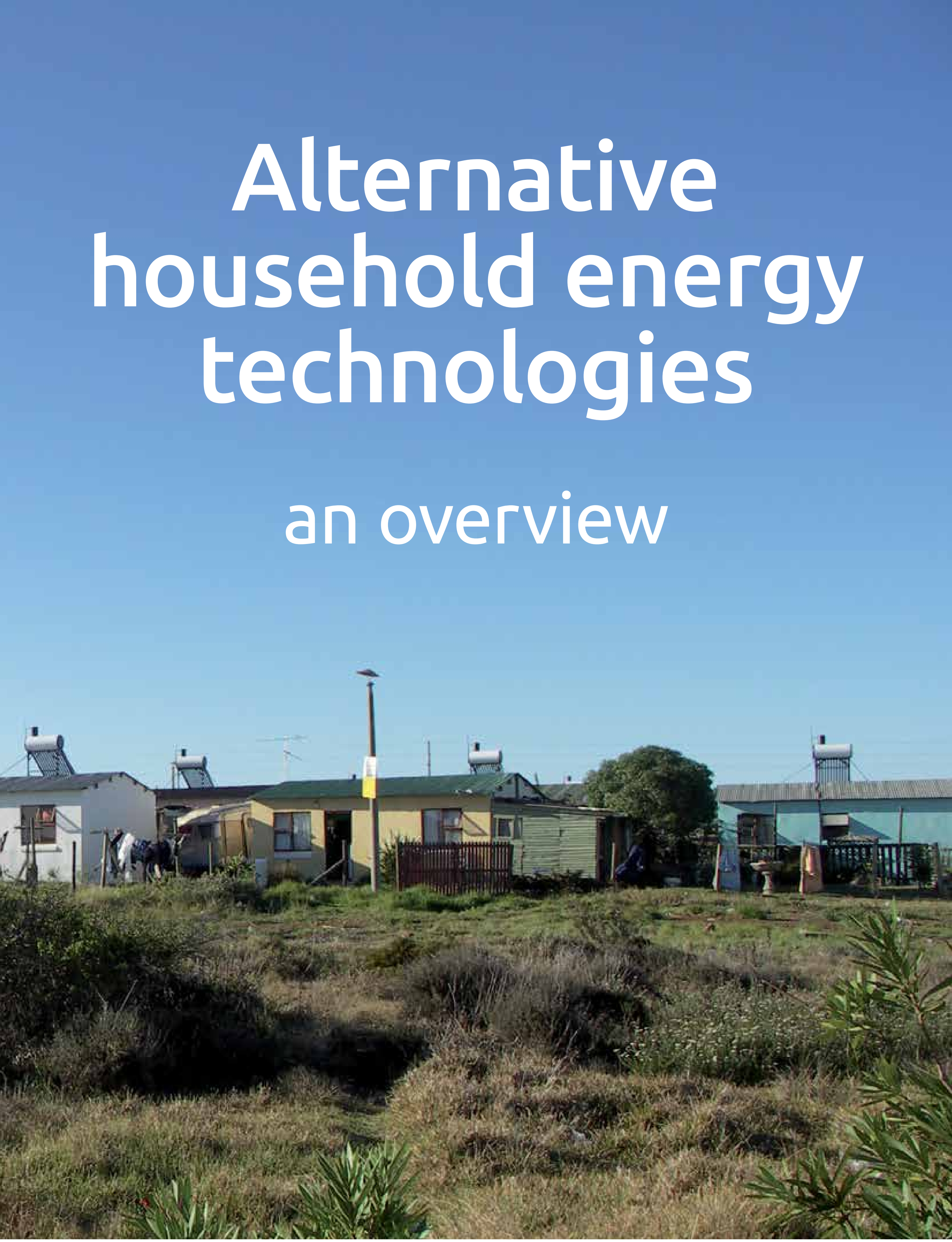
Alternative household energy technologies

an overview



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Solarway

1. Introduction

Since 1994 the South African Government has introduced many laudable and strong pro-poor energy policies, notably the 1998 White Paper on Energy, Free Basic Electricity (FBE), Free Basic Alternative Energy (FBAE) and an impressive national electrification and housing programme. Despite these enormous efforts the country still grapples with energy poverty 20 years into democracy. If the country is to achieve a reduction in energy poverty and reach its goal of universal access to energy, then policy and regulatory frameworks and approaches as well as resources to support energy service delivery, need ongoing constructive review.

