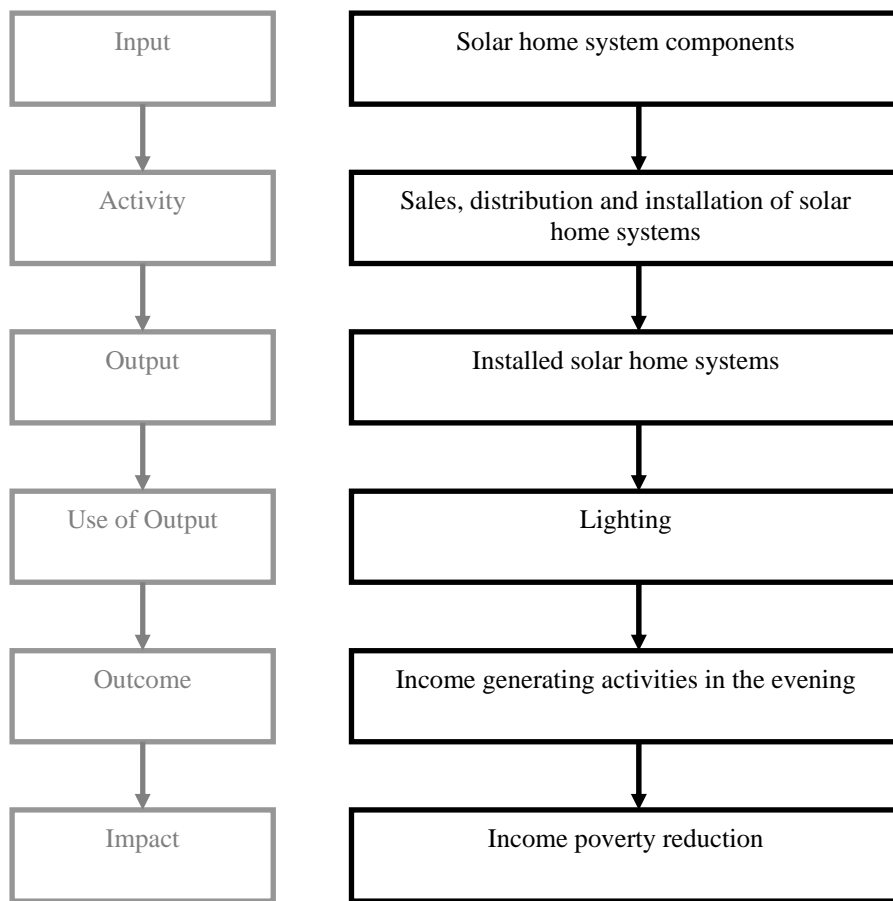


Figure 2.2 A simple results chain for a solar home system project

Figure 2.3 below shows the links in the results chain depicted in a complex “real-world” context. As can be seen, causality in the context of the results chain should not be confused with a linear sequence of causes and effects. Attribution of results to the energy intervention up to the level of outputs and use of outputs is relatively easy in most cases. From an empirical perspective, if a causal relationship between outputs and observed development changes can be demonstrated, the project can make a credible claim to development as a direct benefit (GTZ, 2004).

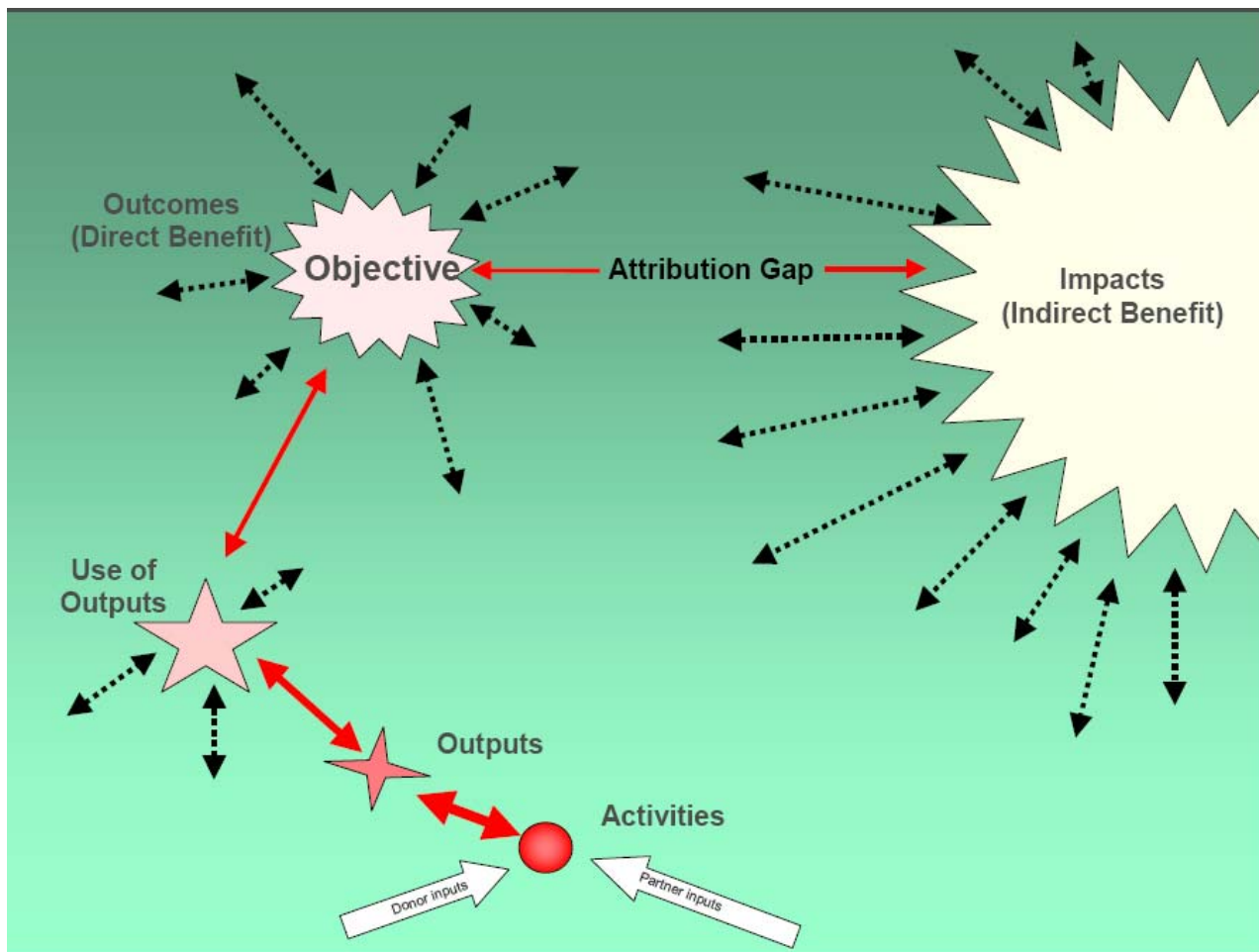


Figure 2.3 The results chain “Use of Outputs” as an element between Outputs and Outcomes [source GTZ (2004)].

Hulme (2000) lists three main elements to a conceptual framework for impacts assessments that would be relevant for the APPLES project;

- a model of the impact chain
- the specification of the level/unit for impact assessment
- the specification of the types of impact that are to be assessed

All of these elements are discussed separately for each of the sites in sections 4 and 5 below.

3 Bridging theoretical models and reality: choosing indicators and data considerations

Based on a model of the impact (and/or results) chain, the choice of unit(s) or level(s) for the assessment is made. The latter selection commonly involves one or several of: the household, the enterprise, or the institutional environment in which the agents operate. With respect to the type of impact looked for, the number of (indicator) variables that can be identified is almost infinite. Two general criteria for the selection of such variables are that they must be defined with precision and must be measurable by either quantitative or qualitative methods.

3.1 Choosing indicators

Two classes of indicators are the economic and the social. The former encompasses changes in income, levels and patterns of expenditure, consumption and assets (an advantage of which is that they do not fluctuate as much as other economic indicators) (Barnes, 1996). The social indicators encompass, for example, educational status, health service access, nutritional intake levels, anthropometry, contraceptive use, control over resources, involvement in household and community decision-making, levels of participation in community and/or social networks, as well as electoral participation. Another useful distinction in this context is that of “domains of change” and “markers of change”, examples of which would be respectively household income and amount of income, number of income sources or seasonality of income (Sebstad et al. (1995), Hulme (2000)).

The direct changes or outputs may be easier to measure than outcomes or impacts. As mentioned previously, development projects sometimes aim to contribute to large national objectives such as improving health or gender equality. On the one hand you may have to try to conceive of measurable indicators that describe these larger, “macro” goals. On the other hand, you will also have to find indicators for the more concrete or “micro” level inputs or consequences that you have identified.

A useful step in identifying indicators for the different elements in the causal tree is to think of a number of research questions for each element. These are in fact the key questions to which answers are sought, and they are specific to the link with which they correspond. The questions can also relate to linkages with other sectors. Further, the questions should provide some idea of where or with whom the relevant information rests.

In choosing indicators for the links of a results chain, one would want to keep the following criteria in mind:

- pertinence to the project
- interest for project stakeholders
- ease and cost of measurement or data collection
- the possibilities for triangulation between sources of information

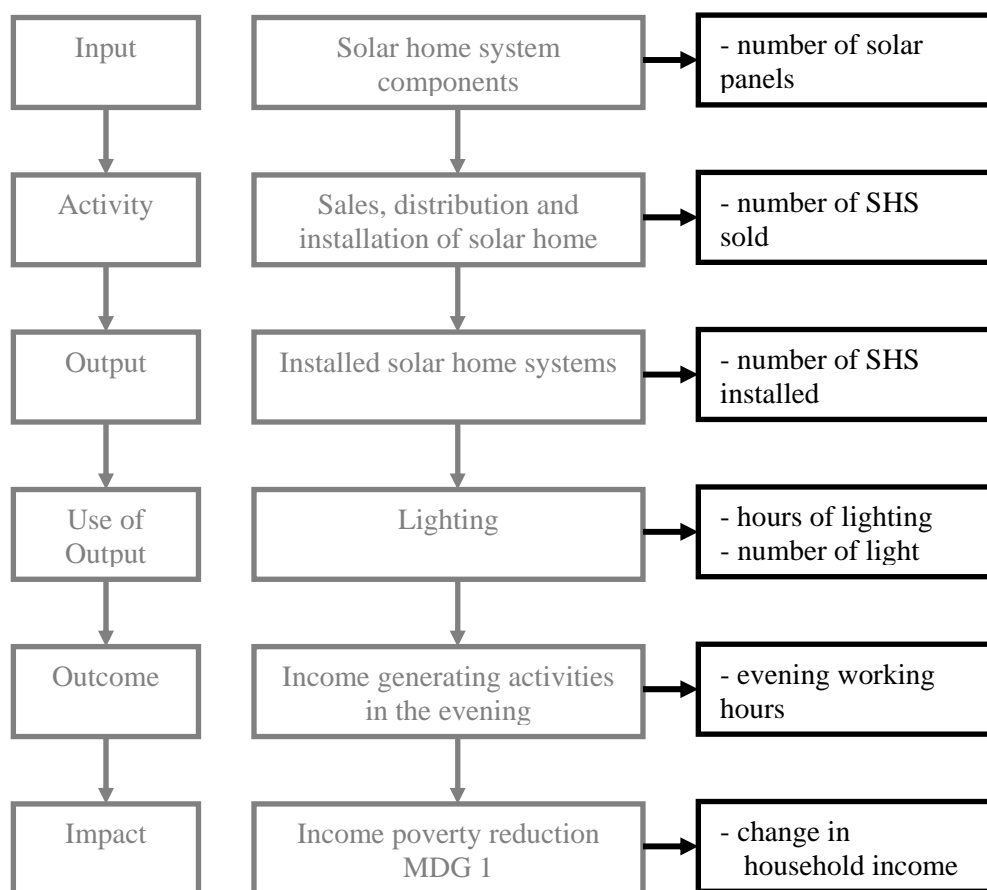


Figure 3.1 Examples of indicators with units of measurement

Indicators do not have to be numeric. Indicators may be qualitative. In some cases, information stored as pictures, videos or voice recordings of “anecdotal” information may be the most pertinent indicator formats. In other cases behavioural change or attitude may be an indicator. The rightmost section of Figure 3.1 provides examples of indicators for each level of the solar home results chain from the previous section.

