Financial costs of household energy services in four South African cities

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Executive summary

This report examines the life-cycle costs of using various appliance-fuel combinations in low-income households in urban South Africa. For cooking, water heating, space heating, lighting and refrigeration services, the life cycle costs faced by end-users are calculated. The present values of these are amortised to common bases, such as 10 useful Megajoules of energy for the thermal services (cooking, water and space heating), 1000 lumen-hours for lighting and Rands per day (for refrigeration). The estimates are ranked from lowest to highest cost. In estimating the life-cycle costs, some assumptions are made, and these, along with empirical price variations, are utilised in testing the sensitivity of the LCC to input variables.

It is clear that the ranges of LCCs are broad, and in some instances extend to three times or more of the minimum of the range. In most instances the estimated range of LCCs does not provide incisive clarity as to which appliance/fuel combination will deliver the lowest priced energy service to the end-user. However, this reflects the reality of appliance and fuel combinations in use. Because the cost depends on a large number of parameters, not least, the behaviour of the end-user, there is much uncertainty as to which combinations will provide the least-cost service. Thus the compounding effect of many small variations in the parameters can result in large LCC variations.

The conclusion that too much variation exists to make direct comparisons is fortunately not the rule. To simplify analysis, the mid-point of price ranges was used. On this basis, some appliance-fuel combinations provide services distinctly cheaper than others. Lighting and refrigeration are services where grid electricity will provide services at considerably lower cost than with all other competitive commercial fuel and appliance combinations. Similarly, a clear conclusion can be drawn from the range of LCCs describing water heaters, where integral solar water heaters have significantly lower LCCs than all others. But despite the low LCC at which the integral solar water heater provides the water heating service, the quality of the service cannot be realistically compared with the provision of hot water on demand. A second best could be either a solid fuel stove with a water jacket or a solar/electric water heater, which uses electricity to top up the solar shortfall and provide hot water on demand.

The comparisons of levels of service with respect to water heating is one methodological question that needs to be considered when policy is developed, but a similar questions can be raised about the LCC methodology when applied to lighting. Will, for example, end-users be making choices on the basis of lumens when choosing lighting, or will any light source be adequate regardless of its quality? If the latter is closer to the end-users' reality, then a candle may provide a lower cost lighting source than the electric lamp. Such observations may provide some insight into the slower than anticipated movement towards electrical saturation of low-income household energy services.

Amongst the thermal energy services, uncertainty about the lowest priced option is greater since LCCs are confined within a comparatively narrow range compared, to say, the lighting LCCs. It is apparent that unless solid fuels are available, cheap and clean, the possibility to meet energy service needs could feasibly be any one of the electrical, gas or paraffin options. Though what has not been factored in are the externalities that can affect health negatively through burns, indoor and outdoor pollution, fires.

The main conclusions which can be drawn from the financial cost analysis are the following. The least-cost financial cost options for fulfilling the energy services are:

- coal stoves for cooking;
- heat-pumps (for multi-family dwellings and commercial buildings) and coal stoves for space heating;
- integral solar water heaters for water heating;
- 18W compact fluorescents for lighting; and
- electric fridges and freezers for refrigeration.

The outcome of this life-cycle costing exercise should ideally be used to develop a least-cost mix of options from a national economic perspective.

The sensitivity of the national average LCCs for cooking fuels and appliances are tested by varying fuel price, appliance price, energy efficiency, durability and real discount rates independently. As fuel price, appliance price, and discount rates increase, so do the LCCs. When energy efficiency and durability increase, the trend is one of decreasing LCCs, The sensitivity is linked to the proportional contributions to the total LCC of the operational and appliance price components and the breadth of the ranges being tested. For example, gas rings for cooking have a LCC which is almost entirely made up of operational costs. So there is little sensitivity to appliance price, appliance durability and the discount rate, but high sensitivity to energy efficiency and fuel price.

1
Introduction

The work contained in this report constitutes part of the research programme entitled `*Energy efficiency, equity and environment: improving access to energy services for the urban poor of South Africa'*. The paper aims to provide a robust assessment of the cost implications for households of various appliance-fuel combinations in meeting basic energy needs in low-income urban South Africa in 1996. This report is one of several being produced in this phase of the project, and follows several reports published earlier (Thorne 1996, Simmonds 1996, Mammon 1996).

This report provides estimates of the financial life-cycle costs of different fuel and appliance combinations and ranks them from lowest to highest cost. This is a necessary step for purposes of developing a least cost energy plan. Based on the savings potential that will accrue to end-users, the national economy and other stakeholders, a selection of urban demand-side management (DSM) options can be selected and costed and policy instruments designed to achieve lower cost energy services.

The main output of the paper is the presentation of life-cycle cost estimates and sensitivity analyses. Before listing these, the methodologies used in their estimation are discussed in Chapter 2, which also identifies data sources. Chapter 3 summarises the estimated costs of fulfilling basic energy services, estimating the life-cycle cost (or financial cost) of the fuel and appliance combinations. Sensitivity to assumptions and variables are tested in Chapter 4. The final chapter, Chapter 5, draws some conclusions, without pre-empting future phases in the project which will identify the costs and benefits of selected least-cost energy services and strategies to approach them.

The paper has been kept as readable as possible; the large amounts of data and calculations involved in estimating the costs are presented as figures and tables in the body of the text, and the details supporting the results can be found in the appendices.

2
Methodological approach to estimating the financial costs of energy services in urban South Africa

2.1 Introduction

An important policy goal for government is to determine the economic least-cost mix of energy services and to design appropriate policy instruments to achieve this mix. In support of this goal, this paper sets out to evaluate the financial costs to end-users under the status quo. This chapter briefly discusses the life-cycle assessment and costing methodologies and sources of data. The specific methodological steps taken and detailed calculations of estimating the cost of energy services are included in Appendices A to F; the questionnaires and the raw data acquired during the appliance cost surveys are in Appendices G and H.

Calculations of costs are based on available prices and costs, such as appliance life-spans, energy transformation efficiencies, average power output of, for example, stoves and heaters during their operational lives, and so on. As there are gaps in current data on energy services, particularly appliance costs, the project included a short primary data collection phase.

2.2 Methodologies

In introducing the selected methodologies utilised in this paper, it is necessary to discuss some of the more popular methodologies applied to the estimation of costs associated with the supply and/or use of fuels and appliances. These methodologies, although initially applied to the energy supply industry, are not exclusively confined to energy applications, but have generic applications to products and processes, and are used increasingly as management and accounting tools in industrialised countries.

The life-cycle assessment (LCA) and the life-cycle cost (LCC) estimate are the central focus. Other life-cycle tools are: life-cycle accounting, analysis, design, inventories, management, and review (LCA Source Book 1993: 112).

Product life-cycles can be organised into the following stages:

- raw material acquisition;
- bulk material processing;
- engineering and speciality materials production;
- manufacturing and assembly;
- use and service;
- retirement; and
- disposal (EPA 1993: 13).

The present study is primarily directed to the product use and service stage.

2.2.1 Life-cycle assessment

Life-cycle thinking and techniques can be applied to products, processes or systems in various ways. The most all-encompassing approach used in evaluating the implications of the products and processes is life-cycle assessment. This is the overall process of assessing the life-cycle impacts associated with a system, function, product or service (LCA Source Book 1993: 111). Described in another way, LCA is one of the tools used to examine the economic and environmental cradle-to-grave consequences of making and using products or providing services (SETAC 1993).

The LCA comprises a range of techniques promoted on the basis that they can help to assess a product's life-cycle economic costs (abbreviated to LCA_{econ}), social costs (LCA_{soc}) or environmental costs (LCA_{env}). Such analysis is often referred to as looking at the 'cradle-to-grave' impacts of products or systems (LCA Source Book 1993: 15).

The LCC estimate must be contrasted with the LCA and a life-cycle cost inventory (LCI). There are numerous tools that can be applied to the assessment of life-cycle costs and numerous perspectives from which they can be applied. For example, the suppliers' perspective could be explained as follows:

> [A] company may investigate the life-cycle cost of its products, for example, hoping to cut them - or to prove to customers that the high initial purchase cost will be offset by lower overall life-cycle costs. (LCA Source Book 1993: 15)

LCA typically includes four phases: initiation, inventory, impact assessment and improvement. These phases are called the four `Is' of LCA, which are expanded as follows:

1. the initiation phase – scoping a process to define the problem and establish the LCI and LCA objectives;
2. the inventory phase – which provides a detailed picture of the raw material, energy (and water) inputs, used by the system - and of the solid, liquid and gaseous wastes produced as outputs;
3. the impact assessment phase – linking inventoried inputs and outputs to real world environmental problems); and
4. the improvement phase – focusing on changes to the system to improve its overall environmental performance.

It is in the inventory stage where the system boundary is considered. In this respect (as well as in others) the LCA differs from the LCC estimate, which is used in this paper . The LCC is exclusively interested in the end-users' perspective, whose system boundary differs from that of the product or service supplier. The LCC could therefore be considered as a component of LCA.

2.2.2 End-user perspectives on life-cycle costs

> An essential part of the end-use oriented approach is the use of economic analysis techniques that allow for a rational comparison among supply, end-use efficiency, and energy alternatives. In the present conventional approach, supply expansion, energy efficiency, improvement and renewable alternatives are planned and implemented by different government agencies using varied and inconsistent economic criteria. The budgets for these activities are determined independently, largely according to fashion or for political reasons. This, together with energy subsidies, market imperfections, and institutional obstacles, leads to gross misallocation of resources. (Asian Development Bank 1994: 196)

The initial step in estimating the costs of appliance-fuel combinations is to select the most appropriate method to estimate the cost to end-users. The method must also provide cost estimates that will facilitate comparisons between different fuel and appliance combinations.

A simple approach to comparing the effectiveness of an appliance and fuel combination is the simple payback period (SPP):

$$\text{SPP} = \text{cost of conservation measure}/\{(\text{annual energy savings})*(\text{unit price of energy})\}$$

The investment is considered cost effective if the SPP is small – smaller, say, than three to four years.

This indicator has many drawbacks in that:

- it does not take account of the time value of money;
- it does not consider the useful life of the conservation measure;
- it does not compare the conservation measure with alternative investment opportunities open to the end-user;
- it omits the environmental costs of energy provision;
- it masks the tax and subsidy influences on the price of energy; and
- it cannot be used for direct investment comparisons even for end-users, as the lower SPP does not necessarily imply the better investment (Asian Development Bank 1994: 196).

Alternative assessments of cost include the Internal Rate of Return (IRR), Cost of Saved Energy (CSE) (also referred to as the Cost of Conserved Energy (CCE) (Gadgil & Januzzi 1992), Net Present Value (NPV), Life-Cycle Cost (LCC), and Annualised/Amortised Life-cycle Cost (ALC). The SPP, IRR and CSE (CCE) can only be used to make comparisons between two or more alternatives.[1] The ALC provides a common time base for comparison (something that the LCC does not). The ALC, while providing a measure by which a number of options providing identical classes of services can be compared, cannot be used to compare different energy services, like lighting and refrigeration.

The financial analyses have limitations which include foreign exchange implications, the cost of institutional changes, the cost of environmental and/or social impacts, employment consequences and the quality or convenience of the different energy services (Asian Development Bank 1994: 196-202).

In conclusion, the ALC indicator is used to measure and rank the comparative prices of the differing fuel and appliance combinations. In this paper the basis is not time, but rather the price per unit of the energy service (the exception here being the case of refrigeration). These comparative life-cycle costs per unit of service are referred to as LCCs. The step-by-step calculation is included in Appendix A.

2.2.3 The life-cycle cost estimate

The aim of the life-cycle costing exercise in this report is to estimate the cost of fulfilling energy services within the household in different urban centres in South Africa. The cost estimates are based on secondary and primary data, the former compiled by Simmonds and Mammon (1996) on a city-by-city basis, and the latter gathered as part of this study. The paper ranks the costs of the services in order to reveal where the largest savings can be affected.

The costs which are included in the LCC estimate are financial prices (purchase prices, costs of capital, etc.) of appliances and fuels. These prices include taxes, subsidies, and other transfers within the economy, but exclude social costs or costs to the environment (CO_2, NO_x, SO_x, and other emissions), health related costs (morbidity and mortality, poisonings and burns), fires, explosions, and so on. In an economic analysis, on the other hand, taxes and other transfers would be excluded, whilst social and environmental externalities would be included in the assessments.

Fuels/energy sources under consideration in this study are electricity, petroleum fuels (paraffin, liquefied petroleum gas (LPG) and candles), coal, wood, and solar. Appliances for cooking, water- and space-heating, lighting and refrigeration are likewise costed. Where this data could not be sourced for the South African context, comparable figures from elsewhere are utilised for approximations - the energy consumption of refrigerators on the South African market is just such a data gap, although projects are currently being undertaken which assess the energy performance of locally available refrigerators, freezers and combinations of these.

The end-users' costs are those experienced by end-users, as distinct from suppliers or the economy as a whole. They see only the direct financial costs of energy services; however, some of the costs which cover immediate externalities could be considered to be indirectly captured through taxes levied outside of the energy service arena. For example, income taxes are one way in which costs related to health problems amongst household members breathing polluted air can be captured. At the very least, the costs experienced by the user will include the price paid for the appliance and fuel. The life-cycle cost varies as:

- prices paid by consumers for fuels vary from one part of South Africa to another;
- efficiencies of the fuel and appliance combinations vary;
- there are ranges of retail cash and hire purchase prices paid for appliances; and
- the time that each appliance is in use each day differs from household to household.

The maxima and minima of each of these parameters are included in estimating the range within which the LCC is most likely to fall. Assumptions included in calculations are:

1 It is likely that some of these measures may be used in the next phase of work, where comparisons are required to inform policy.

- the durability of the appliance (in operative hours);
- an average power estimate (units of fuel per operative hour);
- a real discount rate (the rate may change if fuel switching is suggested in strategies). Rate changes are as a result of risks associated with the switch (Hasset & Metcalf 1993; Awerbuch & Deeham 1995);
- the distribution of the cost of gaining access to an energy service (such as the cost of an electricity connection);
- the division of the costs of electrical connections and solid fuel stoves between the different energy services – for example, 15-25% of the cost of the coal stove is attributed to space-heating; and
- the maintenance costs of appliances (these are assumed to be between 10 and 20% of the initial price of the appliance.

For the sake of simplicity, the mid-points of these variables are utilised in estimations of LCCs. The LCC's sensitivity to assumptions and variables that exhibit ranges is tested and reflected in Chapter 4. All costs are in 1996 Rands; where figures from previous years had to be used, these were brought forward to the 1996 baseline using consumer price indices for the intervening years.

2.3 Sources of data

The information required to produce LCC estimates includes: the retail price of fuels and appliances, the cost of finance, efficiency/efficacy of appliances, hours each year the appliance is in use, durability and maintenance requirements. With the exception of operational hours per year, durability and maintenance costs, these figures were obtained either through primary research undertaken as part of this study or from secondary data sources. Where gaps exist, assumptions are made.

A short primary research phase aimed at identifying the current price of the most popular appliances and the cost of purchasing these on hire purchase terms was undertaken (the questionnaire used, and the raw data are included in Appendices G and H respectively).

Sources of price data include the DMEA database. Appliance information is sourced from suppliers, manufacturers and the South African Bureau of Standards. As a last resort the recommended retail price and the product specifications are used as a basis for estimates. Specifications and test data are likely to belie the performance of appliances in situ, and as such remain a last resort. The cost of fuels is sourced from the parallel work of Simmonds and Mammon (1996) which synthesises much secondary data – notably on fuel consumption and prices in Johannesburg, Durban, Port Elizabeth and Cape Town.

3
Life-cycle costs of appliance-fuel combinations

3.1 Introduction

This chapter summarises the life-cycle costs of appliance and fuel combinations commonly used to fulfil domestic energy services in low-income urban South African homes. The services considered include cooking, water-heating and space-heating, lighting and refrigeration. The areas considered are the Johannesburg, Port Elizabeth, Durban and Cape Town metropolitan areas, the data is also aggregated to provide a national average for comparative purposes. The data are, where possible, presented in a graphic form in the text, with more detail on the steps taken in the estimation of the LCCs given in Appendices B to F. The LCCs are based on:

- prices of appliances;
- prices of fuels;
- hire-purchase charges (where relevant);
- discount rates;
- escalation in the prices;
- efficiencies of transformation of the fuel/energy source in the appliance; and
- fuel use per unit of operational time.

The sources of data include both secondary and primary research, technical specifications and best approximations. The fuel costs are taken from reports compiled within the last two to three years. These reports, by and large, each focus on a specific urban area in South Africa. In some instances, the prices were brought forward to 1996 values using appropriate price indices (Simmonds & Mammon 1996). The appliance data were gathered in Cape Town in a process designed specifically to inform this project (the questionnaire used for this process is included as Appendix G). The range of appliance costs include the price paid under hire-purchase agreements.[2] Conversion efficiency information is drawn from literature surveys. Finally, details of the fuels used per operational unit of time are informed by appliance specifications and secondary data.

3.2 Fuel prices

The fuels used in the life-cycle estimates are priced in the various urban centres. These prices are listed below and include value added tax.

[2] Hire-purchase agreements are most commonly concluded over a 12-21 month period at a rate between 28 and 31%. The lowest cost of appliances is the cash price; in contrast the highest price includes a 31% interest rate and payment over a 21 month period.

Fuel type	*Price by area (* indicates that no data was available)*											
	Johannesburg[1]			*Port Elizabeth*[2]			*Durban*[3]			*Cape Town*[4]		
	min	*mid*	*max*	*min*	*mid*	*max*	*min*	*mid*	*max*	*min*	*mid*	*max*
Electricity (c/kWh)	19.49	23	26.84	20.05	23	26.84	24.17	25.5	26.84	22.86	25	26.84
Connection costs (include deposits)	550	300	50	85	68	50	142.5	96.3	50	350.48	200.2	50
Loose candles (c)		50			*		48	50	54	35	50	65
Packet		252			*		*	*	*	*	*	*
Paraffin (R/litre)		1.67		1.48	1.75	2.02	1.40	1.53	1.66	1.04	1.27	1.50
Coal (R/kg)		0.23			*			*		0.50	0.53	0.55
Gas (R/kg)		3.78		3.6	4.25	4.89	2.45	2.8	3.15	1.66	2.66	3.66
Dry batteries (R)												
PM9		7.68			*			*			6.99	
PM10		10.92			*			*			*	
TP9		7.92			*			*			*	
PP10		16.99			*			*			*	
PP30		*			*			*			19.99	
R20PP		1.40			*			*			*	
R6PP		*			*			*			1.22	
Car batteries per charge for 12 volt battery (Rands)		5.29			*		4.65	5.46	6.26		5.00	
Wood (kg)		*			*		0	0.73	1.46	0.43	0.44	0.45

Notes

1. These are draft figures for a study being completed by the Palmer Development Group. Information is for an area about 160 km north-east of Pretoria.
2. Electricity, coal, paraffin and LPG prices are taken from SA Energy Statistics (1996).
3. Electricity prices are taken from SA Energy Statistics (1996) and other fuel prices are taken from Hoets and Golding (1992) and updated to 1995 levels using the CPI.
4. Paraffin, LPG, vehicle battery, dry battery and candle prices are taken from Mehlwana and Qase (1996). The electricity price is taken from SA Energy Statistics (1996). Coal and wood prices are taken from Cape Coal (Pty) Ltd (1996). The price ranges for coal and wood are based on collected versus delivered prices. Coal is sold in 40 kg bags for between R20.00 and R22.00, while wood is sold in 20 kg bags for between R8.50 and R9.00.

TABLE 3.1 Fuel prices in various urban centres of South Africa
Source: Simmonds and Mammon (1996)

These prices include 14% VAT but, in the case of gas, do not include the price of the larger LPG bottles as, technically, these remain assets of gas companies (the price of servicing the bottles is included in the price of gas) (SAPIA 1996). Similarly, the costs of electrical infrastructure and services which are not paid for in the price per unit are included in estimates. LPG bottles cost the following:

Gas bottles' numbers	Quantity of LPG (kg)	Quantity of energy (watt-hours)	Lowest price (excl. vat)	Highest price (excl. vat)
3	1.4	90	123	125.4
7	3.4	111	136.8	151.6
10	4.5	123	167.6	193.8
13	9	246	228*	228
larger			85.5 (deposit)	-

* Only one source of data was obtained for the no. 13 bottle price and the larger bottle deposits.

TABLE 3.2 The maximum and minimum price of LPG bottles
Source: Gas Master and Bellstar (1996)

3.3 Assumptions in estimating life-cycle costs

The LCC estimates can, and should, be provided as a range. Such a depiction is most realistic, as there are many influences on efficiency of energy transformation, prices of fuels and appliances, size and quality of pots etc., which are the reality of meeting energy service requirements. The prices of fuels which are unregulated (such as LPG, wood and coal) can vary from distributor to distributor. For example, LPG in Cape Town is recorded as being priced between R1.66 and R3.66 per kg. Likewise the price of wood can vary considerably from that collected at no financial cost to the end-user, to bundles purchased at a café or garage. Because of the dual economies of wood, it has been suggested that wood stoves and open fires be excluded from the comparison with other fuels in this paper.

To illustrate the ranges of LCCs, Figure 3.1 shows the LCC range for cooking appliance and fuel combinations used in Cape Town.

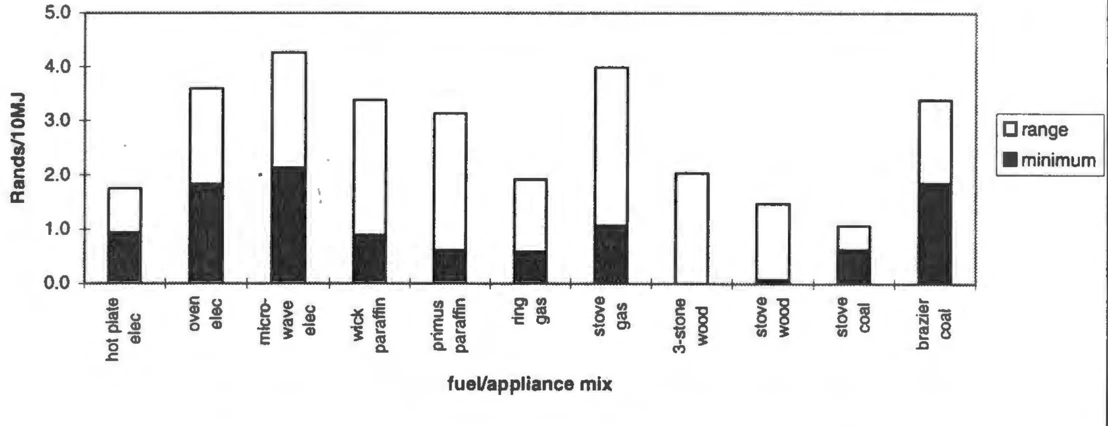

FIGURE 3.1 The range of LCCs for cooking fuel and appliances in Cape Town

Figure 3.1 while demonstrating the LCC realities provides little information for comparative purposes. To sharpen the estimates of costs for comparative purposes, the methodology employed utilises an arithmetic mid-point in the price ranges and efficiency for the calculation of the metropolitan areas and the national average. The ranges are reflected in the sensitivity analyses included in Chapter 4.

Assumptions and parameters which contribute to the range of prices for fuels and appliances are listed and discussed below.

1 Discount rates and price escalation

A constant real discount rate of 10% has been used. No price escalation have been assumed, so that the real prices of all appliances and fuels have remained constant relative to each other.

Similarly there is a zero increase in the escalation of operation and maintenance of appliances included in the LCCs.

2 Prices

Where required, prices are brought to a common 1996 base using the overall consumer price index. The CPI applies to all items purchased by low-income households, and is as follows: 1993: 8.6%; 1994: 8.7%; and 1995: 8.78% (Central Statistical Services 1995).

3 Maintenance

Similarly, there are insufficient empirical data on maintenance costs. Where such data are not available in the literature, an estimate of between 10% and 20% of the initial purchase price of the appliance is used to reflect these costs.

4 Replacements of parts of appliances

The costs of replacing all or part of an appliance or the infrastructure connecting the household to the electrical network should be incorporated in the LCCs. For simplicity, appliance replacements costs are considered to be part of the maintenance costs, whereas the present value of the replacements of the electrical connection are added to the LCCs separately. In cases where significant replacement costs are planned for such things as bladders for integral solar water heaters, batteries for photovoltaic systems, fluorescent bulbs (without the ballasts), these are factored in over and above the maintenance value through a replacement component in the LCCs.

The replacement costs of electrical reticulation are estimated over a 30-year lifespan.

5 Power factors

To complete a life-cycle cost estimate, a further assumption is needed – the average amount of energy consumed per hour of operation. To overcome the dearth of empirical data, 'power factors' were assumed for each appliance/fuel combination, where they could not be drawn from *Electrowise* (n.d.) data and other sources.

6 Hire-purchase

Hire-purchase costs are added to the high end of the appliance price range. The highest recorded increment is based on finance charges at 31% over a 21 month repayment period. This would typically result in an additional 47% increase to the price of the appliance. While the increment should be added on a monthly basis over the first 21 months after purchase, the cost estimate calculation instead adds 47% to the high end of the appliance price range (for larger appliances which are likely to be purchased on terms) to reflect the cost of financing the hire-purchase in addition to purchase price.

7 Connection cost and multi-utility appliances

In considering the connection and service costs of electricity, a question arises as to how this cost should be divided amongst the different energy services for which electricity could be used. A similar question arises when considering multi-utility appliances such as solid fuel stoves. This could be addressed by using one of the following methods:

- apportioning costs to the services in a ratio accorded to the proportion of electrical energy used;
- apportioning costs (in the case of electricity connection costs) in a ratio accorded to the power demanded by the different energy services; and
- using the 'power factor' and 'hours per day' ranges for each of the appliance/fuel combinations to calculate electrical energy consumption proportions.

Through the reconstruction of energy use utilising end-use survey data (Simmonds & Mammon 1996), the consumption and demand for the different fuels can be estimated. For electricity connection costs, the demand estimates are utilised (as the sizing of the infrastructure is designed with reference to after diversity maximum demand). For solid fuel stoves, the energy consumption for the different services are used to disaggregate the costs between end-uses.

The disaggregation of these costs has been estimated in accordance with delivered energy consumption ranges and is as follows:

Energy service	Electrification	Coal/wood stoves
Cooking	25 to 30	20 to 40
Space-heating	15 to 20	20 to 40
Water-heating (for solar/elec. heaters)	35 to 45 (0.15 to 0.25)	30 to 50
Lighting	5 to 10	-
Refrigeration	5 to 10	-

TABLE 3.3 The percentage division of multiple utilities to different energy services
Source: estimates drawn from Simmonds and Mammon (1996)

8 Space heating seasons
In the calculations of the space-heating LCCs it is necessary to provide a space-heating season. For the sake of the calculations these are estimated for the 'min', 'mid' and 'max' scenarios to be 2, 3 and 4 months for Durban, and 4, 5 and 6 for the remaining three cities.

9 Other costs
As the LCC estimates are undertaken from an end-use perspective, all costs reflected in the calculations include taxes. This additional cost would not be included if a national economic or societal perspective was taken, however; in such an instance, other costs which impact on society, like environmental costs, would need to be reflected. For the present, no adjustment has been made for these items.

3.4 Life-cycle cost estimates of energy services

The LCC estimates for cooking, water- and space-heating, lighting and refrigeration which follow are provided for a national average and then disaggregated to show the differences between Johannesburg, Durban, Port Elizabeth and Cape Town. The estimates of cost are expressed as follows:

- for thermal energy services: Rands per unit of useful energy;
- for lighting: Rands per 1000 lumenhours;
- for refrigeration: Rands per litre (normalised for a 200 litre fridge/freezer).

Detailed calculations are included in Appendices B to F. The LCCs are arranged in ascending order to facilitate easy identification of financial cost rankings. For purposes of this ranking, the Johannesburg LCCs are used as the sorting costs.

3.4.1 Cooking

The range of appliances considered are those using electricity, paraffin, LPG, wood, and coal. The prices of these fuels vary from city to city, and in some instances so do the prices of appliances (good examples are coal stoves). However, appliance prices are maintained constant for each urban area.

The classes of cooking appliances considered include:

- top cookers: electric hot plates;
- gas and paraffin cookers;
- solid fuel stoves;
- electric and gas ovens; and
- microwave ovens.

Within each of these classes of cooking appliances there are sub-classes. Sub-class distinctions are necessary to define so as to be able to provide justifiable comparisons. For example, the energy performance of a large oven will be different from that of a small oven because of the heated surface area-to-volume ratio. (In general, South Africa ovens appear to be oversized for daily services.) Likewise, pressurised paraffin cookers primus will display a different performance pattern when compared with a wick cooker. For the sake of simplicity, many of the sub-classes are aggregated into the broader categories mentioned above. The quality of service is assumed to be equivalent across the appliance range.

The prices of appliances utilised in the LCC estimates are listed in the table below. This data was collected in Cape Town using the questionnaire in Appendix G which captured the raw data appended in Appendix H.

Class of cookers	*Lowest price (excl. vat)*		*Highest price (excl. vat)*	
Top cookers: electric hot plates	109	Pineware 1021	395.9	Philips
Gas cookers	25	cooker top and No.3 bottle	55	cooker top and No. 13 bottle
Paraffin cookers (wick)	23	Flame single	221	Beatrice
Paraffin cookers (pressure)	64	local primus	221	imported Primus
Solid fuel stoves (cast iron)	1 516	Falkirk Dover No. 6	3 071	Falkirk Dover No. 88 smokeless
Brazier and 3-stone fire	0		0	
Electric ovens	1 399	Estia	3 921	Defy 131
Gas ovens	690	*	3 675	*
Microwave ovens	639	Daiwoo 60s	3 821	Sharp R851

TABLE 3.4 Cooking appliances and their prices
Sources: Various appliance retailers and wholesalers (see Appendices B to E)

The LCC estimates are best described graphically. The national average LCCs for cooking are included in Figure 3.2 below.