This booklet briefly examines alternative energy technologies and associated energy sources available in the market that are cleaner, appropriate, applicable and sustainable relative to those that are currently available and used by informal households for their domestic energy requirements. Key issues, including technical specification, impacts and risks, pro's, con's, availability and social acceptability factors for each of the alternative technology and fuel options are highlighted, serving as a cost benefit and emissions analysis by which options can be compared easily against each other. This overview is not comprehensive, but has been developed as the start of a knowledge base on alternative household energy services. It should also be noted that the financing and delivery mechanisms for alternative energy service delivery are not discussed here.

Detailed description of Alternative Energy Technologies and Energy Options

This guide provides detailed technical descriptions of 'alternative' energy technologies and energy sources. In addition, it highlights the costs and benefits of each option in relation to the needs of households living in urban, peri-urban or informal communities, as well as in relation to the goals of: (1) reduced air pollution levels; (2) improved health and safety; (3) affordability; and (4) sustainable energy supply. Social acceptability factors such as cooking time and ease of use have been included. However, this is a complex area and a detailed evaluation of social acceptability is not covered here.

The overview includes the following energy service areas:

1. Cooking
2. Lighting
3. Space heating
4. Water heating
5. Thermal insulation of housing
6. Solar home systems

Technologies in this space are constantly innovating and evolving. This overview is not comprehensive or final and updates will be available on our website (www.cityenergy.org.za) as new information is gathered.

1. Cooking

#1 Cooking Technology

ONE AND TWO PLATE METHANOL/ETHANOL STOVE

Technical Description:

Composition: The stove is made up of a stainless steel body, one or two fuel chambers (canister) with capacities of between 0.5 - 1.2 litres each, and one or two plates.
Fuel: Ethanol or Methanol
Calorific value [1]: 22.7 MJ/kg for Methanol
Fuel consumption rate: between 0.171 and 0.250 litres per hour, per canister
Lifespan: 6 – 10 years

Costs:

Capital Cost: Ranging between R500 and R1 200 depending on stove
Monthly Operating Cost: R180 (R90 per plate based on average of 3 hours of cooking on each per day)

Safety for users:

The canisters hold an absorbent mineral fibre covered by a protective mesh metal, preventing fuel from spilling or leaking from it even when the stove is inverted. The flame can be extinguished easily with the regulator. The refueling is on the exchange of canisters for safety purposes (to avoid any potential risk of ingestion of the fuel by children or any other hazards).

Emission factor:

CO (carbon monoxide)/CO_2 (carbon dioxide) ratio of 1:0.003, which meets the South African Bureau of Standards specification (less than 2%) for open flame devices permissible for indoor cooking and heating.

Figure 1: *Two plate stove (Above); Fuel chamber canister without lid (Below left); Fuel chamber canister with lid (Below right)*

Pros	Cons	Risks	Energy Impacts	Remarks
• Safe, clean and more efficient than paraffin • No odours • High calorific value compared to more traditional fuels like paraffin and wood • Sustainable supply of the technology and the fuel • Potential for Small Medium and Micro-sized Enterprises (SMME) development for fuel distribution in canister, since refueling is on the basis of exchange of canisters that are in easily-manageable sizes • Stove is easy to use • Operating costs are comparable to the going rate of paraffin that is currently in use.	• Due to the recent introduction of this fuel on the market, there is a great need to raise awareness of this fuel for household cooking.	• Ethanol/ methanol fuels still an emerging market reliant on government financing. Security and affordability of fuel supply is not guaranteed.	• Uses green fuel, so reduces carbon impact of cooking and household air pollution.	• The fuel is sometimes felt to be a 'slow' fuel, not cooking with much power.

