Alleviation of Poverty through the Provision of Local Energy Services

APPLES

(Project no. EIE-04-168)

Project Deliverable No. 18:

Selected energy best practices for low-income urban communities in South Africa: Implementation Guidelines

December 2008

Bill Cowan

(ENERGY RESEARCH CENTRE, UNIVERSITY OF CAPE TOWN)

bill.cowan@uct.ac.za

Abstract

The present report is deliverable no. 18 of the COOPENER project 'Alleviation of Poverty through the Provision of local Energy Services(APPLES)' and covers Work Package 4. The APPLES project commenced on 1 June 2005 and is implemented in South Africa by ECN, The Netherlands, University of Oxford, UK, Risoe National Laboratory, Denmark, Parallax South Africa and the Energy Research Centre of the University of Cape Town.

The main objectives of 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 the embryonic networks of existing energy centres in South Africa.

The present report presents a set of implementation guidelines and recommendations drawn from the main report on Work Package 4 of the APPLES project. The work has bene based in the community of Imizamo Yethu, near Hout Bay, on the Cape Peninsula, a lower-income settlement and the recommendations are intended to be useful for similar lower-income communities in South Africa.

The APPLES project is supported by the Intelligent Energy Europe programme of the European Commission.

Table of Contents

Abbreviations and acronyms

ANC	African National Congress
APPLES	Alleviation of poverty through the provision of local energy services
BP	British Petroleum
CaRe	Centre for Actuarial Research, University of Cape Town
CEF	Central Energy Fund (SA)
CFL	Compact fluorescent lamp
DA	Democratic Alliance (a SAn opposition party)
DIY	do-it-yourself
DME	SA Department of Minerals and Energy
DST	SA Department of Science and Technology
ECI	Environmental Change Institute, Oxford University
ECN	Energy research Centre of the Netherlands
ERC	Energy Research Centre, University of Cape Town
FBAE	Free Basic Alternative Energy
FBE	Free Basic Electricity
HSRC	Human Sciences Research Council (SA)
IeC	Integrated Energy Centre
IP	Illuminating paraffin (kerosene)
IY	Imizamo Yethu
KAPS	Khayelitsha Air Pollution strategy
LED	Light-emitting diode
LPG, LPGas	Liquified petroleum gas
PPC	Parliamentary Portfolio Committee (SA)
PSA	Paraffin Safety Association
R	SA Rands (ZAR) – approx. ZAR:€=12 (2008)
RDP	Reconstruction and Development Programme
RUoE	Rational use of energy
SA	South Africa / South African
SABS	SA Bureau of Standards
SACP	SA Communist Party
SALDRU	SA Labour and Development Research Unit, University of Cape Town
SANCO	SA National Civics Organisation
UCT	University of Cape Town

1. Introduction

These implementation guidelines are essentially sets of recommendations drawn from the main report for Work Package 4 of the APPLES project, *"Identification and demonstration of selected best energy practices for low-income urban communities in South Africa"*. The work has been based in the community of Imizamo Yethu, near Hout Bay, on the Cape Peninsula, a lower-income settlement combining a range of formal and informal ("shack") housing, and the recommendations are intended to be useful for similar lower-income communities in South Africa.

When assessing the major energy-related needs affecting the Imizamo Yethu community, particularly those affecting people's experience of relative poverty, three main themes were identified for attention during the APPLES project there:

1. Enabling Rational Use of Energy for low-income households, with main focuses on staple energy uses for cooking and lighting.
2. Reducing energy-related hazards, with a primary focus on the devastation of fires in communities like Imizamo Yethu.
3. Addressing the energy needs of marginal communities presently "left out" from mainline urban services provision, mainly those without normal electricity supplies.

The guidelines and recommendations which follow are arranged under these three themes.

2. Encouraging "rational use of energy" for cooking and lighting

The term "Rational Use of Energy" is broad. In the context of lower-income urban / peri-urban households, key issues here were taken as:

- The ability to afford, obtain and use suitable energy appliances – which are efficient, cost-effective, safe and "fit for purpose" – in particular, appliances for the primary energy services in lower-income households, cooking and lighting.
- The ability to obtain, afford and choose optimum available fuels, for such purposes.
- The ability to adopt affordable, efficient and safe energy-use practices, for example in cooking and household lighting, and to balance the best available energy options against householders' preferences (e.g. ways of preparing meals, economical choices of foods, lighting preferences, etc.).
- The knowledge, means and ability to avoid particular energy-related hazards, such as fires, burns, air pollution and electric shocks.

3. Efficient, affordable and safer cooking options

Lower-income householders – like other households – do not always choose the most cost-efficient fuels, appliances and cooking methods, from the options available to them. By providing information about cooking costs, using different fuel/appliance combinations, and advice about more efficient cooking practices, it is possible to assist householders to make more optimal choices.

3.1 Choices of fuels and appliances

It is difficult for householders to assess the costs of cooking with different fuels and appliances. They may not be able to experiment with a range of options. It is also difficult for them to separate out the *cooking* energy costs from overall energy costs, especially in the case of using electricity.

Based on tests and demonstrations, the following examples of comparative cooking costs applied in mid to late 2008, in Imizamo Yethu. Typical fuel prices then were: paraffin R11/litre, LPGas R20 to R25 / kg, and electricity R0.42 to R0.65 per kilowatt-hour.

- Cooking a pot of mealie meal

Fuel type	*Cooking cost*
Electricity	R0.27
Paraffin	R0.93
LPGas	R1.26

- Cooking a pot of rice

Fuel type	*Cooking cost*
Electricity	R0.15
Paraffin	R0.49
LPGas	R0.57

- A chicken and vegetable stew

Fuel type	*Cooking cost*
Electricity	R0.28
Paraffin	R0.96
LPGas	R1.19

- Cooking a pot of samp and dried beans

Fuel type	*Cooking cost*
Electricity	R0.51
Paraffin	R1.72
LPGas	R2.07

These figures show the clear financial advantages of using electricity, rather than the non-electric fuels paraffin or LPGas, for a variety of common types of meals. The advantages are particularly great because high prices for paraffin and LPGas prevailed in 2008. Despite this, it came as a shock to many people in Imizamo Yethu that electricity was so much cheaper to use than paraffin. Some people still believed that paraffin was cheaper to use, for cooking long slow meals.

Further information about such cost comparisons is contained in the main report, covering a wider variety of cooking situations and explaining the methods used. Graphs which summarise this wider range of information are also included in Appendix 1 of this document.

Several ways of disseminating such information have been used in Imizamo Yethu or can be considered for wider outreach.

- *Public cooking events.* Public cooking competitions proved popular in Imizamo Yethu, had high impact, and were repeated on request in another low-income community (Masiphumelele). In these, community members cooked comparable meals, using different stoves and fuels, in front of a community audience. Energy consumption was measured and corresponding cooking-energy costs were announced. These events

were highly successful in terms of audience participation, and perceived relevance. However, they require considerable organisation. An important ingredient, in attracting large audiences, was to provide meals for the audience members, which requires resources.

- *Including cooking energy cost information in an "Imizamo Yethu Energy Cookbook"*. Typical local recipes were collected in the community. The recipes will be mixed with information about the energy costs for cooking the meals, in different ways.