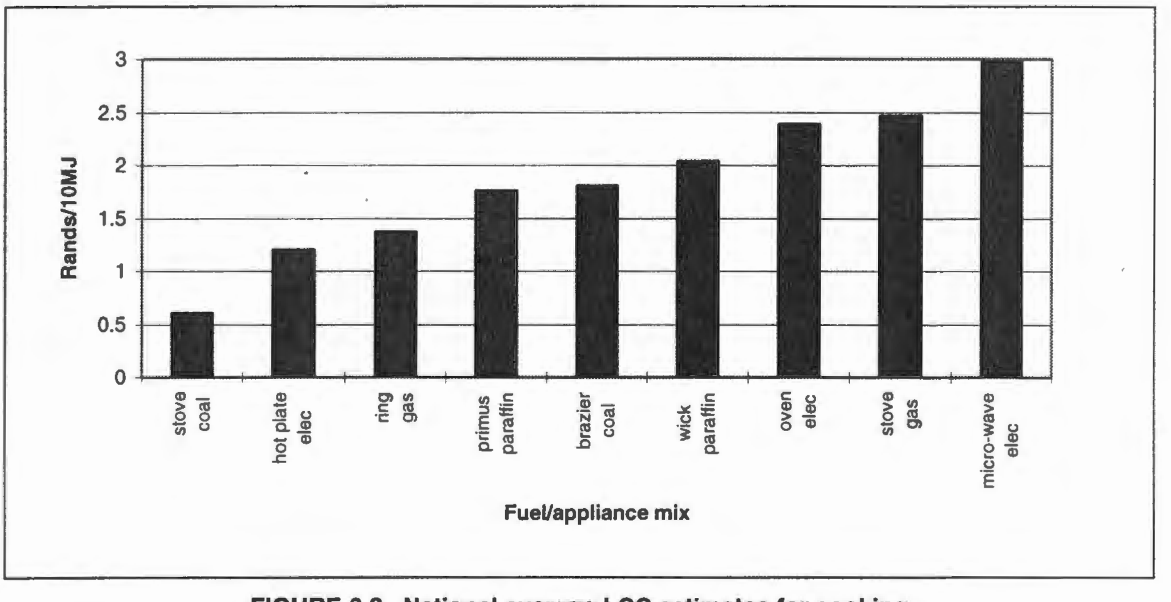

FIGURE 3.2 National average LCC estimates for cooking

Figure 3.2 shows the life-cycle estimates for cooking for the middle of all ranges for an aggregate value of all four urban areas. Figure 3.3 shows the regional variations in LCC for the different metropolitan areas. The ranking is from lowest to highest cost for Johannesburg.

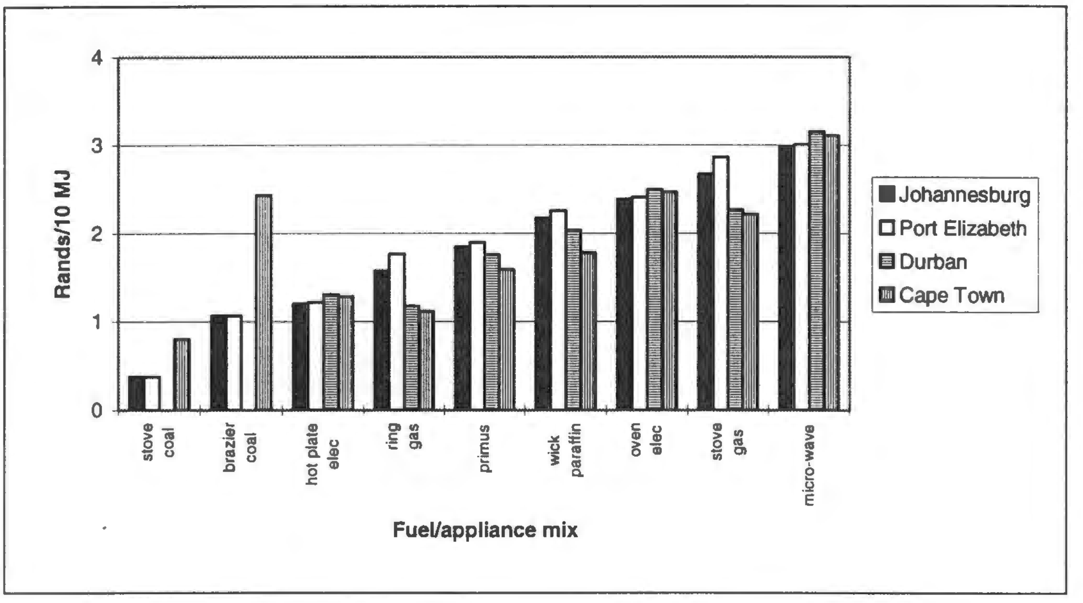

FIGURE 3.3 Life-cycle cost estimates of cooking

Predictably the lowest LCCs are those for coal-burning appliances. The coal based cooking LCCs are followed by the electrical hot-plates and gas rings. It is apparent that gas is expensive in Johannesburg, where the LCC is considerably higher than Durban and Cape Town. In these cities gas rings are cheaper to use than in Port Elizabeth and Johannesburg where electric hot-plates would appear to be a better option.

The LCCs of the electric and gas stoves and ovens are jeopardised by comparatively high first-costs. The high LCC of the micro-wave could be attributed to the low utilisation time per annum in relation to a high capital cost.

The LCC regional variations are most apparent in the case of coal (between Johannesburg and Durban) and shows the lowest variation in the case of electrical appliances.

3.4.2 Space-heating

There are a variety of classes of space-heaters considered in this section:

- electric, gas and paraffin radiant heaters;
- electric fan and convection (finned) heaters
- electric heat-pumps;
- solid fuel appliances without chimneys; and
- solid fuel appliances with chimneys.

Not considered are passive design features which could mitigate heating requirements or replace them entirely in some of South Africa's climatic zones.

Space-heating is a complex issue as it is a service often incidentally derived from other energy services, such as cooking or water-heating. In fact, a large proportion of the thermal energy involved in providing these services will end up as space heat. Sometimes this is a benefit, while at other times it is not - for example, during hot periods of the year. The range of contribution to space-heating of, for example solid fuel stoves, is estimated in the life-cycle estimates. The life-cycle estimates illustrated below consider only the benefits of space-heating during a 4-6 month (2-4 month in the case of Durban) annual heating season. The multi-utility feature of cooking appliances is most notable for appliances such as coal stoves, which in winter are also heavily relied on as space-heaters.

In South Africa, electric space-heating appears to be of increasing concern for the electricity supply industry, which experiences annual peak demands coinciding with the coldest evenings of the year. This trend will undoubtedly be exacerbated as access to electricity increases.

The LCC estimates for the different classes of space-heating appliance/fuel combinations in the various urban areas are illustrated below. Detailed spreadsheets of the data behind these calculations are presented in Appendices B to F. Table 3.5 is a list of common space-heaters and their prices.

Class of space heaters	*Lowest price (excl. vat)*		*Highest price (excl. vat)*	
Electric				
Radiant heaters	40	Nu world 800 watts	278	De Longhi
Oil-filled heaters	229	Saisho 9 fin	836	MCE 11 fin
Fan/blower heaters	149	De Longhi	219	De Longhi
Gas heaters	124	Safire	647	Bosch Rollabout
Paraffin heaters	20	Rondowick	50	Rondowick
Electric heat-pumps	6 000	*	8 000	*
Solid fuel appliances without chimneys (brazier)	0	self-made	0	self-made
Solid fuel appliances with chimneys	714	Falkirk Queen Anne	3 502	Falkirk Dover No. 88 smokeless

TABLE 3.5 Space heaters and their prices

Figure 3.4 illustrates the national average LCC for space-heating.

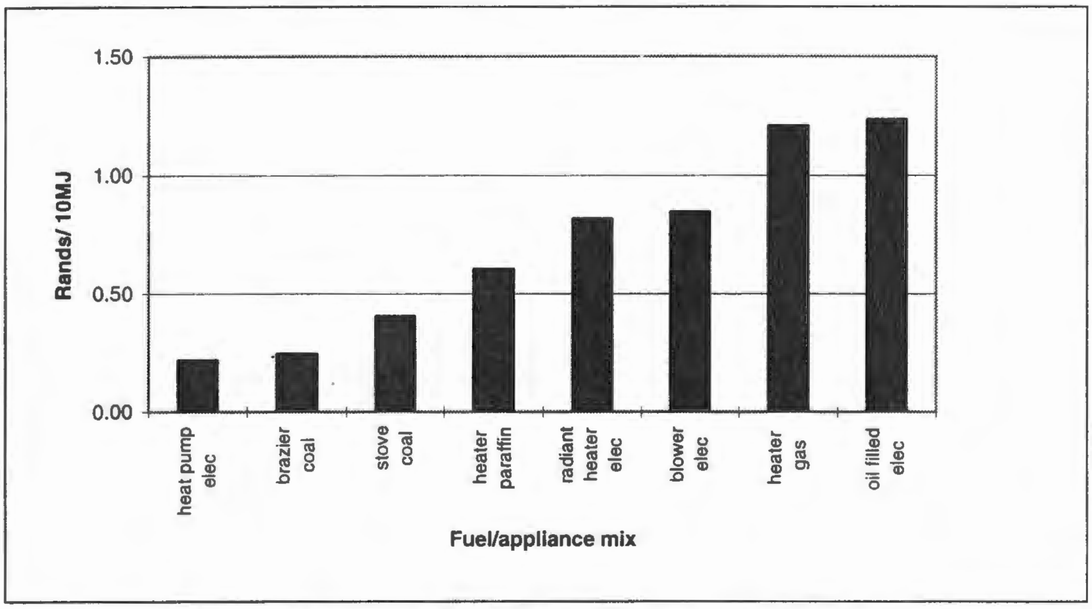

FIGURE 3.4 National average LCC estimates for space-heating

Figure 3.5 shows the fuels and appliances used for domestic space heating in the four urban areas.

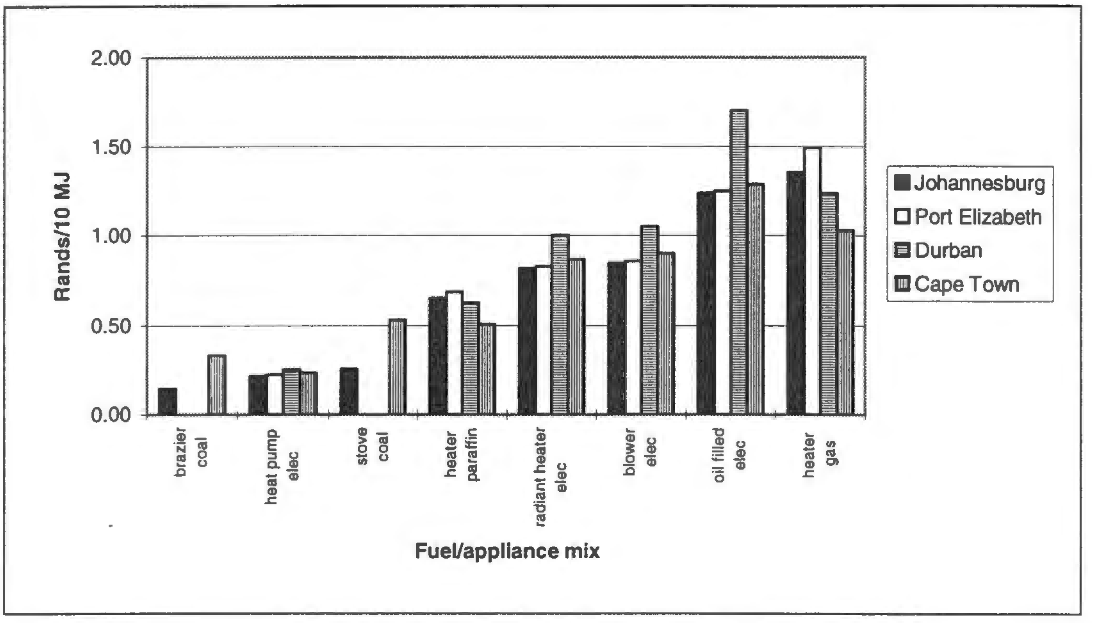

FIGURE 3.5 The life-cycle cost estimates of space heating

The lowest financial cost incurred by users to meet their space heating needs is associated with the use of electric heat pumps, coal and wood. The lowest cost is the heat pump followed by the coal brazier which, though cheap, is extremely smoky. Both coal and wood burned in this manner would emit almost all their heat to space-heating, but the crude 'appliance' does not have a chimney. In the present LCC analysis these negative externalities are not reflected, but their consideration could, in principle, lead to a different ranking of options.

After the solid fuels, the electric heat pump provides a good option, but heat pump applications are currently limited to locations where large space-heating loads are desirable. Applications of this technology, which is very costly in first-cost terms, would be limited to multi-family dwellings (such as hostels) or commercial buildings.

Paraffin heaters appear to be a good option before the other electric heaters, and gas is the most costly. In almost all cases, the LCCs in Durban are higher than elsewhere because of the shorter heating season.

3.4.3 Water-heating

Water heating is the last of the thermal energy services to be considered. This service can be provided using the following classes of water-heating systems:

- electric hot-water storage geysers;
- solar/electric hot-water storage geysers;
- solar-only hot water geysers;
- electric and gas in-line instantaneous water heaters;
- water heating using solid fuel stoves with a hot water jacket; and
- water heating in a pot on an electric, paraffin, coal, wood, or gas cooker.

Class of water heaters	*Lowest price (excl. vat) (* includes installation costs)*		*Highest price (excl. vat) (* includes installation costs)*	
Electric hot water storage heaters	1 117	Kwikot ("sinkhot") 100l, 100 kPA	2 309	Kwikot 200l 100 kPA
Gas hot water storage geyser	4 800	Valiant 190l (8.2 kW)	5 000	Valiant 220l (8.6 kW)
Solar/electric hot water geysers	4 676*	Sol Energy 200l 200 kPA	6 195*	Mikado 200l (3 kW)
Solar only hot water heaters	482*	Sol Energy 100l	1 234*	Sol Energy 100l
Electric in-line water heaters	820.8	AEG MT 60 5.75 kW 3.1 l/min	1 098	AEG DD LT 18/21 kW, 10.5 l/min
Gas in-line water heaters	1 117	Junker 5l/min	2 849	Valiant 275 10 l/min
Solid fuel heater with water jacket and high pressure boiler	1 835	Falkirk Union No. 9	3 406	Falkirk Dover 88
Heating in pot on electric, coal etc.	see cooking above			

TABLE 3.6 Water heaters and their prices

Figure 3.6 illustrates the national average LCCs for water heating options.

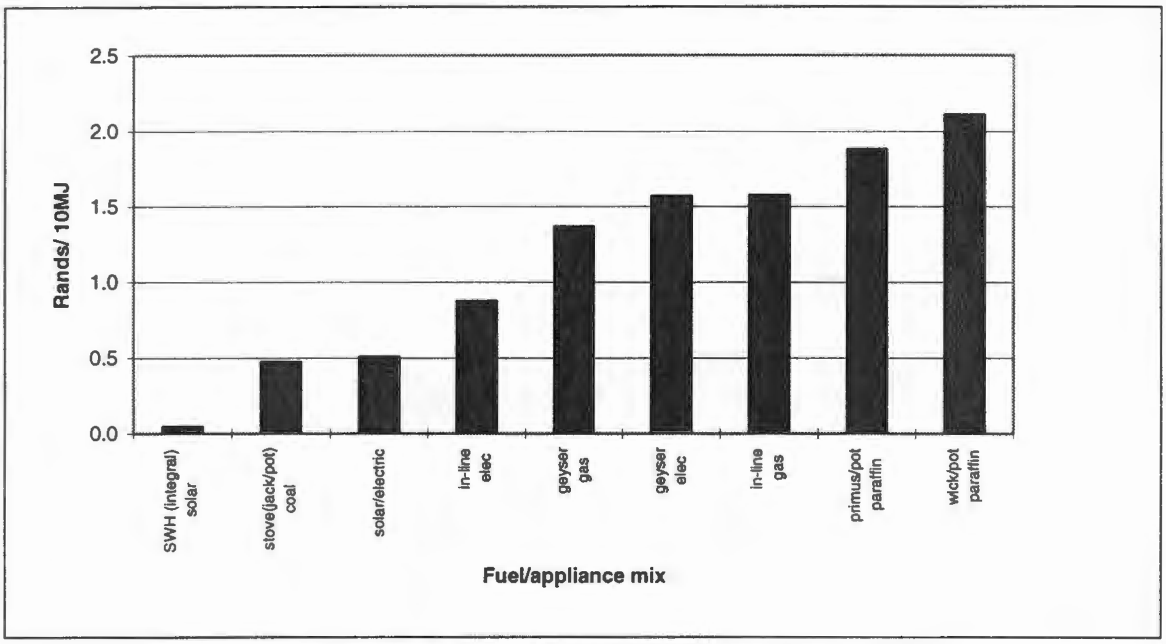

FIGURE 3.6 National average LCC of water heaters

The LCC estimates for the different classes of water-heating appliance/fuel combinations in the various urban areas are illustrated below in Figure 3.7. Detailed calculations behind this figure are in Appendices B to F.

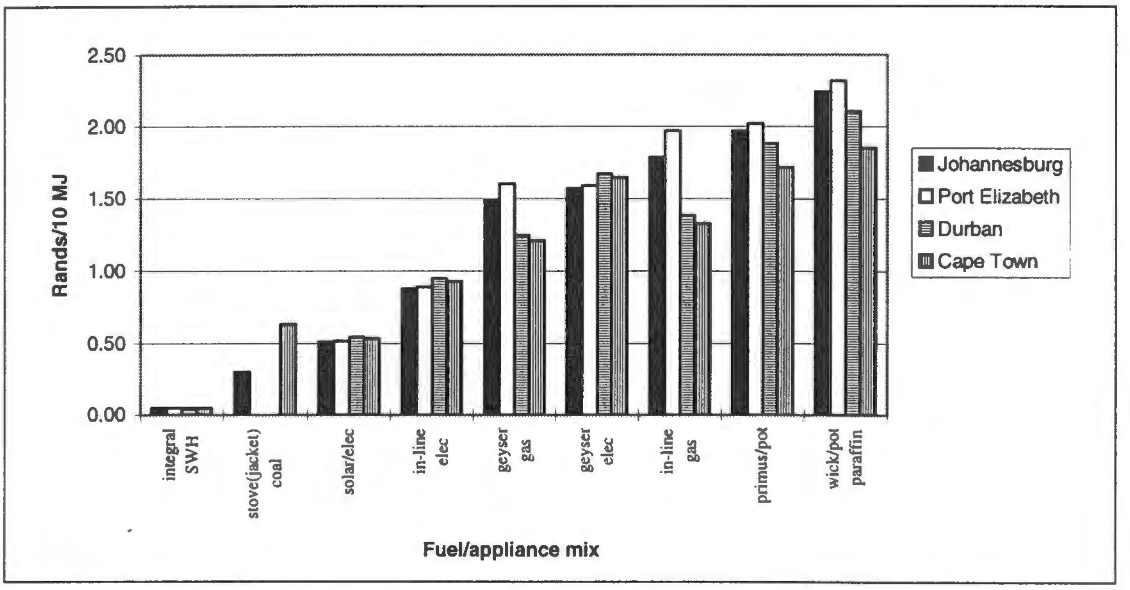

FIGURE 3.7 The life-cycle cost estimates of water heating

The lowest cost option for water-heating is the integral solar water heater. However, it is perhaps unfair to compare this class of heater with other water-heating systems because hot water will not always be available on demand. This is similarly the case for the second-lowest option, the water jacket (with high pressure boiler) on the coal stove, which is in a similar class to the integral solar water heater in that a fire would have to be ignited prior to the water being heated and this may take some time - in other words a coal stove also does not provide hot water on demand.

Next is the solar/electric water-heater which tops up the solar energy shortfall with electricity, combining the best of cheap solar energy and hot water on demand. Solar electric water-heaters have high first-costs which would constitute a considerable barrier for low-income households, unless the purchase is arranged through a housing bond or some other facility at the time of purchase.

The hot-water storage geysers using gas and electricity respectively follow the electric in-line heaters, which, while not expensive in first-cost terms, have high power demands which are, for the larger flow systems, only available where three-phase electricity connections are in place. Three-phase is a technology option being decreasingly utilised in newly electrified households. Low-income households are more and more frequently being connected to 20 Amp single-phase supplies, which facilitate only very low-flow in-line heating – typically less than 5 litres per minute.

After the gas in-line heaters, paraffin options on conventional multi-purpose primus and wick stoves are the next lowest cost options.

3.4.4 Lighting

The classes of lighting considered are:

- electric incandescent;
- electric fluorescent;
- candles;
- paraffin wick;
- paraffin pressure; and
- gas lamps.

Class of lighting	*Lowest price (excl. vat)*		*Highest price (excl. vat)*	
Electric incandescent				
60 watt	2.10	*	2.70	Philips
100 watt	2.17	*	3.00	Mercury
Electric fluorescent				
10-11 watt	53	Mercury	68.39	Sanji
13 watt	53.98	Philips	54.99	Mercury
18 watt	56.99	Philips ES	68.39	Sanji
Candles	0.35		0.65	
Paraffin wick	8	Hazel lamp	14	*
Paraffin pressure	199	Coleman	239	Coleman
Gas lamps	64	Cadac 100 cp	105	Cadac 300 cp

TABLE 3.7 Light sources and their prices

The LCC estimates for the different classes of lamp/fuel combinations in the various urban areas are illustrated below in Figures 3.8 and 3.9. A detailed spreadsheet of the data behind these figures is presented in Appendixes B to F.

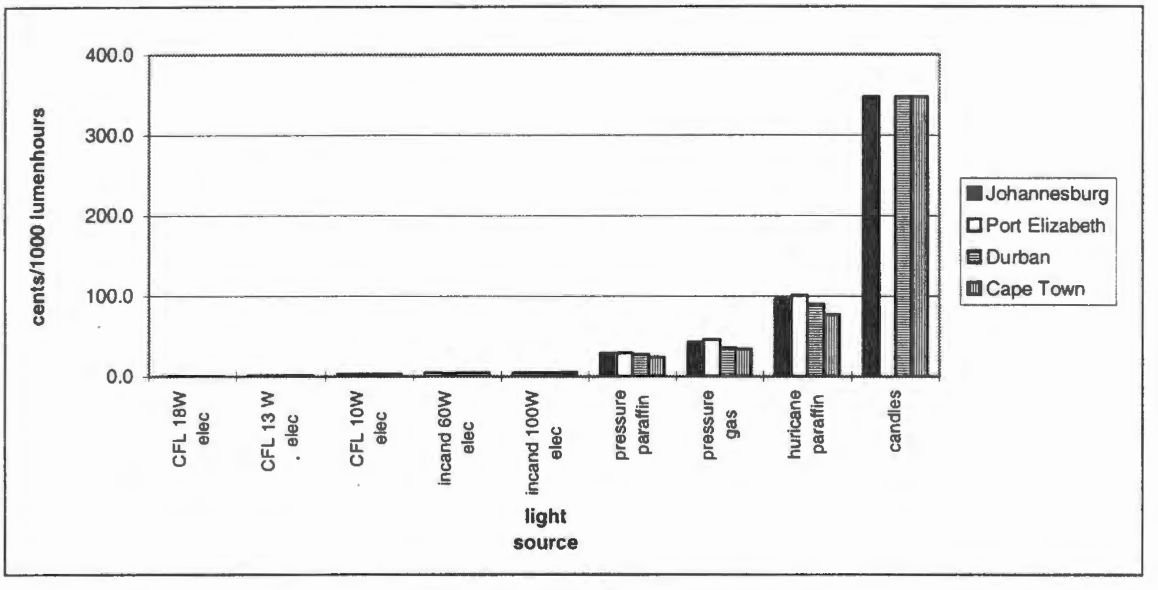

FIGURE 3.8 The life-cycle cost estimates of lighting

The results reflected in Figure 3.8 are clear-cut. The electric options are considerably lower-cost options than the others per unit of light output. Paraffin and gas pressure lamps follow with comparable costs. Candles are the most expensive after paraffin hurricane lamps. It is questionable, however, whether the methodology for evaluating the cost of light should not be costs per light source, regardless of the *quality* of lighting service provided. Cowan et al (1992) estimate these costs, which reflect a close correlation between electric lighting and candles as *light sources*.

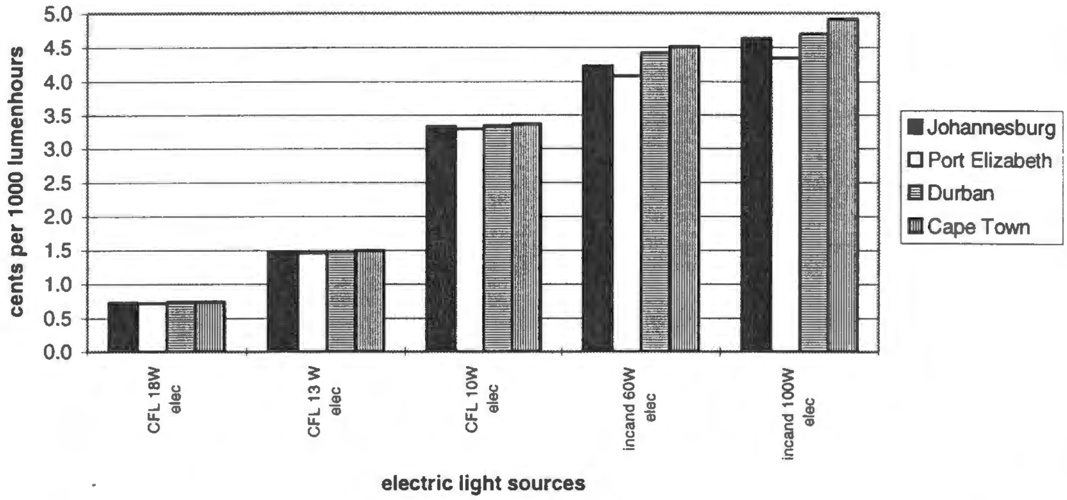

FIGURE 3.9 The life-cycle cost estimates of some electrical lighting options

Figure 3.9 shows the costs of the least-cost electric lighting options. The compact fluorescents (CFLs) of higher efficacy, cost in life-cycle terms about one-eighth of the incandescent options with similar light outputs. Unfortunately CFLs have a low penetration, once again as a result of their initial purchase prices, which are often 20 times those of the incandescents. The penetration of CFLs is likely to remain low unless this barrier is addressed.

The variation between the life cycle-costs from city to city are low enough to make an national average comparison unnecessary.

3.4.5 Refrigeration

The classes of refrigerators costed include:

- electric 250 to 300 litre fridge/freezers;
- electric 330 litre upright freezers;
- electric 120 to 300 litre chests freezers; and
- gas or paraffin absorption fridges/freezers.

Class of fridge/freezer	*Lowest price (excl. vat)*		*Highest price (excl. vat)*	
Electric 250 to 330 litre fridge/freezers	1 599	Fridgemaster 255	3 820	KIC 265
Electric upright freezers	2 339	Kelvinator FA 330	3 838	Kelvinator FA 330
Electric 120 to 300 litre chests freezers	999	KIC 210 and Defy 210	2 718	Defy 420
Gas absorption fridge/freezers	1 400	KIC 110	3 675	KIC 220

TABLE 3.8 Refrigerators/freezers and their prices

As there are very little data on the efficiency of refrigerators sold on the South African market, the range of efficiencies of refrigerators of comparable size and class is used as an approximation. This approximation is partly flawed in that the countries in which the energy efficiency of appliances are available are most likely to be countries with either (or both) appliance labelling schemes and/or minimum energy performance standards. In 16 countries comparative or endorsement labels do exist (Duffy 1996), but even then the testing procedures may have little correlation with the real performance of the appliance in use. Refrigerators demonstrate the fallibility of transforming test data to in situ data as performance is sensitive to ambient temperatures. For example, the European Union refrigerator standard ISO 5155 - 1983, conducts tests at 25°C and Australian standards at 32°C. The European test requires a fully loaded fridge while the Australian test method requires standard packing of the fridge.

Currently Eskom is testing a range of the most popular fridges sold in South Africa to obtain a performance baseline for an energy performance labelling feasibility study (Smoog 1996). Initial estimates of efficiencies of South African refrigerators and freezers utilised in the estimates was sourced from Power People Manufacturers (1996). This data is not documented, but it is the only available data on the energy performance of refrigerators available in South Africa at the time of writing.

A possible way of estimating the energy consumption of South African refrigerators is to multiply the rated power consumption of the compressors by a factor of between 0.5 and 0.8. Fridgemaster, which enjoys the largest portion (nearly 40%) of the South African refrigerator market, uses a 50% to 80% running time rule-of-thumb in matching fridges and compressors (Shear 1996). Power People Manufacturers (1996) indicate that from their energy performance tests of refrigerators, energy consumption differences between the most and least efficient fridge in South Africa is in the region of a factor of 10 for similar classes and volumes!

Figure 3.10 illustrates the national average LCC of domestic refrigeration equipment.

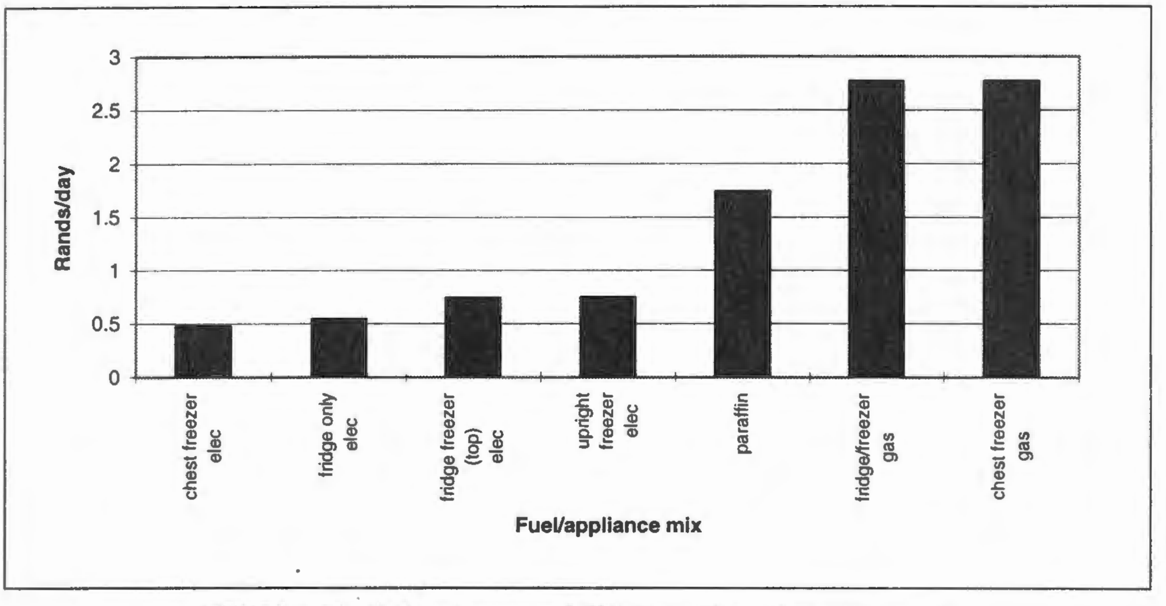

FIGURE 3.10 National average LCCs for refrigeration equipment

The LCC estimates for the different classes of refrigerator/fuel combinations in the various urban areas are illustrated below in Figure 3.11. A detailed spreadsheet of the data behind these calculations is presented in Appendixes B to F.