1. Calorific value of a fuel is the measure of the amount of heat released during the combustion of a specific amount of the fuel (https://en.wikipedia.org/wiki/Heat_of_combustion).

#2 Cooking Technology

EFFICIENT BIOMASS COOKSTOVES

Technical Description:

The stove is made up of a galvanised or stainless steel base with a ceramic, heat-absorbing liner. It comes with a stainless steel grill and a stainless steel pot spacer. The liner is heated by either wood or charcoal. Once hot, it optimises the heat. The clay liner significantly reduces burning fuel required, which in turn reduces smoke emissions; decreasing costs, carbon footprint and health risks. It is much safer than paraffin or gas stoves and uses only 7-15 pieces of charcoal to cook a meal for a family.

Fuel: Charcoal, wood or other biomass

Calorific value: Depends on fuel. Charcoal 29.6 MJ/kg. Wood 14.4 MJ/kg.

Fuel consumption rate: Depends on fuel – temperature and fuel consumption rate controlled by ventilation lever.

Lifespan: 10+ years

Figure 2 *: Example of a cookstove manufactured by Mbaula.*

Cost:

Capital Cost: approximately R450

Monthly Operating Cost: None if wood or coal is collected from surroundings. If purchased, R115 for wood or R270 for coal (based an estimate of 1kg of fuel per day – clay liner reduces fuel quantity required).

Safety for users: Must be used in ventilated area. Uses burning fuel and is therefore a fire risk.

Emission factor: Charcoal 3.3 kg CO_2e/kg. Wood 1.18 kg CO_2e/kg (Note: these fuels are from renewable sources)

Pros	Cons	Risks	Energy Impacts	Remarks
• Efficient • Uses familiar and available fuels • Compact and mobile.	• Cannot be used indoors • Uses "dirty" fuels that negatively affect air quality and use of wood may impact on the environment.	• Is a fire risk if not used safely • Can have significant health impacts if used indoors.	• More efficient use of fuels therefore reduces costs and air pollution.	• Efficient stove for fuels that are already widely used and available.

#3 Cooking Technology

LIQUID PETROLEUM GAS (LPG) ONE OR TWO PLATE COOKSTOVE AND CYLINDER

Technical Description:

Composition: The stove is made up of a stainless steel body with two plates. It connects to a separate gas cylinder via a hose and flow regulator.
Weight: Gas cylinders of 3kg, 5kg or 9kg when full.
Fuel: LPG
Calorific value: 61.4 MJ/kg,
Fuel consumption rate: 5kg (9.52 litres) per household per month for cooking and water heating, roughly 0.108 litres per hour (based on 3 hours of cooking and water heating per day).
Lifespan: 5 years

Figure 3: *Example of two plate cookstove*

Costs:

Capital Cost: Ranges between R700 and R1 100
Monthly Operating Cost: R125 per plate

Safety for users:

LPGSASA Safe Appliance Approval. Safety is ensured through adhering to safety precautions for careful handling and storage, especially with children around. Gas leaks are possible if regulator lever not closed properly, which poses a risk of explosions.