- *Presentations to planners and policy-makers*. The information has high policy relevance (e.g. towards electrification and electricity-pricing policies, and support measures for those households unable to use electricity). Community members addressed the relevant parliamentary portfolio committee, and another grouping of energy-supply stakeholders, including local government and Eskom (electricity utility) representatives.

- *Information for schools.* An Eskom representative proposed including such comparative costs information in their programme for energy awareness presentations at schools.

The comparative costs information needs to be updated on a fairly regular basis, due to the volatility in fuel prices. This need not be a difficult task.

It may be simple and useful to have a straightforward bulletin board in a public place in Imizamo Yethu (and similar communities) so that residents passing by can see what the latest costs are for cooking typical meals using different energy options. This can help them make more optimal choices.

3.2 Efficient cooking techniques

Although low-income households have a strong incentive to save money, they may not always use efficient cooking techniques, which can save energy consumption and cooking-energy costs.

Apart from sometimes not choosing more efficient and cheaper fuel-appliance combinations (from their range of available options – different for households with or without electricity), it is quite common that some cooks keep pots boiling at a higher heat setting than necessary, may not use well-fitting lids as far possible, feel that a stove needs to be "prepared" by turning on for a period before use, among a range of possibilities observed in Imizamo Yethu.

Based on such observations, tests and workshop demonstrations, a number of recommendations or items of advice were prepared. Examples of recommendations for efficient boiling and simmering (common cooking processes for staple local meals) are:

Advice for efficient boiling

- Bring water to the boil at a rapid rate (at high power, but within limits). This reduces heat losses over the boiling time, and shortens the time taken to reach boiling point.
- However, avoid using such a high stove power that the heat is going to waste around the sides of the pot – especially if the pot is small, or the stove/flame is wide.

- It can be faster and more efficient to heat water to boiling-point first in a kettle, rather than in a pot on the stove. Electric kettles are generally faster, more efficient and use less energy than a pot on a stove.
- When boiling water in a pot, use a tight-fitting lid to reduce the heat losses that occur when the water starts to steam. (On lower-power stoves, it may be essential to use a good lid on the pot, just to bring the water to boiling point.) Keep the lid closed, as far as possible.
- It can help to cover the lid of a pot with a folded dish-towel, or some other/better type of insulation. A lot of the heat losses occur through the top surface of a pot. By insulating the lid, these are reduced, and less energy is used.
- Do not boil more water than needed for the satisfactory cooking of the dish in question.
- If it is possible to warm up the water to be boiled to some extent beforehand, this can reduce the energy needed to bring it to boiling point. For example, a small solar water heater (or a black water container left in the sun) could provide warm water, to start the cooking, saving on fuel costs.
- Most people in South Africa use cylindrical pots with flat bottoms for boiling water on electric or paraffin/gas stoves. Flat bottomed pots are usually the best choice on electric stoves. On an electric stove, the bottom of the pot should completely cover the hotplate.
- For boiling water and cooking on an open fire, in rural areas, round-bottomed pots are commonly used. This helps the heat of the fire and flames to travel smoothly around the pot, increasing efficiency.
- Round-bottom pots can also be more efficient on flame stoves (e.g. paraffin, LPGas) but may be difficult to position safely on common paraffin/LPGas stove tops.
- When flat-bottomed pots are used on flame stoves (e.g. paraffin, LPGas) the size of the bottom of the pot should be big enough to suit the stove's heat output.
- Once a pot of water with food has reached boiling point, the stove should be turned down, otherwise the water will continue to boil and steam, wasting a lot of energy.

Advice for efficient simmering

- Avoid unnecessary heat and steam losses, by using a pot with a tight-fitting lid.
- Use the minimum stove power required to maintain a simmering temperature.
- Use a stove which can maintain this steady low-power setting, preferably with a minimum of adjustment and supervision by the cook during prolonged simmering periods.
- Use the best fuel/stove combination available for economical and efficient simmering. At current fuel prices, an electric stove with a good turn-down ratio (a good low power setting) is the preferred choice.
- Use a pot which is large enough to cover the heat source of the stove, but not unnecessarily large for the amount of food being cooked.
- Use a minimum amount of liquid, compatible with the preferred cooking method.
- Avoid unnecessary stirring and opening of the pot's lid.
- The use of insulation can reduce the amounts of fuel needed for simmering. This can range from placing a folded towel over the pot's lid, to high-insulation methods, such as taking the boiling pot off the stove and placing it in a highly insulated "hot box" or heat retention cooker.

Further items of advice for efficient and cost-saving cooking options have been prepared (as described in the main report), both for individual households and in collective cooking situations.

Some ways of disseminating such information that have been used in Imizamo Yethu, are planned, or can be considered for wider outreach, include the following.

- *Door-to-door dissemination of useful cooking advice, by community workers.* Most of the local APPLES team members in Imizamo Yethu were voluntary community workers, engaged particularly in health care and nutrition. In small-group workshops, efficient cooking methods were discussed together. The community workers were able to share advice in the course of their household visits in the community. However, there are limits to "voluntarism". If possible, such teams should be in a position to earn money through their work.

- *Sharing cooking advice in the course of collecting local recipes from households in the community.* However, this had only a limited reach, and this activity was specific to the APPLES project.

- *Including energy-efficiency tips, and explanations, in the Imizamo Energy Cookbook.* The items of advice will be included and illustrated in the Imizamo Yethu Energy Cookbook under preparation. It has also been considered to take some of these recipes, and associated energy advice, and offer them to high-circulation newspapers and magazines, to reach a wider readership.

- *Discussion and explanation of some efficient (and inefficient) cooking techniques at public cooking events.* A few of the most important matters here were discussed in front of audiences attending public cooking competitions. However, it is felt that such large-scale and high-spirited events are more suitable for communicating high-impact messages rather than more detailed options in people's cooking practices.

4. Affordable, energy-efficient and safer lighting options

4.1 Comparative costs of electric and non-electric lighting

Electric lighting is far more efficient than non-electric lighting, and safer. An investigation of comparative costs of using electricity, paraffin lamps and candles for household lighting led to the following approximate figures (at 2008 fuel prices in Imizamo Yethu). In the case of electricity, it is assumed here that energy-efficient CFLs (compact fluorescent lamps) are used.

- Approximate energy costs for lighting

Using:	*Cost per hour*
Electricity (CFL)	less than R0.01
Paraffin lamps	R0.17
Candles	R0.25

Apart from the much lower hourly operating cost, the light output of the electric lamps is far superior to that of paraffin lamps and candles.

4.2 Recommendations for electric lighting

For households with electricity, the main recommended practices for less expensive and more efficient lighting are simple:

- Use energy-efficient lamps, typically CFLs in a small-household setting.
- Do not leave lights on when they are not needed.

Additional recommendations included the following:

- *Lamp-holders and lamp shades*. CFLs are sometimes used without lamp shades, which increases the overall lighting efficiency, but may not fit people's lighting preferences in terms of glare, or "homeliness". At least, heavy lamp shades which obscure much of the light should be avoided, for efficient lighting.
- *Surrounding surfaces*. The illumination levels are increased if the surrounding surfaces are light in colour.
- *Task lighting*. For tasks which require relatively high illumination levels, such as sewing, reading, etc., it is more efficient to use lower-power task lights which can be positioned close to the task, rather than higher-power general room lights, since the illumination levels are roughly proportional to the square of the distance between the lamp and the work surface. Suitable directional reflectors behind the lamp (or in some cases, built into the lamp) help to control and increase the localised illumination levels, and reduce glare.