In addition to the links and national development objectives, there are many cross-cutting issues which may be important to the sustainability and success of a project. The following transversal issues should if possible be incorporated, taking into account the needs of projects and stakeholders:

- gender dimensions and equality; the different impacts of your project on women, men and children of different gender
- discriminatory impacts on community subgroups (according to poverty status, religious affiliation or ethnic group)
- long term viability and project replicability:
- economic/financial, technical and environmental sustainability - including the impact on GHG emissions, biodiversity, wildlife, forests, and harvests
- social and cultural acceptability of your project activities
- revenue-creating activities, job creation
- end-user satisfaction
- training and capacity building
- local ownership and participation
- outside conditions, not under the control of the project, but which influence project results

Often the choice of indicators will be affected by the choice of methodology. This raises problems especially in the case of multi-method approaches where it may be difficult to maintain a single definition of an indicator across all methods applied. Further, as a rule, impact assessors would want to keep the number indicators to a manageable number rather than attempt a comprehensive approach which may have adverse effects on both the data quality and on study relevance.

3.2 Data considerations

The particularity of each intervention and context implies that each project has to be approached with specific methodologies and the assessment depends crucially on the quality of the collected data. Ideally each indicator should be measured using one or more data collection methods.¹ An *ideal* data set would have three characteristics (Gomez-Lobo, Foster, and Halpern 1999). It should contain:

- data on both energy-related behaviour and income or consumption of households
- information that allows the computation of [indicator] index values both immediately before an energy intervention and some time after, for the same households
- identical data for a control group of households that has not been affected by the intervention

The data that can be collected in IA studies is however, often very limited. It is therefore important to first undertake qualitative research so as to determine which indicators provide the most accurate reflection of the type of impact information that one wishes to gather. A common mistake is to select indicators based on an insufficient understanding of the processes one seeks to assess.

In the sections below designated to each of the APPLES sites we will elaborate on the specific choices of baseline indicators for this project. Due to the delay in finance, very limited time

¹ A long range of participatory data collection and knowledge creation methods exist that can be applied to impact assessment studies. Each of those as well as the quantitative methods has a different pattern of strengths and weaknesses. A detailed account of impact assessment tools is found in Simanovitz (2001). Rai (2005) provides a fuller account of participatory approaches for impact studies of energy programs.

available and consecutive late realizations on which inputs were realistically to be provided, no data was collected specifically for the evaluation of the APPLES project. Hence, our choices of indicators are contingent on what can be derived from available, relevant data that has often been collected for other purposes. The latter data only remotely resemble the “ideal” data set, referred to above. This should not however, necessarily delimit a future assessor to those indicators, since complementary baseline information can be derived from by respondents’ recall. The contents of this document must however be limited to a chosen set of indicators and to the contextual information which partly serves to inform of potential mediating processes.

4 Imizamo Yethu – project activities and a base-line for developments impacts

In the Hout Bay township Imizamo Yethu, near Cape Town, the APPLES activities aimed to contribute towards attracting attention to energy-related problems that affect poverty in urban and peri-urban settlements. Common to these problems were that they need be addressed both at a local community level and at a government planning, policy, and regulatory level. Given the time and resource constraint, two such issues were addressed, namely; (i) the dangers of ravaging township fires, often associated with unsafe use of paraffin or candles and reinforced by unfavourable settlement density and housing materials; and (ii) the disparity in welfare, energy expenditures and living standards between informal township shack areas which have access to grid electricity and (the minority) that do not.

As will be returned to in the following subsection, the expected results of the APPLES activities in Imizamo Yethu were to (i) reduce energy-related hazards; (ii) encourage savings in energy expenditures among local households; and (iii) inform policy makers of the energy related problems – including the two aforementioned – affecting homes with no regular electricity supply. The ultimate beneficiaries of these activities are quite naturally the township’s households and residents. Given the overt intention also to inform policy for peri-urban areas, ambitions are that lessons learned in Imizamo Yethu will be of benefit elsewhere in South Africa and in the developing world.

In the next subsection we provide some further detail on the APPLES activities in Imizamo Yethu and briefly explain how we expect these to generate development impacts. The settlement has many unique features that affect the methodological scope for measuring impacts. We therefore re-introduce Imizamo Yethu’s socio-economic conditions in subsection two.² Thereafter we return to methodological considerations in the third subsection, followed by selected baseline indicator values in the fourth subsection.

² The socio-economic profile draws heavily on its counterpart in Cowan and Dieden (2008).

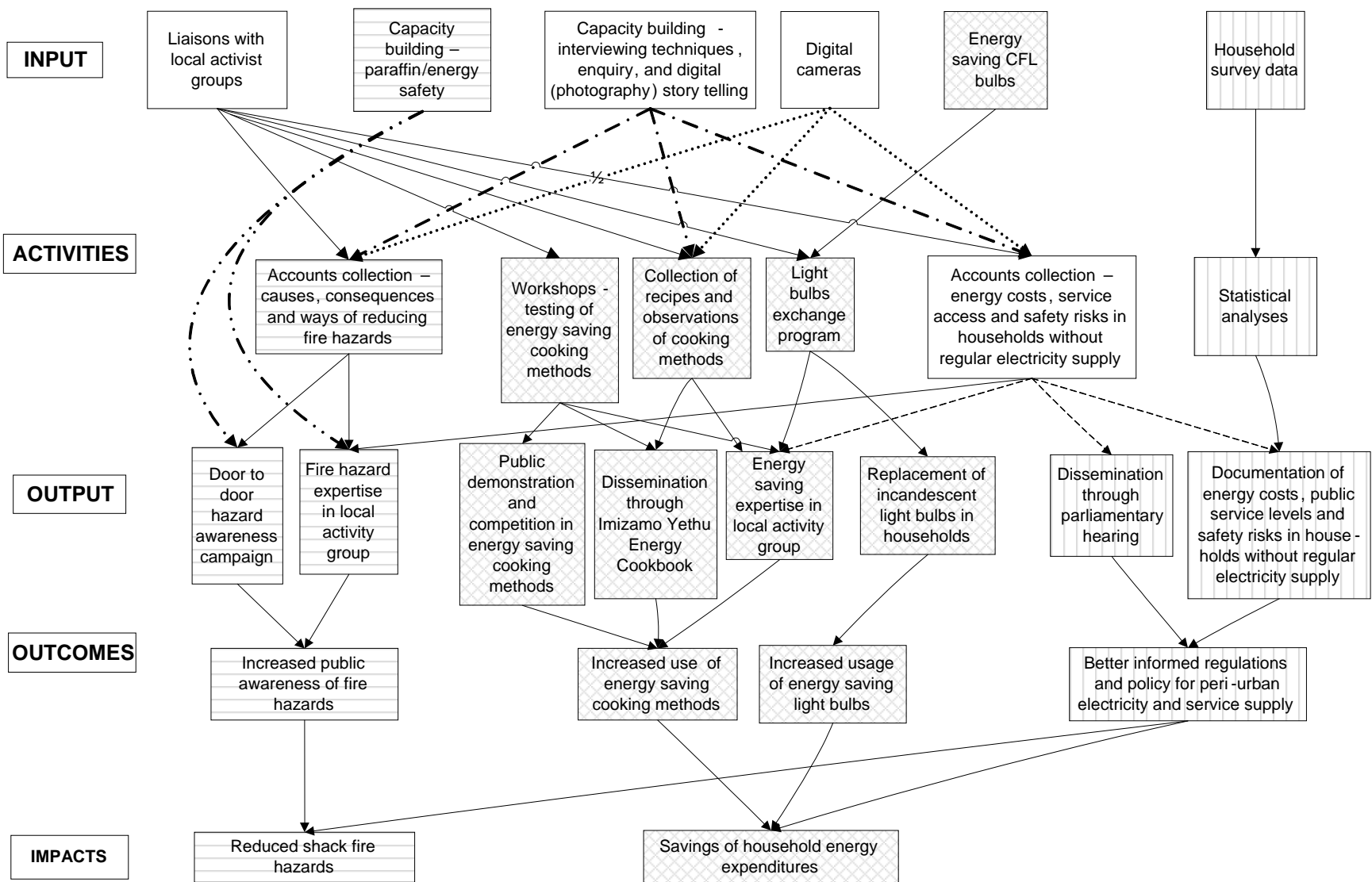


Figure 4. 1) Causal chain diagram for APPLES activities in Imizamo Yethu

4.1 APPLES project activities and expected impacts

This account of activities in Imizamo Yethu is greatly facilitated by a brief discussion of the key methodological components. As discussed in the Cowan and Dieden (2008), the specific activities were chosen through a series of consultative workshops with the community, which were also used for the establishment of local buy-in. Following these workshops further measures were taken to liaise with local activist (women's and youth) groups from which members were recruited into teams. The team members were thereafter educated in different aspects of data collection, such as interviewing techniques, enquiry and digital photography, as well as in issues pertaining to energy expenditures savings and fire hazards. In parallel to further capacity building interactions and workshops, the teams were deployed in the collection of various sets of accounts from residents, related to the broad objectives of the APPLES project. Two important reasons for the above approach were to ensure adequate rapport with the Imizamo Yethu residents and to set the stage for lasting impacts through the advisory capacity built in the team members.

In Figure 4.1 the APPLES activities are illustrated in a causal chain diagram, with different shadings applied to links aimed at the same specific objectives. The liaisons with local activist groups and various capacity building events are found in the top level "Input" section. Chiefly in combination with either capacity building in energy hazards and/or data collection methodology, the liaisons form key building blocks for all consequent "Activities", with the exception of statistical data analysis. One of the activities in which the team members were enrolled had the final aim (or "Impact" at the bottom level) to reduce fire hazards. There the team collected residents' views on causes, consequences and suggested means of reducing the dangers. Based on this experience and on two capacity building workshops conducted by the Paraffin Safety Association, a door to door campaign was designed and conducted (as a project "Output") with the ambition to create a greater public awareness of fire hazards (at the "Outcome" level). Intentions were that the expertise built in the team members could contribute to the same end e.g. through future informal consultations by residents.

Two efforts were conducted with the aim of helping households reduce their energy expenditures. One of these efforts was a light-bulb exchange program, in which the team members were engaged to help residents swap their incandescent light bulbs for energy-efficient CFLs. This activity took place both from a central office as well as through door-to-door visits. The second effort focused on reducing households' cooking expenditures by attracting attention to efficient cooking methods, with considerable efforts to disseminate gains by cooking with electricity rather than e.g. paraffin. Here the team members collected residents' recipes and observed cooking methods and collecting recipes. A workshop was conducted to test various cooking methods with the team members, the experiences from which were later used in a public demonstration and competition in energy saving cooking techniques. These two sets of experiences and the collected recipes form the basis for a forthcoming illustrated "Imizamo Yethu Energy Cookbook", which will be distributed both locally and to wider audience. The same experiences would also have prepared the team members to provide households with energy and expenditure saving advice in the future.