Emission factor: 1.622 kg CO_2e/litre

Pros	Cons	Risks	Energy Impacts	Remarks
• Convenient, clean and relatively safe • High calorific value reduces cooking time significantly. • LPG is a clean burning fuel and reduces indoor air pollution by as much as 90%[2] in comparison to burning traditional fuels • LPG stoves quickly supply heat and work more efficiently than wood and paraffin stoves. The simple and precise regulation simplifies the cooking process and can save time. • Good existing distribution.	• Reliance on distributor and distribution network – does not promote enterprise development through SMMEs/cooperative • LPG tank management is difficult (storage, transportation) due to their sizes. • LPG operating costs are high and are more suitable for the middle- to high-income earning households. • May not be user-friendly. • Gas is not regulated so the costs can vary over time making this difficult to include in a municipal programme.	• Risk of gas tank explosions in the informal settlements that may lead to fatal shack fires IF not properly used. • Distributer cost recovery • Assurance of LPG supply.	• Good impact on heating/cooking provision, as well as space heating.	• There is a great need for widespread household education and awareness on the safe and efficient use of this technology.

2. *World Health Organisation (WHO). Health in the Green Economy. http://www.who.int/hia/hgebrief_henergy.pdf*

#4 Cooking Technology

SOLAR COOKER

Technical Description:

Composition: The stove is made up of a rugged plastic body, with space inside for several cooking pots. The Perspex lid allows light in, but traps heat within the cooker. The cooker works best with black pots.
Weight: 4.3 kg
Fuel: Sunlight
Calorific value: Not applicable
Fuel consumption rate: Not applicable
Lifespan: 10+ years

Figure 4: *Example of solar cooker manufactured by Sunstove*

Costs:

Capital Cost: R650
Monthly Operating Cost: None

Safety for users: Very safe, needs little supervision

Emission factor: Zero emissions

Pros	Cons	Risks	Energy Impacts	Remarks
• Free to operate • Safe • Needs little supervision • Can cook entire meal at once • Provides better air quality indoors, reduces carbon monoxide emissions and cooler temperatures indoors can be enjoyed	• Relies on the sunlight for cooking (not predictable, can only cook during the day), and also makes it difficult to use during winter months or rainy days • Cooking takes significantly longer than conventional methods • Bulky appliance • Cannot be used indoors.	• Food cannot be cooked using this appliance on days that are not sunny – therefore does not allow flexibility as to what part of day household can cook. • There is the risk of food being stolen while it cooks outdoors.	• Free to operate, therefore saves significantly on energy costs.	• Unlikely to provide all the cooking services needed by households. A backup appliance that operates on another fuel source will be needed when weather is unfavourable or whenever the sun is hidden. • Perceived as slow and unreliable.

#5 Cooking Technology

HOT BOX

Technical Description:

Composition: The hot box is an insulated cooker made up of two poly-cotton bags filled with expanded polystyrene (EPS) balls, into which a pot of food brought to the boil can be placed. The hot box uses the principle of thermal insulation to continue the cooking process without needing additional heat. EPS is ecologically harmless, contains no chlorofluorocarbons (CFCs) and is fully recyclable.
Weight: 250g
Fuel: None
Calorific value: Not applicable
Fuel consumption rate: Saves at least 6.5 litres of paraffin per week. Monthly savings: R50 – R75, if used 2-3 times per week
Lifespan: 3 years

Figure 4: *Example of hot box*

Costs:

Capital Cost: Can be self-made with cardboard and newspaper, or straw, or bought for between R260 to R360 per bag

Monthly Operating Cost: None

Safety for users: Very safe, needs little supervision

Emission factor: Zero emissions

Pros	Cons	Risks	Energy Impacts	Remarks
• Free to operate • Safe and convenient • In the many households where paraffin or coal is used for cooking, a direct improvement in indoor air quality can be expected as does not emit any health damaging pollutants. • Needs little supervision • Low capital cost • Reduces the amount of fuel needed for cooking (estimated to save up to 30% of total fuel costs associated with cooking with paraffin alone) • Good for food that takes long time to cook, such as beans, samp, tripe, rice, stews. • Safe to use • Easy to use • Meals can be safely prepared ahead of time • Hotboxes are relatively easy to make, and thus lend themselves to decentralised small business production in low-income areas, and can be made using low-cost, recycled materials.	• Cannot cook all food types, such as steamed bread, pap, and food that require stirring.	• No known risks.	• Free to operate, therefore saves on energy costs • Medium impact on cooking provision • High impact on energy efficiency • Saves on cooking time and energy but can be only be used to complement another form of energy.	• Unlikely to provide all the cooking services needed by household. Perceived as slow.