Discussions in Imizamo Yethu, during 2008, indicated that most houesholders seemed aware of the cost advantages of CFLs, compared with incandescent bulbs. This was probably the result of a CFL exchange campaign in Imizamo Yethu the previous year. However, the discussions also indicated that some people were not entirely satisfied with the light from lower-power CFLs, or their appearance, and for these or other reasons (such as purchase price, and more difficult access) might not replace existing CFLs, and might revert to using incandescents.

Some of the barriers which might discourage the take-up or continued use of CFLs, in communities such as Imizamo Yethu, were identified as follows:

- As mentioned above, their somewhat higher purchase cost, compared with incandescent bulbs, and the fact that (in Imizamo Yethu) they are not readily available within the community and instead need to bought from shops further away.
- While subsidised exchange schemes indeed encourage people to switch from incandescent bulbs to CFLs, if these are conducted as a one-off campaign in particular communities, households may revert to using incandescent bulbs when future replacements are needed.
- The quality of light from many CFLs is often not enjoyed, especially those with a "cold" colour spectrum. The intensity of the light from low-wattage CFL may be perceived as rather dim.
- The variety of colours and powers of lower-cost CFLs is rather limited, in most shops, and/or models which have higher light outputs or other specialised features tend to be considerably more expensive. This can make it more difficult for householders to meet their lighting preferences at an affordable cost.
- Apart from consuming less energy, CFLs are also cheaper in the long run, due to their longer expected life-time. However, households with little income find it difficult to

make decisions based on “life-cycle costs” and will often choose appliances or other goods which are simply cheaper to purchase. This can be regarded as a barrier to the uptake and continued use of more energy-efficient lamps.
- For households without any access to electricity, that is of course the primary barrier.

Some corresponding opportunities for measures to support the use of CFLs included the following:

- Extending electrification to the maximum extent feasible.
- Encouraging local shops, within the community, to stock CFLs. Assistance with bulk buying contracts, possibly with a public-interest intermediary such as Eskom involved in this, may be needed to keep prices low.
- If subsidised CFL exchange opportunities are conducted in the form of a house-to-house “sweep”, these opportunities may need to be repeated from time to time (during APPLES, such a repeat sweep in 2008 was moderately successful).
- More permanent local facilities for subsidised CFL exchanges, and possibly subsidised CFL sales, would probably increase the take-up and continued use of CFLs.
- Both exchange schemes and subsidised sales should take account of more carefully studied lighting preferences of customers (e.g. in terms of preferred power and colour of light).
- There is probably scope for developing more attractive and versatile but low-cost lamp holders, reflectors, shades, etc., suitable for use with CFLs (including adjustable task lights).

4.3 Recommendations for non-electric lighting

For households without electricity, which require the use of non-electric fuels for lighting, the main recommendations (based on the Imizamo Yethu context) were to:

- Use paraffin lamps in preference to candles, in view of the somewhat lower operating costs, greater stability, wind protection and steadier, more controllable flame.
- Keep the glass of a paraffin lamp clean.
- Where possible, hang such lamps in a secure and safe position. If used on table tops, shelves, etc., try to ensure they cannot easily be knocked over, e.g. by children.
- For task lighting, such as for reading, position lamps close to the task, preferably with a light coloured or reflecting surface behind the lamp, but at the same time try to keep the flame out of the line of sight, as the glare impairs vision.
- When using candles, always make use of a secure candle-holder, with protection for catching melting wax. One option is to insert the candle into sand in the bottom of a suitable-sized glass jar (as demonstrated at energy safety events, and in a door-to-door energy safety awareness campaign in Imizamo Yethu).
- Do not place candles (or lamps) on easily inflammable surfaces or near inflammable materials such as curtains.
- Take care not to place candles in a position where they could be easily knocked over.
- Do not leave lamps or candles burning unattended.
- Do not fall asleep with a lamp or particularly a candle still burning.

These recommendations are largely “common sense” – but are none the less highly important practices, given the high rate of fire accidents, especially associated with the use of candles in areas such as Imizamo Yethu.

For houses with electricity supplies, but temporarily without power, for example as a result of power cuts or running out of electricity units, the same practices would be recommended as for un-electrified households. It is recognised that electrified households are more likely to use candles for occasional temporary lighting, rather than paraffin lamps. This was considered a potential danger, aggravated by periodic power cuts in the community.

5. Space-heating for Imizamo Yethu homes

Unlike in colder areas of South Africa, space heating is unlikely to be essential for survival in Imizamo Yethu, and in this respect may not be considered a "basic energy need". However, those households able to afford energy appliances for space-heating use heaters at cold times of year. The most common heaters are paraffin heaters. Electric heaters are rare.

During APPLES, space heater options were discussed in small-group workshops, but not at a wider community level, nor demonstrated. However, some tests were conducted to compare the operating costs of common types of paraffin and electric heaters.

A typical small two-bar electric heater consumed approximately 1600 W. At an electricity price of 60 cents/kWh, this implied an operating cost of about R1 per hour.

In the case of paraffin heaters, the rate of paraffin consumption can be variably adjusted. At a medium setting, typical measured paraffin consumption rates were in the region of 250 ml (about 200 g) per hour. At a local 2008 paraffin price of R11/litre this implied an operating cost of around R2.75 per hour.

Based on efficiency estimates, and the figures above, the paraffin heater was expected to have a somewhat higher heating output (about 2000 W) compared with about 1600 W from the electric heater used in this example.

It is therefore not clear that the preference for using paraffin heaters rather than electric heaters was a cost-effective choice, in 2008 conditions. Paraffin heating could be about twice as expensive as electric heating, at typical local 2008 energy prices, and more dangerous.

Other factors affecting the achievement of indoor warmth and comfort include

- availability of warm clothing
- beds and blankets
- protection from rain and moisture
- thermal insulation provided by the house structure
- thermal storage in the house (e.g. capturing heat during sunny hours and storing this for colder periods)

It was stressed, in workshop discussions, that people living in shacks tend to be badly equipped, in the above respects. The housing structures are less weatherproof and have less ability to control and store natural energy flows (e.g. solar energy flows). Shack-dwellers also tend to be poorer, and less able to afford warm clothing, blankets, etc. This may increase their need or desire to use space-heating energy, during cold periods, with associated problems of high energy costs and possibly indoor air pollution. It was stressed that improvements in housing quality and people's livelihoods / incomes were primary concerns here.

6. Low-cost domestic energy appliances: problems and recommendations

Both electric and non-electric cooking appliances, commonly bought by households in communities like Imizamo Yethu, have often showed major shortcomings, in aspects such as efficiency, controllability, ease of use, adequate user instructions, reliability and durability. In addition, many of the specific appliances used in cooking tests, demonstrations and competitions showed potential or *immediately* serious safety dangers.

These concerns should be considered by energy planners, policy-makers, suppliers, appliance manufacturers and standards organisations, as well as by householders, community energy activists and advice organisations.