A third collection of accounts conducted by the team members were those pertaining to the energy costs, the public service levels experience, and the safety risks in households without regular electricity supply. (These accounts also served to inform the fire-hazard reducing effort as well as the measures to disseminate means of saving energy expenditures.) At the outcome level, the conditions in non-serviced household have been brought to stakeholders' attention through a presentation by team members at a parliamentary hearing in Cape Town as well as in policy

information documents. The documents are built also on in-depth analyses of statistics from the household surveys mentioned in the introductory section. It is a project ambition that these dissemination methods will contribute to better regulation and policies to the benefit of households without regular electricity supply. In summary, these three separate although overlapping efforts aim to reduce energy-related hazards, generate energy expenditures savings in the Imizamo Yethu homes, and inform policy makers of these and other energy related challenges in the target population. The next section provides the context in which that population is found.

4.2 Socio-economic context

Imizamo Yethu is an informal settlement located in the Cape Town suburb of Hout Bay. During the apartheid regime Hout Bay was populated largely by the white population group but included a section for “coloured” residence in the harbour area. Before rapid urbanisation in the 1970s, the area mostly resembled a rustic village. In 1985 the white and coloured population groups each amounted to some 4 000 persons. According to the South African 2001 census, both the white and coloured population groups had tripled in size by then, to about 14 300 and 12 000 respectively. Meanwhile the African population group however had increased by more than 5 000 percent from just over 300 persons in 1985 to approximately 16 500 by 2001. Out of the latter group, around 9 900 lived in Imizamo Yethu. Attesting to very high immigration into the area, the Hout Bay 2005 Migration Survey, conducted by SALDRU and CaRe of the University of Cape Town, assessed that over four-fifths of the population in Imizamo Yethu had not been born there.

Imizamo Yethu has been settled in stages, with an old section called “Dotsoayake” built in the early 1990s and newer sections called “Hector Petersen” and “Shooting Range”, developed after devastating fires in February 2004. According to the 2001 census, there were nearly 2 800 dwellings in Imizamo Yethu at the time. Out of those, 85 percent were classified as shacks (makeshift DIY housing, using available materials) raised on both approved and non-approved areas. Since the Census, part of the community has been converted into solid 2 and 3-bedroom houses through a project funded by the Irish philanthropist Niam Mellon. The impact of the latter effort is revealed by an increase in the number of solid houses in the area from 36 in 2001 to 85 in 2005.

As captured by the census, 96 percent of the population in Imizamo Yethu belonged to the African population group, with a slight majority of men at 52 percent. The high impact of work-seeking immigration on the population structure is further reflected by a relatively small share of children below age 15 (around one-quarter), the remainder being of working age. By comparison, the fraction of children in South Africa’s total population is around one-half. Elderly people are virtually absent – and the median age is about 24 years old.

Turning now to some information from the SALDRU 2005 survey, the data can shed considerable light on many aspects of livelihoods in Imizamo Yethu. The reader needs to be aware however, that the survey sampling methodology restricts inference to the total population of the neighbourhoods. The survey sample included all freestanding shacks (not in backyards) in the two settlements, one quarter of the shacks in backyards, and more than twice the number of formal houses in the 2001 census. Hence, the sample may not be adequately representative of residents in all types of dwellings in the area. The total number of respondents in the two informal settlements was 1 992 out of which nearly 90 percent lived in shacks. Almost 45 percent of the captured households were female headed. Two-fifths of the households contained sole individuals and more than three-quarters had three members or less. The average household size in Imizamo Yethu is two members.

With respect to migration, less than 15 percent of the surveyed residents were born in the Western Cape (in which Cape Town and Imizamo Yethu is found). Five percent were not born in South Africa and almost 80 percent were born in the neighbouring province Eastern Cape. Roughly half the residents had arrived since 2006. From the perspective of kinship and social coherency, however, one-third of the migrants from the Eastern Cape originated in the same magisterial district (Willowvale/Gatyana) and half the migrants had migrated straight to Imizamo Yethu. While more than 60 percent of the migrants stated employment-related reasons for leaving their place of birth, the unemployment rate among South African residents is still rather high at 32 percent. Among the employed, around 25 percent were domestic workers and in total 40 percent were employed by private households. Other occupational categories of distinct size were: fishing-related occupations with around one-tenth of the employees, almost 15 percent in construction, and a similar fraction employed by hotels or restaurants.

The often small household sizes and low prevalence of non-working age individuals result in relatively small support burdens for income earners. Hence, despite the high unemployment rate, average household per-member incomes in 2005 were found at R958 per month (with the corresponding median at R700). When the adult population in the settlement were asked what they liked best about living in the area, 19 percent mentioned the availability of jobs or opportunities. A slightly more frequent answer to the same question was the environment (nature, scenery) while also safety (low crime and violence) was a frequent answer with 15 percent of the adults. As an indication of the unique conditions in the settlement, when adults were asked for reasons that would make them leave the Hout Bay area, over 40 percent answered “Nothing/never/no reason/death”.³

4.3 Methodological considerations

As mentioned, the three objectives for the APPLES activities in Imizamo Yethu were to reduce energy-related hazards, promote energy expenditures savings among households, and inform policy makers of energy related challenges in the community with a special view to homes with no formal electricity connection. To capture impacts towards either one of those ends poses considerable challenges. We therefore commence by delimiting the focus of the baseline and thereafter discuss data availability for the selected set of impacts.

4.3.1 Baseline focus

In terms of impacts’ measurability, the natural indicators for a reduction in fire hazards would be the frequency of shack fires and/or the extent of damage caused. However, since shack fires and the associated damage are “rare events” in statistical terms, a quantitative baseline can only be envisioned for a very long time span, to the matter of perhaps several decades.⁴ If such a baseline had been established, the attribution of fire/damage reduction to greater hazard-awareness among local residents is still not straightforward, since over long time changes in factors such as settlement density, types of buildings, building materials, fuel usage, or improved rescue services may come into play (and possibly be more accurately attributable to APPLES policy information oriented activities!). It could however be argued that greater hazard awareness would reduce risky behaviours. If such behaviours were adequately defined, their extent could in principle be assessed, but currently no such data is available.

³ The respondents here also include residents in the formal “harbour” area in Hout Bay.

⁴ In the hypothetical case that a shack fire eventuates on average once a year, the probability for observing a day with a shack fire is 1/365. Firstly, it would take several years firstly to establish that frequency. Secondly, it would also take a large number of years with longer periods of no fires to establish a change in the frequency.

As for affecting the implementation of regulations and policies for households without formal electricity provision, it is reasonable to assume that the provision of relevant information would be a contributing factor to policy formulation. Among other factors that would affect formulation and implementation would be found fiscal constraints, the priorities (and prioritization by politicians) of other constituencies, and/or unexpected external events, that may override or obscure the impact of information.

The implementation of relevant policy or regulation obviously lies in the future. We obviously encourage an evaluator of the APPLES project to keep an eye on future policy and regulation decisions at not only the municipal level, but also regional and national levels. In terms of assessing the quality or success of such policies, one obviously needs to be aware that the final, implemented policy may involve a trade-off between all the aforementioned factors that could also override or obscure the impact of APPLES activities.

The remaining least cumbersome impact to measure would be that in saved household energy expenditures. In face of novel information, households may change their cooking behaviours towards using electricity instead of paraffin. Such behaviour would be traceable at the household level by relatively readily available indicators such as total energy expenditures, electricity and paraffin (fuel) expenditures, or ownership of electricity stoves and/or paraffin stoves. In the next subsection we discuss the data available for those purposes and justify the chosen means of analysis.

4.3.2 Available data on household cooking fuels and expenditures

Since the 2001 Census, at least three household surveys having been conducted in Imizamo Yethu. However, those surveys only provide rather limited information for our specific baselines needs.⁵ The first survey and that with the largest sample was the aforementioned SALDRU2005 survey, with almost 2000 households and a focus on demography rather than energy issues (henceforth “SALDRU 2005”).

The first energy-specific survey was carried out jointly by the University of Cape Town Energy Research Centre in June 2006 (henceforth “IY2006”). This survey covered a sample of 105 households and its main purpose of this survey was to establish a baseline picture of energy use in Imizamo Yethu. At the onset of the APPLES project, intentions were to monitor changes in energy choices among the Imizamo Yethu residents with later follow-up surveys, including one of mainly paraffin-dependent households during 2008. However, due to the disappointments in funding and implied time constraints those surveys were not possible to conduct under the prevailing conditions.

A third survey was sponsored by GNESD and also carried out by the Energy Research Centre. The survey covered 100 Imizamo Yethu households in 2007 with a focus on “energy access among the peri-urban poor in developing countries” (henceforth “IY2007”). Despite a fraction of 70 percent being connected to the electricity-grid, almost 90 percent of the sampled households reported some domestic use of paraffin. While the latter is highly relevant to the reduction of township fire hazards, this survey was not designed to generate a specific baseline for judging the APPLES intervention.

For the purposes of drawing a baseline for the other APPLES project site, in rural KwaZulu-Natal, we identify and extract from the national 2005/06 Income and Expenditure Survey (IES2005/06) a

⁵ The nature of these surveys is discussed in greater detail in Cowan and Dieden (2008).

subsample which can be believed to represent the rural target group's expenditure patterns. (The methodology is described in more detail in the Highflats section). In the urban case, the considerable migrant density of Imizamo Yethu does make the township highly relevant to the dynamic demographic characteristics of peri-urban South Africa today. However, for several reasons the settlement's unique socio-economic characteristics cannot readily be matched by a subsample from the same national household survey. Firstly, the IES2005/06 does not identify peri-urban areas per se. In brief, the sampling of households for the survey was conducted in two-stages. In the first stage "enumerator areas" were selected from a stratified sample as Primary Sampling Units (PSUs). From these, 10 households were drawn and attached with weights, so as to make the whole sample representative of the total population by population group, province and urban or non-urban area. A peri-urban sample could be defined by a certain frequency of shacks in urban African PSUs. However, none of the sampled PSUs have fractions of (second-stage sampled households in) shacks above 34 percent, which is far below Imizamo Yethu's.

A second approach to define a subsample from the IES2005/06 would be to include only households that reside in shacks (and disregard PSUs' fractions of shacks). In order for such a sample to be large enough for reliable statistical inference, one would have to include sampled households from urban areas all over South Africa. Average energy expenditures in such a sample would however not be representative due to the variation in space heating needs across the country. The latter is comparatively high in Imizamo Yethu due to the cold winters in the Western Cape. Furthermore, due to the IES2005/06 data format, the employment statuses of shack dwellers cannot be assessed for representation of Imizamo Yethu conditions. However, the average and median household per-member incomes in the IES2005/06 shack sample were R766 and R494 respectively, which is in turn 20 and 30 percent lower than in those in the SALDRU2005 Imizamo Yethu sample.

Since household energy expenditures are likely to be associated both with climatic conditions and income levels, an IES 2005/06 sample cannot readily be constructed to represent conditions of the peri-urban APPLES site. Left with no other option we are thus restricted here to summarizing information drawn from the aforementioned surveys. The main activity thrust towards expenditure savings were on conveying the benefits of switching fuels for cooking. The rationale for those efforts was developed through one of several thorough analyses by Cowan and Dieden (2008). For baseline purposes we proceed to isolate and streamline the most relevant data material from that document, in which the further detail is found.