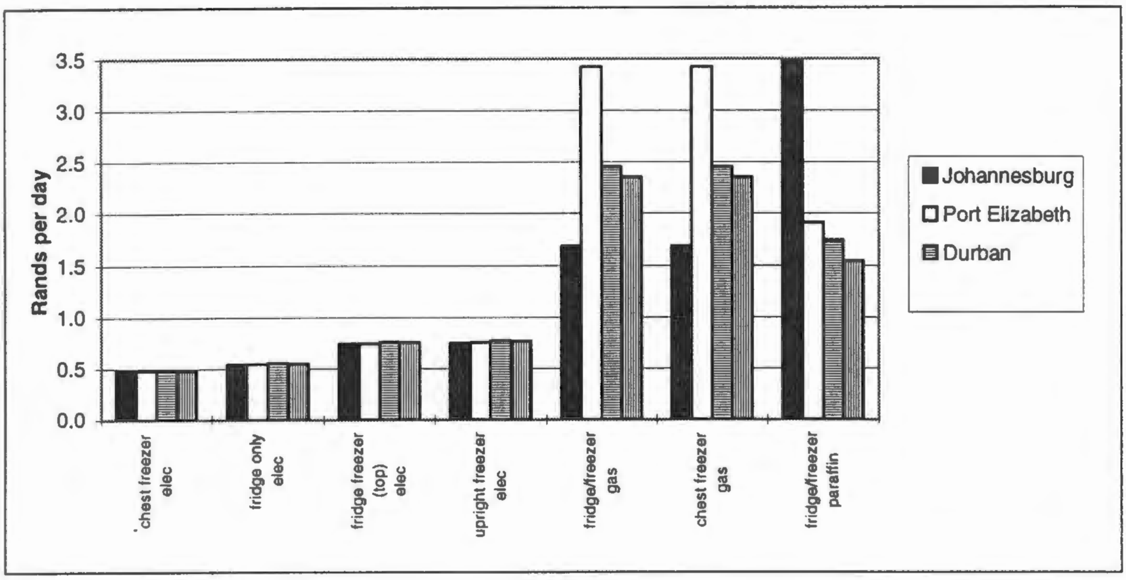

FIGURE 3.11 The life-cycle cost estimates of refrigerators

It is apparent from the figure that electric fridges and freezers and fridge/freezers have LCCs less than half those of the gas and paraffin absorption refrigerators. As with lighting, electrical options are far less expensive for users over the life of the appliance. Chest freezers, that usually have 10 cm of insulation material and are top-opening, have the best performance.

3.5 Conclusions

Chapter 3 has presented the financial life cycle costs of various appliance-fuel combinations, using many assumptions pertaining to key variables.

There are some conclusions from the LCC analysis:

- A wide range of life-cycle costs can be expected for any single appliance fuel combination.
- In the majority of the cases, the present value of operational costs are larger than the present value of initial costs. Exceptions to this include (most notably) microwave cooking, in which appliance costs dominate.
- For cooking, coal has the lowest LCC in Johannesburg and Port Elizabeth, followed by electric hot-plates and gas burned on a ring. In Durban and Cape Town, the gas price is low enough to make cooking with gas a better option than with electricity.
- In water-heating, solar water-heaters provide the lowest financial cost options. Electric hot water storage geysers have comparatively high LCCs.
- For space-heating, electric heat-pumps, followed by coal used in a brazier or a stove, have the lowest LCCs.
- For lighting and refrigeration, grid connected electrical options have lower LCCs than the other options.

4
Sensitivity analysis

4.1 Sensitivities of life-cycle costs

The LCC estimate is subject to a number of assumptions and parameters that can have a range of values. This chapter sets out to assess how sensitive the LCC estimate is to some of these assumptions and parameters. In undertaking the sensitivity analysis, the LCC is estimated by changing one variable across a range while all other variables and assumptions remain constant. The variables and parameters against which the LCCs are tested in this sensitivity exercise are:

- the price of the fuel;
- the price of the appliance;
- the appliance efficiency;
- the rate of consumption of fuels;
- the durability of the appliance; and
- the discount rate.

For the first three variables listed above, a range is defined in the LCC calculations. The mid-point of this range was used for demonstrating the average LCC (described in Chapter 3), but for the sensitivity analysis five equidistant increments are set between the maxima and minima, at which the sensitivity is tested. This method thus provides six points at which sensitivity is tested. The result of the test is presented as the percentage change in LCCs using the LCCs at the bottom of the range as a baseline. A second presentation of sensitivity shows the effect on the LCC of five appliance combinations – coal stove, paraffin wick and primus, gas ring and electric hot-plate for cooking at minimum, mid and maximum points on the variable's range. In the case of the last three variables, an estimate of the reasonable fluctuation in the parameter is also divided into four increments. For example, 8, 12, 16, 20, and 24% increments for the discount rate analysis, and 5, 15 and 25% above and below the mid-point are used for assessing the sensitivity to variable durability.

Rather than conduct sensitivity analysis on all the estimates for all the urban areas, the national average LCCs for cooking serve as the test case. Figure 4.1 describes the connection cost, maintenance cost, operation cost and appliance price contributions to the LCC for cooking appliances. It is evident that the operational costs and appliance prices dominate the LCC, and that the ratio in the majority of cases is weighted towards a larger contribution from the operational costs.

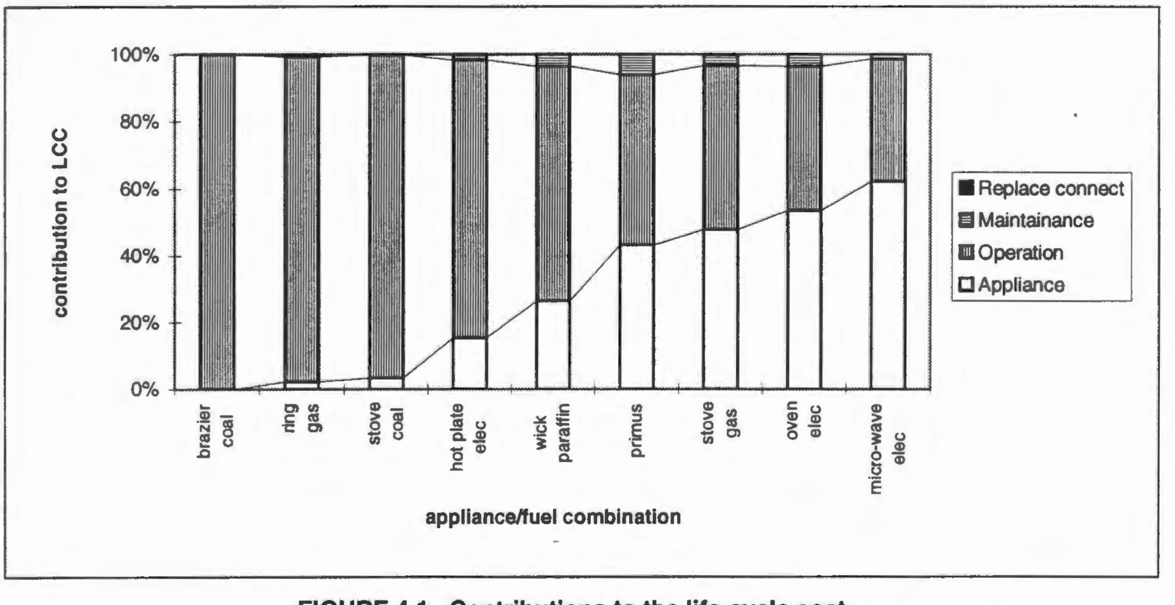

FIGURE 4.1 Contributions to the life-cycle cost

Table 4.1 summarises the variables and the ranges and increments at which the life-cycle costs were tested.

Variable	*Top of the range*	*Bottom of the range*	*Increments*
Price of the fuel	home light 1 (in most cases)	municipal tariff	20%
Price of the appliance	highest price	lowest price	20%
Efficiency	most efficient	least efficient	20%
Durability	25% above listed estimate	25% below listed estimate	10%
Discount rate.	24%	8%	4%

TABLE 4.1 Sensitivity variables, ranges and increments

4.1.1 Sensitivity of life-cycle cost estimates with respect to variable fuel prices

The sensitiyity of the LCC is tested with respect to increasing fuel prices. The result of the exercise is illustrated in Figure 4.2.

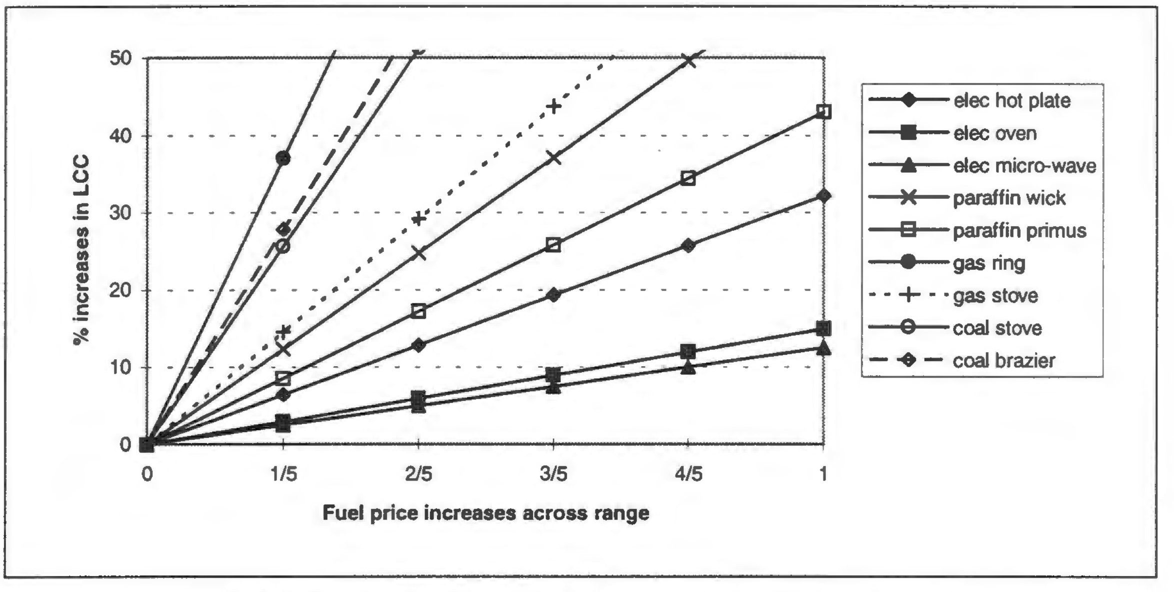

FIGURE 4.2 Life-cycle cost sensitivity to fuel price variations

The increase in the price of fuel results in increasing LCCs for all fuel/appliance combinations. In the case of the gas ring, the sensitivity analysis revealed pronounced increases of up more than 50% as the fuel price was increased across the range of fuel prices. The high sensitivity of gas could be attributed to the broad fuel price range of between 1.66 and 3.66 Rands per kilogram. In addition, when referring to Figure 4.1, the gas ring shows that more than 90% of the LCC is made up of the operation cost component, which further exacerbates the sensitivity to fuel price. For the other appliances the range is far more modest, with the least variation being displayed by the electrical appliances, of which the oven and micro-wave oven display the lowest operation components in the LCC. Electricity prices are confined to a relatively narrow price range which further desensitises life-cycle cost to fuel price variations.

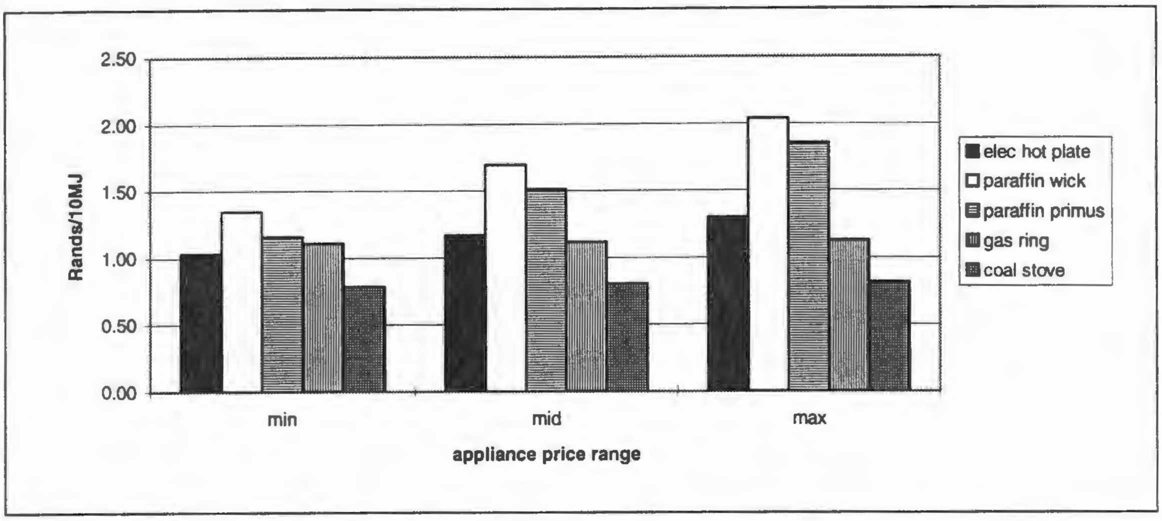

FIGURE 4.3 Effects on LCC of varied fuel prices

Figure 4.3 is derived from Figure 4.2 by converting the % increases into Rands per 10 Megajoules reflecting the LCC at the lowest, mid and highest prices in the fuel price range. It also visualy reveals the high sensitivity of the LCCs of gas- and paraffin-based cooking to fuel price increases, while electrical and coal based cooking show little sensitivity.

4.1.2 Sensitivity of life-cycle cost estimates with respect to variable appliance prices

The sensitivity of the LCC is tested with respect to increasing appliance prices. The result of the exercise is illustrated in Figure 4.4.

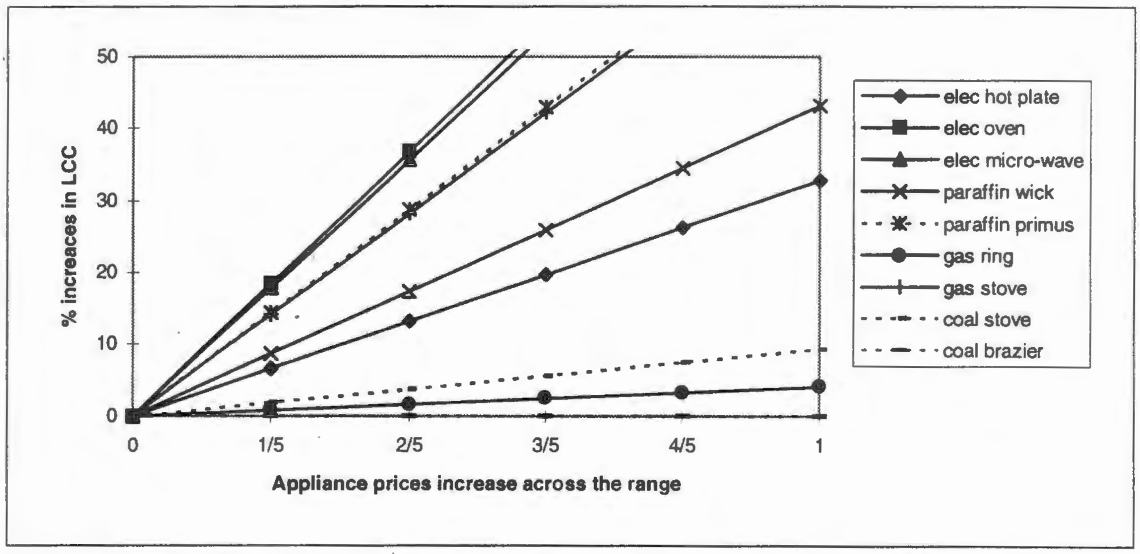

FIGURE 4.4 Life-cycle cost sensitivity to appliance price variations

As was seen in the case of fuels, an increase in the price of appliances results in an increase in LCCs, the most pronounced increases appearing where the range of prices of the appliances is the largest. This is the case with both paraffin appliances which, though modestly priced, have a wide price range between local and imported goods. Low sensitivity to appliance prices are revealed in the cases of the coal and gas burning appliances. Figure 4.5 shows the actual LCC variations across the range for cooking appliances.

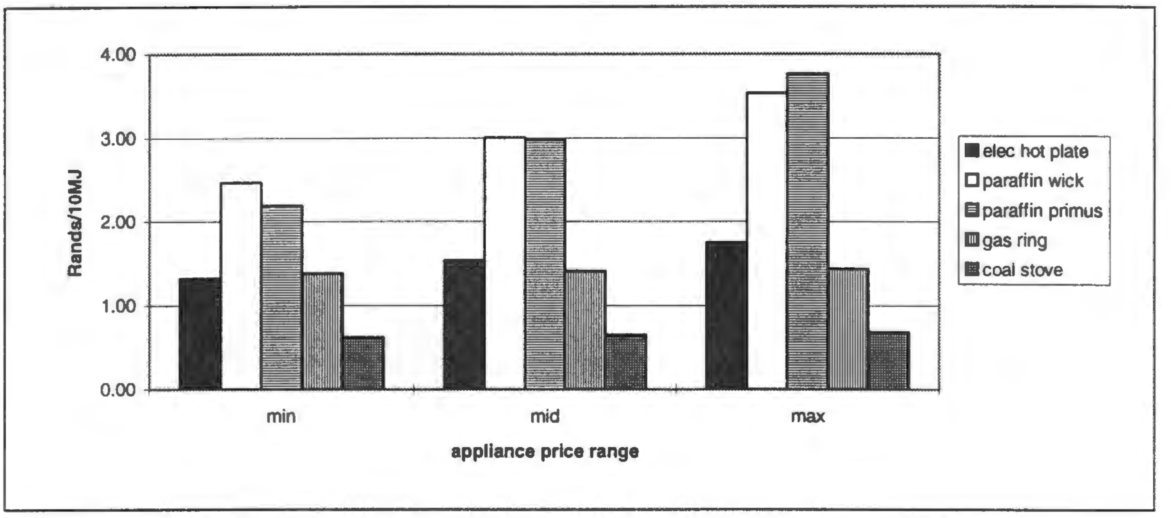

FIGURE 4.5 Effects on LCC of varied appliance prices

Figure 4.5 shows the higher sensitivity of paraffin cooking appliances and the lower sensitivity of coal- and gas-based cooking to variations in the price of appliances. Coal stoves have the lowest LCC across the appliance price range.

4.1.3 Sensitivity of life-cycle cost estimates with respect to variable efficiency

The sensitivity of the LCC is tested with respect to increasing appliance efficiency. The result of the exercise is illustrated in Figure 4.6.

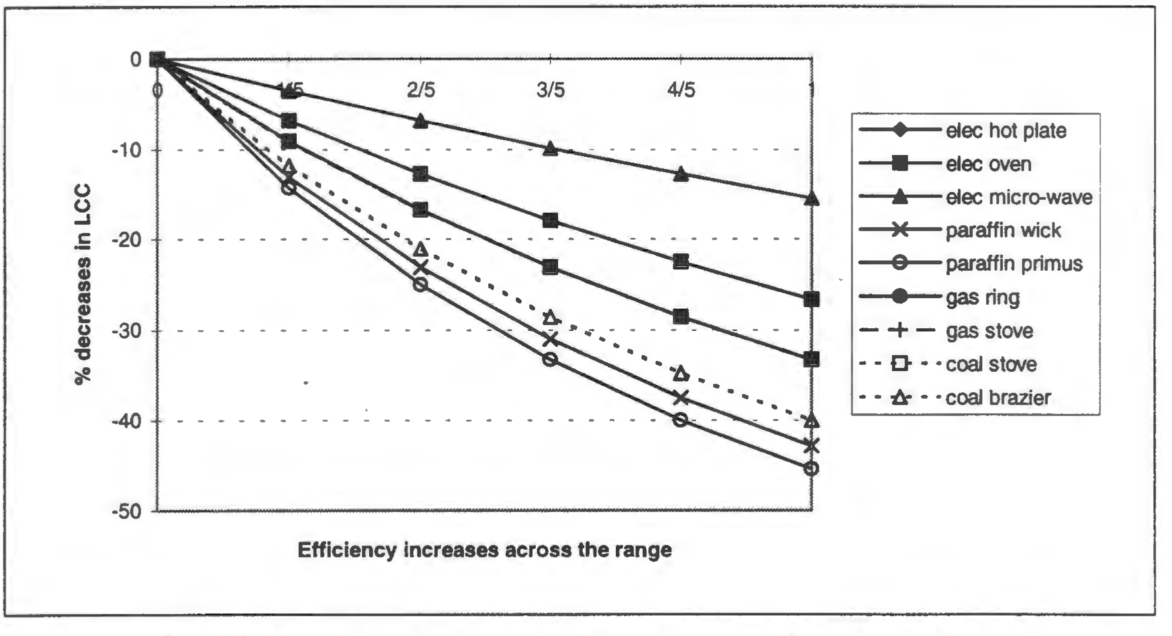

FIGURE 4.6 Life-cycle cost sensitivity to appliance efficiency variations

The increase in appliance efficiency reduces, as expected, the LCCs of fuel and appliance combinations. Across the efficiency range, LCCs vary for the selection of appliances between 15 and 45%, the highest being where is the efficiency range is at its broadest, as is the case for the solid and liquid fuelled appliances. A general conclusion which can be drawn is that there is a wide range of estimates, which will obviously affect the calculation of LCCs. Where the costs of fuels are a relatively smaller part of the LCC, and the efficiency range lowest (as is the case with the micro-wave oven), the LCC estimate is least sensitive to variations in efficiency. Most sensitive are the paraffin appliances, followed by coal burned in a brazier. Figure 4.7 shows the actual changes in LCC for cooking with increasing efficiency.

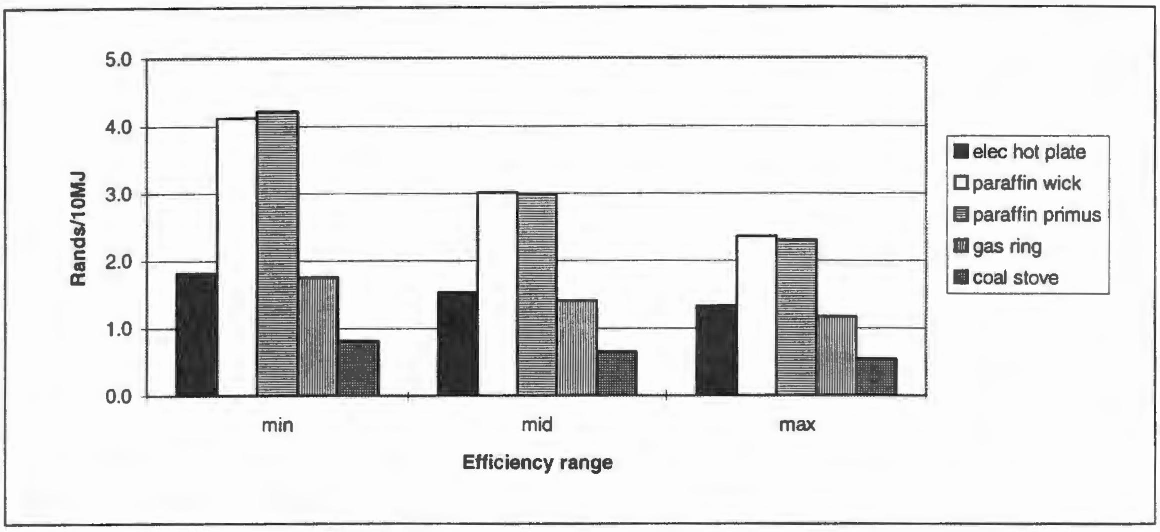

FIGURE 4.7 Effects on LCC of increasing efficiency

The most heavily affected by the increase in efficiency are the paraffin appliances which show a rapid reduction in the LCC across the range. Reductions in the LCCs of electrical, gas and coal based cooking show less dramatic reductions.

4.1.4 Sensitivity of life-cycle cost estimates with respect to variable power assumptions

The sensitivity of the LCC is tested with respect to changes in the average power output (or the number of units of fuel utilised in an hour of operation). This 'power factor' estimate can vary considerably between settings for any appliance of variable operation – for example, a stove could have between one and four plates in use at any one time. Nevertheless, as the basis of the LCCs is in useful energy units (10 MJs), there is no sensitivity to the LCC estimate with changing power assumptions.

4.1.5 Sensitivity of life-cycle cost estimates with respect to durability assumptions

The sensitivity of the LCCs were estimated with respepe to a factor that describes the number of useful years of operation which could be expected from the appliance. Figure 4.8 shows the effects on LCC when the useful durabilities of the appliances are changed.

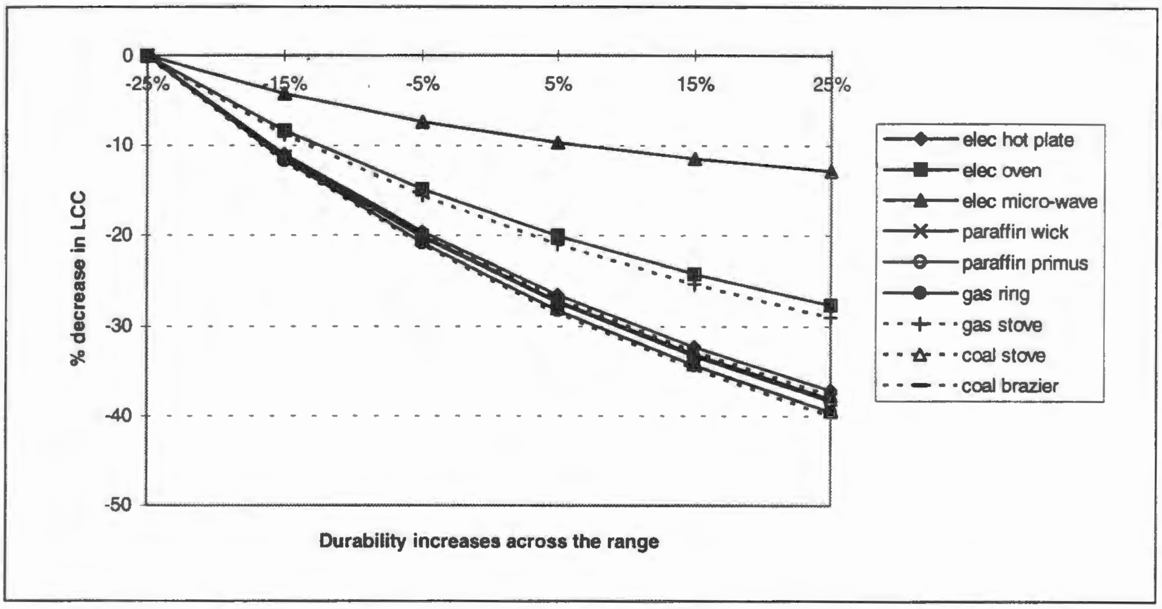

FIGURE 4.8 Life-cycle cost sensitivity to durability variations

The LCCs decrease in all cases (although where the appliance costs nothing, as is the case with the coal brazier, there is obviously no change). The appliances which are the most affected are the paraffin primus and the electric oven, which have relatively high first-cost to operating-cost ratios. The sensitivity to durability of appliances appears modest when compared to other variables tested in this analysis. Figure 4.9 shows the effect on LCC of increasing durability.

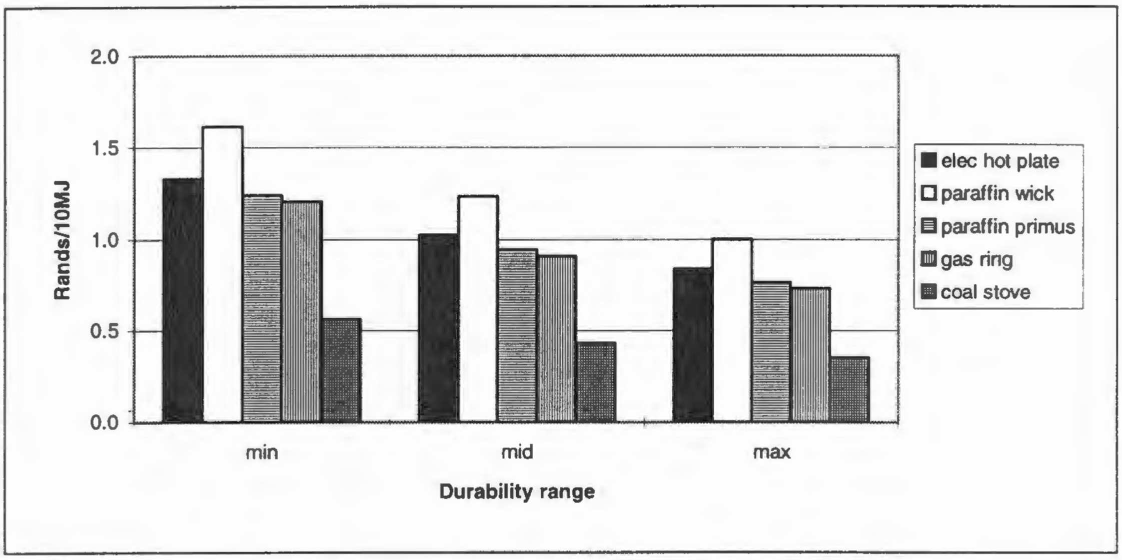

FIGURE 4.9 Effects on LCC of increasing appliance durability

The figure reiterates the modest changes in LCC with increasing appliance durability. Only the paraffin combinations show pronounced changes across the range.

4.1.6 Sensitivity of life-cycle cost estimates with respect to variable discount rates

The sensitivity of the LCC is tested with respect to fluctuations in the discount rate. In conducting the exercise, the discount rate used to calculate the Net Present Value (NPV) of the all the costs was altered from 8-24%, while the discount rate used in the amortisation of the NPV was kept constant at 10%. The result of the exercise is illustrated in Figure 4.10.