6.1 Some of the problems experienced

Although some other types of household energy appliances were also considered in the main report, this and the following section will focus mainly on types of stoves commonly used in lower-income South African communities. The information comes from surveys and discussions in Imizamo Yethu, information drawn from surveys and discussions in other low-income communities, and experience during the project in the course of stoves tests and demonstrations.

Two-plate electric hotplates are the commonest cooking appliances in lower-income electrified homes. Many different models are readily available, from different appliance manufacturers, and most can be considered fairly low-cost to purchase (between R100 and R200). They tend to share similar features, with heating elements of approximately 1000 W each, at 230 Volts, and thermostat-type controls in the variable heat-control settings. The main variation is between models using solid plates and those using spiral rings, the latter being more common.

Common defects or limitations experienced with many of these stoves include the following.

- *Temperature/power regulation mechanisms.* Although most of these stoves are expected to operate at similar efficiencies, at full power, many models are found to have inconsistent and variable-performance temperature control mechanisms, in some cases making it difficult to turn down the stove to a suitable low-power simmering temperature. This can have quite a strong adverse effect on overall cooking efficiencies, especially for meals which require a long simmering period.
- *Unreliable on-off control.* This was not confirmed in any of the tests during APPLES, but several reports have been received of two-plate stoves where both plates heat up when only one plate is switched on.
- *Earth faults.* It seems fairly common for these stoves to develop earth faults (i.e. electrical connection between live and earth cables), which trips out well-wired electricity supplies and could be potentially dangerous in inadequately wired systems. The problem could be potentially more dangerous through the reported common practice, among local electricians, of disconnecting the earth wires in such cases.
- *Limited maximum power.* The maximum power of 1000 W or less (depending on supply voltage) can be considered rather low for bringing medium to large pots to the boil in a reasonable time, or for higher temperature cooking tasks like browning meat before stewing.

- *Ability to accommodate larger pots.* The lightweight construction, especially of spiral-plate models, is known to be a durability problem when heavy pots are used. Secondly, the plates are usually spaced rather closely together.
- *Other durability concerns.* These are most often to do with heating elements burning out, and heating control mechanisms failing.

During the cooking demonstrations and tests, seven models were used, and several of these displayed a number of the above faults. In this small sample, there was no correlation between purchase price and reliability or quality of performance. In fact the cheapest models gave the best performances.

Among LPGas stoves, only three different types were tested and demonstrated (during the project). The first was a simple single burner mounted directly on the gas cylinder (sold together as one unit). This unit performed reliably, but with the following limitations:

- The screw-in control valve was both difficult to access during cooking and not suited for making fine adjustments to the burning rate. This was particularly a problem when trying to simmer pots (and sometimes led to unnecessarily high gas consumption).
- The stove top tended to be slippery, for some of the pots used, requiring cooks to hold the pots in place.

A more expensive table-top two-plate LPGas stove with self-ignition showed the following problems:

- It was hard to regulate down to low heat settings, and on several occasions the flame went out – with gas still escaping – when cooks tried to do this.
- At high power settings, the build-up of heat under the stove caused damage to a wooden table surface.
- On one ring, the self-ignition became unreliable.
- One of the control knobs jammed during a cooking competition, and became inoperable, and the other control knob broke off.

A simple and solid cast-iron two ring burner performed very well at high power settings (up to about 3750 W per ring, useful for rapid boiling). However,

- The large-diameter burners could be a disadvantage for slower cooking tasks or the use of smaller pots, and lead to efficiency losses.
- The stove proved quite difficult to assemble – almost impossible for an average householder without suitable tools.
- One of the cast iron legs snapped off, when lightly knocked.

Locally available low-cost paraffin stoves have a notorious reputation for low efficiencies, poor durability, and most importantly, serious safety dangers. The most common types used by lower-income families in South Africa are unpressurised wick stoves. Single burner stoves of this type used to be exceptionally cheap to purchase (R20 to R30) which has presumably been the main reason for their large sales volumes. Using the example of the “old Panda” type of stove, recognised problems have included

- dangerously high temperatures of the paraffin reservoir when used for a longish period
- a rather long and smoky start-up period
- difficulties in turning off the stove safely (small explosions common, possibilities of re-ignition, smoke)
- low efficiencies

- non-ideal stability (mainly due to the smallish size and lightweight construction)
- low durability
- dangers of spilt paraffin collecting in the base of the stove
- dangers of "explosions" (very rapid run-away fires) if knocked over

These stoves have effectively been banned from sale, since the introduction of mandatory South African safety standards for unpressurised paraffin wick stoves, which the "old Panda" failed meet, but they are still in use, and can still be purchased (at a higher price, now) at some unregulated outlets.

So-called "new Panda" stoves were tested, and employed with limited success in cooking demonstrations. They incorporate some improved safety features, but also a number of limitations which discourage their popularity among local cooks, including the following:

- the operating instructions are difficult to understand
- practical operating techniques are difficult to learn
- there can be difficulties in lighting the stove, without a special probe
- maximum heat output was considered inadequate for large pots or high-temperature activities like browning meat
- the heat rate is difficult to control, without activating the spring-loaded shut-off mechanism inadvertently
- the construction is flimsy and some parts of the stove easily slip apart

Only one of the local cooks in the cooking competitions managed to complete a meal successfully on one of these stoves.

The Parasafe pressure stove has higher quality construction, and some effective safety features, including an effective mechanism for stopping, or almost stopping, the paraffin flow if the stove is knocked over or tilted. This stove is a bit difficult to light, but once burning it appears to have a clean blue flame, similar to LPGas. However, in the course of workshops, interviews and cooking demonstrations, a number of features of these stoves were criticised by local cooks and discussants. These included:

- The pressure-pumping mechanism involves repeatedly squeezing a rubber bulb attached to the stove. This was considered inconvenient and arduous, and particularly unsuitable for older women who might have arthritis.
- Even with vigorous pumping, the heating rate was considered too low.
- At local prices (e.g. more than R150 from Hout Bay stores) the stove was considered costly.
- Because of low heating rates, they had to be abandoned in the public cooking competition in Imizamo Yethu.
- Several people felt the black rubber squeeze ball could be an attraction for young children to "play" with the stove.
- The rubber pressure ball came off, during attempts to increase the stove's heat output.

Members of the IY APPLES team said that they did not consider this type of stove presently suitable for their community. Perhaps with modifications, taking account of such concerns, it could be developed into a more attractive alternative. If so, such modifications should preferably be developed in consultation with local cooks.

6.2 Recommendations

Broad recommendations are that

- Manufacturers of low-cost domestic appliances, particularly common types of stoves used by lower-income households, should pay more careful attention to the design, durability and safety of these products, and to how well they meet typical user requirements.
- Major retailers should also take an active interest in this, and express this in their choice of product ranges.
- They should also insist on reliable safety and other quality assurance checks by the manufacturers of appliances stocked.
- Applicable national standards should, if possible, include some key durability tests.