4.3.3 Baseline household cooking expenditures in Imizamo Yethu

In this section we present the baseline cooking expenditures for households in Imizamo Yethu. As explained above, a main effort of the APPLES project was to disseminate the potential savings that can be captured by switching from cooking on paraffin to electricity. We therefore commence with an illustrative example of the savings potential in the first subsection below. One conceivable indicator of a positive influence from this APPLES effort would be reduced expenditures on paraffin among households already connected or lower paraffin expenditures among households observed to have made a recent switch in the future. A parallel set of indicators can be derived by observing paraffin and electricity stove ownership among connected households. In the second subsection below we therefore develop and present baseline cooking energy expenditures among households with different electricity access, as captured by ERC2006. We also indicate ownership of various kinds of stoves in the three categories.

Table 4.1 Comparison of approximate fuel-costs for cooking in Imizamo Yethu, late 2007

	Cooking fuel		
	Electricity	Paraffin	LPGas
A. Energy costs			
Fuel price (retail)	R0.40-0.50/ kWh	R5-R8 / litre	R10-20 / kg
Unit energy-content cost	R0.40-0.50/ kWh	R0.50-0.80/ kWh	R0.78-1.57 / kWh
Typical conversion efficiency	75%	40%	65%
Fuel cost, per kWh of useful cooking energy	R0.53-0.67	R1.25-2.00	R1.20-2.40
B. Appliance costs			
Typical basic cooker costs	R160 (2-plate electric cooker)	R30 (single wick stove)	R370 (single cooker/cylinder)

4.3.4 Potential savings

The useful cooking-energy costs developed in Table 4.1 constitute a cornerstone of the analysis underlying the effort to promote potential savings in cooking expenditures in Imizamo Yethu.⁶ As can be seen, at the prices assumed to prevail in 2008, paraffin and LPGas is approximately twice as expensive as electricity in terms of useful cooking-energy costs. In the case of paraffin this cost difference is very much attributable to the typically poor efficiency of paraffin stoves. While the usage price of LPG is not much higher than that of paraffin, the higher cost of cooking appliances is likely to be a barrier to less affluent households. The reader should be notified that the lower per unit electricity costs is based on an assumed monthly consumption of 250 kWh including the current 50 kWh Free Basic Electricity (FBE) allowance. Many households without a regular electricity connection may in effect pay considerably more per unit of electricity and are not ensured an FBE allowance.

⁶ The table replicates Table 7 in Cowan and Dieden (2008), in which the underlying assumptions are also developed.

Table 4.2 Two levels of useful-energy requirements for basic cooking and water heating

USAGE		USEFUL ENERGY REQUIREMENT		
<i>Daily energy service:</i>		<i>Per day</i>		<i>Per month</i>
Level 1	a) Boil 4 litres of water	1.3 MJ/day	360 Wh/day	11 kWh/month
	b) Simmer at 200W for 1 hour	0.7 MJ/day	200 Wh/day	6 kWh/month
	Total	2 MJ/day	560 Wh/day	17 kWh/month
Level 2	a) Boil 10 litres of water	3.3 MJ/day	900 Wh/day	27 kWh/month
	b) Simmer at 200 W for 2 hours	1.4 MJ/day	400 Wh/day	12 kWh/month
	Total	4.7 MJ/day	1.3 kWh/day	39 kWh/month
Useful energy requirement		Level 1	Level 2	
		17 kWh/month	39 kWh/month	
Using electric stoves				
Assumed average efficiency		75%	75%	
Electricity consumption required (kWh/month)		23 kWh/month	52 kWh/month	
Expenditure		R11.5 – 13.8	R26.0 – 31.2	
Using paraffin wick stoves				
Assumed average efficiency		40%	40%	
Paraffin consumption required (kWh/month)		43 kWh/month	98 kWh/month	
Paraffin consumption required (litres/month)		4.2 litres/month	9.5 litres/month	
Expenditure		R29.4 – 37.8	R66.5 – 85.5	

In Table 4.2 are presented two (hypothetical) energy consumption levels for very basic cooking and water heating needs.⁷ The needs are converted from MJ/day into kWh/month, taking average efficiency of electric and paraffin wick stoves into account. The computed expenditures for each type of stove and consumption levels, in the lower section of the table, can be thought of as applications of the per-unit costs developed in Table 4.1 As can be seen, by using electricity rather than paraffin to meet the assumed needs, a household consuming at Level 1 could save in the range of R17.9 – 24.0 per month. At Level 2 savings would be in the range of R35.3 – 59.5 per month. Taking the 50 kWh Free Basic Electricity Allowance into account would increase the savings potential considerably, which at these very basic levels correspond to two to six percent of a two member household with the median per capita income (2 x R700) as captured by SALDRU2005.

Table 4.3 Imizamo Yethu electrification levels according to household surveys

Source	Electrified households			Not electrified	Total	n
	Metered	Informal/ Shared	All			
SALDRU 2005	-	-	58	42	100	1992
ERC2006	28	27	55	45	100	105
ERC2007	45	28	74	27	100	99

⁷ The table largely merges Tables 8 and 9 in Cowan and Dieden (2008), in which the underlying assumptions are developed.

4.3.5 The scope for energy expenditure saving among households - baseline usage of electricity and paraffin

In order to be able to benefit from the proposed switch from cooking with paraffin to electricity, a household that cooks with paraffin would obviously need an electricity connection. The exact fractions of connected households, whether by metered or informal connection are currently not known and likely to change over time. Table 4.3 shows the fractions captured by the various surveys.⁸ The considerably higher figure for ERC2007, at almost three-quarters of the sample, could indicate that electricity access has increased substantially in the settlement, although the small sample size restricts the scope for reliable statistical inference. Most of the figures below are derived from the ERC2006 survey and for future reference the reader may wish to note that connected households were divided approximately equally between the metered and informally connected.

Table 4.4 Total monthly energy expenditures per household

ELECTRIFICATION STATUS	MONTHLY HOUSEHOLD RAND EXPENDITURE				n
	Mean	Median	Minimum	Maximum	
Metered	236	228	110	697	27
Informal/shared connection	156	135	80	331	28
No electricity	142	131	50	403	42

Source: ERC (2006)

As can be seen in Table 4.4 energy expenditures are relatively sizeable and compare to around 15 percent of the median household income in metered households, which tend to spend around 70 percent more than informally connected households or those without electricity.⁹ Neither mean nor median values differ much between the latter two. A considerably greater spread in expenditures among the formally connected can also be observed. If cooking contributes a large share of total energy expenditures and if cooking costs also increase with household size, a greater variation in size among connected households may explain the greater spread in energy expenditures. The latter line of reasoning is consistent with shacks hosting primarily small, informally connected households.

Table 4.5 Breakdown of fuel expenditures among households with median total energy expenditures

Electrification status	Monthly household rand expenditure				
	Electricity	Paraffin	Candles	Batteries	Total
Metered	200	25	5	-	228
Informal/Shared connection	100	25	6	-	135
No electricity	-	125	6	-	131

Source: ERC (2006)

⁸ The table is a replication of Table 3 in Cowan and Dieden (2008).

⁹ The table is a replication of Table 19 in Cowan and Dieden (2008).

Table 4.5 shows a breakdown of expenditures on different fuels for six households that spend close to the median total energy expenditure for each category. In both connected categories the households spend R25 per month on paraffin. In the informal case however, that figure amounts to one-fifth of total energy expenditures, whereas it is only one-ninth of the typical expenditure for formally connected. Households with no electricity connection typically spend R125, or 95 percent of their total energy expenditure, per month on paraffin. Hence, it is presumably among these households that substantial savings could be made through an electricity connection. As discussed by Cowan and Dieden (2008), a formal connection would however, in many cases require the municipality's approval of the relevant area for settlement. The case may also be that many of these households are located at some distance from connected households and do not have the option to share a connection.

Table 4.6 Primary fuels used for cooking, column percentages.

Primary energy source for cooking	Connection status		All
	Connected	Not connected	
Electricity	80.8	1.4	47.1
Paraffin	17.9	97.0	51.5
Gas	1.1	1.3	1.2
Wood	0.2	0.0	0.1
Other	0.0	0.2	0.1
Total	100.0	100.0	100.0
Fraction	57.6	42.4	
n	1147	845	1992

Source: SALDRU (2005) – own computations.

While the SALDRU2005 survey did not distinguish between metered and informally connected households, the figures in Table 4.6 can shed some light on the scope for saving energy expenditures by switching fuels for cooking. Please note that the figures refer to primary fuels. As can be seen, in total more than half the households captured by the 2005 survey cooked primarily with paraffin, among which 97 percent were non-connected. However, consistent with the breakdown of expenditures on fuels in Table 4.5, almost one-fifth of the connected who cook primarily on paraffin.

Table 4.7 Estimated average household electricity consumption levels and electrical stove ownership

CONSUMPTION	MEASURE	HOUSEHOLD CONNECTION STATUS	
		Metered supply	Informal/shared supply
Monthly electricity expenditure in Rand	ZAR/m		
	Mean	188	115
	Median	165	100
Estimated monthly consumption, excluding FBE allowance	kWh/m		
	Mean	375	< 230 (?)
	Median	320	< 200 (?)
Estimated monthly consumption, including FBE allowance	kWh/m		
	Mean	425	
	Median	370	

Ownership of appliance (percentage)		
Electric stoves	100	82
1 plate	17	4
2 plate	50	71
2 plate + oven	17	0
Full stove + oven	30	7
n	30	28

Source: ERC2006

The first two rows of figures in the upper section of Table 4.7 restate the total electricity expenditures for households with a formal (metered) electricity connection and for those sharing supply (non-regular).¹⁰ Both the mean and median expenditures are higher among households with metered supply. In addition, since the per-unit rates paid by households sharing a supply are likely to be higher, the difference in estimated per kWh consumption between those and sharing households is probably greater than the difference in expenditures. Given that a shared connection may also be less stable than a metered one, sharing households may have more reason to keep a paraffin stove for back-up purposes. Relatively high per-unit electricity costs for the informally connected may also cause cooking on paraffin to appear as a less unattractive option.

In the lower section of Table 4.7 is shown that all households with a metered connection have some sort of an electrical stove, whereas around four-fifths of the sharing households do. Hence, one-fifth of the sharing category was not equipped to benefit from switching to cook with electricity, should they have wished to do so. (Table A.4.1 in the Appendix of this section provides an overview of the spread in electricity expenditures among the same households by connection status.)

Table 4.8 Average reported paraffin consumption and wick stove ownership

Consumption	Measure	Electricity status of households		
		Metered supply	Informal/shared supply	No electricity
Paraffin expenditure in Rand	ZAR/m			
	Mean	49	43	126
	Median	25	25	125
Estimated monthly paraffin consumption	Litres			
	Mean	10	9	25
	Median	5	5	25
Proportion using paraffin at some time of year (percentage)		80	82	100
Proportion owning a paraffin wick stove (percentage)		77	82	96
n		30	28	47

Source: ERC2006

The first two rows of figures in Table 4.8 re-state the paraffin expenditures in Table 4.6, which in the consecutive two rows have been converted into litres consumed.¹¹ Of perhaps greater interest are the facts that four-fifths of the connected households claim to use paraffin some time of the year and that a very similar fraction also own a wick stove. As discussed in the Cowan and Dieden (2008), wick stoves are very likely kept as back-up solutions to power black-outs. The high ownership figures do therefore not necessarily imply a frequent everyday usage. However, lower

¹⁰ The table largely merges Table 5 with extracts from Table 13 in Cowan and Dieden (2008).