2. Lighting Technologies

#1 Lighting Technology

SOLAR LIGHTING

Technical Description:

Composition: Solar PV module for charging and an LED light
Weight: Light-weight
Fuel: None
Calorific value: Not applicable
Fuel consumption rate: Not applicable

Costs:

Capital Cost: Ranging between R400 and R1500
Monthly Operating Cost: None

Safety for users: Very safe, needs no supervision

Emission factor: Zero emissions

Figure 6: *Solar light*

Pros	Cons	Risks	Energy Impacts	Remarks
• Free to operate • Safe to use • Needs no supervision • Safer, cleaner and brighter than candles and paraffin lamps • Simple to use • Children can do homework and study at night • Zero emissions • Low maintenance costs (after lifespan, only battery needs to be replaced).	• Much higher capital cost compared to candles and paraffin lamps • Needs sunlight, therefore charging time limited during winter • Operation/management required – to move apparatus indoors at night for lighting and outdoors during the day for charging.	• Risk of theft if left unattended or solar panel installed on the roof.	• Free to operate, therefore saves significantly on energy costs • Medium impact on lighting provision • High impact on indoor air pollution.	• Unlikely to provide all the lighting services needed by household. • Perceived as expensive.

#2 Lighting Technology

A LITRE OF LIGHT

Technical Description:

Composition: A plastic bottle (e.g. 1.5 or 2 litre Coke bottles) filled with water and some bleach (to prevent algal growth), is embedded into the corrugated iron shack roof, with the top part of it protruding outside to capture sunlight. The bottom half serves as a light source (commonly referred to as a solar bulb) inside the dwelling. The hole is covered with sealant for weatherproofing.

Charging hours per day: None, only needs contact with bright sunlight to emit light instantly

Lighting provision: Only works during the day for as many hours as there is daylight

Light output: 450 Lumen (35 candle power or 1 lightbulb power)

Fuel: None

Calorific value: Not applicable

Fuel consumption rate: Not applicable

Lifespan: 5 years (if properly installed)

Figure 7: *A litre of light embedded in shack roof*

Costs:

Capital Cost: R100

Monthly Operating/Maintenance Cost: R2 (R24 bottle of bleach averaged over 12 months)

Safety for users: Very safe, no supervision

Emission factor: Zero emissions

Acceptance/Adoption: Mature technology, used in many low-income communities globally.

Pros	Cons	Risks	Energy Impacts	Remarks
• Free to operate • Safe to use • Needs no supervision • Safer, cleaner and brighter than candles and paraffin lamps • Low maintenance costs • Can be used in shacks that are not well lit, during the day, given that shacks usually do not have windows to allow natural light to stream in.	• Use is limited to daytime only and cannot be used at night.	• There is the risk of falling from the roof and possibly injuring occupants, if not well installed.	• Free to operate, therefore saves on energy costs where daylighting is required • No impact on night lighting but high impact on day lighting • Positive impact on indoor air pollution if daylighting is required.	• Does not provide all the lighting services needed by household.

#3 Lighting Technology

LPG LAMP

Technical Description:

Composition: The lamp connects directly to a gas cylinder via a flow regulator.
Weight: Gas cylinders of 3kg, 5kg or 9kg when full.
Fuel: LPG
Calorific value: 61.4 MJ/kg
Fuel consumption rate: 0.060 kg/hour
Light output: 1300 lumen (100 candle power or 3 lightbulb power)
Lifespan: 5 years

Figure 7: *Example of an LPG lamp*

Costs:

Capital Cost: R230
Monthly Operating Cost: R225 (based on a fuel consumption estimate of 0.060kg per hour, for 5 hours of lighting per day)

Safety for users:

LPGSASA Safe Appliance Approval. Safety is ensured through adhering to safety precautions for careful handling and storage, especially with children around. Gas leaks are possible if regulator lever not closed properly, which poses a risk of explosions. The lamp has a stay-cool carry handle.