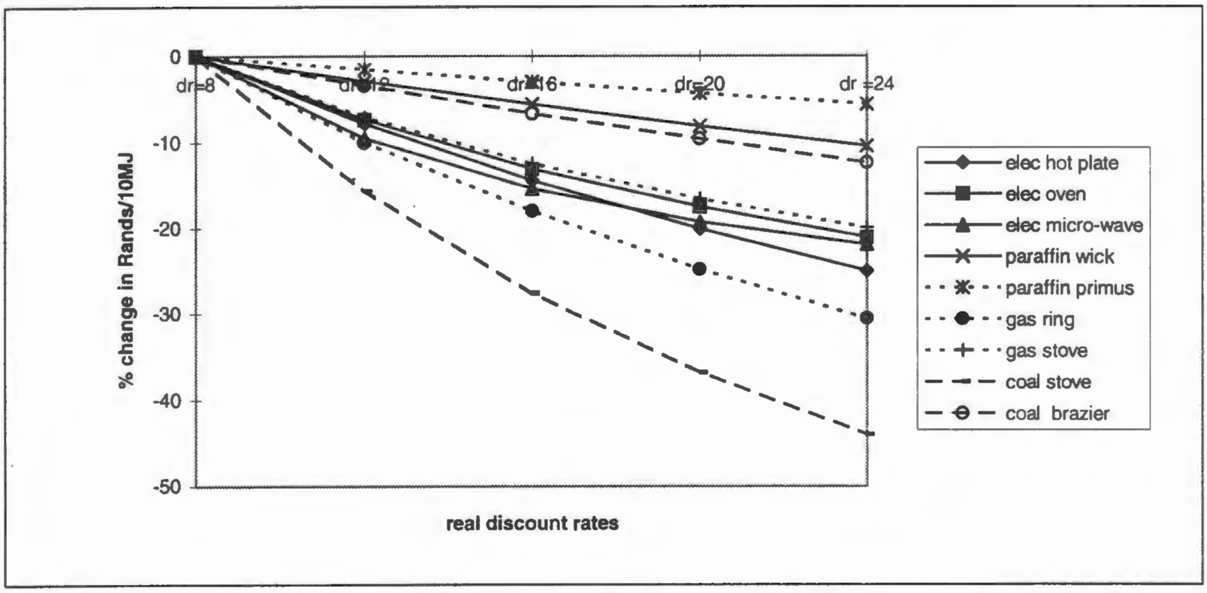

FIGURE 4.10 Life-cycle cost sensitivity to real discount rates

The relationship between LCC and real discount rates is non-linear, as expected. It was expected that in all cases an increase in the discount rates would result in a decrease in the LCC. This trend is reflected in the present value of the LCCs, and the amortised the LCCs per unit of energy.

The largest increases are recorded for the coal stove, gas-ring, and electric hot plate. The smallest changes in LCCs are recorded for the paraffin appliances and the coal brazier. Figure 4.11 shows the sensitivity of the LCC to discount rate increases.

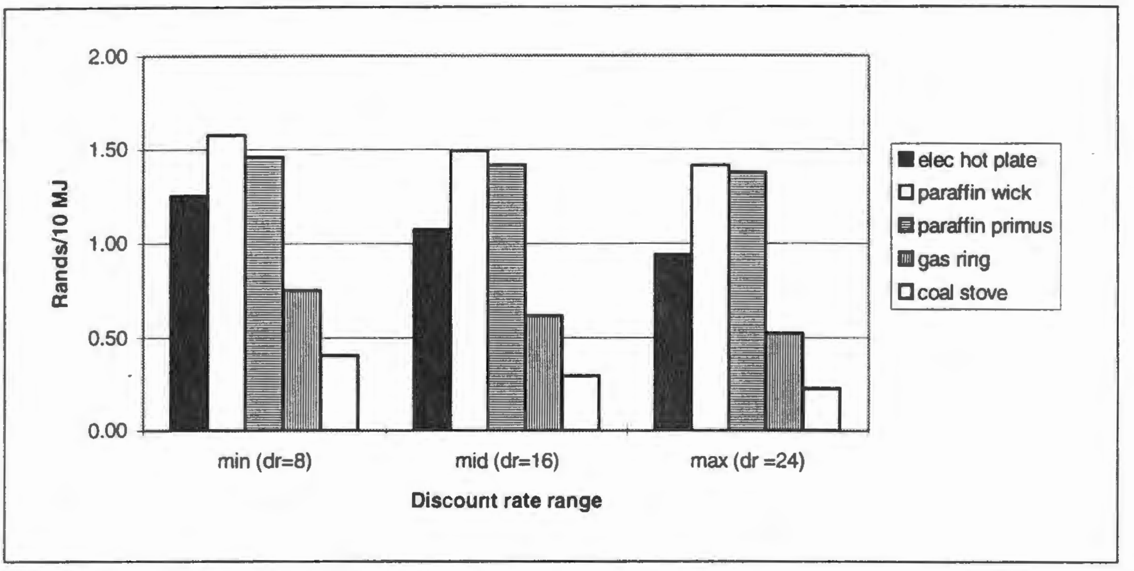

FIGURE 4.11 Effects on the LCC of an increasing discount rate

Figure 4.11 shows the modest sensitivity of all the fuel and appliance combinations to increases in the discount rate.

4.2 Conclusions

Chapter 4 has presented the sensitivity to some key assumptions and variables, of the national average amortised LCCs for cooking services. There are a few conclusions which can be drawn from this analysis:

- The LCC of gas cooking is highly sensitive to fuel price increases whereas electrical cooking shows a low sensitivity.
- The LCCs of cooking using an electric stove, microwave or a paraffin primus are most sensitive to appliance price increases.
- All appliance/fuel combinations are affected by increases in efficiency. Most sensitive are the paraffin appliances and least sensitive are the electrical stoves and ovens.
- The LCCs of all combinations are not affected greatly by changes in the durability of the appliances and efficiency.
- The LCCs were in general most sensitive to fuel and appliance price changes across the range.
- Throughout the sensitivity study, coal-based cooking in a stove remained on average the least-cost option for cooking in South African cities, with gas and electric heating appearing similar in LCCs.

5
Conclusions

It is clear that the ranges of LCCs are broad, in some instances extending to three times or more the minimum of the range. In most cases an estimated range of LCCs does not provide incisive clarity to the end-user who wants to know which appliance/fuel combination will be deliver the lowest-priced energy service to the end-user. This reflects the reality of appliance and fuel combinations in use. Because the cost depends on a large number of parameters, not least the behaviour of the user, there is much uncertainty as to which combination will provide the least-cost service, so the compounding effect of many small variations in the parameters can result in large LCC variations.

The conclusion that too much variation exists to make direct comparisons is not, thankfully, the rule. Some appliance fuel combinations provide services distinctly cheaper than the rest. Lighting and refrigeration are services where grid electricity will provide considerably lower cost services than all other competitive commercial fuel and appliance combinations. Similarly, a clear conclusion can be drawn from the range of LCCs describing water-heaters, where integral solar water heaters have significantly lower LCCs than all others. But despite the low LCC at which the integral solar water-heater provides the service, the quality of the service cannot be realistically compared with the provison of hot water on demand. A second best could be either a solid fuel stove with a water jacket or a solar/electric water heater, which uses electricity to top up the solar shortfall and provide hot water on demand.

The comparisons of levels of service with respect to water-heating is one methodological question that needs to be considered when policy is developed, but a similar question can be raised about the LCC methodology when applied to lighting. Will, for example, users be making choices on the basis of lumens when choosing lighting, or will any light source be adequate for their needs, regardless of its quality? If the latter is closer to the users' reality, then a candle may provide a lower cost lighting source than the electric lamp. Such observations may provide some insight into the slower than expected movement towards electrical saturation of low-income household energy services, and questionable bases for analysis and marketing.

Amongst the thermal energy services, uncertainty about the lowest-priced option is greater as LCCs are confined within a comparatively narrow range compared to, say, the lighting LCCs. It is apparent that unless solid fuels are available, cheap and clean, the possibility to meet energy service needs could feasibly be any one of the electrical, gas or paraffin options, although what has not been factored in are the externalities that can affect health negatively through burns, indoor and outdoor air pollution and fires.

The main conclusions which can be drawn from the life-cycle cost analysis are the following. The least financial cost options for fulfilling the energy services are:

- coal stoves for cooking;
- heat-pumps (for multi-family dwellings and commercial buildings) and by coal stoves for space heating;
- integral solar water heaters for water heating;
- 18W compact fluorescents for lighting; and
- electric fridges and freezers for refrigeration.

The outcome of this life-cycle costing exercise should ideally be used to develop a least-cost mix of options from a national economic perspective. Howeve, this is the content of the following papar in this series.

The sensitivity of the average national LCCs for cooking fuels and appliances were tested by varying fuel price, appliance price, energy efficiency, durability and real discount rates independently. As fuel price and appliance prices increase, so do the LCCs. When energy efficiency, discount rate and durability increase, the trend is one of decreasing LCCs. The sensitivity is linked to the proportional contributions to the total LCC of the operational and appliance price components and the breadth of the ranges being tested. For example, gas rings for cooking have a LCC which is almost entirely made up of operational costs. So there is lower sensitivity to, appliance durability and the discount rate, and energy efficiency variations than to fuel and appliance prices.

A general observation with respect to the sensitivity analysis, was that there was a strong linear sensitivity to fuel and appliance price variations. The sensitivity to the remaining variables (efficiency, discount rate and durability) were linear and less strong within the ranges tested.

6
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Appendix A

1. The life-cycle cost estimate

The life-cycle cost provides an estimate of the cost in current financial terms of all the costs involved in the use of an appliance, from purchase to the disposal. The life-cycle cost (LCC) is composed of the sum of the initial costs, the present value of any replacements or maintenance, and the present value of operational costs. The life-cycle cost is the present value cost of the entire system over the appliance's lifetime (Davis 1991). In the calculations below the LCC is presented in 1996 Rands per 10 Megajoules of useful energy. The useful energy is the delivered energy multiplied by the efficiency of energy transformation of the appliance.

The LCC includes the actual amount paid for the asset (appliance), C, the present value of replacing all or part of that asset R_{pva}, the present value of replacing the connection to the energy infrastructure (electrical or gas) R_{pvc}, the present value of operating the appliance O_{pv}, and the present value of the maintenance M_{pv}, that would be required by the appliance over the life-cycle:

$$LCC = C+R_{pva}+R_{pvc}+O_{pv}+M_{pv} \quad (1)$$

1.1.1 The cost of the appliance (C) and its replacement cost (R_{pva})

The cost of the appliance can be obtained from retailers and manufacturers. The replacement cost of the appliance is calculated using the following equation:

$$R_{pva} = C * ((1+esc_p)/(1+dr))^n \quad (2)$$

n is the life of appliance in years. The terms esc_p and dr refer to the escalation in the cost of the purchase price of appliances and the discount rate gives an indication of the future value of money.

The replacement cost of the appliance is estimated using the operational lifetime and dividing this by the time the appliance is in use during an average year. In the life-cycle cost estimates in this paper, the operational or useful life of the project coincides with the life-cycle of the project, therefore there is assumed to be no residual value accorded the appliance. Similarly, replacement of parts of the appliance is covered in the maintenance cost estimate.

For the minimum replacement costs, the minimum cost of the appliance is used and the maximum life in years is used. For the maximum replacement costs, the maximum cost of the appliance and the minimum life in years is used.

1.1.2 The operating costs of the appliance (O_{pv})

This quantity is calculated from the annual operating costs over the life of the appliance. The annual operating costs is the product of the annual operational hours, the average power estimate (fuel use per unit of operational time) and the cost of the fuel.

$$O\ annual = hours\ used\ per\ year * units\ per\ hour * cost\ per\ unit \quad (3)$$

The present value of operation is:

$$O_{pv} = O\ annual * ((1+esc_o)/(dr-esc_o))*(1-((1+esc_o)/(1+dr))^n) \quad (4)$$

The terms esc_o and dr refer to the escalation in the cost of operating the appliance (fuel price increases) and the discount rate gives an indication of the future value of money.

The minimum operating cost is calculated using the lowest annual operational time and the lowest price for the fuel. The highest operational costs are calculated using the highest number of hours per year and the highest fuel costs per unit.

1.1.3 The maintenance cost of the appliance (M_{pv})

This quantity is calculated in a similar way to the operating costs. In most cases information on the maintenance costs of appliances is not readily available, and has to be estimated.

1.1.4 The amortised LCC per day

At this point the LCC can be calculated using equation 1, above. However, to amortise this down to a daily amount is the next step:

$$\text{LCC (amortised)} = \text{LCC} * ((1+dr)^n * dr)/((1+dr)^n - 1) \qquad (5)$$

The annualised LCC can be divided by 365 to provide a daily LCC[1].

1.1.5 The amortised LCC for ten Megajoules of utilised (useful) energy

The final step in the calculation is to give cost of providing a utilised arbitrary quantity of energy service. For most thermal energy services 10 Megajoules of utilised (or useful) energy is considered as the amount of heating energy for services of cooking, water heating and space heating, while for lighting 1 000 lumenhours is used. For refrigeration the volumes are normalised linearly to 200 litres and the life-cycle cost estimated in R/day.

$$\text{LCC (10MJ)} = 10\text{ MJ} * \text{LCC (R per day)/MJ per day (utilised)} \qquad (6)$$

The minimum LCC per ten Megajoules of useful energy is calculated using the minimum daily LCC divided by the minimum daily Megajoules and multiplying this by ten. The maximum LCC per ten Megajoules of useful energy is calculated using the maximum daily LCC divided by the maximum daily Megajoules, dividing by the conversion efficiency and multiplying this by ten.

---

[1] The daily amortised figures can be calculated using the *Microsoft Excel* function@PMT(LCC, dr, n)/365.

Port Elizabeth													
			fuels			cost of access							
fuel	appliance		prices							efficiency			
	cooking		minima	middle	maxima	minima	middle	maxima	MJ/unit	worst	middle	best	
elec	hot plate		0.20	0.23	0.27	12.5	19.0	25.5	3.6	55	65	75	
	oven		0.20	0.23	0.27	12.5	19.0	25.5	3.6	55	65	75	
	micro-wave		0.20	0.22	0.27	12.5	19.0	25.5	3.6	55	60	65	
paraffin	wick		1.48	1.75	2.02	0	0.0	0.0	37	20	27.5	35	
	primus		1.48	1.75	2.02	0	0.0	0.0	37	30	42.5	55	
gas	ring		3.6	4.245	4.89	97.5	178.7	259.9	49	40	50	60	
	stove		3.6	4.245	4.89	97.5	178.7	259.9	49	40	50	60	
wood	3-stone		*	#VALUE!	*	0	0.0	0.0	17	13	14	15	
	stove		*	#VALUE!	*	0	0.0	0.0	17	20	25	30	
coal	stove		*	#VALUE!	*	0	0.0	0.0	27	20	25	30	
	brazier		*	#VALUE!	*	0	0.0	0.0	27	6	8	10	
	water heating												
elec	geyser		0.20	0.23	0.27	17.5	27.9	38.3	3.6	48	70	92	
	in-line		0.20	0.23	0.27	17.5	27.9	38.3	3.6	96	96	96	
paraffin	wick/pot		1.48	1.75	2.02	0	0.0	0.0	37	20	27.5	35	
	primus/pot		1.48	1.75	2.02	0	0.0	0.0	37	30	42.5	55	
gas	in-line		3.6	4.245	4.89	97	178.7	259.9	49	40	50	60	
	geyser		3.6	4.245	4.89	97	178.7	259.9	49	75	83.5	92	
wood	pot/fire		*	#VALUE!	*	0	0.0	0.0	17	13	14	15	
	pot/stove		*	#VALUE!	*	0	0.0	0.0	17	20	25	30	
solar	SWH (integral)		0	0	0	0	0.0	0.0	1	1000	1000	1000	
mix	solar/electric		0.20	0.23445	0.2684	17.5	27.9	38.3	3.6	160	233.5	307	
coal	stove(jacket/pot)		*	#VALUE!	*	0	0.0	0.0	27	20	33	46	
	space heating												
elec	radiant heater		0.20	0.23445	0.2684	7.5	12.3	17.0	3.6	100	100	100	
	oil filled		0.20	0.23445	0.2684	7.5	12.3	17.0	3.6	100	100	100	
	heat pump		0.20	0.23445	0.2684	7.5	12.3	17.0	3.6	300	320	340	
	blower		0.20	0.23445	0.2684	7.5	12.3	17.0	3.6	100	100	100	
paraffin	heater		1.48	1.75	2.02	0	0.0	0.0	37	45	72.5	100	
gas	heater		3.6	4.245	4.89	97.5	178.7	259.9	49.0	40.0	70	100	
wood	open fire		*	#VALUE!	*	0	0.0	0.0	17	85	92.5	100	
	stove		*	#VALUE!	*	0	0.0	0.0	17	20	40	60	
coal	stove		*	#VALUE!	*	0	0.0	0.0	27	20	40	60	
	brazier		*	#VALUE!	*	0	0.0	0.0	27	17	58.5	100	
	lighting									efficacy			lumens
										lumens/watt			max
elec	incandescent	60	0.20	0.23445	0.2684	2.5	5.5	8.5	3.6	10	10	10	400
		100	0.20	0.23445	0.2684	2.5	5.5	8.5	3.6	11	11	11	660
	fluorescent	10 to 11	0.20	0.23445	0.2684	2.5	5.5	8.5	3.6	50	50	50	600
		13	0.20	0.23445	0.2684	2.5	5.5	8.5	3.6	62	62	62	1250
		18	0.20	0.23445	0.2684	2.5	5.5	8.5	3.6	75	75	75	3000
paraffin	hurricane		1.48	1.75	2.02	0	0.0	0.0	37	0.3	0.3	0.3	80
	pressure		1.48	1.75	2.02	0	0.0	0.0	37	1.2	1.2	1.2	1500
gas	pressure		3.6	4.245	4.89	97.5	178.7	259.9	49	1	1	1	200
	candles		*	*	*	0	0.0	0.0	3.5	0.2	0.2	0.2	30
	refrigeration		prices							Units/day			efficiency
	200 litres normalised vol		minima	middle	maxima	minima	middle	maxima	MJ/unit	minima	mid	maxima	worst
elec	fridge only		0.20	0.23	0.27	12.5	23.8	35.0	3.6	0.35	1.4	2.40	
	fridge freezer (top)		0.20	0.23	0.27	12.5	23.8	35.0	3.6	1.03	2.0	2.90	
	chest freezer		0.20	0.23	0.27	12.5	23.8	35.0	3.6	0.67	0.8	0.95	
	upright freezer		0.20	0.22	0.27	12.5	23.8	35.0	3.6	1.09	1.7	2.40	
gas	fridge/freezer		3.6	4.245	4.89	97.5	178.7	259.9	37	1.10	1.1	1.10	
	chest freezer		3.6	4.245	4.89	97.5	178.7	259.9	37	1.10	1.1	1.10	
paraffin			1.48	1.75	2.02	0.0	0.0	0.0	49	0.76	0.8	0.76	

1: Leach and Gowen (1987)	11: Heater blower specifications
2: Greyvenstein (1992)	12: Hall (1993)
3: Energuide (1996)	13: Turiel (1986)
4: KIC (1993)	14: Morkels (1996)
5: Allison & Dutkiewicz in Viljoen (1993:11)	15: Macros (1996)
6: McGranahan et al (1980), Smith (1981) and Stanford (undated) in Gill (1987)	16: Russels (1996)
7: Beute (1993)	17: Tafelberg (1996)
8: Cowan et al. (1992)	18: Value Super (1996)
9: Horsfall (1992)	19: Bellstar (1996)
10: Easigas (1993)	20: Gas Masters (1996)

Appendix B

						appliance price				expected ser	hrs/day	years	hrs/day	years
	reference					max	mid	min	referen	hours	max	low	mid	mid
	1					451	287.8	124	14,15	4000.0	4.0	2.7	2.5	4.4
	1					4470	3032.4	1595	16,17	8000.0	4.0	5.5	2.5	8.8
	4					4356	2542.2	728	17,17	10000.0	2.0	13.7	1.3	21.9
	1					221	122.0	23	18,19	2190.0	8.0	0.8	4.5	1.3
	1					221	142.5	64	20,19	1095.0	8.0	0.4	4.5	0.7
	1					55	40.0	25	20,21	4380.0	4.0	3.0	2.5	4.8
	1					4190	2543.3	897	20,20	8000.0	4.0	5.5	2.5	8.8
	1					0	0.0	0		20000.0	4.0	13.7	2.5	21.9
	1					1400	873.0	346	22,22	20000.0	4.0	13.7	2.5	21.9
	1					1400	873.0	346	22,22	20000.0	8.0	6.8	5.0	11.0
	6					0	0.0	0		1000.0	4.0	0.7	3.0	0.9
	7				100litre	2632.26	1952.8	1273	23,23	10000.0	2.0	13.7	1.3	21.9
	7				3.1 to 10.5l/mi	1251.72	1093.8	936	24,24	5000.0	0.5	27.4	0.5	27.4
	1					221	122.0	23	18,19	2190.0	2.0	3.0	1.3	4.8
	1					221	142.5	64	20,19	1000.0	2.0	1.4	1.3	2.2
	1					3248	2260.6	1273	21,20	4380.0	1.0	12.0	0.8	16.0
	13,10					5700	5586.0	5472	21,21	10000.0	2.0	13.7	1.3	21.9
	1					0	0.0	0		1.0	1.0	0.0	1.0	0.0
	1					2132	1507.3	882	22,22	8000.0	1.0	21.9	1.0	21.9
	12				100l & 50l	2052	1805.8	1560	25,26	43800.0	8.0	8.0	7.0	17.1
	12				200l, 200kPa	8550	7980.0	7410	26,26	43800.0	8.0	8.0	7.0	17.1
	1,5					2132	1507.3	882	22,22	50000.0	4.0	34.2	3.0	45.7
						317	178.5	40	17,27	5000.0	4.0	3.4	2.5	5.5
						953	607.0	261	14,15	5000.0	4.0	3.4	2.5	5.5
	2					8000	7000.0	6000	28,28	130000.0	24.0	14.8	24.0	14.8
	11					250	209.8	170	17,17	5000.0	4.0	3.4	2.5	5.5
						50	35.0	20	19,19	8000.0	4.0	5.5	2.5	8.8
	9					738	430.8	124	20,27	4380.0	4.0	3.0	2.5	4.8
	9,5					0	0.0	0		20000.0	4.0	13.7	2.5	21.9
	9					1400	873.0	346	22,22	8000.0	4.0	5.5	2.5	8.8
	9					1400	873.0	346	22,22	20000.0	8.0	6.8	4.5	12.2
	5					0	0.0	0		1000.0	4.0	0.7	2.5	1.1
		watts/1000lu		hrs/1000 lhrs										
min		max	min	max	min									
400	8,8	100.00	100.00	2.50	2.50	2.7	2.4	2.1	29,27	1000.0	6.0	0.5	3.5	0.8
660	8,8	90.91	90.91	1.52	1.52	3.0	2.6	2.1	29,27	1000.0	6.0	0.5	3.5	0.8
600	8,8	20.00	20.00	1.67	1.67	68	60.7	53	29,27	5000.0	6.0	2.3	3.5	3.9
1250	8,8	16.13	16.13	0.80	0.80	55	54.5	54	29,15	5000.0	6.0	2.3	3.5	3.9
3000	8,8	13.33	13.33	0.33	0.33	68	62.7	57	27,15	5000.0	6.0	2.3	3.5	3.9
20	8	3333.33	3333.33	50.00	12.50	14	11.0	8	30,18	4000.0	4.0	2.7	2.5	4.4
500	8	833.33	833.33	2.00	0.67	239	219.0	199	19,31	4000.0	4.0	2.7	2.5	4.4
300	8	1000.00	1000.00	3.33	5.00	105	84.5	64	20,20	4000.0	4.0	2.7	2.5	4.4
10	8	5000.00	5000.00	100.00	33.33	0.65	0.5	0.35	32,32	10.0	4.0	0.0	3.0	0.0
						price	price	price		volume rang	volume			expected
middle	best		accept	reference		max	mid	min		volume (cu.f	max	mid	min	hours
				3, 33, 34		2299	2403	2507	14,15	11.8 to 13.6	385	360	335	131400
				3, 33, 34		4273.29	3048	1823	16,17	8.8 to 11.7	320	285	250	131400
				3, 33, 34		3162	2150	1139	27,27	4.2 to 10.6	420	270	120	131400
				3, 33, 34		4355	3347	2339	17,17	11.7	330	330	330	131400
				3,34		4275	2936	1596	20,20		220	165	110	131400
				3,34		4275	2936	1596	20,20		220	165	110	131400
				3,34		4275	2936	1596	20,20		100	100	100	131400

21: ADC (1996)	31: Cape Union Mart (1996)
22: Dayline Sales (1996)	32: Simmonds & Mammon (1996)
23: Penny Pinchers (1996)	33: Fridge Master (1996)
24: AEG (1996)	34: Power People Manufacturers cc. (1996)
25: Solar Specialists (1996)	
26: Sol Energy (1996)	
27: Diona (1996)	
28: Cape Energy (1993)	
29: Hyperama (1996)	
30: Mowbray Station Superette(1996)	

						operating				dr=	0.1		esc cap=
hrs/day	years	Units pe	R/10MJ			min	mid	max	ave power	ref.	LCC calculations		
min	high	vol.or m	min	mid	max	R/year	R/year	R/year	assumption		Rpv ma	Rpv mid	Rpv min
1.0	11.0	2.0	0.7	1.0	1.4	146	428	784	2.0	12.0	348	190	44
1.0	21.9	1.9	0.7	1.0	1.4	139	406	745	1.9	12.0	2652	1315	197
0.5	54.8	1.5	0.9	1.0	1.4	55	149	294	1.5	33.0	1180	315	4
1.0	6.0	0.1	1.1	1.7	2.7	70	374	767	0.1	12.0	206	107	13
1.0	4.0	0.1	0.7	1.1	1.8	53	374	767	0.1	12.0	213	134	44
1.0	12.0	0.2	1.2	1.7	2.5	250	736	1356	0.2	12.0	41	25	8
1.0	21.9	0.2	1.2	1.7	2.5	250	736	1356	0.2	12.0	2485	1103	111
1.0	54.8	2.6	#######	#VALUE!	#VALUE!	0	#VALUE!	0	2.6	1.0	0	0	0
1.0	54.8	2.6	#######	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	2.6	1.0	380	108	2
2.0	27.4	4.0	#######	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	4.0	12.0	729	307	25
2.0	1.4	4.0	#######	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	4.0	?	0	0	0
0.5	54.8	3	1.2	0.9	1.6	110	321	588	3		713	242	7
0.5	27.4	9	0.6	0.7	0.8	329	385	441	9		92	80	69
0.5	12.0	0.13	1.1	1.7	2.7	35	104	192	0.13		166	77	7
0.5	5.5	0.13	0.7	1.1	1.8	35	104	192	0.13		194	116	38
0.5	24.0	1.85	1.2	1.7	2.5	1216	2152	3305	1.85		1035	492	129
0.5	54.8	0.62	0.8	1.0	1.3	405	1195	2203	0.62		1483	692	31
1.0	0.0	3	#######	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	3		0	0	0
1.0	21.9	3	#######	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	3		264	187	109
6.0	15.0	2	0.0	0.0	0.0	0	0	0	2		957	352	373
6.0	15.0	2	0.2	0.3	0.5	1171	1198	2939	2		3989	1557	1774
2.0	68.5	4	#######	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	4		34	19	1
1.0	13.7	2	0.6	0.7	0.7	49	178	392	2	26.0	229	106	11
1.0	13.7	2	0.6	0.7	0.7	49	178	392	2	26.0	688	360	71
24.0	14.8	12	0.2	0.2	0.2	7026	10269	14107	12	23.0	1945	1701	1458
1.0	13.7	2	0.6	0.7	0.7	49	178	392	2	24.0	180	124	46
1.0	10.0	0.2	0.4	0.7	1.2	79	133	295	0.2	12.0	30	15	8
1.0	12.0	0.4	0.7	1.2	2.5	175	646	1428	0.4	12.0	554	273	40
1.0	54.8	3	#######	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	3	1.0	0	0	0
1.0	21.9	3	#######	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	3	1.0	831	379	43
1.0	54.8	4	#######	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	4	12.0	729	274	2
1.0	2.7	4	#######	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	4	12.0	0	0	0
		lumen/u	cents/1000 lumen hours										
		lumenhr	min	mid	max								
1.0	2.7	2778	2.0	2.3	2.7	4.4	18.0	35	0.06		2.6	2.2	1.6
1.0	2.7	3056	1.8	2.1	2.4	7.3	30.0	59	0.10		2.9	2.4	1.6
1.0	13.7	13889	0.4	0.5	0.5	0.9	3.6	7	0.01		42.6	41.8	14.4
1.0	13.7	17222	0.3	0.4	0.4	1.0	3.9	8	0.01		43.4	37.5	14.6
1.0	13.7	20833	0.3	0.3	0.4	1.3	5.4	11	0.02		45.9	43.2	15.4
1.0	11.0	8	48.0	56.8	65.5	8.8	25.9	48	0.016		10.8	7.2	2.8
1.0	11.0	32	12.0	14.2	16.4	43.8	129.5	239	0.081		184.1	144.2	70.0
1.0	11.0	20	26.4	31.2	35.9	24.1	71.1	131	0.018		80.9	55.6	22.5
2.0	0.0	58	#######	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	0.104		0.6	0.5	0.3
hrs/day	years	hrs/day	years	hrs/day	years	Units per hour	cents/litre/day						
max	low	mid	mid	min	high	vol.or mass	min	mid	max				
	10.0		15.0		20.0		0.018	0.090	0.19				
	10.0		15.0		20.0		0.065	0.162	0.31				
	10.0		15.0		20.0		0.032	0.070	0.21				
	10.0		15.0		20.0		0.066	0.115	0.20				
	10.0		15.0		20.0		1.800	2.830	4.89				
	10.0		15.0		20.0		1.800	2.830	4.89				
	10.0		15.0		20.0		1.131	1.337	1.54				