¹¹ The table is a replication of Table 6 in Cowan and Dieden (2008).

ownership figures observed in the future would be consistent with a shift towards more cooking on electricity. (Table A.4.2 in the Appendix of this section provides an overview of the spread in paraffin expenditures among the same households by connection status.)

4.4 Conclusions and lessons for assessment of APPLES impacts in Imizamo Yethu

In conclusion, the efforts towards encouraging households' use of electricity appear well justified. The use of paraffin is widespread in Imizamo Yethu. The associated costs show up as non-negligible components of households' expenditures, also among those with an electricity connection. The proposed switch of energy sources for cooking obviously becomes impossible without an electricity connection. Such connections appear to be increasing in Imizamo Yethu already. However, given cooking energy's substantial contribution to household expenditures, the APPLES activities may be one of several factors that underlie a continued increase in household electrification rates there. For the monitoring of APPLES impacts one may therefore wish to keep one eye on the connection rates. To the extent that all informally connected households are not confined to such a connection by distance from the supply, increased formal connections could also follow in the wake of this project. Nonetheless, expenditure on paraffin among informally connected, appears a more interesting indicator, which could well be assessed in parallel with changes in ownership of electrical stoves in the same household. Unaware of the potential economical gain such households may previously have been more hesitant to challenge the load of their connection with cooking.

APPENDIX 4.1

Table A.4.1 Electricity: monthly expenditures per household (based on IY2006 survey data).

Electrification status	Monthly spend (R/month per household)				N Valid
	Mean	Median	Minimum	Maximum	
Formally-connected (own meter)	180	165	50	600	28
Informally-connected	114	100	250	35	28
No electricity	n/a	n/a	n/a	n/a	

Table A.4.2 Paraffin: monthly expenditures per household (based on IY2006 survey data).

Electrification status	Monthly spend (R/month per household)				N Valid
	Mean	Median	Minimum	Maximum	
Formally-connected (own meter)	49	25	6	120	25
Informally-connected	43	25	15	100	24
No electricity	126	125	50	400	44

5 Highflats – project activities and a baseline for developments impacts¹²

The APPLES project objective in the impoverished, rural settlement Highflats, in the Ubuhlebezwe municipality, was to demonstrate and establish an alternative, cooperative “Integrated Energy Centre” (IEC) model, for the South African Department of Minerals and Energy’s IEC Programme. The IEC Programme is a component of the country’s overall Integrated Sustainable Rural Development Programme (ISRDP) and its objectives are to: (i) increase access to affordable energy services; (ii) stimulate economic development through promotion and support of SMMEs in poor communities; and (iii) integrate the provision of wider energy choices with initiatives in other sectors such as water supply, education, housing, agriculture and small business.

As will be returned to in the next subsection, the expected results from the establishment of the “Highflats Energy Centre” (HEC) were to (i) increase awareness in the local population of energy alternatives and related issues; (ii) improve the availability and reduce end-user expenditures on commercial energy products; and (iii) generate employment and income (directly) among the coop members and (indirectly) in new SMMEs brought about by the availability of energy products.

With respect to development impacts from the establishment of the HEC, it is reasonable to perceive households as the ultimate beneficiaries. A key constraint in the construction of a baseline against which to gauge those impacts is the shortage of detailed data on households’ fuel usage and expenditures. No such information has been collected specifically for Ubuhlebezwe since the 2001 Census. However, as we shall see, Statistics South Africa’s national household Income and Expenditure Survey in 2005/06 (IES 2005/06) included households which may suffice for the current purpose. It is important to be aware that the survey was designed to yield an *aggregated* representative sample of households on a *national* and *provincial* level. The sample does not cover sufficiently large numbers of observations on any location to return reliable results for a specific municipality.

Two immediate objectives of this section follow. Firstly must be identified conceivable medium-term impacts from the HEC for which relevant indicator baseline values can be derived from the survey data. The second, consequent objective becomes to identify a set of surveyed households sufficiently similar to those in Ubuhlebezwe to serve as a baseline sample. We start addressing these two objectives by presenting in some more detail the APPLES project components in Highflats. Thereafter we commence the baseline construction by providing the socio-economic context of the Ubuhlebezwe municipality, followed by a brief outline on how we utilized the census 2001 information to identify a survey sample, for which we finally present baseline indicator values.

5.1 APPLES project activities and expected impacts

The intended foci of activity for the Highflats Energy Centre (HEC) were:

- to act as a central purchasing point of energy products, for the distribution through a network entrepreneur cooperative members with their own outlets in the rural areas of the Ubuhlebezwe municipality

¹² The introductory part of this section partly draws on the APPLES business plan for the Highflats Energy Centre

- over-the-counter-sales of affordably energy products that would serve as alternatives or compliments to the widely used fuel wood and candles
- to provide energy-related information and education activities, which are especially pertinent to the promotion and safe use of alternative sources or uses of fuel

Based on identified use patterns and desired changes expressed through the APPLES Needs Assessment exercise, the team begun negotiations with suppliers for a range of products and services to be supplied by the centre. By April this year reached very favourable preliminary terms had been reached for the following products and services (suppliers in brackets): paraffin, LPG, candles, solar home systems, safe paraffin stoves, ethanol gel and gel stoves, LP Gas stoves, improved wood stoves, solar cell phone chargers, prepaid electricity and cell phone airtime, efficient lamps and leisure batteries. At the time of writing, the HEC's future hinges crucially on funding from the National Development Agency (NDA). By 31 June the venue and some seed capital had been provided, and training of staff was scheduled to take place shortly afterwards. In the absence of sufficient financial capital and surety while awaiting the NDA response, the final terms for all products listed above had not been secured. The initial range of products encompassed gel fuel, energy efficient lamps, improved biomass stoves, paraffin stoves, gel fuel stoves and lamps, as well as LP Gas and cookers.

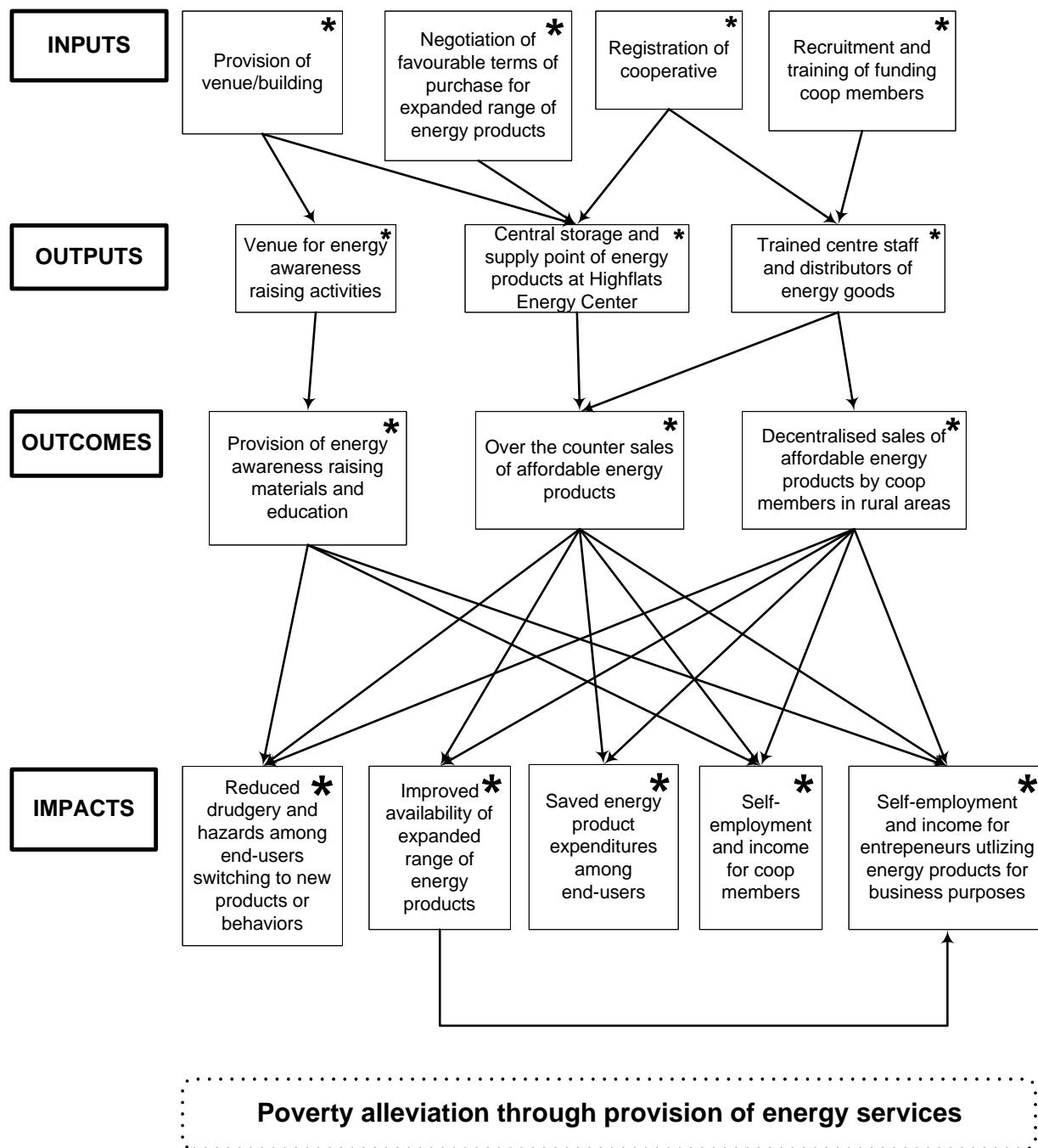


Figure 5.1 Causal chain diagram for the HEC

In Figure 5.1 we illustrate the expected project results by a four-level causal chain diagram. Through the provision of a venue, recruitment and training of cooperative members, registration of the cooperative as a formal business, and negotiation of favourable terms of delivery for energy products, the projects delivers the staffed HEC. With the centre acting *inter alia* as a central supply and a sales point, the cooperative members are expected to engage in sales of energy products, either over the counter or in rural outlets. The centre staff would also either be involved in or organize materials and activities that inform and advice the general public on energy related issues.

With households as the ultimate beneficiaries, final expected impacts are summarized as (i) increased awareness of energy alternatives and related issues, such as paraffin safety or indoors pollution from firewood, that in turn reduce the daily workload and/or improve safety conditions, (ii) improved availability and reduced end-user expenditures on commercial energy products, with (iii) generation of employment and income (directly) among the coop members and (indirectly) in new SMMEs brought about by the availability of energy products. We return to the issue of *measurable* impacts after the contextual information in the socio-economic profile.

5.2 Baseline outline

5.2.1 Socio-economic context

The Highflats settlement is a transport hub located in the Ubuhlebezwe municipality in a remote area of South-Western KwaZulu-Natal. The geographic area of the municipality is approximately 1600 square kilometres divided into 12 wards, yielding an average population density of around 160 individuals or 35 homes per km². Homes are typically quite modest, containing on average three rooms, with mostly thatched roofs and walls built with either traditional mud or cement-block. Some houses have fully or partly galvanized iron roofing due to a lack of thatching grass. In terms of household energy access, given the dispersed low density settlement characteristics, large tracts of the community is unlikely to receive grid electricity in the foreseeable future.