Emission factor: 1.622 kg CO_2e/litre

Pros	Cons	Risks	Energy Impacts	Remarks
• High light output, better than candles and paraffin, roughly equivalent to a 100W incandescent lightbulb • Good calorific value • Convenient and relatively safe • LPG is a clean burning fuel and reduces indoor air pollution (health damaging air pollutants like particulate matter) • Good existing supply distribution network.	• Reliance on distributor and distribution network – does not promote enterprise development through SMMEs/ cooperative • LPG tank management is difficult (storage, transportation) due to their sizes • LPG operating cost are high and are more suitable for the middle- to high-income earning households • May not be user-friendly.	• Risk of gas tank explosions in the informal settlements that may lead to fatal shack fires **if** not properly used. • Distributor cost recovery • Assurance of LPG supply.	• High impact on lighting provision for one-roomed dwellings and households without access to electricity • Fossil fuel, therefore contributes to Greenhouse Gas Emissions (GHG) emissions.	• Awareness required for how to use the technology properly to ensure safety.

3. Space Heating Technologies

#1 Space Heating Technology

LPG HEATER

Technical Description:

Composition: The heater is made up of a metal housing with the heating elements at the front. The housing holds the LPG cylinder, which connects via a hose and flow regulator.
Weight: Gas cylinders of 3kg, 5kg or 9kg when full.
Fuel: LPG
Calorific value: 94 MJ/m^3, k
Fuel consumption rate: 100g per panel per hour. Roughly 600g of gas per day (two panels on for three hours per day).
Lifespan: 10+ years

Figure 10: Example of a LPG heater

Costs:

Capital: R1 200
Operating: R225 (based on 9kg per month and using 1 panel per day for 30 days)

Safety for users:

Safety is ensured through adhering to safety precautions for careful handling and storage, especially with children around. Gas leaks are possible if regulator lever not closed properly, which poses a risk of explosions

Emission factor: 1.622 kg CO_2e/litre

Pros	Cons	Risks	Energy Impacts	Remarks
• High calorific value which heats efficiently • LPG is a clean burning fuel and reduces indoor air pollution (health damaging air pollutants like particulate matter) • Good existing distribution.	• Reliance on distributor and distribution network – does not promote enterprise development through SMMEs/ Cooperative • LPG tank management is difficult (storage, transportation) due to their sizes • LPG operating cost are high and are more suitable for the middle- to high-income earning households • May not be user-friendly.	• Risk of gas tank explosions in the informal settlements that may lead to fatal shack fires **if** not properly used. • Distributor cost recovery • Assurance of LPG supply.	• Very efficient for space heating provision.	• Strong awareness required for the users on how to properly use the technology to ensure safety.

#2 Space Heating Technology

PARAFFIN HEATER

Technical Description:

Composition: The stove is made from mild steel with a paraffin reservoir at the bottom and a heating element with a protective cage above. There is often a cooking plate above the heating element to allow one to heat food or water. Needs to be SABS approved (there are many illegal heaters sold in the market).
Weight: 3-5 kg
Fuel: Paraffin
Calorific value: 46 MJ/kg
Fuel consumption rate: Depends on stove but approximately 200 ml – 400 ml per hour.
Lifespan: Varies

Safety for users: Should be used in ventilated area. Uses burning fuel and is therefore a fire risk. Poison risk if ingested. Creates moisture in confined space when burned. The legal SABS approved appliances usually have a self-extinguishing mechanism in the event of the appliance being knocked over accidently.