Specific recommendations for improved low-cost electric hotplates suitable for lower-income families are that

- manufacturers consider introducing *two-ring hotplate models where at least one of the rings is capable of higher maximum power*, e.g. 1500 W, to accommodate the cooking needs of families using larger pots
- *higher quality and more durable heat regulation mechanisms* should be used, capable of reliably turning down the power to a simmering temperature
- the heat control knobs should be much more *clearly marked* (power levels) to facilitate more accurate and efficient cooking control
- the plates should be *further apart*, to accommodate larger pots
- the plate supports should be *more rugged*, in the case of spiral hotplates, to accommodate heavy pots and stirring activities
- essential safety checks should be completed on all products before packaging

Regarding paraffin stoves, the most urgent requirement is for the ready availability of safer, affordable paraffin stoves, which comply with national safety standards – and which at the same time meet the typical cooking requirements of lower-income householders. Some of the recommended features required here are:

Safety features

- greater stability – able to support large pots safely; less likely to be knocked over
- good extinguishing mechanisms – both for normal turning off, and in event of the stove being knocked over
- no paraffin leakage, when upright, and minimal when knocked over
- safer filling mechanisms – preferably making it impossible to re-fill the stove while it is burning; by reducing the dangers of spilt paraffin, through designs that do not trap such spills in parts of the stove body; and preferably enough visibility (or filling gauges) to reduce the risks of over-filling
- safe temperature limits maintained – the paraffin reservoir must not heat up to dangerous temperatures, and outside parts of the body of the stove must not become too hot to touch
- clean-burning – clean and full combustion, preferably at all heat settings, to reduce the emission of particulates, fumes and carbon monoxide
- clear, high-quality instructions for proper use (accessible to people with low literacy as well as others)

Performance features

- adequate maximum power – able to bring medium to large pots to the boil in a reasonably short time (preferably a heating rate of at least 1500 W delivered to the pot, at maximum power)
- an adequate and easily controllable turn-down ratio – the lowest, steady clean-burning heat setting should allow pots to be simmered, without excessive steaming (preferably a heating rate of about 300 W delivered to the pot, at a low flame setting); and flame levels should be able to be maintained without frequent adjustments by the cook
- adequate efficiency – preferably higher than 45% (as measured in standard water-heating tests), certainly over 40%
- sufficient tank size – to allow a full meal to be cooked, without the necessity of refilling the tank during the cooking period

Affordability features

- affordable purchase prices – probably at present in the range of about R50 to R120
- durable construction – with an expected useful/safe lifetime in years rather than months
- adequate fuel efficiency – for example, a householder using 20 litres paraffin per month in a 35%-efficiency stove could save almost R800 per year by adopting a 50%-efficient stove (at a paraffin price of R11/litre)

The main recommendations for improved, affordable LPGas stoves would be:

- adequate maximum power delivery and controllable turn-down ratio (as recommended above for paraffin stoves)
- in particular, the ability to turn down to a simmering rate, without dangers of the flame going out and gas continuing to escape
- non-slip cooker tops
- clear, high-quality instructions for proper use (accessible to people with low literacy as well as others)

Returning to the questions raised about the quality, durability and performance characteristics of two-plate electric hotplates – which are increasingly the cooking mainstay for electrified lower-income households, who in turn represent the majority of urban households – the common problems and limitations experienced with many of these stoves could be regarded as something of a market failure. Ideally, there should be enough product range in the market for householders to be able to choose appliances which best meet their cooking needs, and which are most durable and best value-for-money. Consumer choices, if well-informed, should then reward the most successful product manufacturers.

In practice, however, it appears difficult for individual householders to gain access to information about the performance, durability and relative costs of different models. From workshop discussions in Imizamo Yethu, it seems that people do share information and "common knowledge" about problems experienced across a *range* of such stoves, but are generally unable to assess particular models in a systematic way. It could therefore be useful to maintain a register over time, within such a community, of stove failures, types of failure, how long the stove lasted, and the purchase costs of various models used. This is the kind of function which a local energy office – or other community office, even the library – could perform. It could help consumers make better-informed choices. Such community-collected information could be easily shared with other communities, for wider benefits.

7. Reducing energy-related hazards

7.1 Main energy-related hazards in Imizamo Yethu

The energy-related hazards which can be experienced in lower-income urban communities are often severe. They can include such risks as health-threatening air pollution (indoor and outdoor), poisoning, burns and fires.

- *Township fires.* Of these, fires stand out as the gravest source of damage and injuries in informal settlements in the Western Cape. In 2008 alone, some 1800 such fires were reported in informal settlements, resulting in widespread destruction of homes and 26 reported deaths. Imizamo Yethu (IY) has been one of the badly affected areas. This year, about 23 IY homes were destroyed by a fire in February, more than 60 in August, another 200 in late November, and another 200 in early December, rendering more than 2000 people homeless.

- *Burns.* The worst burns are usually experienced during run-away township fires, with children particularly susceptible. Effects can be long-lasting, and can include social isolation arising from disfigurement of seriously-afflicted victims. Burns can also occur through indoor accidents, such as knocking over a pot of boiling water.

- *Paraffin ingestion.* Again, young children are particularly at risk of "paraffin poisoning", e.g. as a result of mistakenly drinking paraffin contained in a cool-drink bottle.

- *Electric shocks.* Poorly wired or faulty electrical appliances may pose shock risks, especially in wet conditions. It is not known to what extent this hazard has been experienced in Imizamo Yethu.

- *Indoor and outdoor air pollution.* The main dangers of indoor air pollution, in a settlement like Imizamo Yethu (where wood and coal are seldom used indoors), arise from possible carbon monoxide poisoning and paraffin fumes. Outdoor pollution levels in this particular community are unlikely to be severe, except during fires, due to its mountain-side location and fresh winds. However, other lower-income settlements can suffer serious levels of outdoor air pollution, both in Western Cape, and in areas of the country where coal is widely used.

7.2 Multi-dimensionality

While all the above hazards can be related to energy use, it has to be recognised that some, and in particular the township fires, are multi-dimensional problems. They are affected by many other factors, acting together. For example, in the case of Imizamo Yethu fires, these factors include

- climatic conditions – with hot, dry, windy summers
- vegetation – some of the indigenous plant species are actually *dependent* on periodic low-intensity fires, while exotic species like pine trees can cause the intensity of fires to increase
- housing materials – with many of the "shack" houses in informal parts of Imizamo Yethu constructed with wood and other flammable materials

- very high housing densities – increasing the rate at which fires spread from house to house, and often making access for fire-control vehicles more difficult
- cramped indoor conditions – also associated with the high housing density and shortage of land, making indoor accidents more common
- behavioural patterns – for example, the fondness for alcohol among some residents, and dangers from resulting "carelessness" or falling asleep while cooking

Such multi-dimensionality makes it more difficult to reduce the fire risks successfully, and means that the degree to which energy safety awareness campaigns (the main community-level strategy carried out in the APPLES project) can reduce these hazards.

Improved access to land, allowing less dense housing, better settlement planning, and improved provision of "proper" housing, built of more permanent and less inflammable materials, need to regarded as primary problems. If these higher-level problems are not addressed, it will be difficult to curb such devastating township fires.

7.3 Community energy safety awareness campaigns

In the APPLES project period, the following elements of a community-directed energy safety awareness campaign were carried out. They benefited greatly from participation and assistance from the Paraffin Safety Association. Within the limitations of such safety awareness campaigns, mentioned briefly above, they could be regarded as quite successful, and capable of wider and continuing application.

- *Collecting community accounts of fires and other energy-related hazards.* The members of causes and consequences of past fires, and other energy-related mishaps. They also documented this process with digital cameras (as well as current fire events). The information was shared, discussed and videoed in small-group workshops, attended by APPLES team members, further community participants, and members of the Paraffin Safety Association.