In terms of the municipality's economic activity, agriculture is the biggest contributor to salaries, followed by retail and wholesale trade and government services. There is very little industrial activity and many households depend crucially on social transfers such as the Old Age Pension for their daily bread. According to the 2001 census the municipality's total population is approximately 102 000 individuals hosted by a good 23 000 households. Just below half the population is children below the age of 15 and around 5 percent were above working age. Almost 60 percent of the households were headed by females.

The 2001 Census captured a little less than one-third of working-age adults as having no formal education at all and a similar share had either some or complete primary schooling. Roughly one-quarter had *some* secondary schooling and less than 15 percent had complete secondary or any tertiary education. Hence, adult literacy rates are not likely to exceed two-thirds. There are just under 9 000 individuals in employment in the municipality, yielding an *average* official unemployment rate of around 60 percent, but exceeding 70 percent in eight of the municipality's twelve wards. Hardly surprising thus, we will find widespread poverty in Ubuhlebezwe.

Table 5. 1 Basic demographics and earnings in the wards of Ubhlebezwe municipality

COMMUNITY PROFILE OF UBHLEBEZWE LOCAL MUNICIPALITY								
Ward number	Population		Earners and dependants			Incomes (2001 Rand)		
			Fractions of income earners		Depend-ants	Fraction households w/o income	Per capita income Rand / month	
	Share of households	Share of individuals	All	Earning >R3200			All individuals	Poorest 94%
2	10.9	6.1	13.6	32.7	4.2	18.0	688	263
4	9.3	6.8	11.8	22.3	5.5	19.4	902	324
9	9.2	8.5	8.3	7.8	8.5	35.1	755	151
1	9.8	9.1	10.1	5.0	8.8	31.7	409	157
3	7.5	8.8	6.6	6.4	9.4	43.6	320	109
5	5.9	6.8	7.2	2.3	6.7	33.9	218	129
6	5.3	6.5	4.9	3.0	7.0	42.9	179	95
7	7.8	8.9	8.1	4.2	9.1	39.8	319	122
8	10.6	12.5	9.1	5.6	13.3	41.8	341	102
10	8.3	9.1	6.6	4.8	9.7	47.9	350	103
11	8.1	8.6	8.6	3.9	8.7	31.9	324	123
12	7.2	8.3	5.2	2.1	9.0	51.2	299	86
All	100.0	100.0	100.0	100.0	100	35.4	462	146
n	23.093	101.846	20.368	1.508	81.589	8.163	101.957	100.449

Source: Census 2001 figures provided by the South African Demarcation Board, own computations.

In Table 5.1 the levels and variation in poverty among the municipality's wards are illustrated with figures from the 2001 Census. For those purposes, the municipality's wards with urban populations have been separated out and listed before those with predominantly rural settlements. The main town and administrative centre, Ixopo, is divided between wards 2 and 4. Highflats is found in ward 9. As can be seen by adding up entries in the first two columns of figures, together the three first wards contain some 30 percent of the households and a good one-fifth of the population. The same wards contain 40 percent of the municipality's income earners and 60 percent of those earning more than R3 200 per month, while their fraction of dependants is less than one-fifth.¹³

From above follows that 80 percent of Ubhlebezwe's dependants rely 60 percent of the income earners, the vast majority of whom would earn less than R3200/month. The dire situation in the municipality is illustrated in the three rightmost columns of the table. While subject to some variation between wards, more than one-third of the households in Ubhlebezwe received no cash income at all.

The commonly applied deep-poverty line of US\$1 (in 1985 Purchasing Power Parity (PPP)) would be drawn at roughly R175 per household-member in 2001. If one includes all income earners in the calculation, very conservative estimates render the average household per-capita income, at R461/month, well above twice the poverty datum¹⁴. However, if earners of more than R3200/month

¹³ Dependants are individuals earning no income, including children below age 15.

¹⁴ The census income data is only available in intervals format (brackets), not in continuous format. The same data cannot be broken down into smaller units than the wards. Hence, we are confined to ward level average incomes derived from income interval mid-point estimates, which presumably underestimates incomes among the poor. A

and their households are excluded, the average income among the remaining 94 percent fell far below the poverty line to R146. Hence, in 2001 it appears as the overwhelming majority of Ubuhlebezwe's population live in conditions that could benefit from the alleviation of poverty, whether through local energy services or by other means.

5.2.2 Baseline focus

With respect to *measurable* impacts, we start the discussion with the last point above, employment creation. As mentioned in the socio-economic profile above, in 2001 there were some 20 000 regular income earners supporting a good 100 000 individuals in Ubuhlebezwe. The overwhelming majority of the citizens lived in or near abject income poverty. The current number of members in the HEC cooperative is around 10. The development over time of the number coop members (i.e. self-employed energy goods distributors) is of obvious interest as a performance indicator for the HEC. The income generated among its members may be also of dire need to the members and their households. However, from a societal perspective, even if the number of HEC coop members and self-employed benefiting from access to energy products were ten-, twenty-, or even fifty-fold the current number of coop members, the increased employment is not likely to make an identifiable dent in the municipality's poverty. Hence, we will not attempt to create a baseline for such an impact here.

Impacts from the increased awareness of energy alternatives and related issues may yield important improvements in the fields of e.g. safety and health, as well as households switching to fuels that do not require labour time spent on collection of fuel wood. The latter could in turn imply a reduction of foremost women's and girls' drudgery, more time spent on income-generating activities, studies or catering for the households' young or elderly. Unfortunately however, the household survey data at hand does not provide the level of detail needed to construct a meaningful base line for such time-use impacts. With respect to the remaining point, improved availability of energy goods at affordable prices, this may encourage households to switch to modern fuels from non-commercial ones and/or to increase their use at a lower than current level of expenditure. The household survey was designed to trace expenditures and also covers current primary-fuel usage for various domestic purposes. Hence, the baseline will focus on household fuel usage and expenditures on fuels.

An assessment of the APPLES project's impacts would analyze whether households use more or less quantities of commercial fuels, or whether they pay less (in real prices) for their baseline quantities. The IES 2005/06 only provides data on specific fuel expenditures, not quantities consumed. Hence, for comparison over time expenditures must be converted into fuel quantities. The various fuel prices for rural KwaZulu-Natal were however not available to the APPLES team at the time of compiling this report. A conversion to quantities is therefore unfortunately beyond the scope of this study.¹⁵ Furthermore, since larger households have to e.g. heat larger meals, which would also take a longer time to heat, fuel quantities consumed will be assumed to vary with the number of household members. The indicators used here will therefore be per-capita expenditures on the fuels accounted for by the IES 2005/06; Electricity, Gas in cylinders, Paraffin, Firewood bought, Candles, Coal, Other fuels/sources. Finally, the survey figures are in 2006 Rand. A later assessment must consider that prices for various fuels may have changed between then and then starting point for the HEC provision of fuels, in response to which households' may also have changed.

large number of income earners among are Old Age Pensioners, who received R780 in 2001 placing them at the lower end of the R801-R1600 interval.

¹⁵ The SA Department of Minerals and Energy publishes price developments until 2005 in its "Price report" downloadable at <http://www.dme.gov.za/pdfs/energy/statistics/PriceReport%202005.pdf> . More recent but less detailed fuel price information is available at http://www.dme.gov.za/energy/liquid_prices.stm .

5.2.3 Matching a representative sample in the IES 2005/06 data

Since the project impacts pertain to changes on the energy user side, one wants an impression of how households in the area currently meet their energy needs and the expenditures incurred. The fuel and energy consumption levels of households are largely driven by their incomes and household size (number of members). A most crucial matching characteristic for the survey sample is therefore households' per-member income. It is also reasonable to assume that energy consumption patterns are associated with ethnic traditions, such as the rural usage of fuel wood for cooking and space heating. Traditional consumption patterns were also historically reinforced by apartheid era discriminatory practices, which would e.g. *confine* rural African households to fuel wood usage by impeding geographic and financial access to other energy sources. Finally, energy consumption may be associated with the range of fuels or appliances immediately available. Limitations in such access will here be approximated by geographic location.

In Appendix 5.1 we show how ethnicity and location correlate with income levels in order to justify the delimitation of the household survey sample to rural and urban African households in KwaZulu-Natal.

As an informal test of the extent of matching between the survey sample and the Ubuhlebezwe population, we start by comparing income levels among households in the two data sets. The data originate from different points of time and we have to undertake several adjustments to the 2001 income figures, subject to a number of methodological challenges. Firstly, the census income data is only available in pre-defined brackets, not in continuous format as in the survey. Secondly, the census data cannot be broken down into smaller units than wards, up to a level of which the survey's household data can *not* be aggregated. Hence, for the 2001 census figures we are confined to ward level per-capita income estimates, rather than at the household level, which we derive from interval mid-points. Thirdly, the monthly pay-out amounts of two essential social grants have increased since 2001 as have the uptake rates of those grants.¹⁶ Fourthly, in order to depict the income situation in the African population groups in Ubuhlebezwe, we assume that the highest paid 1.5 percent of the urban income earners are non-African and remove those from the census income data (see Appendix 5.1). Finally, we adjust for inflation by multiplying the census income figures increase in CPI from September 2001 to March 2006.

Table 5.4 Adjusted census per-capita income in 2006 Rand estimates, by ward and averages

Earners	Ward												Averages		
	2	4	9	1	3	5	6	7	8	10	11	12	All	Urban	Rural
All	1491	942	750	541	522	317	297	479	455	473	456	356	453	1021	442
Less 5% highest paid urban	448	366	253	316	275	317	254	282	267	274	286	232	284	342	269

Source: Census 2001, own adjustments and computations

¹⁶ In 1998 a child care grant of R100 per month was introduced for children aged 0-6 years living in households earning less than R1100 month. The eligibility has since been extended to all children aged 0-14. Among the eligible in 2001 the uptake was fifty percent (Access 2002). According to Budlender et al (2005) the uptake rate in KwaZulu-Natal increased from 65 to 85 percent between 2005 and 2006. In the absence of other alternatives, we will proceed to assume that in addition to the 2001 number another 30 percent of children aged 0-6 in Ubuhlebezwe received the grant in 2006. In addition to those we add 85 percent of those aged 7-14 as grant recipients and income earners. The pre-defined income intervals do not allow controls for the increase in the grant from R100 to R190 in the period. Due to the change in Old Age Pensions from R780 to R870 we have moved everyone in the age brackets above 65 into the R801-1600 interval as well as half of those aged 60-65. All women in the latter category are eligible and we conservatively assume women to constitute half that category.

The resultant ward per-capita incomes from the 2001 Census are found in Table 5.4 and can be summarized as follows; when including all earners the estimated overall per-capita income in the municipality was R453. Without the assumed non-African earners the income level drops by almost one-half to R284. Similarly, without the top earners the difference in average per-capita incomes between wards with partly urban populations and with exclusively rural, drop from R580 to R73. An approximate estimate for the US\$1 1985PPP poverty datum for 2006 is R216. Per-capita income estimates in all wards are now found above the poverty line. Hence, the increased grants and widened uptake appear to have improved the income poverty situation to some extent.

Table 5.5 Minimum, maximum and average household per-capita incomes among African households in KwaZulu-Natal, by population-category quintiles and type of settlement

Per-capita income	Household income quintile					All	Urban	Rural
	1	2	3	4	5			
Lowest	1	154	248	403	811	1	7	1
Highest	154	249	402	810	26 881	26 881	26.881	13.366
Average	103	199	317	566	2 084	653	993	397
<i>n</i> 9 626								

Source: Statistics South Africa Household Income and Expenditure Survey 2005/06, own computations, weighted figures.