Figure 11: Typical paraffin heater

Emission factor: 2.58 kg CO_2e/litre

Pros	Cons	Risks	Energy Impacts	Remarks
• Uses familiar and available fuel • Relatively cheap to purchase and operate • Versatile - also provides for cooking needs.	• Requires adequate ventilation • Can be dangerous • Paraffin emits health damaging air pollutants and negatively affects indoor air quality.	• Fire hazard • Can cause poisoning if ingested (paraffin needs to be carefully stored away in sealed, marked containers) • Noxious fumes can be hazardous • Creates large amounts of moisture if burned indoors.	• High impact on space heating provision.	• Often used in low-income settlements, mainly due to low cost of heater and fuel and familiarity with technology.

4. Water Heating

#1 Water heating

SOLAR WATER HEATERS

Technology description:

Solar Water Heater (SWH) technology is well established and is financially viable in existing and new residential and institutional buildings, and many commercial facilities.

Lower income homes that have no existing hot water boiler are generally fitted with 'low pressure' solar water heaters. Low pressure systems are designed for low income housing as these are more affordable due to not requiring high strength materials to withstand high pressures.

Aside from low and high pressure systems, the two main types of SWH technology are the flat plate (see picture) and vacuum tube systems. The technology type will depend on the end-use application, cost, local climate conditions, as well as potential requirements of the financing partner.

Lifespan: 20 years

Figure 12: Typical solar water heater with flat plate collector

Costs:

Capital: System costs will depend on the size of the geyser and the type of technology (flat plate, evacuated tube, coupled, decoupled). Low pressure systems (including installation) approximately R5 000 – R6 000; High pressure systems range between R17 000 to R25 000 depending on the system chosen.

Operating: minimal, as fuel is 'free' from the sun; but regular maintenance may be required as tubes can break and leaks arise when washer's wear through.w

Pros	Cons	Risks	Energy Impacts	Remarks
• Free heating of water • Reduce peak load where electricity has been used for water heating by electric geyser or kettle or stove.	• The initial costs of SWHs are considered prohibitive. Adequate long-term financing is essential for any chance of mass rollout.	• System maintenance must be catered for.	• Reductions in water heating energy requirements of over 50% can be expected with SWHs in mid-high income houses, particularly when used in conjunction with a timer which regulates when the backup electrical element is switched on.	• The benefits of using SWHs are not widely enough known in the residential sector, contributing to slow uptake (along with the absence of financing mechanisms).

#2 Water heating

HOT WATER BOXES

Technology description:

Hot water boxes are small mobile solar water heaters that heat and disinfect a small amount of water over a number of hours in the sun. Hot water boxes provide a lower cost alternative to conventional solar water heaters. In good sun such technologies may heat 10 litres of water in 4 -5 hours while also using solar ultra-violet to disinfect the water. It does not need any domestic plumbing system and requires no installation.

New systems, some involving mounting, are under development.

Costs

Capital: Approximately R200 – R300 for very small systems; larger, mounted systems will cost more.

Operating: None

Figure 13: *Example of a hot water box manufactured by Tshisa Box*

Pros	Cons	Risks	Energy Impacts	Remarks
• Cost saving as no fuel such as wood, coal or biomass is needed • Portable • No domestic plumbing system needed.	• Only heats a small amount of water at one time • May not work in sunny, but windy conditions.		• High where it is replacing 'dirty' or costly fuels.	• These technologies are under development and may offer a more affordable, less capital intensive solution for water heating, but have yet to be established.

5. Thermal insulation of housing

#1 Thermal insulation

CEILINGS AND INSULATION IN LOW INCOME HOUSING

Technical Description:

Reducing the flow of heat into and out of the house is one of the best ways of making a house more energy efficient. As most heat is gained and/or lost through the roof, the best way of reducing this heat transfer is by installing a ceiling. This creates an air gap between the living area and the roof and the air acts as an insulator. The effectiveness of a ceiling can be further improved by adding an additional insulating material above the ceiling or using a ceiling material, which is also a good insulator.