- *Safety awareness training workshops.* The Paraffin Safety Association conducted two one-day training workshops on energy safety issues, with Cape Town and IY APPLES team members, as well as some additional IY colleagues. The purpose was to increase the understanding of energy-related hazards, how these can be reduced, and what to do in the event of accidents such as fires or paraffin ingestion, in preparation for wider community-level awareness campaign activities.

- *A door-to-door energy safety awareness campaign*. After this training, the IY APPLES team members conducted a door-to-door energy safety awareness campaign, visiting households with information materials supplied by the Paraffin Safety Association, and offering advice. This took place in an informal area of Imizamo Yethu, judged to have particularly high fire risks, over the course of a week. Safer ways of using candles were also demonstrated.

- *A public community energy safety event.* A large event was organised, which combined entertainment sessions by local performance groups, safety awareness messages from the Paraffin Safety Association, municipal safety officer and members of the IY APPLES team, and speeches by local community leaders. Some of the highest-impact messages were communicated through edu-drama. This event was appropriately organised on national Women's Day. It attracted an overflowing crowd

of all ages to the large community hall, and resulted in high-spirited audience participation. Newspaper journalists were invited.

The main energy safety messages, materials and communication methods used in these campaigns have been developed and refined by the Paraffin Safety Association (which has a broader energy safety mission, not focusing only on paraffin) over many years, and can be accessed from members of the PSA, at +27 21 671 5767, www.paraffinsafety.org.

7.4 Limitations of the energy safety awareness campaigns

The following were considered to be some of the limitations of the energy awareness campaigns, as carried out in Imizamo Yethu during the course of the APPLES project.

- *Limited reach.* The energy safety awareness messages in 2008 reached a few hundred people in Imizamo Yethu, directly. Indirect passing-on of these messages, in various forms, could extend to perhaps a thousand people (adults and children) in this community, which could be a significant contribution, but others remain uncontacted, possibly including some of the most high-risk groupings such as people living on the fringes, new residents, single males, etc.

- *The need for reinforcement, repetition and continuity.* Such energy safety messages probably need to be repeated at regular intervals to reinforce people's consciousness about the dangers and ways to reduce them. The PSA has therefore discussed plans with the local IY APPLES team members to carry on with regular safety campaign events beyond the period of the APPLES project.

- *Effectiveness in reducing accidental behaviour and "carelessness"*. By encouraging safer everyday practices, the scope for accidents can be reduced, but the phrase "accidents do happen" is relevant. It is important to mitigate the dangerous environmental factors (housing quality, density, etc.) which can lead to such individual accidents leading to community-wide disastrous consequences. Everyday energy safety precepts may also not be very effective when people are not fully conscious, e.g. when falling asleep, or intoxicated.

- *Lack of choices.* A lack of practical choices can constrain people's ability to adopt safer energy practices. These include lack of access to adequate land and housing, lack of access to electricity for some households in fringe areas (forcing more dangerous fuel use), and non-availability of safer, affordable paraffin stoves.

7.5 Necessary or desirable best practices, at planning and supervisory levels

While a community-oriented energy safety awareness campaign mainly targets energy users, it is recognised that a reduction in energy-related hazards in lower-income communities also requires measures to be implemented at planning and supervisory levels.

The latter may involve local government departments and planners, service suppliers, standards authorities, national government, and local community supervisory structures.

A summary list of necessary or desirable best practices at a planning / supervisory level, relevant to Imizamo Yethu, would include the following:

(i) De-densification measures and improvements in housing

- Houses, if they are separate units, need to be further apart so that fire-spreading dangers are reduced and roads are accessible to fire control services.
- Houses should be permanent and built of fire resistant materials.
- De-densification may require enlarged land allocations for existing resident communities, as well as possible forms of regulation to control and reduce "in-filling" practices (e.g. the spread of "back-yard shacks") and continuing in-migration of new residents into a given planned settlement.

(ii) Co-operative community-government relationships

- Some of the regulatory implications above could be politically complex, and inherently conflictual, favouring some groups and disfavouring others. A trusted relationship between government authorities and representative community organisations would be a crucial ingredient.
- Successful implementation would probably require the active participation of representative community structures in shaping and monitoring such regulations in their electoral area.

(iii) Re-densification measures, for more efficient improved housing

- In the situation of land shortages, and for other reasons, the common style of low-cost government-supported housing (small single-storey houses on small separate plots) can be improved upon through higher density housing options, such as flats or multi-storey attached housing units, in some areas.
- These would need to be designed well, in compliance with high safety and service standards, and with regard to residents' preferences.

(iv) Policies and support for extended electrification

- Although access to electricity does not guarantee avoidance of more dangerous (and more expensive) uses of household energy, it is likely to make a significant contribution to a reduction in energy-related hazards.
- Policies and planning strategies should be adjusted to maximise formal electricity services available in urban lower-income settlements, including provision to people presently living in "shacks".
- Pro-poor pricing of electricity for low-income households should be continued, including the provision of a modest Free Basic Electricity allowance to poor households, to encourage safer, affordable household energy use.
- Informal electrification practices (e.g. the use of extension cords or other extra wiring installed by local electricians) should be subject to some regulatory oversight, particularly with regard to safety aspects.

(v) Other safety standards

- High on the list would be the effective implementation of national safety standards for paraffin stoves – combined with the availability of affordable stoves which do meet the safety standards.

8. Addressing the energy needs of marginal communities presently "left out" from mainline urban services provision

In the present context, the groups of "marginal communities presently left out from mainline services provision" are primarily

- people inhabiting informal settlements on areas of land which have not been approved for normal services provision, such as electrification
- "backyard shack" dwellers

It is recognised that there are strong areas of overlap between this theme and the two main themes discussed in earlier sections. However, the energy service supply and planning challenges are particularly great in the case of such marginal (and often dynamically changing) groups of households. The recommendations in this section are particularly addressed to associated policy, regulatory and planning questions.

The following sections focus on

- electrification issues, as they affect presently under-serviced households in communities such as Imizamo Yethu
- opportunities for improved supply, use, affordability and safety of non-electric fuels, especially for households not able to use electricity

8.1 Electrification issues

There are very strong benefits for households able to use normal electricity supplies, as opposed to non-electric fuels, particularly for low-income households. They include:

- *Financial benefits.* In latter 2008, electricity prices applicable to lower-income households in Cape Town areas ranged from about 42 to 65 cents per kWh, depending on consumption levels, applicable tariff and access to the Free Basic Electricity (FBE) allowance. The use of paraffin and LPGas was shown to be at least three times more expensive than using electricity, for cooking, at prevailing prices. The advantages of using electricity for lighting were even stronger. Comparative figures were calculated for (i) basic cooking: paraffin R85/month, electricity R26/month; (ii) basic lighting: paraffin and candles combination R36/month, electricity (using CFLs) less than R2/month. These figures exclude the additional benefits of an FBE allowance.
- *Quality of life and safety benefits.* If households can avoid using more dangerous fuels, fire dangers are reduced. Electricity also allows for cleaner, unpolluted indoor environments, and the quality-of-life benefits of improved lighting, the potential to use a wider range of appliances, and improved communications and inormation.