												LCC
0		esc op =	0			Connection			LCC	LCC	LCC	amort
												R/day
O pv max	O pv mid	O pv min	M pv ma	M pv mid	M pv min	R pv ma	Rpv mid	R pv mi	min	mid	max	min
1801	1461	949	70	28	4	1.5	1.1	0.7	1078.0	1778.5	2323.4	0.5
3029	2302	1218	530	197	20	1.5	1.1	0.7	2833.6	5532.9	8030.6	0.9
2143	1304	546	236	47	0	1.5	1.1	0.7	1275.5	3894.6	6736.0	0.4
529	446	306	41	16	1	0.0	0.0	0.0	330.2	584.0	791.1	0.2
269	230	167	43	20	4	0.0	0.0	0.0	235.3	392.6	532.9	0.2
3373	2702	1701	8	4	1	14.9	10.2	5.6	1732.5	2756.0	3451.5	0.7
5518	4168	2187	497	165	11	14.9	10.2	5.6	3101.4	6887.5	10219.8	1.0
0	#VALUE!	0	0	0	0	0.0	0.0	0.0	0.0	#VALUE!	0.0	0.0
#VALUE!	#VALUE!	#VALUE!	76	16	0	0.0	0.0	0.0	#VALUE!	#VALUE!	#VALUE!	#VALUE!
#VALUE!	#VALUE!	#VALUE!	146	46	3	0.0	0.0	0.0	#VALUE!	#VALUE!	#VALUE!	#VALUE!
#VALUE!	#VALUE!	#VALUE!	0	0	0	0.0	0.0	0.0	#VALUE!	#VALUE!	#VALUE!	#VALUE!
4285	2812	1092	143	36	1	2.2	1.6	13.1	2379.0	4802.4	7062.1	0.7
4085	3568	3051	18	12	7	2.2	1.6	7.4	4001.6	4675.5	5357.0	1.2
477	381	239	33	12	1	0.0	0.0	0.0	263.0	514.7	730.9	0.1
235	196	143	39	17	4	0.0	0.0	0.0	210.6	355.5	494.4	0.1
22518	16834	10930	207	74	13	14.9	10.2	81.7	12297.8	19178.6	25987.6	3.7
16061	10474	4033	309	104	3	14.9	10.2	91.9	9599.9	16173.7	22085.0	2.6
#VALUE!	#VALUE!	#VALUE!	0	0	0	0.0	0.0	0.0	#VALUE!	#VALUE!	#VALUE!	#VALUE!
#VALUE!	#VALUE!	#VALUE!	53	28	11	0.0	0.0	0.0	#VALUE!	#VALUE!	#VALUE!	#VALUE!
0	0	0	191	53	37	0.0	0.0	0.0	1596.9	1858.6	2243.5	0.6
15679	9642	8906	798	234	177	0.0	1.6	0.0	16493.5	17857.4	25027.0	5.9
#VALUE!	#VALUE!	#VALUE!	16	3	0	0.0	0.0	0.0	#VALUE!	#VALUE!	#VALUE!	#VALUE!
1091	725	356	46	16	1	1.0	0.7	0.4	397.2	920.3	1454.9	0.1
1091	725	356	138	54	7	1.0	0.7	0.4	624.2	1387.0	2182.8	0.2
106781	77729	53179	389	255	146	1.0	0.7	0.4	59324.8	84984.7	115171.3	21.5
1091	725	356	36	19	5	1.0	0.7	0.4	530.7	954.5	1378.0	0.2
1200	754	485	6	2	1	0.0	0.0	0.0	505.8	791.0	1255.7	0.2
3551	2370	1194	111	41	4	14.9	10.2	5.6	1327.3	2852.1	4414.2	0.5
#VALUE!	#VALUE!	#VALUE!	0	0	0	0.0	0.0	0.0	#VALUE!	#VALUE!	#VALUE!	#VALUE!
#VALUE!	#VALUE!	#VALUE!	166	57	4	0.0	0.0	0.0	#VALUE!	#VALUE!	#VALUE!	#VALUE!
#VALUE!	#VALUE!	#VALUE!	146	41	0	0.0	0.0	0.0	#VALUE!	#VALUE!	#VALUE!	#VALUE!
#VALUE!	#VALUE!	#VALUE!	0	0	0	0.0	0.0	0.0	#VALUE!	#VALUE!	#VALUE!	#VALUE!
												R/day
												min
15.0	12.9	10.1	1	0	0	0.5	0.3	0.1	12.5	16.0	18.7	0.01
25.0	21.5	16.8	1	0	0	0.5	0.3	0.1	19.2	24.8	29.1	0.02
13.8	11.2	6.4	11	6	1	0.5	0.3	0.1	61.0	78.5	93.7	0.02
14.9	12.1	6.9	9	6	1	0.5	0.3	0.1	62.5	72.6	79.3	0.02
20.7	16.8	9.6	11	6	2	0.5	0.3	0.1	68.3	86.3	100.6	0.03
109.9	88.4	56.8	2	1	0	0.0	0.0	0.0	65.1	100.5	126.1	0.03
549.5	442.2	283.9	37	22	7	0.0	0.0	0.0	489.9	682.8	825.4	0.21
301.4	243.0	156.4	16	8	2	14.9	10.2	5.6	228.3	346.1	437.4	0.10
#VALUE!	#VALUE!	#VALUE!	0	0	0	0.0	0.0	0.0	#VALUE!	#VALUE!	#VALUE!	#VALUE!
	LCC calculations			R/200litres						connection		
	Rpv max	Rpv mid	Rpv min	O pv max	O pv mid	O pv mir	M pv ma	M pv mi	M pv min	R pv max	Rpv mid	R pv min
	886	575	373	1068	497	101	68.3	86.3	96.7	2.0	1.4	0.7
	1648	730	271	1729	898	359	127.0	109.5	70.3	2.0	1.4	0.7
	1219	515	169	1181	390	176	94.0	77.2	43.9	2.0	1.4	0.7
	1679	801	348	1084	639	369	129.5	120.2	90.2	2.0	1.4	0.7
	1648	703	237	27151	15713	9994	127.1	105.4	61.5	14.9	10.2	5.6
	1648	703	237	27151	15713	9994	127.1	105.4	61.5	14.9	10.2	5.6
	1648	703	237	8569	7424	6278	127.1	105.4	61.5	0.0	0.0	0.0

		LCC			LCC		
Energy	**LCC**	**amort**	**Energy**	**LCC**	**amort**	**energy**	**LCC**
MJ/day	**R/10MJ**	**R/day**	**MJ/day**	**R/10MJ**	**R/day**	**MJ/day**	**R/10MJ**
minima	**minima**	**mid**	**mid**	**mid**	**maxima**	**maxima**	**maxima**
5.4	0.8	1.4	11.7	1.2	2.8	16	1.7
5.1	1.7	2.7	11.1	2.4	5.4	15	3.6
1.8	2.0	1.2	4.1	3.0	2.5	6	4.3
1.7	1.2	1.3	6.0	2.3	3.1	8	4.1
2.6	0.8	1.7	9.2	1.9	4.2	12	3.6
5.6	1.2	2.1	11.6	1.8	3.8	15	2.6
5.6	1.7	3.3	11.6	2.9	6.9	15	4.6
6.6	0.0	#VALUE!	15.5	#######	0.0	23	0.0
13.3	#VALUE!	#VALUE!	27.6	#######	#VALUE!	35	########
64.8	#VALUE!	#VALUE!	135.0	#######	#VALUE!	173	########
21.6	#VALUE!	#VALUE!	25.9	#######	#VALUE!	26	########
5.0	1.3	1.5	9.5	1.6	2.7	10	2.6
15.6	0.8	1.4	15.6	0.9	1.6	16	1.0
0.8	1.3	0.4	1.7	2.3	0.8	2	4.2
1.3	1.1	0.5	2.6	2.0	1.1	3	3.8
27.2	1.4	6.7	34.0	2.0	10.4	36	2.9
13.9	1.9	5.1	31.6	1.6	8.3	45	1.8
6.6	#VALUE!	#VALUE!	6.2	#######	#VALUE!	6	########
13.3	#VALUE!	#VALUE!	11.1	#######	#VALUE!	9	########
8.4	0.7	0.6	140.0	0.0	1.2	8	1.4
20.1	3.0	6.1	117.7	0.5	12.9	92	1.4
99.4	#VALUE!	#VALUE!	106.9	#######	#VALUE!	86	########
2.4	0.6	0.6	7.5	0.8	1.4	14	1.0
2.4	1.0	0.9	7.5	1.2	2.1	14	1.5
1175.0	0.2	30.8	1382.4	0.2	41.7	1555	0.3
2.4	0.8	0.6	7.5	0.9	1.4	14	0.9
2.5	0.9	0.4	5.6	0.7	0.8	7	1.3
6.5	0.8	2.1	14.3	1.5	4.9	16	3.1
14.7	#VALUE!	#VALUE!	42.6	#######	#VALUE!	75	########
8.8	#VALUE!	#VALUE!	18.4	#######	#VALUE!	18	########
21.6	#VALUE!	#VALUE!	81.0	#######	#VALUE!	86	########
36.0	#VALUE!	#VALUE!	65.8	#######	#VALUE!	37	########
lumenhrs	**c/1000lmh**	**R/day**		**c/1000lmhrs**		**lumenho**	**c/1000lmhrs**
min	**min**	**mid**	**mid**	**mid**	**max**	**max**	**max**
600.0	2.5	0.06	0.08	8.0	0.12	3600	3.3
1100.0	2.1	0.09	0.14	6.8	0.19	6600	2.8
600.0	3.8	0.07	0.08	9.1	0.13	3600	3.6
806.0	2.9	0.06	0.10	6.3	0.11	4836	2.3
1350.0	1.9	0.08	0.17	4.5	0.14	8100	1.7
50.0	55.0	0.08	0.00	179.2	0.15	200	75.1
1000.0	20.7	0.55	0.09	60.9	0.98	4000	24.6
250.0	38.6	0.28	0.02	123.4	0.52	1000	52.1
40.0	#VALUE!	#VALUE!	0.00	#######	#VALUE!	80	########

LCC			**R/day**		
min	**mid**	**max**	**minima**	**mid**	**max**
2705.4	2987.8	3644.9	0.37	0.55	1.00
2253.2	4057.1	3680.6	0.31	0.74	1.01
1360.0	2618.6	2415.5	0.19	0.48	0.66
2798.7	4107.9	3554.3	0.38	0.75	0.97
11657.5	18764.6	28889.4	1.60	3.43	7.91
11657.5	18764.6	28889.4	1.60	3.43	7.91
7935.8	10464.5	10292.1	1.09	1.91	2.82

Durban												
		fuels		cost of access								
fuel	appliance	prices							efficiency			
	cooking	minima	middle	maxima	minima	middle	maxima	MJ/unit	worst	middle	best	
elec	hot plate	0.24	0.26	0.27	12.5	27.6	42.8	3.6	55	65	75	
	oven	0.24	0.26	0.27	12.5	27.6	42.8	3.6	55	65	75	
	micro-wave	0.24	0.25	0.27	12.5	27.6	42.8	3.6	55	60	65	
paraffin	wick	1.4	1.53	1.66	0	0.0	0.0	37	20	27.5	35	
	primus	1.4	1.53	1.66	0	0.0	0.0	37	30	42.5	55	
gas	ring	2.45	2.8	3.15	97.5	178.7	259.9	49	40	50	60	
	stove	2.45	2.8	3.15	97.5	178.7	259.9	49	40	50	60	
wood	3-stone	0	0.73	1.46	0	0.0	0.0	17	13	14	15	
	stove	0	0.73	1.46	0	0.0	0.0	17	20	25	30	
coal	stove	*	#VALUE!	*	0	0.0	0.0	27	20	25	30	
	brazier	*	#VALUE!	*	0	0.0	0.0	27	6	8	10	
	water heating											
elec	geyser	0.24	0.26	0.27	17.5	40.8	64.1	3.6	48	70	92	
	in-line	0.24	0.26	0.27	17.5	40.8	64.1	3.6	96	96	96	
paraffin	wick/pot	1.4	1.53	1.66	0	0.0	0.0	37	20	27.5	35	
	primus/pot	1.4	1.53	1.66	0	0.0	0.0	37	30	42.5	55	
gas	in-line	2.45	2.8	3.15	97	178.7	259.9	49	40	50	60	
	geyser	2.45	2.8	3.15	97	178.7	259.9	49	75	83.5	92	
wood	pot/fire	0	0.73	1.46	0	0.0	0.0	17	13	14	15	
	pot/stove	0	0.73	1.46	0	0.0	0.0	17	20	25	30	
solar	SWH (integral)	0	0	0	0	0.0	0.0	1	1000	1000	1000	
mix	solar/electric	0.24	0.26	0.2684	17.5	40.8	64.1	3.6	160	233.5	307	
coal	stove(jacket/pot)	*	#VALUE!	*	0	0.0	0.0	27	20	33	46	
	space heating											
elec	radiant heater	0.24	0.255	0.2684	7.5	18.0	28.5	3.6	100	100	100	
	oil filled	0.24	0.26	0.2684	7.5	18.0	28.5	3.6	100	100	100	
	heat pump	0.24	0.26	0.2684	7.5	18.0	28.5	3.6	300	320	340	
	blower	0.24	0.26	0.2684	7.5	18.0	28.5	3.6	100	100	100	
paraffin	heater	1.4	1.53	1.66	0	0.0	0.0	37	45	72.5	100	
gas	heater	2.45	2.80	3.15	97.5	178.7	259.9	49.0	40.0	70	100	
wood	open fire	0	0.73	1.46	0	0.0	0.0	17	85	92.5	100	
	stove	0	0.73	1.46	0	0.0	0.0	17	20	40	60	
coal	stove	*	#VALUE!	*	0	0.0	0.0	27	20	40	60	
	brazier	*	#VALUE!	*	0	0.0	0.0	27	17	58.5	100	
	lighting								efficacy			lumens
									lumens/watt			max
elec	incandescent #	0.24	0.26	0.2684	2.5	8.4	14.3	3.6	10	10	10	400
	#	0.24	0.26	0.2684	2.5	8.4	14.3	3.6	11	11	11	660
	fluorescent 1	0.24	0.26	0.2684	2.5	8.4	14.3	3.6	50	50	50	600
	#	0.24	0.26	0.2684	2.5	8.4	14.3	3.6	62	62	62	1250
	#	0.24	0.26	0.2684	2.5	8.4	14.3	3.6	75	75	75	3000
paraffin	hurricane	1.4	1.53	1.66	0	0.0	0.0	37	0.3	0.3	0.3	80
	pressure	1.4	1.53	1.66	0	0.0	0.0	37	1.2	1.2	1.2	1500
gas	pressure	2.45	2.80	3.15	97.5	178.7	259.9	49	1	1	1	200
	candles	0.48	0.50	0.54	0	0.0	0.0	3.5	0.2	0.2	0.2	30
	refrigeration	prices							Units/day			efficiency
	200 litres norma	minima	middle	maxima	minima	middle	maxima	MJ/unit	minima	mid	maxima	worst
elec	fridge only	0.24	0.26	0.27	12.5	23.8	35.0	3.6	0.35	1.4	2.40	
	fridge freezer (to	0.24	0.26	0.27	12.5	23.8	35.0	3.6	1.03	2.0	2.90	
	chest freezer	0.24	0.26	0.27	12.5	23.8	35.0	3.6	0.67	0.8	0.95	
	upright freezer	0.24	0.26	0.27	12.5	23.8	35.0	3.6	1.09	1.7	2.40	
gas	fridge/freezer	2.45	2.8	3.15	97.5	178.7	259.9	37	1.10	1.1	1.10	
	chest freezer	2.45	2.8	3.15	97.5	178.7	259.9	37	1.10	1.1	1.10	
paraffin	fridge/freezer	1.4	1.53	1.66	0.0	0.0	0.0	49	0.76	0.8	0.76	

1: Leach and Gowen (1987)
2: Greyvenstein (1992)
3: Energuide (1996)
4: KIC (1993)
5: Allison & Dutkiewicz in Viljoen (1993:11)
6: McGranahan et al (1980), Smith (1981) and Stanford (undated) in Gill (1987)
7: Beute (1993)
8: Cowan et al. (1992)
9: Horsfall (1992)
10: Easigas (1993)
11: Heater blower specifications
12: Hall (1993)
13: Turiel (1986)
14: Morkels (1996)
15: Macros (1996)
16: Russels (1996)
17: Taleberg (1996)
18: Value Super (1996)
19: Bellstar (1996)
20: Gas Masters (1996)

						appliance price				expected servi	hrs/day	years
	reference					max	mid	min	reference	hours	max	low
	1					451	287.8	124	14,15	4000.0	4.0	2.7
	1					4470	3032.4	1595	16,17	8000.0	4.0	5.5
	4					4356	2542.2	728	17,17	10000.0	2.0	13.7
	1					221	122.0	23	18,19	2190.0	8.0	0.8
	1					221	142.5	64	20,19	1095.0	8.0	0.4
	1					55	40.0	25	20,21	4380.0	4.0	3.0
	1					4190	2543.3	897	20,20	8000.0	4.0	5.5
	1					0	0.0	0		20000.0	4.0	13.7
	1					1400	873.0	346	22,22	20000.0	4.0	13.7
	1					1400	873.0	346	22,22	20000.0	8.0	6.8
	6					0	0.0	0		1000.0	4.0	0.7
	7				100litre	2632.26	1952.8	1273	23,23	10000.0	2.0	13.7
	7				3.1 to 10.5l/mi	1251.72	1093.8	936	24,24	5000.0	0.5	27.4
	1					221	122.0	23	18,19	2190.0	2.0	3.0
	1					221	142.5	64	20,19	1000.0	2.0	1.4
	1					3248	2260.6	1273	21,20	4380.0	1.0	12.0
	13,10					5700	5586.0	5472	21,21	10000.0	2.0	13.7
	1					0	0.0	0		1.0	1.0	0.0
	1					2132	1507.3	882	22,22	8000.0	1.0	21.9
	12				100l & 50l	2052	1805.8	1560	25,26	43800.0	8.0	8.0
	12				200l, 200kPa	8550	7980.0	7410	26,26	43800.0	8.0	8.0
	1,5					2132	1507.3	882	22,22	50000.0	4.0	34.2
						317	178.5	40	17,27	5000.0	4.0	3.4
						953	607.0	261	14,15	5000.0	4.0	3.4
	2					8000	7000.0	6000	28,28	130000.0	24.0	14.8
	11					250	209.8	170	17,17	5000.0	4.0	3.4
						50	35.0	20	19,19	8000.0	4.0	5.5
	9					738	430.8	124	20,27	4380.0	4.0	3.0
	9,5					0	0.0	0		20000.0	4.0	13.7
	9					1400	873.0	346	22,22	8000.0	4.0	5.5
	9					1400	873.0	346	22,22	20000.0	8.0	6.8
	5					0	0.0	0		1000.0	4.0	0.7
		watts/1000lu		hrs/1000 lhrs								
min		max	min	max	min							
400	8,8	100.00	100.00	2.50	2.50	2.7	2.4	2.1	29,27	1000.0	6.0	0.5
660	8,8	90.91	90.91	1.52	1.52	3.0	2.6	2.1	29,27	1000.0	6.0	0.5
600	8,8	20.00	20.00	1.67	1.67	68	60.7	53	29,27	5000.0	6.0	2.3
1250	8,8	16.13	16.13	0.80	0.80	55	54.5	54	29,15	5000.0	6.0	2.3
3000	8,8	13.33	13.33	0.33	0.33	68	62.7	57	27,15	5000.0	6.0	2.3
20	8	3333.33	3333.33	50.00	12.50	14	11.0	8	30,18	4000.0	4.0	2.7
500	8	833.33	833.33	2.00	0.67	239	219.0	199	19,31	4000.0	4.0	2.7
300	8	1000.00	1000.00	3.33	5.00	105	84.5	64	20,20	4000.0	4.0	2.7
10	8	5000.00	5000.00	100.00	33.33	0.65	0.5	0.35	32,32	10.0	4.0	0.0
						price	price	price		volume range	volume	
middle	best		accept	reference		max	mid	min		volume (cu.ft)	max	mid
				3, 33, 34		2299	2403	2507	14,15	11.8 to 13.6	385	360
				3, 33, 34		4273.29	3048	1823	16,17	8.8 to 11.7	320	285
				3, 33, 34		3162	2150	1139	27,27	4.2 to 10.6	420	270
				3, 33, 34		4355	3347	2339	17,17	11.7	330	330
				3,34		4275	2936	1596	20,20		220	165
				3,34		4275	2936	1596	20,20		220	165
				3,34		4275	2936	1596	20,20		100	100

21: ADC (1996)	31: Cape Union Mart (1996)
22: Dayline Sales (1996)	32: Simmonds & Mammon (1996)
23: Penny Pinchers (1996)	33: Fridge Master (1996)
24: AEG (1996)	34: Power People Manufacturers cc. (1996)
25: Solar Specialists (1996)	
26: Sol Energy (1996)	
27: Dions (1996)	
28: Cape Energy (1993)	
29: Hyperama (1996)	
30: Mowbray Station Superette(1996)	

								operating				dr=
hrs/day	years	hrs/day	years	Units per hour	R/10MJ			min	mid	max	ave power	ref.
mid	mid	min	high	vol.or mass	min	mid	max	R/year	R/year	R/year	assumption	
2.5	4.4	1.0	11.0	2.0	1	1	1	176	465	784	2.0	12.0
2.5	8.8	1.0	21.9	1.9	1	1	1	168	442	745	1.9	12.0
1.3	21.9	0.5	54.8	1.5	1	1	1	66	170	294	1.5	33.0
4.5	1.3	1.0	6.0	0.1	1	2	2	66	327	630	0.1	12.0
4.5	0.7	1.0	4.0	0.1	1	1	1	50	327	630	0.1	12.0
2.5	4.8	1.0	12.0	0.2	1	1	2	170	485	874	0.2	12.0
2.5	8.8	1.0	21.9	0.2	1	1	2	170	485	874	0.2	12.0
2.5	21.9	1.0	54.8	2.6	0	3	7	0	1732	0	2.6	1.0
2.5	21.9	1.0	54.8	2.6	0	2	4	0	1732	5542	2.6	1.0
5.0	11.0	2.0	27.4	4.0	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	4.0	12.0
3.0	0.9	2.0	1.4	4.0	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	4.0	
1.3	21.9	0.5	54.8	3	1	1	2	132	349	588	3	
0.5	27.4	0.5	27.4	9	1	1	1	397	419	441	9	
1.3	4.8	0.5	12.0	0.13	1	2	2	33	91	158	0.13	
1.3	2.2	0.5	5.5	0.13	1	1	1	33	91	158	0.13	
0.8	16.0	0.5	24.0	1.85	1	1	2	828	1419	2129	1.85	
1.3	21.9	0.5	54.8	0.62	1	1	1	276	788	1419	0.62	
1.0	0.0	1.0	0.0	3	0	3	7	0	693	1386	3	
1.0	21.9	1.0	21.9	3	0	2	4	0	693	1386	3	
7.0	17.1	6.0	15.0	2	0	0	0	0	0	0	2	
7.0	17.1	6.0	15.0	2	0	0	0	1411	1303	2939	2	
3.0	45.7	2.0	68.5	4	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	4	
2.5	5.5	1.0	13.7	2	1	1	1	29	116	261	2	26.0
2.5	5.5	1.0	13.7	2	1	1	1	29	116	261	2	26.0
24.0	14.8	24.0	14.8	12	0	0	0	4234	6702	9405	12	23.0
2.5	5.5	1.0	13.7	2	1	1	1	29	116	261	2	24.0
2.5	8.8	1.0	10.0	0.2	0	1	1	37	70	162	0.2	12.0
2.5	4.8	1.0	12.0	0.4	1	1	2	60	256	613	0.4	12.0
2.5	21.9	1.0	54.8	3	0	0	1	0	433	1847	3	1.0
2.5	8.8	1.0	21.9	3	0	1	4	0	433	1847	3	1.0
4.5	12.2	1.0	54.8	4	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	4	12.0
2.5	1.1	1.0	2.7	4	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	4	12.0
				lumen/unit	cents/1000 lumen hours							
				lumenhrs/MJ	min	mid	max					
3.5	0.8	1.0	2.7	2778	2.4	2.6	2.7	5.3	19.5	35	0.06	
3.5	0.8	1.0	2.7	3056	2.2	2.3	2.4	8.8	32.6	59	0.10	
3.5	3.9	1.0	13.7	13889	0.5	0.5	0.5	1.1	3.9	7	0.01	
3.5	3.9	1.0	13.7	17222	0.4	0.4	0.4	1.1	4.2	8	0.01	
3.5	3.9	1.0	13.7	20833	0.3	0.3	0.4	1.6	5.9	11	0.02	
2.5	4.4	1.0	11.0	8	45.4	49.6	53.8	8.3	22.6	39	0.016	
2.5	4.4	1.0	11.0	32	11.4	12.4	13.5	41.4	113.2	197	0.081	
2.5	4.4	1.0	11.0	20	18.0	20.6	23.1	16.4	46.9	84	0.018	
3.0	0.0	2.0	0.0	58	250.4	266.1	281.7	36.6	57.1	82	0.104	
	expected servi	hrs/day	years	hrs/day	years	hrs/day	years	Units per hour	cents/litre/day			
min	hours	max	low	mid	mid	min	high	vol.or mass	min	mid	max	
335	131400		10.0		15.0		20.0		0.022	0.097	0.19	
250	131400		10.0		15.0		20.0		0.078	0.176	0.31	
120	131400		10.0		15.0		20.0		0.038	0.076	0.21	
330	131400		10.0		15.0		20.0		0.080	0.135	0.20	
110	131400		10.0		15.0		20.0		1.225	1.867	3.15	
110	131400		10.0		15.0		20.0		1.225	1.867	3.15	
100	131400		10.0		15.0		20.0		1.070	1.169	1.27	

0.1		esc cap=	0		esc op =	0			Connection			LCC
LCC calculations												
Rpv max	Rpv mid	Rpv min	O pv max	O pv mid	O pv min	M pv max	M pv mid	M pv min	R pv max	Rpv mid	R pv min	min
348	190	44	1801	1589	1143	70	28	4	2.4	1.6	0.7	1272.7
2652	1315	197	3029	2504	1468	530	197	20	2.4	1.6	0.7	3083.7
1180	315	4	2143	1489	658	236	47	0	2.4	1.6	0.7	1387.5
206	107	13	435	390	289	41	16	1	0.0	0.0	0.0	313.6
213	134	44	221	201	158	43	20	4	0.0	0.0	0.0	226.3
41	25	8	2173	1782	1158	8	4	1	14.9	10.2	5.6	1189.1
2485	1103	111	3555	2750	1489	497	165	11	14.9	10.2	5.6	2402.6
0	0	0	0	15175	0	0	0	0	0.0	0.0	0.0	0.0
380	108	2	40402	15175	0	76	16	0	0.0	0.0	0.0	345.8
729	307	25	#VALUE!	#VALUE!	#VALUE!	146	46	3	0.0	0.0	0.0	#VALUE!
0	0	0	#VALUE!	#VALUE!	#VALUE!	0	0	0	0.0	0.0	0.0	#VALUE!
713	242	7	4285	3058	1316	143	36	1	3.7	2.3	13.1	2603.1
92	80	69	4085	3881	3678	18	12	7	3.7	2.3	7.4	4627.8
166	77	7	392	333	226	33	12	1	0.0	0.0	0.0	250.0
194	116	38	193	171	135	39	17	4	0.0	0.0	0.0	202.9
1035	492	129	14505	11104	7438	207	74	13	14.9	10.2	81.7	8806.4
1483	692	31	10346	6908	2745	309	104	3	14.9	10.2	91.9	8311.6
0	0	0	4	2	0	0	0	0	0.0	0.0	0.0	0.0
264	187	109	12140	6070	0	53	28	11	0.0	0.0	0.0	893.1
957	352	373	0	0	0	191	53	37	0.0	0.0	0.0	1596.9
3989	1557	1774	15679	10488	10734	798	234	177	0.0	2.3	0.0	18321.4
34	19	1	#VALUE!	#VALUE!	#VALUE!	16	3	0	0.0	0.0	0.0	#VALUE!
229	106	11	728	473	214	46	16	1	1.6	1.0	0.4	255.8
688	360	71	728	473	214	138	54	7	1.6	1.0	0.4	482.8
1945	1701	1458	71188	50730	32046	389	255	146	1.6	1.0	0.4	38192.6
180	124	46	728	473	214	36	19	5	1.6	1.0	0.4	389.4
30	15	8	657	395	229	6	2	1	0.0	0.0	0.0	250.2
554	273	40	1525	938	406	111	41	4	14.9	10.2	5.6	539.7
0	0	0	13467	3794	0	0	0	0	0.0	0.0	0.0	0.0
831	379	43	7515	2452	0	166	57	4	0.0	0.0	0.0	349.9
729	274	2	#VALUE!	#VALUE!	#VALUE!	146	41	0	0.0	0.0	0.0	#VALUE!
0	0	0	#VALUE!	#VALUE!	#VALUE!	0	0	0	0.0	0.0	0.0	#VALUE!
2.6	2.2	1.6	15.0	14.1	12.2	1	0	0	0.8	0.5	0.1	14.6
2.9	2.4	1.6	25.0	23.4	20.3	1	0	0	0.8	0.5	0.1	22.7
42.6	41.8	14.4	13.8	12.2	7.7	11	6	1	0.8	0.5	0.1	62.3
43.4	37.5	14.6	14.9	13.2	8.4	9	6	1	0.8	0.5	0.1	64.0
45.9	43.2	15.4	20.7	18.3	11.6	11	6	2	0.8	0.5	0.1	70.3
10.8	7.2	2.8	90.3	77.3	53.7	2	1	0	0.0	0.0	0.0	62.0
184.1	144.2	70.0	451.6	386.6	268.5	37	22	7	0.0	0.0	0.0	474.5
80.9	55.6	22.5	194.1	160.3	106.5	16	8	2	14.9	10.2	5.6	178.3
0.6	0.5	0.3	0.5	0.5	0.5	0	0	0	0.0	0.0	0.0	0.9

LCC calculations			R/200litres					
Rpv max	Rpv mid	Rpv min	O pv max	O pv mid	O pv min	M pv max	M pv mid	M pv min
886	575	373	1068	541	122	68.3	86.3	96.7
1648	730	271	1729	977	433	127.0	109.5	70.3
1219	515	169	1181	424	213	94.0	77.2	43.9
1679	801	348	1084	749	444	129.5	120.2	90.2
1648	703	237	17490	10365	6802	127.1	105.4	61.5
1648	703	237	17490	10365	6802	127.1	105.4	61.5
1648	703	237	7042	6490	5939	127.1	105.4	61.5

		LCC			LCC			LCC		
CC	LCC	amort	Energy	LCC	amort	Energy	LCC	amort	energy	LCC
		R/day	MJ/day	R/10MJ	R/day	MJ/day	R/10MJ	R/day	MJ/day	R/10MJ
id	max	min	minima	minima	mid	mid	mid	maxima	maxima	maxima
1907.2	2324.4	0.5	5.4	1.0	1.5	11.7	1.3	2.8	16	1.7
5735.5	8031.6	1.0	5.1	1.9	2.8	11.1	2.5	5.4	15	3.6
4080.1	6737.0	0.4	1.8	2.2	1.3	4.1	3.2	2.5	6	4.3
528.0	696.9	0.2	1.7	1.2	1.2	6.0	2.0	2.8	8	3.6
363.7	484.9	0.2	2.6	0.7	1.6	9.2	1.8	3.8	12	3.3
1836.3	2251.2	0.5	5.6	0.9	1.4	11.6	1.2	2.5	15	1.7
5468.5	8256.2	0.8	5.6	1.3	2.6	11.6	2.3	5.6	15	3.7
15174.9	0.0	0.0	6.6	0.0	4.7	15.5	3.1	0.0	23	0.0
16064.1	41878.4	0.1	13.3	0.1	5.0	27.6	1.8	15.7	35	4.5
#VALUE!	#VALUE!	#VALUE!	64.8	#VALUE!	#VALUE!	135.0	#VALUE!	#VALUE!	173	#VALUE!
#VALUE!	#VALUE!	#VALUE!	21.6	#VALUE!	#VALUE!	25.9	#VALUE!	#VALUE!	26	#VALUE!
5049.9	7063.6	0.7	5.0	1.4	1.6	9.5	1.7	2.7	10	2.6
4989.4	5358.5	1.4	15.6	0.9	1.5	15.6	0.9	1.6	16	1.0
466.7	646.0	0.1	0.8	1.2	0.3	1.7	2.1	0.7	2	3.7
330.9	452.6	0.1	1.3	1.0	0.5	2.6	1.9	1.0	3	3.5
13448.3	17975.1	2.7	27.2	1.0	4.7	34.0	1.4	7.2	36	2.0
12608.4	16370.0	2.3	13.9	1.6	3.9	31.6	1.2	6.2	45	1.4
1.8	3.6	0.0	6.6	0.0	1.9	6.2	3.1	3.8	6	6.6
7605.2	14325.1	0.3	13.3	0.2	2.4	11.1	2.2	4.5	9	5.1
1858.6	2243.5	0.6	8.4	0.7	0.6	140.0	0.0	1.2	8	1.4
18704.3	25027.0	6.6	20.1	3.3	6.4	117.7	0.5	12.9	92	1.4
#VALUE!	#VALUE!	#VALUE!	99.4	#VALUE!	#VALUE!	106.9	#VALUE!	#VALUE!	86	#VALUE!
668.7	1091.8	0.1	1.2	0.8	0.5	4.5	1.0	1.1	10	1.1
1135.4	1819.7	0.2	1.2	1.5	0.8	4.5	1.7	1.8	10	1.9
57986.4	79578.1	13.8	587.5	0.2	21.0	829.4	0.3	28.8	1037	0.3
702.9	1014.8	0.1	1.2	1.2	0.5	4.5	1.1	1.0	10	1.0
432.6	713.2	0.1	1.2	0.9	0.2	3.4	0.6	0.5	4	1.1
1419.9	2388.2	0.2	3.3	0.7	1.1	8.6	1.2	2.6	10	2.5
3793.7	13467.4	0.0	7.4	0.0	1.2	25.6	0.5	5.1	50	1.0
3382.1	9081.9	0.1	4.4	0.2	1.6	11.1	1.5	6.1	12	5.2
#VALUE!	#VALUE!	#VALUE!	10.8	#VALUE!	#VALUE!	48.6	#VALUE!	#VALUE!	58	#VALUE!
#VALUE!	#VALUE!	#VALUE!	18.0	#VALUE!	#VALUE!	39.5	#VALUE!	#VALUE!	24	#VALUE!

