

# Household energy use: a comparison of household energy consumption and expenditure across three provinces

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**R Aitken**

*Restio Energy*

## **Abstract**

*This paper details and contrasts the patterns of household energy consumption from three sample groups across three provinces in South Africa. The three samples were selected from unelectrified areas in the provinces of KwaZulu-Natal, North West and the Eastern Cape. The paper shows the range of energy sources and carriers as well as the most prominent and common applications. Understanding patterns of household energy consumption and expenditure, as well as the energy burden of rural households can be used to shape and inform energy interventions within these regions for both public and private sector concerns.*

*Keywords: household energy use, household energy consumption and expenditure, KwaZulu-Natal, North West Province, Eastern Cape*

## **Introduction**

While South Africa's energy policy and research base is both active and well developed, there does appear to be a paucity of current information on household energy activities. This paper is intended, in some measure, to address this dearth by providing a review of household energy activities in three sample groups from three different provinces. Energy is a key facilitator of development, a relationship that is reaffirmed by the government's commitment to providing improved energy services to all households in South Africa. The evidence to this end includes Eskom's electrification drive, the off-grid concession programme and other initiatives such as the Integrated Energy Centres, the promotion of biomass stoves, the Department of Minerals and Energy's interest in LPG, etc. In supporting these initiatives, it is important that a better understanding of current patterns of energy use, including energy carriers, expenditure, purchasing issues and

fuel switching, is developed in order to both inform and measure the impact of these current and future energy initiatives.

The data presented within this paper is gleaned from a number of commissioned studies undertaken by Restio Energy (formerly called RAPS Consulting). While the company was commissioned by different clients for different purposes, the lead objectives and methodologies employed were sufficiently similar to enable a comparison between sample groups. All three projects focused on rural, un-electrified households within what were former homeland areas, including the provinces of KwaZulu-Natal, North West and Eastern Cape.

## **Study areas**

The surveys were administered to households in unelectrified rural areas in KwaZulu-Natal, the North West province and the Eastern Cape. In KwaZulu-Natal the study areas included the Tribal Authorities of Mbile and Mabaso in the Mbazwana area and the Siqakatha Tribal Authority in the Makhatini Flats area. This study was commissioned by the Nuon-RAPS Utility (NuRa), utilising funding provided by PSOM<sup>1</sup>, for the purposes of assisting with the feasibility study for establishing an off-grid concession in the northern KwaZulu-Natal region.

A study of two villages in the Eastern Cape was commissioned by Ndizani Networks Group, on behalf of Scottish Power, for the purpose of assessing the feasibility of installing a mini-grid in the area. The two villages, Dumsi and Mbandana, fall within the Mbizana Local Municipality. The final study was undertaken as part of a baseline socio-economic and technical assessment in the North West Province. The study was commissioned by KfW and the Department of Minerals and Energy (DME) with a view to better understanding the extent of the off-grid market within the Province. This study was designed to support other activities that together would indicate the viability for establishing an off-grid concession within the Province.

The study area was quite vast including the Municipalities of Zeerest, Mafikeng, Kagisano, Madibeng and Moretele.

### Methodology

In each of the study areas a detailed household survey, designed to elicit information on patterns of energy consumption and expenditure as well as demographic and resource access profiles, was administered. While other more qualitative methods were also utilised, this paper draws exclusively on data derived from the household surveys.

The approach employed regarding enumerator selection and training was standard for the three studies. Enumerators from the respective areas were identified and trained. Local schools principals assisted in identifying recent matriculants who comprised the core group of enumerators. Random sampling was achieved through administering to every second household as well as dispersing enumerators over reasonably wide areas. Due to time constraints we were unable to employ more statistically sound techniques for achieving random samples such as the grid technique, etc. However, enumerators were dispersed across the settlements and required to work randomly in specific geographies of the study area. This ensured that there was always a good mix of households across the geography of the communities.

In the KwaZulu-Natal study, 120 households were included in the study which was applied across the three tribal authorities. A total of 411 households were surveyed in the two villages in the Eastern Cape Province. In the case of the North West study, 212 households from 12 villages were included in the survey.

### Survey data

While the principal data sets are those that detail household energy use, it is nevertheless useful to provide contextual information which will enable a

greater level of comparative analysis. To this end, information on household demographics, income and employment patterns have been included.

### Household demographics

As shown in Table 1, the household demographics of the three sample populations are generally quite consistent. In each sample set, females represent the predominant gender which is consistent with national demographic trends<sup>2</sup>. The country's population is 48% male and 52% female. Only the Eastern Cape sample presents some inconsistency with the national average although the recorded provincial male to female ratio of 46:54 does accord with the figures presented below<sup>3</sup>. The higher female to male ratios within this province can at least in part be accounted for by high levels of migrant labour leaving for the larger commercial centres within the Western Cape, Gauteng and KwaZulu-Natal provinces (Bekker, 2000).

Similarly, the age set structures of the sample populations were fairly consistent with national and provincial population data. South Africa has a young population; this reality is borne out in the samples' age structure presented in Table 2 below. The preponderance of youth within the samples is consistent with national figures which suggest that 45.7% of the population are 19 years or younger<sup>5</sup>.