Conversely, households without any access to electricity end up paying more for their energy supplies, and generally get inferior and more dangerous energy services in the process. They also experience the inequity that, although they may be poor, they do not receive any benefit from the FBE policy.

Households such as backyard shacks which depend on informal electricity supplies, by extension cord from an on-supplying household, also usually do not benefit from the FBE allowance, as they do not have an individual meter. They also usually end up paying more for their electricity (per kWh) than households with a regular metered supply.

In the light of such summary points (described in detail in the main report) the following main recommendations were made.

> *Municipalities and other electricity service suppliers should strive to maximise the provision of regular formal electricity supplies in low-income urban settlements, in South Africa, including the provision of regular metered supplies for informal households and backyard shacks.*

This could entail

- revisiting and amending local government policies and strategies directed towards electricity service provision in unproclaimed informal settlement areas
- re-examination of national government criteria for allocating electrification subsidies/grants for informal settlements
- revising regulations pertaining to "one electricity meter per erf / property", to accommodate the practical situations where groups of households share from a single metered supply at present, with the aim of providing individual prepayment meters for such situations
- broader policy assessments about whether the existing pattern of informal settlements is likely to continue into the future, despite priority attempts to upgrade and provide full services for existing listed informal settlements
- corresponding assessment of the increased dangers and disadvantages for residents in marginalised informal settlements, as well as for some of these dangers spreading into adjacent communities, if they remain un-electrified

The risks of certain dangerous circumstances spreading across adjacent communities include (i) township fires, (ii) some communicable diseases (e.g. tuberculosis, partly associated with unhealthy indoor environments).

> *Municipalities and other electricity service suppliers / planners / regulators should consider co-operative engagement with "informal" electrification practices.*

Informal electrification here refers to the common use of extension cables, and informal wiring (usually not subject to safety standards) by local community electricians and residents.

A range of possible approaches could be considered. A relatively "light" intervention would probably focus on safety and security issues. For example,

- the municipality could provide or facilitate a service for monitoring the quality and safety aspects of informal electricity connections and indoor wiring (this would probably receive community support and cooperation – especially if it involved training and paying a number of local electricians to conduct such services on a regular basis)
- monitor and rule out the most dangerous practices, for example cables on the ground or low-lying overhead cables (which might also be appreciated at a community level, leading to greater safety and confidence)

Given the current prevalence of informal electrification in some lower-income communities, including Imizamo Yethu, a policy objective of prioritising the upgrading of informal settlements before providing standard municipal services should preferably not detract from the parallel advantages of improving the safety and security associated with existing informal electrification practices.

Possible opportunities for *more direct engagement* between electricity authorities and local groups of people involved in informal electrification (e.g. recipient householders, local electricians, and perhaps community organisations) could include:

- assistance by the authority in selecting and approving materials (e.g. cables, switchgear, protection devices, etc.) for use in informal electrification
- possible assistance in establishing economical, regulated procurement channels for these supplies
- making training courses available for local electricians
- provision of formal supply nodes for small-area informal (perhaps temporary) electricity distribution networks, for example using ploughed underground medium-voltage (1000-3000V) cable supplies to local-area transformers (as practiced on some farms)
- assistance for community groups to form small-area electricity distribution groupings, co-ops, etc., to manage supplies, maintenance and payment methods for on-supplied electricity from such supply nodes

These possible suggestions are not complete, could be complex to implement, and are debatable. Some experiences internationally are being built up and shared, about such types of options. Whether they are viable in the South African context remains both an empirical and a policy question.

> *The Free Basic Electricity subsidy should continue to be implemented, together with tariff structures which do not discriminate against electricity customers consuming relatively low quantities of electricity, such as lower-income households.*

Based on interviews, surveys and analysis of costs and benefits, it is considered that the Free Basic Electricity allowance is

- cost-effective and efficient to implement
- generally well targeted to reach the poor (but only those with electricity)
- can bring significant poverty alleviation and quality of life benefits, disproportionate to the costs of implementing the subsidy
- and should therefore be maintained.

There have been some strong pleas from community representatives in Imizamo Yethu that the FBE allowance (presently 50 kWh/month for qualifying households) should be increased, in the light of rising electricity prices. However, given the efficiency and surprisingly high effectiveness of the present FBE quota – especially for poorest households, which are a key target for the subsidy – this could be regarded as debatable.

It is recommended that, as far as possible, some of the anomalies and obstacles which currently prevent certain groups of low-income electricity-consuming households from accessing the benefits of the subsidy should be addressed. This includes measures to enable residents in flats (if they presently do not have individual meters) and others without individual meters (e.g. backyard shack dwellers, at present; other informally electrified shack-dwellers; farm-worker families getting supplied by a farmer, from a single meter) to gain equitable access to the subsidy.

8.2 Improved supply, use and affordability of non-electric fuels and appliances

While in some rural areas, there have been strong motivations for improving the supplies of commercial liquid fuels, particularly paraffin and to some extent LPGas – and this was the primary starting motivation for some communities to establish local village-based "integrated energy centres", which could buy such fuels in bulk, for cheaper local distribution – it is considered that the scope for improved supplies of *paraffin* in an urban situation such as Imizamo Yethu are more limited.

From a commercial and financial point of view, since paraffin sells from local Imizamo Yethu shops at a price below that in larger supermarkets, and not much more than in situations where bulk supply channels are utilised, it is unlikely that a bulk-buying community energy centre concept would be commercially viable / sustainable in this context.

There could be other motivations for a more regulated, community-oriented paraffin supply station. The main ones would be to do with fuel quality, and packaging. If paraffin becomes contaminated with water, or with other fuels like petrol, this can cause damage to appliances or in the latter case introduce explosion risks. A safe and clean local paraffin bottling facility, making use of specialised safer containers (e.g. clearly marked, visibly different from "cooldrink bottles" and with child-resistant safety caps, as promoted by the PSA), could reduce such hazards.

Alternatively, local shops selling paraffin could be incentivised to follow such practices themselves.

While paraffin is readily available from local shops within the community, in small quantities if need be, this is not the case for *LPGas*. Obtaining re-fills of LPgas requires some travel and transport to outlets in neighbouring Hout Bay town. It is possible that this is one of the constraints which reduces the use of LPGas as a regular cooking fuel in Imizamo Yethu. However, the high cost of LPGas (at R20 to R25 / kg during the second half of 2008) is probably an overriding constraint, for poorer households, and this limits the market base for LPGas within the community, which in turn casts doubts about whether the organisation of more direct local supply channels would make a great deal of difference to uptake rates, despite its superior qualities.

Some people believe South African LPGas prices are artificially high, possibly as a result of non-competitive practices among the oil majors in this market, high mark-ups in the distribution chain, "protection" of sales areas by some LPGas suppliers, and an apparent unwillingness or inability to import LPGas at potentially lower international prices.

The South African government has been ambivalent about whether to promote and support the use of LPGas among lower-income non-electrified (or electrified) households. As a result, it seems the following national-level policy-related issues have not yet been resolved:

- Is LPGas a viable fuel for the poor, in South Africa?
- Is there price-fixing in the industry?
- Should greater price regulation be introduced, and would it be beneficial?
- Would subsidies be justified?

It is recommended that such issues *should* be resolved, to facilitate an environment where rational promotion (or otherwise) of LPGas for low-income households can more easily proceed, and appropriate practical support measures implemented.