		R/day	lumenhrs/day	c/1000lmhrs	R/day		c/1000lmhrs		lumenhours/da	c/1000lmhrs
		min	min	min	mid	mid	mid	max	max	max
17.3	19.1	0.02	600.0	2.9	0.07	0.08	8.7	0.12	3600	3.4
26.8	29.4	0.03	1100.0	2.5	0.10	0.14	7.4	0.19	6600	2.9
79.6	94.0	0.02	600.0	3.9	0.07	0.08	9.3	0.13	3600	3.7
73.8	79.6	0.02	806.0	3.0	0.06	0.10	6.4	0.11	4836	2.3
87.9	100.9	0.03	1350.0	2.0	0.08	0.17	4.5	0.14	8100	1.7
89.4	106.5	0.03	50.0	52.4	0.07	0.00	159.4	0.13	200	63.5
627.2	727.4	0.20	1000.0	20.1	0.50	0.09	55.9	0.87	4000	21.7
263.4	330.2	0.08	250.0	30.1	0.21	0.02	93.9	0.39	1000	39.4
1.1	1.3	0.18	40.0	452.5	0.34	0.00	1562.8	0.55	80	691.0

onnection			LCC			R/day		
R pv max	Rpv mid	R pv min	min.	mid	max	minima	mid	max
2.0	1.4	0.7	2726.2	3031.4	3644.9	0.37	0.55	1.00
2.0	1.4	0.7	2326.9	4135.9	3680.6	0.32	0.76	1.01
2.0	1.4	0.7	1396.2	2652.8	2415.5	0.19	0.48	0.66
2.0	1.4	0.7	2874.4	4218.2	3554.3	0.39	0.77	0.97
14.9	10.2	5.6	8464.9	13415.7	19228.2	1.16	2.45	5.27
14.9	10.2	5.6	8464.9	13415.7	19228.2	1.16	2.45	5.27
0.0	0.0	0.0	7596.4	9531.3	8764.9	1.04	1.74	2.40

Cape Town																
Cape Town																
			fuels			**cost of access**										
fuel	**appliance**		**prices**							**efficiency**						
	cooking		**minima**	**middle**	**maxima**	**minima**	**middle**	**maxima**	**MJ/unit**	**worst**	**middle**	**best**				**reference**
elec	hot plate		0.23	0.25	0.27	12.5	58.8	105.0	3.6	55	65	75				1
	oven		0.23	0.25	0.27	12.5	58.8	105.0	3.6	55	65	75				1
	micro-wave		0.23	0.25	0.27	12.5	58.8	105.0	3.6	55	60	65				4
paraffin	wick		1.04	1.27	1.5	0	0.0	0.0	37	20	27.5	35				1
	primus		1.04	1.27	1.5	0	0.0	0.0	37	30	42.5	55				1
gas	ring		1.66	2.66	3.66	97.5	178.7	259.9	49	40	50	60				1
	stove		1.66	2.66	3.66	97.5	178.7	259.9	49	40	50	60				1
wood	3-stone		0	0.23	0.45	0	0.0	0.0	17	13	14	15				1
	stove		0	0.23	0.45	0	0.0	0.0	17	20	25	30				1
coal	stove		0.5	0.53	0.55	0	0.0	0.0	27	20	25	30				1
	brazier		0.5	0.53	0.55	0	0.0	0.0	27	6	8	10				6
	water heating															
elec	geyser		0.23	0.25	0.27	17.5	87.5	157.5	3.6	48	70	92				7
	in-line		0.23	0.25	0.27	17.5	87.5	157.5	3.6	96	96	96				7
paraffin	wick/pot		1.04	1.27	1.5	0	0.0	0.0	37	20	27.5	35				1
	primus/pot		1.04	1.27	1.5	0	0.0	0.0	37	30	42.5	55				1
gas	in-line		1.66	2.66	3.66	97	178.7	259.9	49	40	50	60				1
	geyser		1.66	2.66	3.66	97	178.7	259.9	49	75	83.5	92				13,10
wood	pot/fire		0	0.225	0.45	0	0.0	0.0	17	13	14	15				1
	pot/stove		0	0.225	0.45	0	0.0	0.0	17	20	25	30				1
solar	SWH (integral)		0	0	0	0	0.0	0.0	1	1000	1000	1000				12
mix	solar/electric		0.23	0.2485	0.2684	7.5	47.5	87.5	3.6	160	233.5	307				12
coal	stove(jacket/pot)		0.5	0.525	0.55	0	0.0	0.0	27	20	33	46				1,5
	space heating															
elec	radiant heater		0.23	0.2485	0.2684	7.5	38.8	70.0	3.6	100	100	100				
	oil filled		0.23	0.2485	0.2684	7.5	38.8	70.0	3.6	100	100	100				
	heat pump		0.23	0.2485	0.2684	7.5	38.8	70.0	3.6	300	320	340				2
	blower		0.23	0.2485	0.2684	7.5	38.8	70.0	3.6	100	100	100				11
paraffin	heater		1.04	1.27	1.5	0	0.0	0.0	37	45	72.5	100				
gas	heater		1.66	2.66	3.66	97.5	178.7	259.9	49.0	40.0	70	100				9
wood	open fire		0	0.225	0.45	0	0.0	0.0	17	85	92.5	100				9,5
	stove		0	0.225	0.45	0	0.0	0.0	17	20	40	60				9
coal	stove		0.5	0.525	0.55	0	0.0	0.0	27	20	40	60				9
	brazier		0.5	0.525	0.55	0	0.0	0.0	27	17	58.5	100				5
	lighting									**efficacy**			**lumens**			**watts/1000lm**
										lumens/watt			**max**	**min**		**max**
elec	incandescent	60	0.23	0.2485	0.2684	2.5	28.8	55.0	3.6	10	10	10	400	400	8.8	100.00
		100	0.23	0.2485	0.2684	2.5	28.8	55.0	3.6	11	11	11	660	660	8.8	90.91
	fluorescent	10 to 11	0.23	0.2485	0.2684	2.5	28.8	55.0	3.6	50	50	50	600	600	8.8	20.00
		13	0.23	0.2485	0.2684	2.5	28.8	55.0	3.6	62	62	62	1250	1250	8.8	16.13
		18	0.23	0.2485	0.2684	2.5	28.8	55.0	3.6	75	75	75	3000	3000	8.8	13.33
paraffin	hurricane		1.04	1.27	1.5	0	0.0	0.0	37	0.3	0.3	0.3	80	20	8	3333.33
	pressure		1.04	1.27	1.5	0	0.0	0.0	37	1.2	1.2	1.2	1500	500	8	833.33
gas	pressure		1.66	2.66	3.66	97.5	178.7	259.9	49	1	1	1	200	300	8	1000.00
	candles		0.5	0.5	0.5	0	0.0	0.0	3.5	0.2	0.2	0.2	30	10	8	5000.00
	refrigeration		**prices**							**Units/day**			**efficiency**			
	200 litres normalised volume		**minima**	**middle**	**maxima**	**minima**	**middle**	**maxima**	**MJ/unit**	**minima**	**mid**	**maxima**	**worst**	**middle**	**best**	
elec	fridge only		0.23	0.25	0.27	12.5	23.8	35.0	3.6	0.35	1.4	2.40				
	fridge freezer (top)		0.23	0.25	0.27	12.5	23.8	35.0	3.6	1.03	2.0	2.90				
	chest freezer		0.23	0.25	0.27	12.5	23.8	35.0	3.6	0.67	0.8	0.95				
	upright freezer		0.23	0.24	0.27	12.5	23.8	35.0	3.6	1.09	1.7	2.40				
gas	fridge/freezer		1.66	2.66	3.66	97.5	178.7	259.9	37	1.10	1.1	1.10				
	chest freezer		1.66	2.66	3.66	97.5	178.7	259.9	37	1.10	1.1	1.10				
paraffin			1.04	1.27	1.5	0.0	0.0	0.0	49	0.76	0.8	0.76				

1: Leach and Gowen (1987)	11: Heater blower specifications	21: ADC (1996)
2: Greyvenstein (1992)	12: Hall (1993)	22: Dayline Sales (1996)
3: Energuide (1996)	13: Turiel (1986)	23: Penny Pinchers (1996)
4: KIC (1993)	14: Morkels (1996)	24: AEG (1996)
5: Allison & Dutkiewicz in Viljoen (1993:11)	15: Macros (1996)	25: Solar Specialists (1996)
6: McGranahan et al (1980), Smith (1981) and Stanford (undated) in Gill (1987)	16: Russels (1996)	26: Sol Energy (1996)
7: Beute (1993)	17: Taleiberg (1996)	27: Dions (1996)
8: Cowan et al. (1992)	18: Value Super (1996)	28: Cape Energy (1993)
9: Horsfall (1992)	19: Bellstar (1996)	29: Hyperama (1996)
10: Easigas (1993)	20: Gas Masters (1996)	30: Mowbray Station Superette(1996)

			appliance price				expected servi	hrs/day	years	hrs/day	years	hrs/day
			max	mid	min	reference	hours	max	low	mid	mid	min
			451	287.79	124	14,15	4000.0	4.0	2.7	2.5	4.4	1.0
			4470	3032.40	1595	16,17	8000.0	4.0	5.5	2.5	8.8	1.0
			4356	2542.20	728	17,17	10000.0	2.0	13.7	1.3	21.9	0.5
			221	122.00	23	18,19	2190.0	8.0	0.8	4.5	1.3	1.0
			221	142.50	64	20,19	1095.0	8.0	0.4	4.5	0.7	1.0
			55	40.00	25	20,21	4380.0	4.0	3.0	2.5	4.8	1.0
			4190	2543.34	897	20,20	8000.0	4.0	5.5	2.5	8.8	1.0
			0	0.00	0		20000.0	4.0	13.7	2.5	21.9	1.0
			1400	873.01	346	22,22	20000.0	4.0	13.7	2.5	21.9	1.0
			1400	873.01	346	22,22	20000.0	8.0	6.8	5.0	11.0	2.0
			0	0.00	0		1000.0	4.0	0.7	3.0	0.9	2.0
		100litre	2632.26	1952.8	1273	23,23	10000.0	2.0	13.7	1.3	21.9	0.5
		3.1 to 10.5l/min	1251.72	1093.8	936	24,24	5000.0	0.5	27.4	0.5	27.4	0.5
			221	122.0	23	18,19	2190.0	2.0	3.0	1.3	4.8	0.5
			221	142.5	64	20,19	1000.0	2.0	1.4	1.3	2.2	0.5
			3248	2260.6	1273	21,20	4380.0	1.0	12.0	0.8	16.0	0.5
			5700	5586.0	5472	21,21	10000.0	2.0	13.7	1.3	21.9	0.5
			0	0.0	0		1.0	1.0	0.0	1.0	0.0	1.0
			2132	1507.3	882	22,22	8000.0	1.0	21.9	1.0	21.9	1.0
		100l & 50l	2052	1805.8	1560	25,26	43800.0	8.0	8.0	7.0	17.1	6.0
		200l, 200kPa	8550	7980.0	7410	26,26	43800.0	8.0	8.0	7.0	17.1	6.0
			2132	1507.3	882	22,22	50000.0	4.0	34.2	3.0	45.7	2.0
			317	178.5	40	17,27	5000.0	4.0	3.4	2.5	5.5	1.0
			953	607.0	261	14,15	5000.0	4.0	3.4	2.5	5.5	1.0
			8000	7000.0	6000	28,28	130000.0	24.0	14.8	24.0	14.8	24.0
			250	209.8	170	17,17	5000.0	4.0	3.4	2.5	5.5	1.0
			50	35.0	20	19,19	8000.0	4.0	5.5	2.5	8.8	1.0
			738	430.8	124	20,27	4380.0	4.0	3.0	2.5	4.8	1.0
			0	0.0	0		20000.0	4.0	13.7	2.5	21.9	1.0
			1400	873.0	346	22,22	8000.0	4.0	5.5	2.5	8.8	1.0
			1400	873.0	346	22,22	20000.0	8.0	6.8	4.5	12.2	1.0
			0	0.0	0		1000.0	4.0	0.7	2.5	1.1	1.0
	hrs/1000 lhrs											
min	max	min										
100.00	2.50	2.50	2.7	2.4	2.1	29,27	1000.0	6.0	0.5	3.5	0.8	1.0
90.91	1.52	1.52	3.0	2.6	2.1	29,27	1000.0	6.0	0.5	3.5	0.8	1.0
20.00	1.67	1.67	68	60.7	53	29,27	5000.0	6.0	2.3	3.5	3.9	1.0
16.13	0.80	0.80	55	54.5	54	29,15	5000.0	6.0	2.3	3.5	3.9	1.0
13.33	0.33	0.33	68	62.7	57	27,15	5000.0	6.0	2.3	3.5	3.9	1.0
3333.33	50.00	12.50	14	11.0	8	30,18	4000.0	4.0	2.7	2.5	4.4	1.0
833.33	2.00	0.67	239	219.0	199	19,31	4000.0	4.0	2.7	2.5	4.4	1.0
1000.00	3.33	5.00	105	84.5	64	20,20	4000.0	4.0	2.7	2.5	4.4	1.0
5000.00	100.00	33.33	0.65	0.5	0.35	32,32	10.0	4.0	0.0	3.0	0.0	2.0
			price	price	price		volume range	volume			expected servi	hrs/day
accept	reference		max	mid	min		volume (cu.ft)	max	mid	min	hours	max
	3, 33, 34		2299	2403	2507	14,15	11.8 to 13.6	385	360	335	131400	
	3, 33, 34		4273.29	3048	1823	16,17	8.8 to 11.7	320	285	250	131400	
	3, 33, 34		3162	2150	1139	27,27	4.2 to 10.6	420	270	120	131400	
	3, 33, 34		4355	3347	2339	17,17	11.7	330	330	330	131400	
	3,34		4275	2936	1596	20,20		220	165	110	131400	
	3,34		4275	2936	1596	20,20		220	165	110	131400	
	3,34		4275	2936	1596	20,20		100	100	100	131400	

31: Cape Union Mart (1996)

32: Simmonds & Mammon (1996)

33: Fridge Master (1996)

34: Power People Manufacturers cc. (1996)

									dr=	0.1	
					operating						
years	Units per hour	R/10MJ			min	mid	max	ave power	ref.	LCC calculations	
high	vol.or mass	min	mid	max	R/year	R/year	R/year	assumption		Rpv max	Rpv mid
11.0	2.0	1	1	1	167	454	784	2.0	12.0	348	190
21.9	1.9	1	1	1	159	431	745	1.9	12.0	2652	1315
54.8	1.5	1	1	1	63	170	294	1.5	33.0	1180	315
6.0	0.1	1	1	2	49	271	569	0.1	12.0	206	107
4.0	0.1	1	1	1	37	271	569	0.1	12.0	213	134
12.0	0.2	1	1	2	115	461	1015	0.2	12.0	41	25
21.9	0.2	1	1	2	115	461	1015	0.2	12.0	2485	1103
54.8	2.6	0	1	2	0	534	1708	2.6	1.0	0	0
54.8	2.6	0	1	1	0	534	1708	2.6	1.0	380	108
27.4	4.0	1	1	1	1460	3833	6424	4.0	12.0	729	307
1.4	4.0	2	2	3	1460	2300	3212	4.0	?	0	0
54.8	3	1	1	2	125	340	588	3		713	242
27.4	9	1	1	1	375	408	441	9		92	80
12.0	0.13	1	1	2	25	75	142	0.13		166	77
5.5	0.13	1	1	1	25	75	142	0.13		194	116
24.0	1.85	1	1	2	561	1348	2474	1.85		1035	492
54.8	0.62	0	1	1	187	749	1649	0.62		1483	692
0.0	3	0	1	2	0	214	427	3		0	0
21.9	3	0	1	1	0	214	427	3		264	187
15.0	2	0	0	0	0	0	0	2		957	352
15.0	2	0	0	0	1335	1270	2939	2		3989	1557
68.5	4	0	1	1	1460	2300	3212	4		34	19
13.7	2	1	1	1	56	189	392	2	26.0	229	106
13.7	2	1	1	1	56	189	392	2	26.0	688	360
14.8	12	0	0	0	8010	10884	14107	12	23.0	1945	1701
13.7	2	1	1	1	56	189	392	2	24.0	180	124
10.0	0.2	0	0	1	55	97	219	0.2	12.0	30	15
12.0	0.4	0	1	2	81	405	1069	0.4	12.0	554	273
54.8	3	0	0	0	0	222	854	3	1.0	0	0
21.9	3	0	0	1	0	222	854	3	1.0	831	379
54.8	4	0	0	1	243	1437	3212	4	12.0	729	274
2.7	4	0	0	1	243	798	1606	4	12.0	0	0
	lumen/unit	cents/1000 lumen hours									
	lumenhrs/MJ	min	mid	max							
2.7	2778	2.3	2.5	2.7	5.0	19.0	35	0.06		2.6	2.2
2.7	3056	2.1	2.3	2.4	8.3	31.7	59	0.10		2.9	2.4
13.7	13889	0.5	0.5	0.5	1.0	3.8	7	0.01		42.6	41.8
13.7	17222	0.4	0.4	0.4	1.1	4.1	8	0.01		43.4	37.5
13.7	20833	0.3	0.3	0.4	1.5	5.7	11	0.02		45.9	43.2
11.0	8	33.7	41.2	48.6	6.2	18.8	36	0.016		10.8	7.2
11.0	32	8.4	10.3	12.2	30.8	94.0	178	0.081		184.1	144.2
11.0	20	12.2	19.5	26.9	11.1	44.6	98	0.018		80.9	55.6
0.0	58	260.9	260.9	260.9	38.1	57.1	76	0.104		0.6	0.5
years	hrs/day	years	hrs/day	years	Units per hour	cents/litre/day					
low	mid	mid	min	high	vol.or mass	min	mid	max			
10.0		15.0		20.0		0.021	0.095	0.19			
10.0		15.0		20.0		0.074	0.171	0.31			
10.0		15.0		20.0		0.036	0.074	0.21			
10.0		15.0		20.0		0.076	0.126	0.20			
10.0		15.0		20.0		0.830	1.773	3.66			
10.0		15.0		20.0		0.830	1.773	3.66			
10.0		15.0		20.0		0.795	0.970	1.15			

esc cap= 0 esc op = 0

							Connection			LCC	LCC	LCC
Rpv min	O pv max	O pv mid	O pv min	M pv max	M pv mid	M pv min	R pv max	Rpv mid	R pv min	min	mid	max
44	1801	1549	1082	70	28	4	6.0	3.4	0.7	1210.9	1868.4	2328.0
197	3029	2440	1389	530	197	20	6.0	3.4	0.7	3004.4	5673.2	8035.2
4	2143	1490	622	236	47	0	6.0	3.4	0.7	1352.0	4082.9	6740.6
13	393	324	215	41	16	1	0.0	0.0	0.0	239.2	461.7	655.0
44	200	167	117	43	20	4	0.0	0.0	0.0	185.7	329.5	463.6
8	2525	1693	784	8	4	1	14.9	10.2	5.6	815.8	1747.2	2603.0
111	4130	2612	1009	497	165	11	14.9	10.2	5.6	1922.6	5331.0	8831.7
0	12453	4677	0	0	0	0	0.0	0.0	0.0	0.0	4677.2	12452.7
2	12453	4677	0	76	16	0	0.0	0.0	0.0	345.8	5566.4	13929.0
25	30798	24840	13528	146	46	3	0.0	0.0	0.0	13875.9	25758.7	32344.0
0	2030	1917	1787	0	0	0	0.0	0.0	0.0	1787.0	1916.9	2029.8
7	4285	2980	1245	143	36	1	9.0	5.0	13.1	2532.0	4974.3	7069.0
69	4085	3782	3479	18	12	7	9.0	5.0	7.4	4429.2	4892.7	5363.8
7	354	277	168	33	12	1	0.0	0.0	0.0	191.9	410.1	608.2
38	174	142	100	39	17	4	0.0	0.0	0.0	168.2	301.9	434.0
129	16854	10549	5040	207	74	13	14.9	10.2	81.7	6407.9	12893.2	20323.6
31	12021	6563	1860	309	104	3	14.9	10.2	91.9	7426.6	12263.0	18045.1
0	1	1	0	0	0	0	0.0	0.0	0.0	0.0	0.6	1.1
109	3742	1871	0	53	28	11	0.0	0.0	0.0	893.1	3406.1	5926.9
373	0	0	0	191	53	37	0.0	0.0	0.0	1596.9	1858.6	2243.5
1774	15679	10220	10154	798	234	177	0.0	2.7	0.0	17741.7	18436.4	25027.0
1	30892	22699	14579	16	3	0	0.0	0.0	0.0	15460.9	24209.0	33040.6
11	1091	769	406	46	16	1	4.0	2.2	0.4	447.0	965.3	1458.0
71	1091	769	406	138	54	7	4.0	2.2	0.4	674.0	1432.0	2185.9
1458	106781	82387	60631	389	255	146	4.0	2.2	0.4	66777.7	89644.4	115174.3
46	1091	769	406	36	19	5	4.0	2.2	0.4	580.5	999.5	1381.0
8	891	547	341	6	2	1	0.0	0.0	0.0	361.6	584.3	946.9
40	2658	1485	550	111	41	4	14.9	10.2	5.6	684.0	1967.1	3521.1
0	6226	1949	0	0	0	0	0.0	0.0	0.0	0.0	1948.8	6226.3
43	3475	1260	0	166	57	4	0.0	0.0	0.0	349.9	2189.6	5041.1
2	15399	9869	2420	146	41	0	0.0	0.0	0.0	2766.0	10783.0	16945.1
0	1015	792	559	0	0	0	0.0	0.0	0.0	559.2	791.9	1014.9
1.6	15.0	13.7	11.5	1	0	0	3.2	1.6	0.1	13.9	18.1	21.4
1.6	25.0	22.8	19.2	1	0	0	3.2	1.6	0.1	21.6	27.4	31.8
14.4	13.8	11.9	7.3	11	6	1	3.2	1.6	0.1	61.9	80.5	96.4
14.6	14.9	12.8	7.9	9	6	1	3.2	1.6	0.1	63.5	74.6	81.9
15.4	20.7	17.8	10.9	11	6	2	3.2	1.6	0.1	69.6	88.6	103.2
2.8	81.6	64.2	39.9	2	1	0	0.0	0.0	0.0	48.2	76.3	97.8
70.0	408.1	320.9	199.5	37	22	7	0.0	0.0	0.0	405.5	561.5	683.9
22.5	225.6	152.3	72.1	16	8	2	14.9	10.2	5.6	144.0	255.3	361.6
0.3	0.5	0.5	0.5	0	0	0	0.0	0.0	0.0	0.9	1.1	1.3

LCC calculations			R/200litres						connection	
Rpv max	Rpv mid	Rpv min	O pv max	O pv mid	O pv min	M pv max	M pv mid	M pv min	R pv max	Rpv mid
886	575	373	1068	527	115	68.3	86.3	96.7	2.0	1.4
1648	730	271	1729	952	410	127.0	109.5	70.3	2.0	1.4
1219	515	169	1181	413	201	94.0	77.2	43.9	2.0	1.4
1679	801	348	1084	701	420	129.5	120.2	90.2	2.0	1.4
1648	703	237	20322	9846	4609	127.1	105.4	61.5	14.9	10.2
1648	703	237	20322	9846	4609	127.1	105.4	61.5	14.9	10.2
1648	703	237	6363	5387	4412	127.1	105.4	61.5	0.0	0.0

LCC			LCC			LCC		
LCC			LCC			LCC		
amort	Energy	LCC	amort	Energy	LCC	amort	energy	LCC
R/day	MJ/day	R/10MJ	R/day	MJ/day	R/10MJ	R/day	MJ/day	R/10MJ
min	minima	minima	mid	mid	mid	maxima	maxima	maxima
0.5	5.4	0.9	1.499	11.7	1.281	2.8	16	1.8
0.9	5.1	1.8	2.7	11.1	2.469	5.4	15	3.6
0.4	1.8	2.1	1.3	4.1	3.152	2.5	6	4.3
0.2	1.7	0.9	1.1	6.0	1.781	2.6	8	3.4
0.2	2.6	0.6	1.5	9.2	1.594	3.6	12	3.1
0.3	5.6	0.6	1.3	11.6	1.120	2.9	15	1.9
0.6	5.6	1.1	2.6	11.6	2.216	5.9	15	4.0
0.0	6.6	0.0	1.5	15.5	0.945	4.7	23	2.0
0.1	13.3	0.1	1.7	27.6	0.630	5.2	35	1.5
4.1	64.8	0.6	10.9	135.0	0.807	18.5	173	1.1
4.0	21.6	1.9	6.3	25.9	2.431	8.8	26	3.4
0.7	5.0	1.4	1.6	9.5	1.6	2.7	10	2.6
1.3	15.6	0.8	1.4	15.6	0.9	1.6	16	1.0
0.1	0.8	0.9	0.3	1.7	1.9	0.7	2	3.5
0.1	1.3	0.9	0.4	2.6	1.7	1.0	3	3.4
2.0	27.2	0.7	4.5	34.0	1.3	8.2	36	2.3
2.0	13.9	1.5	3.8	31.6	1.2	6.8	45	1.5
0.0	6.6	0.0	0.6	6.2	0.9	1.2	6	2.0
0.3	13.3	0.2	1.1	11.1	1.0	1.9	9	2.1
0.6	8.4	0.7	0.6	140.0	0.0	1.2	8	1.4
6.4	20.1	3.2	6.3	117.7	0.5	12.9	92	1.4
4.2	99.4	0.4	6.7	106.9	0.6	9.4	86	1.1
0.2	2.4	0.7	0.7	7.5	0.9	1.4	14	1.0
0.3	2.4	1.1	1.0	7.5	1.3	2.2	14	1.5
24.2	1175.0	0.2	32.4	1382.4	0.2	41.7	1555	0.3
0.2	2.4	0.9	0.7	7.5	0.9	1.4	14	0.9
0.2	2.5	0.7	0.3	5.6	0.5	0.6	7	1.0
0.3	6.5	0.4	1.5	14.3	1.0	3.9	16	2.5
0.0	14.7	0.0	0.6	42.6	0.1	2.3	75	0.3
0.1	8.8	0.1	1.1	18.4	0.6	3.4	18	1.9
0.8	21.6	0.4	4.3	81.0	0.5	9.7	86	1.1
0.7	36.0	0.2	2.2	65.8	0.3	4.4	37	1.2
R/day	lumenhrs/day	c/1000lmhrs	R/day		c/1000lmhrs		lumenhours	c/1000lmhrs
min	min	min	mid	mid	mid	max	max	max
0.02	600.0	2.8	0.07	0.08	9.1	0.14	3600	3.8
0.03	1100.0	2.3	0.10	0.14	7.5	0.20	6600	3.1
0.02	600.0	3.9	0.07	0.08	9.4	0.13	3600	3.7
0.02	806.0	3.0	0.07	0.10	6.5	0.11	4836	2.4
0.03	1350.0	1.9	0.08	0.17	4.6	0.14	8100	1.8
0.02	50.0	40.7	0.06	0.00	136.0	0.12	200	58.3
0.17	1000.0	17.1	0.45	0.09	50.1	0.82	4000	20.4
0.06	250.0	24.3	0.20	0.02	91.0	0.43	1000	43.1
0.19	40.0	462.9	0.34	0.00	1562.8	0.54	80	670.1

	LCC			R/day		
R pv min	min	mid	max	minima	mid	max
0.7	2719.6	3017.6	3644.9	0.37	0.55	1.00
0.7	2303.5	4110.9	3680.6	0.32	0.75	1.01
0.7	1384.7	2641.9	2415.5	0.19	0.48	0.66
0.7	2850.4	4169.8	3554.3	0.39	0.76	0.97
5.6	6271.6	12897.5	22059.9	0.86	2.36	6.04
5.6	6271.6	12897.5	22059.9	0.86	2.36	6.04
0.0	6069.3	8428.3	8086.2	0.83	1.54	2.22