Table 5.5 contains the income information for comparison, grouped into the five quintiles of African households in KwaZulu-Natal¹⁷. If our estimates and adjustments of the 2001 Census data are correct, a scrutiny of the figures in the bottom row of Table 5.4 and Table 5.5 would place the Ubuhlebezwe households largely in the second and third of those quintiles, with ward average incomes considerably lower than both rural and urban survey average incomes. We deem that finding consistent with Ubuhlebezwe being a designated “poverty nodal area” and expect the survey sample to be sufficiently similar to the municipality’s households.

5.2.4 Baseline information on households’ energy utilization in Ubuhlebezwe

In this section we first derive an impression of Ubuhlebezwe households’ primary fuel choices for various domestic energy services from the 2001 Census. Unfortunately we have no means to assess the extent to which usage patterns in the municipality have changed since. It is important to also keep in mind that many households utilize more than one fuel for the same service and that the following discussion largely pertains to *primary* fuels.

Households’ energy expenditure patterns are complicated by the fact that many households use different (primary) sources for different purposes. Two identical households that both use e.g. electricity for cooking may incur different expenditures depending on whether they also heat their homes with electricity or not. As we shall see however, a relatively limited number of energy source combinations portfolios account for the consumption of a large share of our sample’s households. We will find that expenditures on fuels are indeed contingent on which portfolio they utilize.

¹⁷ As explained in Appendix 5.1 an income quintile is an “ordered one-fifth” of a sample, with the first quintile containing the fifth of individuals with lowest earnings.

Table 5.6 Primary fuels for domestic uses in different areas of Ubuhlebezwe municipality

Primary fuels for	Areas								
	Ixopo	Highflats	Wards 1, 6 & 12	Wards 3 & 5	Ward 7	Ward 8	Ward 10	Ward 11	All
Lighting									
Electricity	53.8	15.0	10.9	2.2	54.4	49.4	46.2	3.0	28.6
Paraffin	4.7	10.5	2.6	22.4	2.0	3.7	1.3	3.0	6.4
Candles	40.6	72.8	85.4	74.2	42.5	45.3	51.3	90.9	63.6
Solar	0.3	0.3	0.2	0.1	0.4	0.6	0.3	0.7	0.3
Other	0.6	1.3	1.0	1.1	0.7	1.0	0.9	2.4	1.0
Sum	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Cooking									
Electricity	37.9	10.7	6.4	2.1	15.6	17.9	7.3	2.3	14.3
Gas	6.0	4.4	3.2	4.2	4.8	1.8	4.1	2.8	4.0
Paraffin	31.3	14.2	5.2	2.3	20.3	4.2	3.7	6.5	12.0
Wood	23.4	67.4	82.6	89.6	57.7	74.3	80.7	86.3	67.4
Solar	0.3	0.3	0.3	0.6	0.2	0.6	0.7	0.3	0.4
Other	1.1	3.0	2.3	1.2	1.4	1.2	3.6	1.7	1.9
Sum	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Heating									
Electricity	36.6	8.9	5.4	0.9	18.8	17.3	4.0	2.0	13.4
Gas	1.2	1.5	1.1	1.2	0.7	0.0	1.3	1.3	1.0
Paraffin	15.9	11.7	3.9	2.0	3.2	2.0	2.4	8.1	6.7
Wood	36.1	73.9	88.0	93.4	72.1	79.3	87.6	84.4	74.4
Solar	0.1	0.4	0.1	0.0	0.1	0.3	0.3	0.3	0.2
Other	10.2	3.6	1.6	2.5	5.3	1.1	4.4	3.9	4.3
Sum	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Fraction	20.3	9.2	22.3	13.4	7.8	10.6	8.3	8.1	100.0
n 23.063									

Source: Census 2001 figures provided by the South African Demarcation Board, own computations.

Households' primary fuels for domestic energy services in Ubuhlebezwe

In Table 5.6 the figures have been grouped for wards with similar usage patterns. However, for baseline purposes it is important to be aware that the overall figures for the municipality conceal considerable geographical variation in fuel use. In South Africa the electrification rate is often approximated by the fraction of households that use electricity for lighting. To summarize the overall situation and applying that definition, the figure in the top right cell indicates an overall municipal grid-electrification rate of 28.6 percent in 2001.

Almost two-thirds of the households used primarily candles for lighting and a similar fraction used primarily wood for cooking, while almost three quarters used wood as their primary source for heating. The census raw data format does not allow the cross tabulation of primary fuels for different purposes. However, associated with the last two findings is a commonly preferred combination of household primary energy sources. South African annual household survey data since 2002 consistently show that among rural African households in KwaZulu-Natal that used candles for lighting, the overwhelming majority used use wood for cooking. In the later category,

virtually everyone also use wood for heating. Hence, in Ubuhlebezwe one could expect up to sixty percent of households to use such a combination.

Returning to the figures in the first row of Table 5.5, implications are that electricity access was higher than 45 percent in four of the geographical areas in 2001. For the remaining half of the households the rate would have been less than 10 percent. Similarly, in all areas but three, candles were used for lighting by almost all non-electrified households, with a fraction ranging from 40 to 90 percent. However, in Wards 3 & 5, as many as one-fifth used paraffin for lighting and as did a fraction of half that size Highflats.

The overall two-thirds fraction that cooks with wood is brought down to that level by the low fraction of such households in Ixopo. Many of the households that light up their homes with electricity do not use the same source for cooking. It is impossible to say with certainty to which other primary cooking fuels the electrified households switch. However, in Ixopo, Highflats, and Ward 7 the lower numbers of households that use electricity for cooking than for lighting appear in parallel with lower numbers of households that use wood for cooking than for heating. (A residual of households would thus use something other than wood or electricity for cooking.) Hence, in Ixopo, Highflats, and Ward 7 it is not unlikely that households switch from electricity for lighting to paraffin for cooking. It is also noteworthy that in Ward 7, paraffin is used for cooking by as many as one-fifth, which is ten times the size of the fraction using the same fuel for lighting. The reverse pattern applies to Wards 3 & 5 where two percent cook on the fuel, as compared to the fifth that used it for lighting. Also noteworthy is that the overall fraction of households that heat their homes with wood is brought down by the low figure for Ixopo. In other wards the fraction often approaches 90 percent.

Fuel usage and expenditures

As mentioned previously, households' energy expenditure patterns will depend on the combination of fuels they utilize for various purposes. However, a rather low number of energy source portfolios account for the consumption patterns of a large share of the African households in the 2005/06 survey. We therefore start this subsection with a brief overview of the most common energy source portfolios, before we account for household expenditures on fuels.

Table 5.7(a) Primary source portfolios among rural African households in KwaZulu-Natal, cell percentages

Source for lighting	Source for cooking	Source for heating home				Sum
		Electricity	Paraffin	Wood	Not	
Electricity	Electricity	16.4		4.2	3.3	23.9
	Paraffin		2.5	2.2		4.7
	Wood			7.6		7.6
Candles	Paraffin		4.0	5.2		9.2
	Wood			33.2		33.2
Sum		16.4	6.6	52.4	3.3	78.7
n 2325						

Source: Statistics South Africa's Household Income and Expenditure survey 2005/06, weighted figures, own computations.

Household fuel usage patterns

Table 5.7(a) shows the most common energy source portfolios among rural African households. The table is vertically divided by a dotted line into two main sections according to households' main source for lighting, i.e. electricity or candles. Within each vertical section the households' primary choices for cooking and heating are cross-tabulated, with the results presented as cell percentages. Hence, 16.4 percent of the table's households use electricity for all three purposes (lighting, cooking and heating). A fraction of roughly one-quarter that size, 4.2 percent, uses electricity for lighting and cooking, but utilize wood for space heating. From the bottom row can be seen that just over half the table's households heat their homes with wood. Approximately one-third use wood for heating in combination with wood also for cooking and candles for lighting. Taken together the ten portfolios presented in the table cover almost 80 percent of all sampled African households in rural KwaZulu-Natal.

Table 5.7(b) Primary source portfolios among urban African households in KwaZulu-Natal, cell percentages

Source for lighting	Source for cooking	Source for heating home			Sum
		Electricity	Paraffin	Not	
Electricity	Electricity	63.7	1.5	5.9	71.1
	Paraffin	2.3	2.0	5.0	9.4
Candles	Paraffin		5.3	2.3	7.6
Paraffin	Paraffin		2.4		2.4
Sum		66.0	11.2	13.3	90.5
n 1039					

Source: Statistics South Africa's Household Income and Expenditure survey 2005/06, weighted figures, own computations.

Table 5.7(b) presents an approach analogous to that in Table 5.7 (a), but for urban African households in KwaZulu-Natal. The urban sample is dominated by the almost two-thirds of households that use electricity for all three purposes. Consistent with the relatively low electrification rate of Ubhlebezwe and the other census figures in Table 5.5, one would expect households' usage patterns in the municipality to deviate from the survey sample in two ways. Since the municipality's maximum electrification level is 53 percent, in Ixopo, where less than 40 percent use electricity for cooking, considerably lower fractions could be utilizing electricity for any purpose(s). Along similar lines of reasoning, a fraction considerably higher than one-third would use wood for cooking and heating, with candles as the primary choice for lighting.

Table 5.8(a) Households' monthly average per-capita expenditures on energy products, for selected primary source portfolios among rural African households in KwaZulu-Natal, running 2006 Rand

Primary fuel for	Energy source portfolio					
	Electricity	Electricity	Paraffin	Paraffin	Wood	Wood
cooking:	Electricity	Wood	Paraffin	Wood	Wood	Wood
heating:	Electricity	Electricity	Paraffin	Wood	Wood	Wood
lighting:	Electricity	Electricity	Candles	Candles	Electricity	Candles
Expenditure on						
Electricity	28.3	19.2	0.0	0.4	11.2	0.1
Gas in cylinders	0.1	0.0	2.8	2.0	0.2	0.7
Paraffin	1.2	3.0	12.8	11.3	2.3	2.5
Firewood bought	0.0	0.6	0.3	1.3	3.2	1.6
Candles	0.4	0.3	3.0	2.7	0.5	2.5
Coal	0.1	0.0	0.2	0.1	0.2	0.0
Other fuels/sources	0.0	0.5	0.2	0.1	0.2	0.1
Sum energy expenditures	30.2	23.7	19.3	17.8	17.8	7.4
Total per capita expenditure	710.3	393.2	380.7	337.0	303.0	259.5
Energy/Total expenditure (%)	4.3	6.0	4.0	5.3	5.9	2.9
Electricity/Energy expenditure(%)	93.8	80.9	5.1	2.2	62.7	1.1
Fraction of households	16.4	4.2	4.0	5.2	7.6	33.2
n	429	114	107	153	235	1050

Source: Statistics South Africa Household Income and Expenditure Survey 2005/06, own computations, weighted figures.

Household per-capita fuel expenditures

In Table 5.8(a) households' per-capita expenditures on various energy goods have been assembled, as associated with a subset of portfolios that were held by sufficiently large numbers of rural African users in KwaZulu-Natal to draw statistical inference. Altogether the portfolio categories cover 70 percent of the subsample of households. While the study of individual cost items is left to the reader, five general observations should be noted. Firstly, households' energy expenditures are largely driven by the costs for cooking fuels, in shaded cells, although not for those that cook on firewood, which is typically collected. (Unfortunately we have no information on the amounts of wood collected.) Secondly, the widespread although small average expenditures on non-primary fuels indicate that households often utilize more than one energy source for the same type of service (e.g. all categories show positive average expenditures on paraffin and candles).