Returning to the question of *improved paraffin use*, the most urgent requirement is for the ready availability of safer, affordable paraffin stoves, which comply with national safety standards – and which at the same time meet the typical cooking requirements of lower-income householders. This crucial issue was discussed in Section 6.2 above, together with recommendations directed towards paraffin appliance manufacturers and standards bodies.

Finally, the APPLES project attempted some assessment of the opportunities and practicalities of implementing the national government's "Free Basic Alternative Energy" (FBAE) policy, in areas such as Imizamo Yethu. The intentions behind this policy were to provide a degree of subsidy support for the basic energy needs of poor households which do not have access to grid electricity, and which therefore cannot benefit from the Free Basic Electricity subsidy.

On balance, this assessment found that there would be some significant challenges to successful FBAE implementation. These challenges, which would be experienced mainly by municipalities (as they are primarily responsible for enacting any FBAE scheme), included:

- *The identification of non-electrified low-income households eligible to receive FBAE assistance.* Unlike electrified customers, there is no systematic billing system or customer database (although some municipalities elsewhere maintain a register of indigent households).
- *Difficulties in monitoring the use of such subsidies.* This is partly because users of non-electric fuels can buy these from a range of shops, compared with the FBE situation, where payment outlets are connected through a centralised computer billing system.
- *Administration of an FBAE subsidy could be relatively inefficient.* Compared with the cost-efficient means available for administering FBE subsidies, FBAE administration could entail the use of special methods (e.g. issuing subsidy vouchers, and monitoring the integrity of the process) which could increase subsidy-administration overheads.

Such difficulties are not insurmountable, and some suggestions were made how FBAE subsidies could be delivered in particular communities, through partnerships between municipal authorities and community-based structures. Such possibilities are not presented as general recommendations, partly because of the following observations:

- Trialling such possible arrangements in particular local communities could be seen as inequitable, and likely to lead to conflicts, by a large municipality aiming to provide equitable services across a range of communities.
- There appears to be little commitment from national government towards successful implementation of the FBAE policy, partly because of practical difficulties, and partly because of the greater political focus on the policy objective of providing "basic electricity for all" within a few coming years.

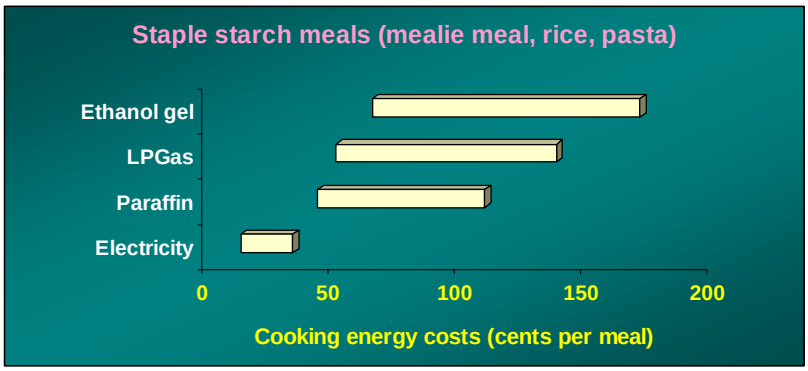
Nonetheless, the APPLES appraisal was that there will remain a proportion of marginalised informal urban communities over coming years, at any time, and although maximum efforts should be made to extend electricity services to all urban households, it is unlikely that this can be fully achieved. This does not argue against the objective of trying to meet this

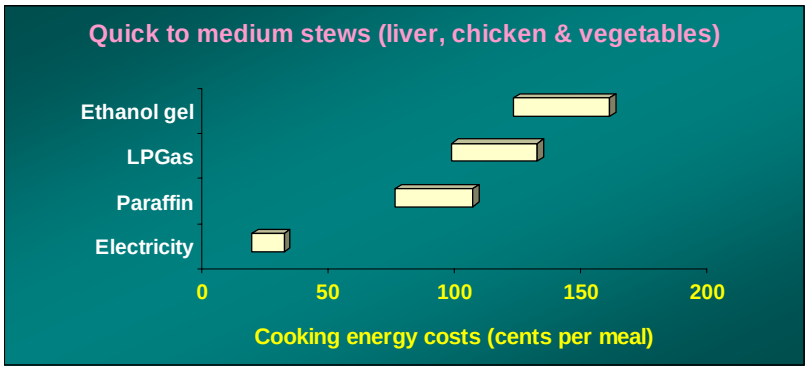
obligation to the highest percentage level possible, within the situational constraints. But it does imply that there should be a remaining concern for the more severe energy needs and energy hazards that are likely to continue in marginal communities left out from mainline urban services provision.

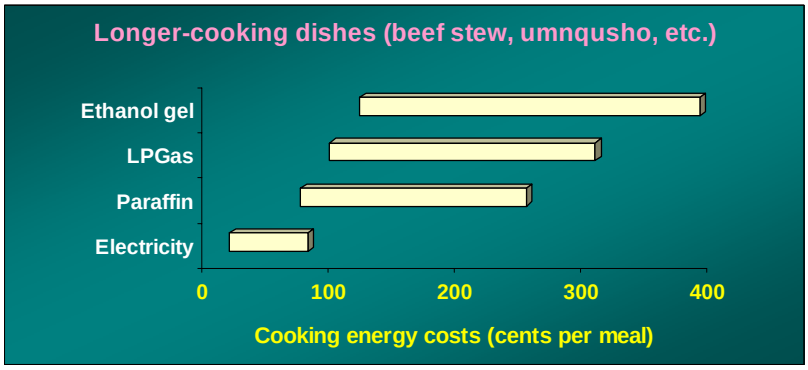
APPENDIX 1: Graphs showing comparative cooking costs using different fuels

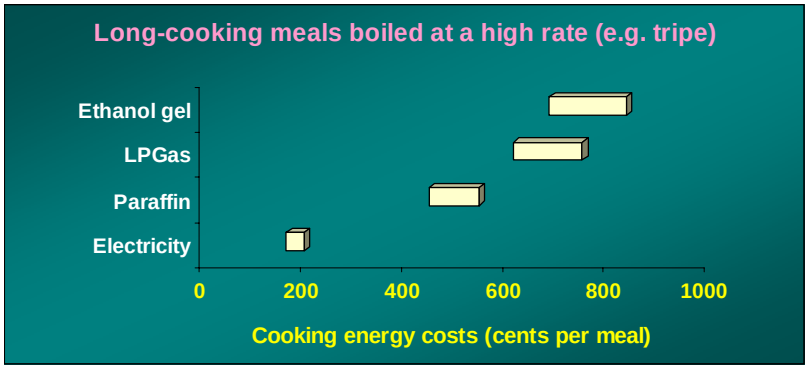
In following graphs, the current local prices (mid 2008) for the fuels were taken as:

	Fuel prices used in figures below:	
Fuel	**Local R/unit sold**	**R/kWh**
Electricity	0.6 R/kWh	0.6 *(ii)*
Paraffin	11 R/litre	1.1
LPGas	20 R/kg	1.6
Ethanol gelfuel	9 R/litre	2.5








Long-cooking meals boiled at a high rate (e.g. tripe)
Ethanol gel
LPGas
Paraffin
Electricity
0
200
400
600
800
1000
Cooking energy costs (cents per meal)