Johannesburg															
		fuels			cost of access										
fuel	appliance	prices							efficiency						
	cooking	minima	middle	maxima	minima	middle	maxima	MJ/unit	worst	middle	best				reference
elec	hot plate	0.19	0.23	0.27	12.5	88.8	165.0	3.6	55	65	75				1
	oven	0.19	0.23	0.27	12.5	88.8	165.0	3.6	55	65	75				1
	micro-wave	0.19	0.21	0.27	12.5	88.8	165.0	3.6	55	60	65				4
paraffin	wick	1.67	1.67	1.67	0	0.0	0.0	37	20	27.5	35				1
	primus	1.67	1.67	1.67	0	0.0	0.0	37	30	42.5	55				1
gas	ring	3.78	3.78	3.78	97.5	178.7	259.9	49	40	50	60				1
	stove	3.78	3.78	3.78	97.5	178.7	259.9	49	40	50	60				1
wood	3-stone	*	#VALUE!	*	0	0.0	0.0	17	13	14	15				1
	stove	*	#VALUE!	*	0	0.0	0.0	17	20	25	30				1
coal	stove	0.23	0.23	0.23	0	0.0	0.0	27	20	25	30				1
	brazier	0.23	0.23	0.23	0	0.0	0.0	27	6	8	10				6
	water heating														
elec	geyser	0.19	0.23	0.27	17.5	132.5	247.5	3.6	48	70	92				7
	in-line	0.19	0.23	0.27	17.5	132.5	247.5	3.6	96	96	96				7
paraffin	wick/pot	1.67	1.67	1.67	0	0.0	0.0	37	20	27.5	35				1
	primus/pot	1.67	1.67	1.67	0	0.0	0.0	37	30	42.5	55				1
gas	in-line	3.78	3.78	3.78	97	178.7	259.9	49	40	50	60				1
	geyser	3.78	3.78	3.78	97	178.7	259.9	49	75	83.5	92			13,10	
wood	pot/fire	*	#VALUE!	*	0	0.0	0.0	17	13	14	15				1
	pot/stove	*	#VALUE!	*	0	0.0	0.0	17	20	25	30				1
solar	SWH (integral)	0	0	0	0	0.0	0.0	1	1000	1000	1000				12
mix	solar/electric	0.19	0.22945	0.2684	17.5	132.5	247.5	3.6	160	233.5	307				12
coal	stove(jacket/pot)	0.23	0.23	0.23	0	0.0	0.0	27	20	33	46			1,5	
	space heating														
elec	radiant heater	0.19	0.22945	0.2684	7.5	58.8	110.0	3.6	100	100	100				
	oil filled	0.19	0.22945	0.2684	7.5	58.8	110.0	3.6	100	100	100				
	heat pump	0.19	0.22945	0.2684	7.5	58.8	110.0	3.6	300	320	340				2
	blower	0.19	0.22945	0.2684	7.5	58.8	110.0	3.6	100	100	100				11
paraffin	heater	1.67	1.67	1.67	0	0.0	0.0	37	45	72.5	100				
gas	heater	3.8	3.8	3.8	97.5	178.7	259.9	49.0	40.0	70	100				9
wood	open fire	*	#VALUE!	*	0	0.0	0.0	17	85	92.5	100			9,5	
	stove	*	#VALUE!	*	0	0.0	0.0	17	20	40	60				9
coal	stove	0.23	0.23	0.23	0	0.0	0.0	27	20	40	60				9
	brazier	0.23	0.23	0.23	0	0.0	0.0	27	17	58.5	100				5
	lighting								efficacy			lumens			watts/100[illegible]
									lumens/watt			max	min		max
elec	incandescent 60	0.19	0.22945	0.2684	2.5	28.8	55.0	3.6	10	10	10	400	400	8,8	100.00
	100	0.19	0.22945	0.2684	2.5	28.8	55.0	3.6	11	11	11	660	660	8,8	90.91
	fluorescent 10 to 11	0.19	0.22945	0.2684	2.5	28.8	55.0	3.6	50	50	50	600	600	8,8	20.00
	13	0.19	0.22945	-0.2684	2.5	28.8	55.0	3.6	62	62	62	1250	1250	8,8	16.13
	18	0.19	0.22945	0.2684	2.5	28.8	55.0	3.6	75	75	75	3000	3000	8,8	13.33
paraffin	hurricane	1.67	1.67	1.67	0	0.0	0.0	37	0.3	0.3	0.3	80	20	8	3333.33
	pressure	1.67	1.67	1.67	0	0.0	0.0	37	1.2	1.2	1.2	1500	500	8	833.33
gas	pressure	3.8	3.8	3.8	97.5	178.7	259.9	49	1	1	1	200	300	8	1000.00
	candles	0.5	0.5	0.5	0	0.0	0.0	3.5	0.2	0.2	0.2	30	10	8	5000.00
	refrigeration	prices							Units/day			efficiency			
	200 litres normalised v[illegible]	minima	middle	maxima	minima	middle	maxima	MJ/unit	minima	mid	maxima	worst	middle	best	
elec	fridge only	0.19	0.23	0.27	12.5	23.8	35.0	3.6	0.35	1.4	2.40				
	fridge freezer (top)	0.19	0.23	0.27	12.5	23.8	35.0	3.6	1.03	2.0	2.90				
	chest freezer	0.19	0.23	0.27	12.5	23.8	35.0	3.6	0.67	0.8	0.95				
	upright freezer	0.19	0.21	0.27	12.5	23.8	35.0	3.6	1.09	1.7	2.40				
gas	fridge/freezer	1.67	1.67	1.67	97.5	178.7	259.9	37	1.10	1.1	1.10				
	chest freezer	1.67	1.67	1.67	97.5	178.7	259.9	37	1.10	1.1	1.10				
paraffin		3.78	3.78	3.78	0.0	0.0	0.0	49	0.76	0.8	0.76				

1: Leach and Gowen (1987)
2: Greyvenstein (1992)
3: Energuide (1996)
4: KIC (1993)
5: Allison & Dutkiewicz in Viljoen (1993:11)
6: McGranahan et al (1980), Smith (1981) and Stanford (undated) in Gill (1987)
7: Beute (1993)
8: Cowan et al. (1992)
9: Horsfall (1992)
10: Easigas (1993)
11: Heater blower specifications
12: Hall (1993)
13: Turiel (1986)
14: Morkels (1996)
15: Macros (1996)
16: Russels (1996)
17: Tafelberg (1996)
18: Value Super (1996)
19: Bellstar (1996)
20: Gas Masters (1996)
21: ADC (1996)
22: Dayline Sales (1996)
23: Penny Pinchers (1996)
24: AEG (1996)
25: Solar Specialists (1996)
26: Sol Energy (1996)
27: Dions (1996)
28: Cape Energy (1993)
29: Hyperama (1996)
30: Mowbray Station Superette(1996)

			appliance price				expected service	hrs/da	years	hrs/day	years	hrs/day	years	Units per	R/10MJ
			max	mid	min	reference	hours	max	low	mid	mid	min	high	vol.or ma	min
			451	287.8	124	14,15	4000.0	4.0	2.7	2.5	4.4	1.0	11.0	2.0	1
			4470	3032.4	1595	16,17	8000.0	4.0	5.5	2.5	8.8	1.0	21.9	1.9	1
			4356	2542.2	728	17,17	10000.0	2.0	13.7	1.3	21.9	0.5	54.8	1.5	1
			221	122.0	23	18,19	2190.0	8.0	0.8	4.5	1.3	1.0	6.0	0.1	1
			221	142.5	64	20,19	1095.0	8.0	0.4	4.5	0.7	1.0	4.0	0.1	1
			55	40.0	25	20,21	4380.0	4.0	3.0	2.5	4.8	1.0	12.0	0.2	1
			4190	2543.3	897	20,20	8000.0	4.0	5.5	2.5	8.8	1.0	21.9	0.2	1
			0	0.0	0		20000.0	4.0	13.7	2.5	21.9	1.0	54.8	2.6	########
			1400	873.0	346	22,22	20000.0	4.0	13.7	2.5	21.9	1.0	54.8	2.6	########
			1400	873.0	346	22,22	20000.0	8.0	6.8	5.0	11.0	2.0	27.4	4.0	0
			0	0.0	0		1000.0	4.0	0.7	3.0	0.9	2.0	1.4	4.0	1
		100litre	2632.26	1952.8	1273	23,23	10000.0	2.0	13.7	1.3	21.9	0.5	54.8	3	1
		3.1 to 10.5l/min	1251.72	1093.8	936	24,24	5000.0	0.5	27.4	0.5	27.4	0.5	27.4	9	1
			221	122.0	23	18,19	2190.0	2.0	3.0	1.3	4.8	0.5	12.0	0.13	1
			221	142.5	64	20,19	1000.0	2.0	1.4	1.3	2.2	0.5	5.5	0.13	1
			3248	2260.6	1273	21,20	4380.0	1.0	12.0	0.8	16.0	0.5	24.0	1.85	1
			5700	5586.0	5472	21,21	10000.0	2.0	13.7	1.3	21.9	0.5	54.8	0.62	1
			0	0.0	0		1.0	1.0	0.0	1.0	0.0	1.0	0.0	3	########
			2132	1507.3	882	22,22	8000.0	1.0	21.9	1.0	21.9	1.0	21.9	3	########
		100l & 50l	2052	1805.8	1560	25,26	43800.0	8.0	8.0	7.0	17.1	6.0	15.0	0	0
		200l, 200kPa	8550	7980.0	7410	26,26	43800.0	8.0	8.0	7.0	17.1	6.0	15.0	2	0
			2132	1507.3	882	22,22	50000.0	4.0	34.2	3.0	45.7	2.0	68.5	4	0
			317	178.5	40	17,27	5000.0	4.0	3.4	2.5	5.5	1.0	13.7	2	1
			953	607.0	261	14,15	5000.0	4.0	3.4	2.5	5.5	1.0	13.7	2	1
			8000	7000.0	6000	28,28	130000.0	24.0	14.8	24.0	14.8	24.0	14.8	12	0
			250	209.8	170	17,17	5000.0	4.0	3.4	2.5	5.5	1.0	13.7	2.	1
			50	35.0	20	19,19	8000.0	4.0	5.5	2.5	8.8	1.0	10.0	0.2	0
			738	430.8	124	20,27	4380.0	4.0	3.0	2.5	4.8	1.0	12.0	0.4	1
			0	0.0	0		20000.0	4.0	13.7	2.5	21.9	1.0	54.8	3	########
			1400	873.0	346	22,22	8000.0	4.0	5.5	2.5	8.8	1.0	21.9	3	########
			1400	873.0	346	22,22	20000.0	8.0	6.8	4.5	12.2	1.0	54.8	4	0
			0	0.0	0		1000.0	4.0	0.7	2.5	1.1	1.0	2.7	4	0
lu	hrs/1000 lhrs													lumen/un	cents/100
min	max	min												lumenhrs	min
100.00	2.50	2.50	2.7	2.4	2.1	29,27	1000.0	6.0	0.5	3.5	0.8	1.0	2.7	2778	1.9
90.91	1.52	1.52	3.0	2.6	2.1	29,27	1000.0	6.0	0.5	3.5	0.8	1.0	2.7	3056	1.7
20.00	1.67	1.67	68	60.7	53	29,27	5000.0	6.0	2.3	3.5	3.9	1.0	13.7	13889	0.4
16.13	0.80	0.80	55	54.5	54	29,15	5000.0	6.0	2.3	3.5	3.9	1.0	13.7	17222	0.3
13.33	0.33	0.33	68	62.7	57	27,15	5000.0	6.0	2.3	3.5	3.9	1.0	13.7	20833	0.3
3333.33	50.00	12.50	14	11.0	8	30,18	4000.0	4.0	2.7	2.5	4.4	1.0	11.0	8	54.2
833.33	2.00	0.67	239	219.0	199	19,31	4000.0	4.0	2.7	2.5	4.4	1.0	11.0	32	13.5
1000.00	3.33	5.00	105	84.5	64	20,20	4000.0	4.0	2.7	2.5	4.4	1.0	11.0	20	27.8
5000.00	100.00	33.33	0.00	0.0	0.00	32,32	10.0	4.0	0.0	3.0	0.0	2.0	0.0	58	260.9
			price	price	price		volume range	volume			expected ser	hrs/day	years	hrs/day	years
accept	reference		max	mid	min		volume (cu.ft)	max	mid	min	hours	max	low	mid	mid
	3, 33, 34		2299	2403	2507	14,15	11.8 to 13.6	385	360	335	131400		10.0		15.0
	3, 33, 34		4273.29	3048	1823	16,17	8.8 to 11.7	320	285	250	131400		10.0		15.0
	3, 33, 34		3162	2150	1139	27,27	4.2 to 10.6	420	270	120	131400		10.0		15.0
	3, 33, 34		4355	3347	2339	17,17	11.7	330	330	330	131400		10.0		15.0
	3,34		4275	2936	1596	20,20		220	165	110	131400		10.0		15.0
	3,34		4275	2936	1596	20,20		220	165	110	131400		10.0		15.0
	3,34		4275	2936	1596	20,20		100	100	100	131400		10.0		15.0

31: Cape Union Mart (1996)

32: Simmonds & Mammon (1996)

33: Fridge Master (1996)

34: Power People Manufacturers cc. (1996)

		operating			dr=		0.1		esc cap=	0		esc op =	0		
		min	mid	max	ave pov ref.		LCC calculations								
mid	max	R/year	R/year	R/year	assumption		Rpv max	Rpv mid	Rpv min	O pv max	O pv mid	O pv min	M pv max	M pv mid	M pv min
1	1	139	419	784	2.0	12.0	348	190	44	1801	1430	901	70	28	4
1	1	132	398	745	1.9	12.0	2652	1315	197	3029	2253	1158	530	197	20
1	1	52	144	294	1.5	33.0	1180	315	4	2143	1259	519	236	47	0
2	2	79	357	634	0.1	12.0	206	107	13	437	426	345	41	16	1
1	2	59	357	634	0.1	12.0	213	134	44	223	220	188	43	20	4
2	2	262	655	1049	0.2	12.0	41	25	8	2608	2406	1786	8	4	1
2	2	262	655	1049	0.2	12.0	2485	1103	111	4266	3712	2297	497	165	11
#######	######	0	######	0	2.6	1.0	0	0	0	0	#VALUE!	0	0	0	0
#######	######	#VALUE!	######	#######	2.6	1.0	380	108	2	#VALUE!	#VALUE!	#VALUE!	76	16	0
0	0	672	1679	2686	4.0	12.0	729	307	25	12879	10882	6223	146	46	3
1	1	672	1007	1343	4.0	?	0	0	0	849	840	822	0	0	0
1	2	104	314	588	3		713	242	7	4285	2752	1037	143	36	1
1	1	313	377	441	9		92	80	69	4085	3492	2899	18	12	7
2	2	40	99	158	0.13		166	77	7	394	364	270	33	12	1
1	2	40	99	158	0.13		194	116	38	194	187	161	39	17	4
2	2	1277	1916	2555	1.85		1035	492	129	17406	14990	11476	207	74	13
1	1	426	1064	1703	0.62		1483	692	31	12415	9326	4235	309	104	3
#######	######	#VALUE!	######	#######	3		0	0	0	#VALUE!	#VALUE!	#VALUE!	0	0	0
#######	######	#VALUE!	######	#######	3		264	187	109	#VALUE!	#VALUE!	#VALUE!	53	28	11
0	0	0	0	0	2		957	352	373	0	0	0	191	53	37
0	0	1113	1172	2939	2		3989	1557	1774	15679	9437	8462	798	234	177
0	0	672	1007	1343	4		34	19	1	12918	9944	6706	16	3	0
1	1	46	174	392	2	26.0	229	106	11	1091	710	338	46	16	1
1	1	46	174	392	2	26.0	688	360	71	1091	710	338	138	54	7
0	0	6675	10050	14107	12	23.0	1945	1701	1458	106781	76071	50526	389	255	146
1	1	46	174	392	2	24.0	180	124	46	1091	710	338	36	19	5
1	1	89	127	244	0.2	12.0	30	15	8	992	719	547	6	2	1
1	2	184	575	1104	0.4	12.0	554	273	40	2745	2111	1253	111	41	4
#######	######	#VALUE!	######	#######	3	1.0	0	0	0	#VALUE!	#VALUE!	#VALUE!	0	0	0
#######	######	#VALUE!	######	#######	3	1.0	831	379	43	#VALUE!	#VALUE!	#VALUE!	166	57	4
0	0	112	630	1343	4	12.0	729	274	2	6440	4324	1113	146	41	0
0	1	112	350	672	4	12.0	0	0	0	424	347	257	0	0	0
lumen hours															
mid	max														
2.3	2.7	4.2	17.6	35	0.06		2.6	2.2	1.6	15.0	12.6	9.6	1	0	0
2.1	2.4	7.0	29.3	59	0.10		2.9	2.4	1.6	25.0	21.1	16.0	1	0	0
0.5	0.5	0.8	3.5	7	0.01		42.6	41.8	14.4	13.8	11.0	6.1	11	6	1
0.4	0.4	0.9	3.8	8	0.01		43.4	37.5	14.6	14.9	11.9	6.6	9	6	1
0.3	0.4	1.3	5.3	11	0.02		45.9	43.2	15.4	20.7	16.4	9.1	11	6	2
54.2	54.2	9.9	24.7	40	0.016		10.8	7.2	2.8	90.9	84.4	64.1	2	1	0
13.5	13.5	49.4	123.6	198	0.081		184.1	144.2	70.0	454.3	422.0	320.3	37	22	7
27.8	27.8	25.3	63.4	101	0.018		80.9	55.6	22.5	233.0	216.4	164.2	16	8	2
260.9	260.9	38.1	57.1	76	0.104		0.0	0.0	0.0	0.5	0.5	0.5	0	0	0
hrs/day	years	Units per hour	cents/litre/day								LCC calculations			R/200litres	
min	high	vol.or mass	min	mid	max						Rpv max	Rpv mid	Rpv min	O pv max	O pv mid
	20.0		0.018	0.088	0.19						886	575	373	1068	491
	20.0		0.063	0.160	0.31						1648	730	271	1729	887
	20.0		0.031	0.069	0.21						1219	515	169	1181	385
	20.0		0.065	0.113	0.20						1679	801	348	1084	627
	20.0		0.835	1.113	1.67						1648	703	237	9273	6182
	20.0		0.835	1.113	1.67						1648	703	237	9273	6182
	20.0		2.888	2.888	2.89						1648	703	237	16035	16035

						LCC			LCC			LCC		
Connection			LCC	LCC	LCC	amort	Energy	LCC	amort	Energy	LCC	amort	energy	LCC
						R/day	MJ/day	R/10MJ	R/day	MJ/day	R/10MJ	R/day	MJ/day	R/10MJ
R pv max	Rpv mid	R pv min	min	mid	max	min	minima	minima	mid	mid	mid	maxima	maxima	maxima
9.5	5.1	0.7	1030.7	1751.3	2331.4	0.4	5.4	0.8	1.4	11.7	1.2	2.8	16	1.8
9.5	5.1	0.7	2772.9	5487.8	8038.6	0.9	5.1	1.7	2.7	11.1	2.4	5.4	15	3.6
9.5	5.1	0.7	1248.3	3853.6	6744.0	0.3	1.8	2.0	1.2	4.1	3.0	2.5	6	4.3
0.0	0.0	0.0	369.4	563.7	699.5	0.2	1.7	1.4	1.3	6.0	2.2	2.8	8	3.6
0.0	0.0	0.0	256.8	382.1	486.2	0.2	2.6	0.8	1.7	9.2	1.8	3.8	12	3.3
14.9	10.2	5.6	1817.5	2460.0	2685.8	0.7	5.6	1.3	1.8	11.6	1.6	3.0	15	2.0
14.9	10.2	5.6	3210.7	6430.8	8967.2	1.0	5.6	1.8	3.1	11.6	2.7	6.0	15	4.1
0.0	0.0	0.0	0.0	#VALUE!	0.0	0.0	6.6	0.0	#VALUE!	15.5	########	0.0	23	0.0
0.0	0.0	0.0	########	#VALUE!	#VALUE!	######	13.3	#VALUE!	#VALUE!	27.6	########	########	35	#VALUE!
0.0	0.0	0.0	6570.9	11801.2	14425.3	1.9	64.8	0.3	5.0	135.0	0.4	8.2	173	0.5
0.0	0.0	0.0	822.0	839.8	848.8	1.8	21.6	0.9	2.8	25.9	1.1	3.7	26	1.4
14.2	7.6	13.1	2324.6	4748.4	7074.1	0.6	5.0	1.3	1.5	9.5	1.6	2.7	10	2.6
14.2	7.6	7.4	3849.4	4605.4	5369.0	1.1	15.6	0.7	1.4	15.6	0.9	1.6	16	1.0
0.0	0.0	0.0	293.7	497.2	648.3	0.1	0.8	1.4	0.4	1.7	2.2	0.7	2	3.7
0.0	0.0	0.0	229.0	346.6	453.8	0.2	1.3	1.2	0.5	2.6	2.0	1.0	3	3.5
14.9	10.2	81.7	12844.3	17334.6	20876.2	3.9	27.2	1.4	6.1	34.0	1.8	8.4	36	2.3
14.9	10.2	91.9	9801.6	15026.4	18439.2	2.7	13.9	1.9	4.7	31.6	1.5	6.9	45	1.5
0.0	0.0	0.0	########	#VALUE!	#VALUE!	######	6.6	#VALUE!	#VALUE!	6.2	########	########	6	#VALUE!
0.0	0.0	0.0	########	#VALUE!	#VALUE!	######	13.3	#VALUE!	#VALUE!	11.1	########	########	9	#VALUE!
0.0	0.0	0.0	1596.9	1858.6	2243.5	0.6	8.4	0.7	0.6	140.0	0.0	1.2	8	1.4
0.0	7.6	0.0	16049.3	17657.8	25027.0	5.8	20.1	2.9	6.0	117.7	0.5	12.9	92	1.4
0.0	0.0	0.0	7588.4	11454.4	15067.1	2.1	99.4	0.2	3.2	106.9	0.3	4.3	86	0.5
6.3	3.4	0.4	379.4	907.5	1460.2	0.1	2.4	0.6	0.6	7.5	0.8	1.4	14	1.0
6.3	3.4	0.4	606.4	1374.2	2188.2	0.2	2.4	0.9	0.9	7.5	1.2	2.2	14	1.5
6.3	3.4	0.4	56672.5	83329.7	115176.6	20.5	1175.0	0.2	30.2	1382.4	0.2	41.7	1555	0.3
6.3	3.4	0.4	513.0	941.7	1383.3	0.2	2.4	0.8	0.6	7.5	0.8	1.4	14	0.9
0.0	0.0	0.0	568.0	756.5	1047.8	0.3	2.5	1.0	0.4	5.6	0.7	0.7	7	1.1
14.9	10.2	5.6	1387.0	2592.5	3608.2	0.6	6.5	0.9	1.9	14.3	1.4	4.0	16	2.5
0.0	0.0	0.0	########	#VALUE!	#VALUE!	######	14.7	#VALUE!	#VALUE!	42.6	########	########	75	#VALUE!
0.0	0.0	0.0	########	#VALUE!	#VALUE!	######	8.8	#VALUE!	#VALUE!	18.4	########	########	18	#VALUE!
0.0	0.0	0.0	1459.1	5237.6	7985.7	0.4	21.6	0.2	2.1	81.0	0.3	4.6	86	0.5
0.0	0.0	0.0	257.2	346.9	424.4	0.3	36.0	0.1	1.0	65.8	0.1	1.8	37	0.5
						R/day	lumenhrs/	c/1000lmh	R/day	lmhrs/day	c/1000lmhrs		lumenhou	c/1000lmhrs
						min	min	min	mid	mid	mid	max	max	max
3.2	1.6	0.1	12.0	17.0	21.4	0.01	800	1.8	0.06	1400	4.6	0.14	2400	5.7
3.2	1.6	0.1	18.4	25.6	31.8	0.02	1320	1.7	0.10	2310	4.2	0.20	3960	5.2
3.2	1.6	0.1	60.7	79.6	96.4	0.02	1200	1.9	0.07	2100	3.3	0.13	3600	3.7
3.2	1.6	0.1	62.2	73.6	81.9	0.02	2500	0.9	0.06	4375	1.5	0.11	7500	1.5
3.2	1.6	0.1	67.8	87.3	103.2	0.03	6000	0.4	0.08	10500	0.7	0.14	18000	0.8
0.0	0.0	0.0	72.3	96.5	107.0	0.03	40	76.5	0.08	80	96.7	0.13	320	39.9
0.0	0.0	0.0	526.3	662.6	730.1	0.22	1000	22.2	0.53	1875	28.3	0.87	6000	14.5
14.9	10.2	5.6	236.1	319.4	369.0	0.10	600	16.6	0.26	600	42.7	0.44	800	55.0
0.0	0.0	0.0	0.5	0.5	0.5	0.10	40	260.9	0.16	45	347.8	0.21	120	173.9

				connection			LCC			R/day/200litre fridge		
O pv min	M pv max	M pv mid	M pv min	R pv max	Rpv mid	R pv mi	min	mid	max	minima	mid	max
98	68.3	86.3	96.7	2.0	1.4	0.7	2702.6	2981.8	3644.9	0.37	0.54	1.00
349	127.0	109.5	70.3	2.0	1.4	0.7	2243.2	4046.4	3680.6	0.31	0.74	1.01
172	94.0	77.2	43.9	2.0	1.4	0.7	1355.0	2613.9	2415.5	0.19	0.48	0.66
358	129.5	120.2	90.2	2.0	1.4	0.7	2788.4	4095.5	3554.3	0.38	0.75	0.97
4636	127.1	105.4	61.5	14.9	10.2	5.6	6299.4	9232.9	11010.6	0.86	1.69	3.02
4636	127.1	105.4	61.5	14.9	10.2	5.6	6299.4	9232.9	11010.6	0.86	1.69	3.02
16035	127.1	105.4	61.5	0.0	0.0	0.0	17692.5	19075.9	17758.1	2.42	3.48	4.87

national average														
		fuels			cost of access									
fuel	appliance	prices							efficiency					
	cooking	minima	middle	maxima	minima	middle	maxima	MJ/unit	worst	middle	best			reference
elec	hot plate	0.19	0.23	0.27	12.5	88.8	165.0	3.6	55	65	75			1
	oven	0.19	0.23	0.27	12.5	88.8	165.0	3.6	55	65	75			1
	micro-wave	0.19	0.21	0.27	12.5	88.8	165.0	3.6	55	60	65			4
paraffin	wick	1.04	1.53	2.02	0	0.0	0.0	37	20	27.5	35			1
	primus	1.04	1.53	2.02	0	0.0	0.0	37	30	42.5	55			1
gas	ring	1.66	3.275	4.89	97.5	178.7	259.9	49	40	50	60			1
	stove	1.66	3.275	4.89	97.5	178.7	259.9	49	40	50	60			1
wood	3-stone	0	0.73	1.46	0	0.0	0.0	17	13	14	15			1
	stove	0	0.73	1.46	0	0.0	0.0	17	20	25	30			1
coal	stove	0.23	0.39	0.55	0	0.0	0.0	27	20	25	30			1
	brazier	0.23	0.39	0.55	0	0.0	0.0	27	6	8	10			6
	water heating													
elec	geyser	0.19	0.23	0.27	17.5	132.5	247.5	3.6	48	70	92			7
	in-line	0.19	0.23	0.27	17.5	132.5	247.5	3.6	96	96	96			7
paraffin	wick/pot	1.04	1.53	2.02	0	0.0	0.0	37	20	27.5	35			1
	primus/pot	1.04	1.53	2.02	0	0.0	0.0	37	30	42.5	55			1
gas	in-line	1.66	3.275	4.89	97	178.7	259.9	49	40	50	60			1
	geyser	1.66	3.275	4.89	97	178.7	259.9	49	75	83.5	92			13,10
wood	pot/fire	0	0.73	1.46	0	0.0	0.0	17	13	14	15			1
	pot/stove	0	0.73	1.46	0	0.0	0.0	17	20	25	30			1
solar	SWH (integral)	0	0	0	0	0.0	0.0	1	1000	1000	1000			12
mix	solar/electric	0.19	0.22945	0.2684	17.5	132.5	247.5	3.6	160	233.5	307			12
coal	stove(jacket/pot)	0.23	0.39	0.55	0	0.0	0.0	27	20	33	46			1,5
	space heating													
elec	radiant heater	0.19	0.22945	0.2684	7.5	58.8	110.0	3.6	100	100	100			
	oil filled	0.19	0.22945	0.2684	7.5	58.8	110.0	3.6	100	100	100			
	heat pump	0.19	0.22945	0.2684	7.5	58.8	110.0	3.6	300	320	340			2
	blower	0.19	0.22945	0.2684	7.5	58.8	110.0	3.6	100	100	100			11
paraffin	heater	1.04	1.53	2.02	0	0.0	0.0	37	45	72.5	100			
gas	heater	1.7	3.3	4.9	97.5	178.7	259.9	49.0	40.0	70	100			9
wood	open fire	0	0.73	1.46	0	0.0	0.0	17	85	92.5	100			9,5
	stove	0	0.73	1.46	0	0.0	0.0	17	20	40	60			9
coal	stove	0.23	0.39	0.55	0	0.0	0.0	27	20	40	60			9
	brazier	0.23	0.39	0.55	0	0.0	0.0	27	17	58.5	100			5
	lighting								efficacy			lumens		
									lumens/watt			max	min	
elec	incandescent 60	0.19	0.22945	0.2684	2.5	28.8	55.0	3.6	10	10	10	400	400	8,8
	100	0.19	0.22945	0.2684	2.5	28.8	55.0	3.6	11	11	11	660	660	8,8
	fluorescent 10 to 11	0.19	0.22945	0.2684	2.5	28.8	55.0	3.6	50	50	50	600	600	8,8
	13	0.19	0.22945	0.2684	2.5	28.8	55.0	3.6	62	62	62	1250	1250	8,8
	18	0.19	0.22945	0.2684	2.5	28.8	55.0	3.6	75	75	75	3000	3000	8,8
paraffin	hurricane	1.04	1.53	2.02	0	0.0	0.0	37	0.3	0.3	0.3	80	20	8
	pressure	1.04	1.53	2.02	0	0.0	0.0	37	1.2	1.2	1.2	1500	500	8
gas	pressure	1.7	3.3	4.9	97.5	178.7	259.9	49	1	1	1	200	300	8
	candles	0.35	0.5	0.65	0	0.0	0.0	3.5	0.2	0.2	0.2	30	10	8
	refrigeration	prices							Units/day			efficiency		
	200 litres normalised vol	minima	middle	maxima	minima	middle	maxima	MJ/unit	minima	mid	maxima	worst	middle	best
elec	fridge only	0.19	0.23	0.27	12.5	23.8	35.0	3.6	0.35	1.4	2.40			
	fridge freezer (top)	0.19	0.23	0.27	12.5	23.8	35.0	3.6	1.03	2.0	2.90			
	chest freezer	0.19	0.23	0.27	12.5	23.8	35.0	3.6	0.67	0.8	0.95			
	upright freezer	0.19	0.21	0.27	12.5	23.8	35.0	3.6	1.09	1.7	2.40			
gas	fridge/freezer	1.66	3.275	4.89	97.5	178.7	259.9	37	1.10	1.1	1.10			
	chest freezer	1.66	3.275	4.89	97.5	178.7	259.9	37	1.10	1.1	1.10			
paraffin		1.04	1.53	2.02	0.0	0.0	0.0	49	0.76	0.8	0.76			