Thirdly, it can be seen in the third row from the bottom in the table, that energy expenditures rarely constitute more than six percent of total per-capita expenditures. Hence, reduced energy expenditures are unlikely to have substantial impacts on household budgets. Fourthly, among households that utilize electricity as a primary source, the largely pre-paid, electricity bill constitutes at least 60 percent of the total energy expenditures. Finally, to heat with wood rather than electricity seems to reduce the energy costs for households that use electricity for cooking and lighting. However, the analogous effect does not apply to those that use paraffin for cooking and candles for lighting. Presumably the difference in electricity expenditures between the first two categories reflects overall welfare differences. The difference in total expenditures between those two categories vastly exceeds the difference in energy expenditures. The total expenditures difference is considerably less between those that use paraffin for cooking and candles for lighting.

Table 5.8(b) Households' monthly average per-capita expenditures on energy products, for selected primary source portfolios among urban African households in KwaZulu-Natal, running 2006 Rand

Primary fuel for	Energy source portfolio			
	Electricity	Electricity Not heating	Paraffin Paraffin Candles	Paraffin Not heating Electricity
cooking:	Electricity	Electricity	Paraffin	Paraffin
heating:	Electricity	Not heating	Paraffin	Not heating
lighting:	Electricity	Electricity	Candles	Electricity
Expenditure on				
Electricity	30.8	23.1	0.1	15.5
Gas in cylinders	0.4	0.0	0.5	0.0
Paraffin	0.2	1.1	23.7	11.8
Firewood bought	0.1	0.0	0.0	0.0
Candles	0.1	0.2	6.2	0.4
Coal	0.1	0.0	0.0	0.0
Other fuels/sources	0.4	0.3	0.1	0.2
Sum energy expenditures	32.1	24.8	30.5	27.9
Total per capita expenditure	1107.5	529.8	1244.6	467.3
Energy/Total expenditure (%)	2.9	4.7	2.5	6.0
Electricity/Energy expenditure (%)	96.0	93.1	77.7	42.2
Fraction of households	63.7	5.9	5.3	5.0
n	743	88	44	42

Source: Statistics South Africa Household Income and Expenditure Survey 2005/06, own computations, weighted figures.

We next turn to urban expenditures for the four types of portfolios that account for 80 percent of the urban African households in KwaZulu-Natal. From the first two columns in Table 5.8(b) can be seen that among electricity users, refraining from heating reduces total energy expenditures by roughly one-quarter. Also, households that cook on paraffin, in the rightmost two columns, and refrain from heating halve their per-capita expenditures on the fuel. However, as in the rural case of substituting electricity for candles among otherwise wood users, the cost of lighting up the dwelling with electricity adds considerably to the total energy cost. Also in the urban case it is important to notice that not heating - analogously to using wood rather than electricity for heating in the rural setting - is associated with considerably lower monthly total expenditures.

5.3 Conclusions and lessons for assessment of APPLES impacts in Ubuhlebezwe

A first impression from the above would be that a large variation exists in the utilization of energy sources within the municipality. Distinctly different consumption patterns exist between urban and rural settings, which are also reflected in inter-ward differences. The most important lesson learnt here however, is that the kind of households found in Ubuhlebezwe rarely spend more five or six percent of their total monthly expenditures on fuels. Hence, if the HEC could supply all of these fuels – including (pre-paid) electricity - by as much as 20 percent below prevailing prices, everything else identical to the 2006 situation, it would save households 1.0-1.2 percent of their expenditures. In monetary terms, a rural household with five members would thus typically save in total R.7.5 – R 15 per month and an urban household closer to the upper end of that range. The monetary poverty alleviating impact is thus likely to be very limited and difficult to detect.

Many households do not use other commercial energy sources than candles. We are unable to say whether this is for reasons of economizing on expenditures or due to those households not being connected to the electricity grid. On the one hand, the large fraction of households which appear to use collected wood for cooking and heating, with candles for lighting, also tend to have low total per-capita expenditures. Households that use the same sources for cooking and heating, but use electricity for lighting, spend roughly 15 percent more in total per-capita expenditures, but spend nearly twice as much per month and member on energy. The latter additional cost is on average to the matter of three or four percent of total expenditures.

Affordable energy products are thus not likely to free up considerable cash resources for the households in Ubuhlebezwe. However, improved availability of fuels may provide households with energy services of higher and/or less fluctuating quality. For example, if the relatively high investment cost for improved wood stoves could be over come by the HEC provision of micro finance, the reduced need for firewood could greatly bring down drudgery and free up time for other pressing household chores. An assessment of the APPLES project’s financial impacts on households would require a large and rather varied sample of households. With limited resources at hand, such an analysis may therefore be well advised to focus on changes in fuel usage patterns rather than on household cash savings.

APPENDIX 5.1

The objective here is to identify a sample from the national survey which can sufficiently represent the Ubuhlebezwe citizens’ income, ethnicity, and location wise, so as to return a picture that also matches the municipality in terms of energy use. As we shall see below, the three characteristics are closely interlinked in South Africa.

Table A.5.1.1 Fractions of Ubuhlebezwe population in different categories, cell percentages

Population group	Urban	Rural	Total
Black African	19.0	78.2	97.2
Coloured	1.2	0.3	1.5
Indian or Asian	0.4	0.0	0.4
White	0.8	0.2	0.9
All	21.3	78.7	100.0
N	21 761	80 200	101 961

Source: Census 2001, own compilations

For reference the reader should be familiar with the composition of the Ubuhlebezwe municipality according to population groups. In table A5.1.1 we propose and present eight ethnic-geographic population categories and their sizes. Out of the municipality’s citizens 19 percent fall into the urban African category while 78.2 percent belong to the rural African. Since these two groups jointly make up 97 percent of the population, the other categories are of miniscule size. It should be noted that the non-African categories are largely urban and better off income-wise.

In order to graphically illustrate the position of the population categories in the *national* income distribution we will use income quintiles. Quintiles can be thought of as a “ranked fifths”. They are obtained by, firstly, ranking all sampled individuals in ascending order by their household’s per-

member income and thereafter dividing the resultant sequence into five consecutive segments with equal numbers of individuals. The first section constitutes quintile one, with the least-earning fifth of the sample.

In Figure A.5.1.1 below each population group is associated with a bar, the figure in brackets next to which indicates its fraction of the total population. (We have merged the almost absent rural Indian/Asian population with the urban.) The rural African population group constitutes 40 percent of the South African population as does the urban African, while less than one percent of the population falls into the rural coloured population and so on. The differentially shaded areas within the bars represent the fractions within each category that fall into each of the five income quintiles, as described in the legend. The size of those fractions can be assessed using the 20% lines traversing the figure vertically.

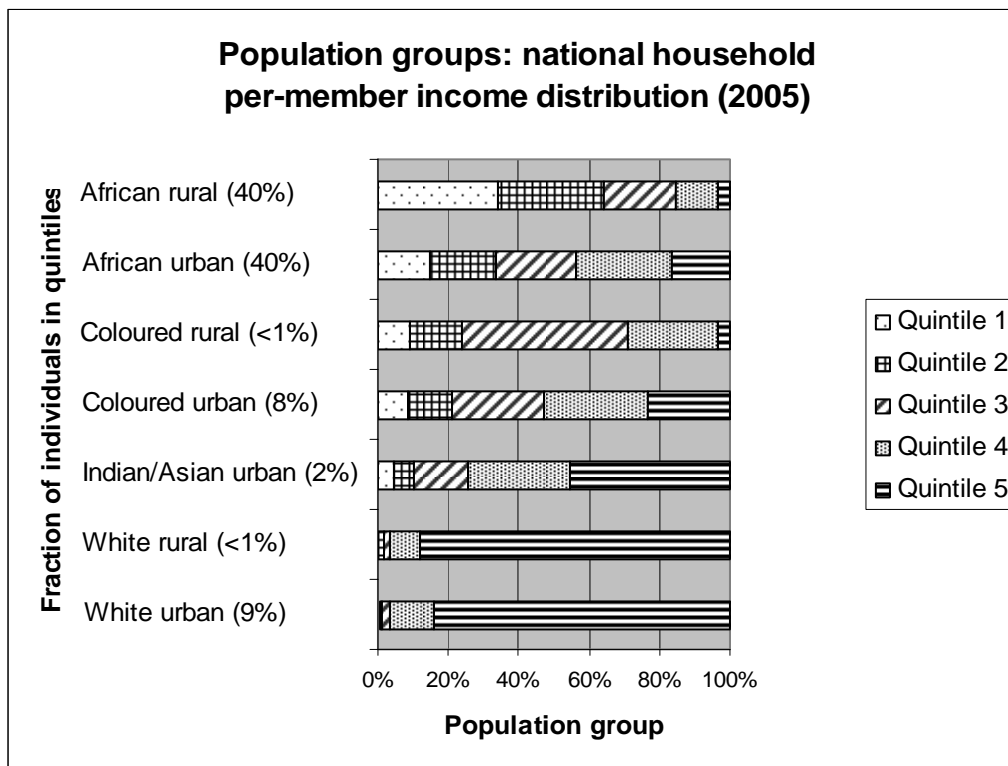


Figure A.5.1.1 Fractions of individuals in income quintiles by various population groups

Source: Statistics South Africa Household Income and Expenditure Survey 2005/06, own computations, weighted figures.

For the rural African category which size-wise dominates Ubuhebezwe’s population, the vertical 60% line cuts through the bar just before the end of the second shaded segment. Thus, a good 60 percent of rural African individuals fall into the first two quintiles and accordingly belong to the poorest 40 percent of South Africa’s population. Continuing rightwards along the rural-African bar, one finds that a little more than 80 percent of the same category belongs to the poorest sixty percent.

The other size-wise significant category in Ubuhebezwe is the urban African category. The graph shows that around one-third of the national population group belong to the poorest two quintiles. While the urban white population is of little size in Ubuhebezwe, an impression of the group’s

impact on the municipal income distribution can be assessed from a good 80 percent of the category nationally belonging to the richest 20 percent of the population.

It follows from above, that the proposed ethnic-geographic population categories are closely associated with the national income distribution. We have assumed that income levels and geographic location affect demand for energy products. Based on that assumption and the observation that the African population group is the overwhelming largest population group in Ukhlebezwe, we proceed to narrow down the household survey sample to include only rural and urban African households. It is also conceivable that the scope for electrification, access to other fuels, such as firewood, and the need for domestic heating, affect demand for energy and that these factors vary across space in South Africa. We therefore attempt to control also for such influences by further delimiting the final survey sample to households located KwaZulu-Natal.

6 Concluding remarks

From the activity descriptions and illustrations of expected impacts a few basic lessons of project impact assessment are evident. Both across the project sites and especially at the Imizamo Yethu site, very different activities have been undertaken. The contexts of the two project sites differ and the communities experience rather different energy-related challenges. The project inputs, outputs and consequent expected downstream results also differ. No single overall approach can be applied to assess all conceivable impacts. Further, given very limited available data as well as the time and budgetary restrictions of the APPLES project, that constrained the team from collecting its own information, baseline information has been provided for a relatively restricted scope of indicators, as compared to the wide range of conceivable results. In order to capture and assess development impacts, a future assessor would wish to apply a mix and wide range of data collection methods. This baseline information would for example be well complemented with respondent recall techniques. Investigations into changing household energy expenditures would be well advised to combine quantitative data collection methods with more in-depth interviews investigating the links to the APPLES project's informational activities or distributors of HEC products.

From a positive point of view however, the varied project actions and settings would provide a future assessor plentiful opportunity to learn and disseminate information about the many conceivable benefits associated with improved local energy services.

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