Figure 14: *Installation of Isoboard*

Costs:

The financial case for ceilings in low-income houses is clear cut due to the relatively low cost of the intervention and the massive savings on both heating and cooling energy. The prices below show the relative retail costs of the materials mentioned above. Costs would vary with bulk orders. Note when comparing costs that Isoboard is a ceiling material and insulation material built into a single product.

Product	Approximate Cost per m^2
Gypsum Board	R42.00
Insulation 40mm	R15.50
Aerolite 50mm	R22.00
Aerolite 100mm	R30.00
Isoboard 25mm *low income	R52.00
Isoboard 25mm *high income	R65.00
Isoboard 30mm	R73.50
Isoboard 40mm	R98.00

Pros	Cons	Risks	Energy Impacts	Remarks
• Energy costs for heating and cooling are drastically reduced, which frees up money for other purposes. • Ceilings last for the life-time of the structure and require little to no maintenance. • Indoor environment is healthier through reducing condensation in winter (which can lead to respiratory illness) and due to decreased heating needs, there is also an improvement in indoor air quality where coal and paraffin were used for heating.	• Currently the national housing subsidy does not include an amount for ceiling and insulation and therefore these costs need to be raised in addition to the current subsidy for any developments outside of the SCCCA.		• Achieve a 70% improvement in thermal performance of the house: warmer in winter and cooler in summer.	• This technology is very mature as it is widely used in almost all mid-hi income housing.

6. Solar home systems

#1 Solar home system technology

Solar Home System

Technical Description:

There are a range of solar home systems emerging. This overview is based on typical entry-level solar home systems specifications.

SHS Composition:

- DB Box fused with cellphone charger socket, 20A input capacity
- 1no. 100Wp Solar Panel and roof-mount bracket
- 1no. 96Ah 12V SLA Battery
- 2no. 3W Internal LED lights with cable and pull switches
- 1no. 2.4W External Security light with motion sensor and cable
- External plug box for TV, Hi-Fi, Radio and DVD
- Optional 15" TV and radio

Operation: The solar panel charges the battery via the DB Box/charge controller that manages the generation and supply of electricity flowing to and from the battery. All loads are connected to the DB box and the system will cut off if the battery voltage drops to a set point. The system will automatically turn on again when the battery has been recharged.

Fuel: The Sun

Lifespan: Panel 10 years ; DB box 10 years ; Battery 2-3 years

Figure 3: Solar Home System Components

Cost:

Capital Cost: +-R6000

Monthly Operating Cost: Operating costs can vary depending on user behavior which will determine the maintenance requirements. End-users can pay a monthly service fee to cover maintenance and replacement battery costs. The system can be remotely turned off which is the response to default in payment. End-users will also have to pay for a new battery every 2-3 years.

Safety for users: SHS should only be installed by qualified individuals to ensure safety. Users should be made aware of basic operation of the SHS as well as battery safety and maintenance.

Acceptance/Adoption:

Off-grid, solar home systems have been deployed in many countries to rural areas with varying levels of success. SHS technology has become more sophisticated over recent years and is able to provide affordable, basic electricity services due to the reduction in costs of solar panels, improved efficiencies of appliances and battery technology/longevity. Viable business models need to be implemented to ensure sustainability.

Pros	Cons	Risks	Energy Impacts	Remarks
• Stand-alone system • Modular design • Renewable fuel source • Provides basic services • Low cost.	• Battery life • Requires maintenance • Users need to manage their energy use.	• Battery overuse • Theft of components • Tampering / Misuse.	• Decentralised electricity generation • Reduction in use of paraffin and candles • Lower CO_2 emissions.	• Solar Home Systems are suitable for off-grid residential and small business applications. Viable business models need to be coupled with implementation.

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