1: Leach and Gowen (1987)
2: Greyvenstein (1992)
3: Energuide (1996)
4: KIC (1993)
5: Allison & Dutkiewicz in Viljoen (1993:11)
6: McGranahan et al (1980), Smith (1981) and Stanford (undated) in Gill (1987)
7: Beute (1993)
8: Cowan et al. (1992)
9: Horsfall (1992)
10: Easigas (1993)
11: Heater blower specifications
12: Hall (1993)
13: Turiel (1986)
14: Morkels (1996)
15: Macros (1996)
16: Russels (1996)
17: Tafelberg (1996)
18: Value Super (1996)
19: Bellstar (1996)
20: Gas Masters (1996)
21: ADC (1996)
22: Dayline Sales (1996)
23: Penny Pinchers (1996)
24: AEG (1996)
25: Solar Specialists (1996
26: Sol Energy (1996)
27: Dions (1996)
28: Cape Energy (1993)
29: Hyperama (1996)
30: Mowbray Station Supere

				appliance price				expected s	hrs/day	years	hrs/day	years	hrs/day	years	Units per	R/10MJ
				max	mid	min	reference	hours	max	low	mid	mid	min	high	vol.or ma:	min
				451	287.8	124	14,15	4000.0	4.0	2.7	2.5	4.4	1.0	11.0	2.0	1
				4470	3032.4	1595	16,17	8000.0	4.0	5.5	2.5	8.8	1.0	21.9	1.9	1
				4356	2542.2	728	17,17	10000.0	2.0	13.7	1.3	21.9	0.5	54.8	1.5	1
				221	122.0	23	18,19	2190.0	8.0	0.8	4.5	1.3	1.0	6.0	0.1	1
				221	142.5	64	20,19	1095.0	8.0	0.4	4.5	0.7	1.0	4.0	0.1	1
				55	40.0	25	20,21	4380.0	4.0	3.0	2.5	4.8	1.0	12.0	0.2	1
				4190	2543.3	897	20,20	8000.0	4.0	5.5	2.5	8.8	1.0	21.9	0.2	1
				0	0.0	0		20000.0	4.0	13.7	2.5	21.9	1.0	54.8	2.6	0
				1400	873.0	346	22,22	20000.0	4.0	13.7	2.5	21.9	1.0	54.8	2.6	0
				1400	873.0	346	22,22	20000.0	8.0	6.8	5.0	11.0	2.0	27.4	4.0	0
				0	0.0	0		1000.0	4.0	0.7	3.0	0.9	2.0	1.4	4.0	1
			100litre	2632.26	1952.8	1273	23,23	10000.0	2.0	13.7	1.3	21.9	0.5	54.8	3	1
			3.1 to 10.5	1251.72	1093.8	936	24,24	5000.0	0.5	27.4	0.5	27.4	0.5	27.4	9	1
				221	122.0	23	18,19	2190.0	2.0	3.0	1.3	4.8	0.5	12.0	0.13	1
				221	142.5	64	20,19	1000.0	2.0	1.4	1.3	2.2	0.5	5.5	0.13	1
				3248	2260.6	1273	21,20	4380.0	1.0	12.0	0.8	16.0	0.5	24.0	1.85	1
				5700	5586.0	5472	21,21	10000.0	2.0	13.7	1.3	21.9	0.5	54.8	0.62	0
				0	0.0	0		1.0	1.0	0.0	1.0	0.0	1.0	0.0	3	0
				2132	1507.3	882	22,22	8000.0	1.0	21.9	1.0	21.9	1.0	21.9	3	0
			100l & 50l	2052	1805.8	1560	25,26	43800.0	8.0	8.0	7.0	17.1	6.0	15.0	0	0
			200l, 200k	8550	7980.0	7410	26,26	43800.0	8.0	8.0	7.0	17.1	6.0	15.0	2	0
				2132.	1507.3	882	22,22	50000.0	4.0	34.2	3.0	45.7	2.0	68.5	4	0
				317	178.5	40	17,27	5000.0	4.0	3.4	2.5	5.5	1.0	13.7	2	1
				953	607.0	261	14,15	5000.0	4.0	3.4	2.5	5.5	1.0	13.7	2	1
				8000	7000.0	6000	28,28	130000.0	24.0	14.8	24.0	14.8	24.0	14.8	12	0
				250	209.8	170	17,17	5000.0	4.0	3.4	2.5	5.5	1.0	13.7	2	1
				50	35.0	20	19,19	8000.0	4.0	5.5	2.5	8.8	1.0	10.0	0.2.	0
				738	430.8	124	20,27	4380.0	4.0	3.0	2.5	4.8	1.0	12.0	0.4	0
				0	0.0	0		20000.0	4.0	13.7	2.5	21.9	1.0	54.8	3	0
				1400	873.0	346	22,22	8000.0	4.0	5.5	2.5	8.8	1.0	21.9	3	0
				1400	873.0	346	22,22	20000.0	8.0	6.8	4.5	12.2	1.0	54.8	4	0
				0	0.0	0		1000.0	4.0	0.7	2.5	1.1	1.0	2.7	4	0
watts/1000lu		**hrs/1000 lhrs**													**lumen/uni**	**cents/1000**
max	**min**	**max**	**min**												**lumenhrs**	**min**
100.00	100.00	2.50	2.50	2.7	2.4	2.1	29,27	1000.0	6.0	0.5	3.5	0.8	1.0	2.7	2778	1.9
90.91	90.91	1.52	1.52	3.0	2.6	2.1	29,27	1000.0	6.0	0.5	3.5	0.8	1.0	2.7	3056	1.7
20.00	20.00	1.67	1.67	68	60.7	53	29,27	5000.0	6.0	2.3	3.5	3.9	1.0	13.7	13889	0.4
16.13	16.13	0.80	0.80	55	54.5	54	29,15	5000.0	6.0	2.3	3.5	3.9	1.0	13.7	17222	0.3
13.33	13.33	0.33	0.33	68	62.7	57	27,15	5000.0	6.0	2.3	3.5	3.9	1.0	13.7	20833	0.3
3333.33	3333.33	50.00	12.50	14	11.0	8	30,18	4000.0	4.0	2.7	2.5	4.4	1.0	11.0	8	33.7
833.33	833.33	2.00	0.67	239	219.0	199	19,31	4000.0	4.0	2.7	2.5	4.4	1.0	11.0	32	8.4
1000.00	1000.00	3.33	5.00	105	84.5	64	20,20	4000.0	4.0	2.7	2.5	4.4	1.0	11.0	20	12.2
5000.00	5000.00	100.00	33.33	0.00	0.0	0.00	32,32	10.0	4.0	0.0	3.0	0.0	2.0	0.0	58	182.6
				price	**price**	**price**		**volume ra**	**volume**			**expected s**	**hrs/day**	**years**	**hrs/day**	**years**
	accept	**reference**		**max**	**mid**	**min**		**volume (c**	**max**	**mid**	**min**	**hours**	**max**	**low**	**mid**	**mid**
		3, 33, 34		2299	2403	2507	14,15	11.8 to 13	385	360	335	131400		10.0		15.0
		3, 33, 34		4273.29	3048	1823	16,17	8.8 to 11.7	320	285	250	131400		10.0		15.0
		3, 33, 34		3162	2150	1139	27,27	4.2 to 10.6	420	270	120	131400		10.0		15.0
		3, 33, 34		4355	3347	2339	17,17	11.7	330	330	330	131400		10.0		15.0
		3,34		4275	2936	1596	20,20		220	165	110	131400		10.0		15.0
		3,34		4275	2936	1596	20,20		220	165	110	131400		10.0		15.0
		3,34		4275	2936	1596	20,20		100	100	100	131400		10.0		15.0

31: Cape Union Mart (1996)

32: Simmonds & Mammon (1996)

33: Fridge Master (1996)

34: Power People Manufacturers cc. (1996)

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ic(1996)

		operating				dr=	0.1	esc cap=		0		esc op =	0			Connectic
		min	mid	max	ave power	ref.	LCC calculations									
mid	max	R/year	R/year	R/year	assumption		Rpv max	Rpv mid	Rpv min	O pv max	O pv mid	O pv min	M pv max	M pv mid	M pv min	R pv max
1	1	139	419	784	2.0	12.0	348	190	44	1801	1430	901	70	28	4	9.5
1	1	132	398	745	1.9	12.0	2652	1315	197	3029	2253	1158	530	197	20	9.5
1	1	52	144	294	1.5	33.0	1180	315	4	2143	1259	519	236	47	0	9.5
2	3	49	327	767	0.1	12.0	206	107	13	529	390	215	41	16	1	0.0
1	2	37	327	767	0.1	12.0	213	134	44	269	201	117	43	20	4	0.0
1	2	115	568	1356	0.2	12.0	41	25	8	3373	2085	784	8	4	1	14.9
1	2	115	568	1356	0.2	12.0	2485	1103	111	5518	3216	1009	497	165	11	14.9
3	7	0	1732	0	2.6	1.0	0	0	0	0	15175	0	0	0	0	0.0
2	4	0	1732	5542	2.6	1.0	380	108	2	40402	15175	0	76	16	0	0.0
1	1	672	2847	6424	4.0	12.0	729	307	25	30798	18452	6223	146	46	3	0.0
2	3	672	1708	3212	4.0	7	0	0	0	2030	1424	822	0	0	0	0.0
1	2	104	314	588	3		713	242	7	4285	2752	1037	143	36	1	14.2
1	1	313	377	441	9		92	80	69	4085	3492	2899	18	12	7	14.2
2	3	25	91	192	0.13		166	77	7	477	333	168	33	12	1	0.0
1	2	25	91	192	0.13		194	116	38	235	171	100	39	17	4	0.0
1	2	561	1660	3305	1.85		1035	492	129	22518	12987	5040	207	74	13	14.9
1	1	187	922	2203	0.62		1483	692	31	16061	8080	1860	309	104	3	14.9
3	7	0	693	1386	3		0	0	0	4	2	0	0	0	0	0.0
2	4	0	693	1386	3		264	187	109	12140	6070	0	53	28	11	0.0
0	0	0	0	0	2		957	352	373	0	0	0	191	53	37	0.0
0	0	1113	1172	2939	2		3989	1557	1774	15679	9437	8462	798	234	177	0.0
0	1	672	1708	3212	4		34	19	1	30892	16862	6706	16	3	0	0.0
1	1	46	174	392	2	26.0	229	106	11	1091	710	338	46	16	1	6.3
1	1	46	174	392	2	26.0	688	360	71	1091	710	338	138	54	7	6.3
0	0	6675	10050	14107	12	23.0	1945	1701	1458	106781	76071	50526	389	255	146	6.3
1	1	46	174	392	2	24.0	180	124	46	1091	710	338	36	19	5	6.3
1	1	55	116	295	0.2	12.0	30	15	8	1200	659	341	6	2	1	0.0
1	2	81	498	1428	0.4	12.0	554	273	40	3551	1829	550	111	41	4	14.9
0	1	0	722	2771	3	1.0	0	0	0	20201	6323	0	0	0	0	0.0
1	4	0	722	2771	3	1.0	831	379	43	11273	4087	0	166	57	4	0.0
0	1	112	1068	3212	4	12.0	729	274	2	15399	7331	1113	146	41	0	0.0
0	1	112	593	1606	4	12.0	0	0	0	1015	588	257	0	0	0	0.0
lumen hours																
mid	max															
2.3	2.7	4.2	17.6	35	0.06		2.6	2.2	1.6	15.0	12.6	9.6	1	0	0	3.2
2.1	2.4	7.0	29.3	59	0.10		2.9	2.4	1.6	25.0	21.1	16.0	1	0	0	3.2
0.5	0.5	0.8	3.5	7	0.01		42.6	41.8	14.4	13.8	11.0	6.1	11	6	1	3.2
0.4	0.4	0.9	3.8	8	0.01		43.4	37.5	14.6	14.9	11.9	6.6	9	6	1	3.2
0.3	0.4	1.3	5.3	11	0.02		45.9	43.2	15.4	20.7	16.4	9.1	11	6	2	3.2
49.6	65.5	6.2	22.6	48	0.016		10.8	7.2	2.8	109.9	77.3	39.9	2	1	0	0.0
12.4	16.4	30.8	113.2	239	0.081		184.1	144.2	70.0	549.5	386.6	199.5	37	22	7	0.0
24.1	35.9	11.1	54.9	131	0.018		80.9	55.6	22.5	301.4	187.5	72.1	16	8	2	14.9
260.9	339.1	26.7	57.1	99	0.104		0.0	0.0	0.0	0.6	0.5	0.3	0	0	0	0.0
hrs/day	years	Units per	cents/litre/day								LCC calculations			R/200litres		
min	high	vol.or ma	min	mid	max						Rpv max	Rpv mid	Rpv min	O pv max	O pv mid	O pv min
	20.0		0.018	0.088	0.19						886	575	373	1068	491	98
	20.0		0.063	0.160	0.31						1648	730	271	1729	887	349
	20.0		0.031	0.069	0.21						1219	515	169	1181	385	172
	20.0		0.065	0.113	0.20						1679	801	348	1084	627	358
	20.0		0.830	2.183	4.89						1648	703	237	27151	12123	4609
	20.0		0.830	2.183	4.89						1648	703	237	27151	12123	4609
	20.0		0.795	1.169	1.54						1648	703	237	8569	6490	4412

		LCC	LCC	LCC	LCC amort	Energy	LCC	LCC amort	Energy	LCC	LCC amort	energy	LCC
n					R/day	MJ/day	R/10MJ	R/day	MJ/day	R/10MJ	R/day	MJ/day	R/10MJ
Rpv mid	R pv min	min	mid	max	min	minima	minima	mid	mid	mid	maxima	maxima	maxima
5.1	0.7	1030.7	1751.3	2331.4	0.4	5.4	0.8	1.4	11.7	1.2	2.8	16	1.8
5.1	0.7	2772.9	5487.8	8038.6	0.9	5.1	1.7	2.7	11.1	2.4	5.4	15	3.6
5.1	0.7	1248.3	3853.6	6744.0	0.3	1.8	2.0	1.2	4.1	3.0	2.5	6	4.3
0.0	0.0	239.2	528.0	791.1	0.2	1.7	0.9	1.2	6.0	2.0	3.1	8	4.1
0.0	0.0	185.7	363.7	532.9	0.2	2.6	0.6	1.6	9.2	1.8	4.2	12	3.6
10.2	5.6	815.8	2138.6	3451.5	0.3	5.6	0.6	1.6	11.6	1.4	3.8	15	2.6
10.2	5.6	1922.6	5935.0	10219.8	0.6	5.6	1.1	2.9	11.6	2.5	6.9	15	4.6
0.0	0.0	0.0	15174.9	0.0	0.0	6.6	0.0	4.7	15.5	3.1	0.0	23	0.0
0.0	0.0	345.8	16064.1	41878.4	0.1	13.3	0.1	5.0	27.6	1.8	15.7	35	4.5
0.0	0.0	6570.9	19371.4	32344.0	1.9	64.8	0.3	8.2	135.0	0.6	18.5	173	1.1
0.0	0.0	822.0	1424.0	2029.8	1.8	21.6	0.9	4.7	25.9	1.8	8.8	26	3.4
7.6	13.1	2324.6	4748.4	7074.1	0.6	5.0	1.3	1.5	9.5	1.6	2.7	10	2.6
7.6	7.4	3849.4	4605.4	5369.0	1.1	15.6	0.7	1.4	15.6	0.9	1.6	16	1.0
0.0	0.0	191.9	466.7	730.9	0.1	0.8	0.9	0.3	1.7	2.1	0.8	2	4.2
0.0	0.0	168.2	330.9	494.4	0.1	1.3	0.9	0.5	2.6	1.9	1.1	3	3.8
10.2	81.7	6407.9	15332.0	25987.6	2.0	27.2	0.7	5.4	34.0	1.6	10.4	36	2.9
10.2	91.9	7426.6	13780.4	22085.0	2.0	13.9	1.5	4.3	31.6	1.4	8.3	45	1.8
0.0	0.0	0.0	1.8	3.6	0.0	6.6	0.0	1.9	6.2	3.1	3.8	6	6.6
0.0	0.0	893.1	7605.2	14325.1	0.3	13.3	0.2	2.4	11.1	2.2	4.5	9	5.1
0.0	0.0	1596.9	1858.6	2243.5	0.6	8.4	0.7	0.6	140.0	0.0	1.2	8	1.4
7.6	0.0	16049.3	17657.8	25027.0	5.8	20.1	2.9	6.0	117.7	0.5	12.9	92	1.4
0.0	0.0	7588.4	18372.1	33040.6	2.1	99.4	0.2	5.1	106.9	0.5	9.4	86	1.1
3.4	0.4	379.4	907.5	1460.2	0.1	2.4	0.6	0.6	7.5	0.8	1.4	14	1.0
3.4	0.4	606.4	1374.2	2188.2	0.2	2.4	0.9	0.9	7.5	1.2	2.2	14	1.5
3.4	0.4	56672.5	83329.7	115176.6	20.5	1175.0	0.2	30.2	1382.4	0.2	41.7	1555	0.3
3.4	0.4	513.0	941.7	1383.3	0.2	2.4	0.8	0.6	7.5	0.8	1.4	14	0.9
0.0	0.0	361.6	696.2	1255.7	0.2	2.5	0.7	0.3	5.6	0.6	0.8	7	1.3
10.2	5.6	684.0	2310.5	4414.2	0.3	6.5	0.4	1.7	14.3	1.2	4.9	16	3.1
0.0	0.0	0.0	6322.9	20201.0	0.0	14.7	0.0	2.0	42.6	0.5	7.6	75	1.0
0.0	0.0	349.9	5017.0	12839.7	0.1	8.8	0.1	2.4	18.4	1.3	8.6	18	4.9
0.0	0.0	1459.1	8245.3	16945.1	0.4	21.6	0.2	3.3	81.0	0.4	9.7	86	1.1
0.0	0.0	257.2	588.3	1014.9	0.3	36.0	0.1	1.6	65.8	0.2	4.4	37	1.2

					R/day	lumenhrs	c/1000lmh	R/day	lmhrs/day	c/1000lmhrs		lumenhou	c/1000lmhrs
					min	min	min	mid	mid	mid	max	max	max
1.6	0.1	12.0	17.0	21.4	0.01	800	1.8	0.06	1400	4.6	0.14	2400	5.7
1.6	0.1	18.4	25.6	31.8	0.02	1320	1.7	0.10	2310	4.2	0.20	3960	5.2
1.6	0.1	60.7	79.6	96.4	0.02	1200	1.9	0.07	2100	3.3	0.13	3600	3.7
1.6	0.1	62.2	73.6	81.9	0.02	2500	0.9	0.06	4375	1.5	0.11	7500	1.5
1.6	0.1	67.8	87.3	103.2	0.03	6000	0.4	0.08	10500	0.7	0.14	18000	0.8
0.0	0.0	48.2	89.4	126.1	0.02	40	50.9	0.07	80	89.7	0.15	320	47.0
0.0	0.0	405.5	627.2	825.4	0.17	1000	17.1	0.50	1875	26.8	0.98	6000	16.4
10.2	5.6	144.0	290.5	437.4	0.06	600	10.1	0.23	600	38.8	0.52	800	65.2
0.0	0.0	0.3	0.5	0.6	0.07	40	182.6	0.16	45	347.8	0.27	120	226.1

		connection				LCC			R/day/200litre fridge		
M pv max	M pv mid	M pv min	R pv max	Rpv mid	R pv min	min	mid	max	minima	mid	max
68.3	86.3	96.7	2.0	1.4	0.7	2702.6	2981.8	3644.9	0.37	0.54	1.00
127.0	109.5	70.3	2.0	1.4	0.7	2243.2	4046.4	3680.6	0.31	0.74	1.01
94.0	77.2	43.9	2.0	1.4	0.7	1355.0	2613.9	2415.5	0.19	0.48	0.66
129.5	120.2	90.2	2.0	1.4	0.7	2788.4	4095.5	3554.3	0.38	0.75	0.97
127.1	105.4	61.5	14.9	10.2	5.6	6271.6	15174.0	28889.4	0.86	2.77	7.91
127.1	105.4	61.5	14.9	10.2	5.6	6271.6	15174.0	28889.4	0.86	2.77	7.91
127.1	105.4	61.5	0.0	0.0	0.0	6069.3	9531.3	10292.1	0.83	1.74	2.82

Appendix G: Appliance price questionnaire

From: Steve Thorne
Energy for Development Research Centre
Private Bag Rondebosch
7700 Rondebosch
Phone: 650 3230
Fax: 650 2830

Retailer name:		
Person referred to:		Phone no:

1.1 List the 3 fastest moving refrigerators, name the model (volume), estimate turnover in an average month, list the price, estimate proportion on HP.

model (volume)	numbers/ month	price		% on HP

1.2 List the 3 fastest moving refrigerator/freezers (volumes), name the model, estimate turnover in an average month, list the price, estimate proportion on HP.

model (volume)	numbers/ month	price		% on HP

1.3 List the 3 fastest moving freezers, name the model (volume), estimate turnover in an average month, list the price, estimate proportion on HP.

model (volume)	numbers/ month	price		% on HP

2.1 List the 3 fastest moving stoves, name the model (features), estimate turnover in an average month, list the price, estimate proportion on HP.

model (volume)	numbers/ month	price		% on HP

2.2 List the 3 fastest moving hobs/top-cookers, name the model (features), estimate turnover in an average month, list the price, estimate proportion on HP.

model (volume)	numbers/ month	price		% on HP

2.3 List the 3 fastest moving micro-waves/ other cookers, name the model (features), estimate turnover in an average month, list the price, estimate proportion on HP.

model (volume)	numbers/ month	price		% on HP

3.1 List the 3 fastest moving heaters, name the model (features), estimate turnover in an average month, list the price, estimate proportion on HP.

model (volume)	numbers/ month	price		% on HP

4.1 List the 3 fastest moving water heaters, name the model (volume, kW), estimate turnover in an average month, list the price, estimate proportion on HP.

model (features)	numbers/ month	price		% on HP

5.1 List the 3 fastest moving lights, name the model (volume, watts), estimate turnover in an average month, list the price, estimate proportion on HP.

model (features)	numbers/ month	price		% on HP

6.1 List the 3 fastest moving fluorescent, name the model (volume, watts), estimate turnover in an average month, list the price, estimate proportion on HP.

model (features)	numbers/ month	price		% on HP

7. others

model (feature)	numbers/ month	price		% hire purchase

8. Please describe the financing schemes, and terms.

income level	references	%	duration

9. Who do you sell to?..

10. What's your edge?..

11. Would appliance energy labelling assist in the your work?..

cooking appliances		Freedom	Russels	Dions	Macros	Morkels	Hyperam	Tafelberg	Gas Masters	ADC	Mowbray Statior	Bellstar (B(	Hawkers p(	Value Super Marke	Day Line Sales
hobs & stoves	model		Defy 511	Defy 621D	Defy Petit chef	Defy S 621		Kelvinator	Gas						Falkirk Dover no. 6
	volume														
	price		1699	1949	1949	2199		1936	950 to 2500						1516.2
	numbers		4	3	4	6		14	5 to 7						
hobs & stoves	model		Univa 010tf4e	Univa 204(	Defy Slimline	KIC		Defy 131T							Dover No. 88 (smokeless)
	volume														
	price		1599	1949	1649	1999		2669							2089.62
	numbers		4	3	4	30		13							
hobs & stoves	model		Estia	Kelvinator 2620				Kelvinator 3691							Union no. 9
	watts		3350												
	price		1399	2099				1599							1607.4
	numbers		10	3				11							
hobs only	model			Defy Solid	Defy Gemini	Defy Gemini		Defy 600S	cadac stainless s	Defy Gemini					
	volume														
	price			999	979	1399		1499	300	979					
	numbers			7				18	20						
hobs only	model			Defy Ceram				Kelvinator	Cadac enamel						
	volume														
	price			2099				1499	150						
	numbers			3				14	12						
hot plates	model	pineware			pineware 1021	Phillips		Defy Petit	Cadac Cooker to	CF 30	CF 30 (LPG)	CF 30	Giant Doub	Flame Double	
	volume														
	price	129			109	269		1956	40	55	36	25 to 50	46	45	
	numbers					9		17	100	135					
hot-plates	model								primus		Beatrice	Beatrice	Giant Singl	Flame single	
	volume														
	price								64		96	150	25	23	
	numbers								20						
micro waves	model	Tatung	Defy Cuisine c	Sharp 33I	Matsui MR29E	Samsung 3	Mercury	Daewoo 115B				Primus (imported)			
	volume			33	1000 watts	32									
	price	695	1399	1599	979	1499	899	959				150			
	numbers	7	10	14	40	25		26							
	model			Samsung	Matsui manual MR29M			Daewoo 610S				Rondo Wick			
	volume														
	price			1299	879			639				25 to 50			
	numbers			12	40			25							
	model			Matsui (range)				Sharp R8R51							
	volume														
	price			999				2599							
	numbers			15				16							

heaters			Bellstar	Gas Masters	Dions	Macros	Morkels	Hyperama	ADC	Russels	Tafelber	Day line sales
	Gas	model		Bosch Rollabo	Saisho (SGH 009)				Bosch Rollabout F 130			Queen Anne
		volume							4200			
		price		549	549				440			627
		numbers		20					2			400
		model		Safire								
		volume										
		price		124								
		numbers		30								
	Paraffin	model	Rondo Wick				MCE					
		volume										
		price	20 to 50				249					
		numbers					25					
	Electric radiant	model			Nu World Single Gl	Nu-world	MCE 11 fin			Salton 9 fir	Haz quartz	
		volume			800 Watts	1600 Watts	2500 watts			2000	2000	
		price			40	79	399			399	139	
		numbers					8			2		
	elec	model			De Longhi 11 fin	Saisho 7 fi	MCE Magil	Mercury 8 fin			De Longhi 7 fin	
		volume			2700 Watts	1500	1200	2000			1800	
		price			569	229		269			399	
		numbers					7					
	elec	model			Saisho 12 fin	Saisho 9 fin		Mercury 11 fin			De Longhi 14 fin	
		volume			2500 Watts	2000 watts		2500				
		price			329	265		299			495	
		numbers										
	elec	model									De Longhi Radiant	
		volume									1200	
		price									189	
		numbers										
	elec	model									De Longhi (blower)	
		volume									2000	
		price									149	
		numbers										

water heaters											
			Gas Masters	Kwikhot	ADC			Penny Pinchers		AEG	
	gas	model	Junker (Bosch)		Valliant 275			horizontal		inline MT60	
		l/min	5		10			circular 100kPA		5.75kW 3..1l/min	
		price	980		1700		litres	100		820.8	
		numbers	10		40		100	760			
							150	885			
	gas	model	Valliant (ADC)		Valliant		200	1378		DDLT	
		l/min	10		190l (8.2 kW)					18/21 kW (10.5l/min)	
		price	1200		4800					1097.82	
		numbers	5								
	gas	model			Valliant						
		l/min			220l (8.6 kW)						
		price			5000						
		numbers									
	elec	model		basin hot (1.5 kW)							
		volume		100							
		price		1200 to 1300							
		numbers									
	elec	model		sink hot (1kW)							
		volume		50							
		price		1000 to 1100							
		numbers									
	elec	model									
		volume									
		price									
		numbers									

lights							
		Hyperama	Macros	Dions	Value Sup	Bellstar	Gas Masters
elec	model	Phillips	Sanji				
incandescent	volume	5*60w	5*100w	5*60w			
	price	14.99	10.6	10.48			
	numbers						
	model	Mercury	Thorn				
	volume	6*60w	5*100w	5*100			
	price	12.99	11.59	10.48			
	numbers						
	model	Mercury	Thorn				
	volume	6*100w	5*60w				
	price	12.99	11.19				
	numbers						
CFLs	model	Mercury	Philips ES	Philips SL			
	volume	10w	13w	18w			
	price	52.99	53.98	58.45			
	numbers						
	model	Mercury	Philips ES	Sanji			
	volume	13w	18w	11w			
	price	54.99	56.99	68.39			
	numbers						
		Mercury		Sanji			
		18w		18w			
		62.99		68.39			
Paraffin	model				Hazel Lam	Coleman (pressure lamp)	
	volume						
2 wicks = 3.49	price				7.99	199 to 239	
wick holder = 5.1	numbers						
Gas	model						Cadac
	volume						100 CP
	price						64
	numbers						36
	model						Cadac
	volume						300 CP
	price						105
	numbers						18

fridges		Freedom	Joshua Doors	Russels Bellville	Dions	Hyperama	Macro	Morkels	Tafelberg	Gas Master
Fridge	model				Kelvinator RD 3	Fridgemaster SDC 385			Daewoo 120	
	volume				335	385			120	
	price				2199	2299			999	
	numbers				4	?			17	
Fridge/Freezers	model	Fridgemaster 285	Fridgemaster 255	Defy 320	KIC BF 30	Fridgemaster 285	Kelvinator 317	Fridgemaster 35	Kelvinator 317	
	volume	285	255	320	304	285	317	350	317	
	price	1999	1599	2499	1849	1700	1979	2199	1879	
	numbers	12	15	4	8	?	10	6	14	
Fridge/Freezers	model	KIC 265	Fridgemaster 278	Defy 260	Kelvinator RD 3	Fridgemaster 425	Defy 260	KIC 350	Fridgemaster 720	
	volume	265	278	260	317	425	260	350	720	
	price	2599	1999	2199	1999	1899	1649	2199	3949	
	numbers	6	10	4	7		12	6	11	
Fridge/Freezers	model		Fridgemaster 335	Kelvinator 320	Fridgemaster FE	Fridgemaster 220	KIC		Kelvinator 320	
	volume		335	320	325	220			320	
	price		2199	2499	1849	999			1799	
	numbers		5	4	6				9	
Freezers	model	Fridgemaster 150	Defy CF 210	Fridgemaster 220	KIC 210		Defy 210	KIC 210	Defy 210	KIC 110 (gas)
	volume	150	210	220	210		210	210	210	110
	price	1399	1299	1199	999		999	1399	999	1400
	numbers	4	7	4	8		12	1	31	5
Freezers	model	KIC 210	Defy CF 270		Kelvinator FA 330		Fridgemaster 2	Defy 210	Kelvinator 330(upr	KIC 220 (gas)
	volume	210	270		330		220	210	330	220
	price	1499	1699		2599		999	1499	2339	2500
	numbers	4	2		5		5	0	10	5
Freezers	model		KIC 210		Defy 420				Defy 270	
	volume		210		420				270	
	price		1.5		1849				1249	
	numbers		1199		3				7	