### Income and employment

Figure 1 looks at income distribution amongst the sample groups. While incomes from the Eastern Cape and KwaZulu-Natal samples are fairly consistent across the income bands, the lower household incomes in the North West Province are shown by the higher proportion of households in the lower income bands. For instance, 50% of Eastern Cape households and 47% of households in KwaZulu-Natal have incomes between R0 and R1000 per month. In the case of North West Province, that same income band accounts for 77% of the sample

**Table 1: Gender ratios amongst the three sample groups<sup>4</sup>**

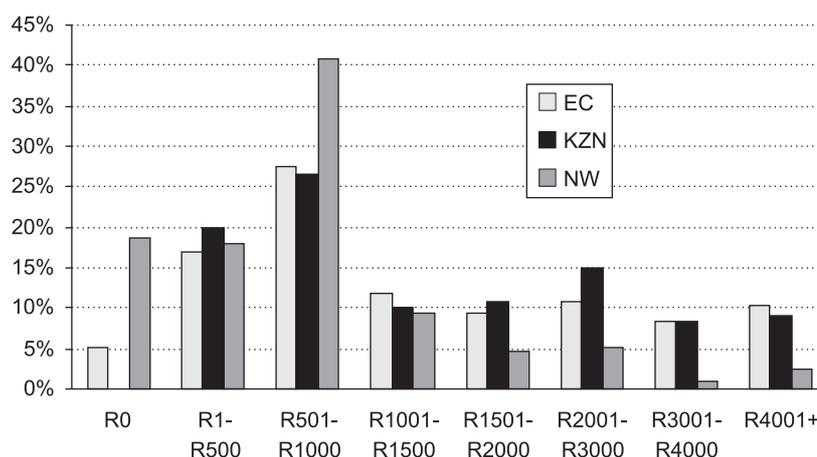
| Description | EC   |      | KZN |      | NW   |      |
|-------------|------|------|-----|------|------|------|
| Male        | 1136 | 45%  | 382 | 48%  | 492  | 47%  |
| Female      | 1385 | 55%  | 411 | 52%  | 554  | 53%  |
| Total       | 2521 | 100% | 793 | 100% | 1046 | 100% |

**Table 2: Age set structures for the three sample groups**

| Age sets | EC   | KZN  | NW  |      |      |      |
|----------|------|------|-----|------|------|------|
| 0-18     | 1194 | 47%  | 373 | 47%  | 454  | 43%  |
| 19-35    | 706  | 28%  | 242 | 31%  | 311  | 30%  |
| 36-59    | 461  | 18%  | 118 | 15%  | 182  | 17%  |
| 60>      | 159  | 6%   | 60  | 8%   | 99   | 9%   |
| Total    | 2520 | 100% | 793 | 100% | 1046 | 100% |

**Table 3: Household income patterns<sup>6</sup>**

| Income category    | EC    |         | KZN   |         | NW  |         |
|--------------------|-------|---------|-------|---------|-----|---------|
|                    | %     | R/month | %     | R/month | %   | R/month |
| Regular employment | 45    | 2 343   | 34    | 1 895   | 18  | 1 701   |
| Casual employment  | 23    | 879     | 20    | 515     | 13  | 736     |
| Self-employment    | 17    | 1 457   | 66    | 835     | 5   | 434     |
| Welfare            | 48    | 604     | 45    | 579     | 62  | 719     |
| No income          | 5     | 0       | 0     | 0       | 19  | 0       |
| Ave. HH income     | 1 791 |         | 1 561 |         | 843 |         |

**Figure 1: Income distribution amongst the sample households**

population. The more impoverished position of North West households is further indicated by the lower levels of formal employment and greater dependency on welfare income as illustrated in Table 3.

The household survey measured income across a range of different employment categories. These categories included *Regular employment*; a reference to full time employment including permanent and contract positions, *Casual employment*; referring to part-time work in the formal sector and/or wage work within the informal sector, *Self employment*; including all self-owned manufacturing, retailing and service activities in the informal sector and *Welfare*; referring to all monetary forms of social support received from the state, including disability, pension and child grants.

The figures in reflect the proportion of households in each sample group which receive income from particular income categories. It should be understood that households may, and indeed do, receive income from more than one income category. The R/month reflects the average amount per household received from particular income categories while the last row of the table simply indicates that the average household income for the entire sample.

As shown in Table 3, a considerable range of

monthly incomes, in terms of both sources and amounts, were recorded across the three sample groups. Monthly incomes across the employment categories (with the exception of welfare income) were generally higher amongst the Eastern Cape sample as opposed to its counterparts in KwaZulu-Natal and the North West Province. Welfare revenue was the greatest in the North West Province where both the proportion of recipients and average amounts were higher than those recorded for the Eastern Cape and KwaZulu-Natal Provinces.

### Household energy use

This section details the patterns of household energy consumption amongst the sample populations. The prevalence of, and expenditure on, particular fuels are discussed as well as the end-uses or 'service requirements' associated with particular fuels.

#### Paraffin

Paraffin (kerosene) usage (see Table 4) is very common in the Eastern Cape and North West provincial samples, a position which contrasts quite sharply with the relatively low take-up recorded amongst the KwaZulu-Natal sample. This can, at least in part, be explained by the correspondingly higher take-up of LPG amongst the KwaZulu-Natal sample (see, for instance, Gothard, 2003)<sup>7</sup>.

**Table 4: Paraffin usage**

|                                   | EC  | KZN | NW  |
|-----------------------------------|-----|-----|-----|
| Sample size                       | 411 | 120 | 212 |
| Paraffin users                    | 368 | 39  | 150 |
| % of sample                       | 90% | 33% | 71% |
| Ave. monthly expenditure (users)  | R63 | R37 | R77 |
| Ave. monthly expenditure (sample) | R56 | R12 | R55 |

While paraffin is used in a range of domestic applications, Table 5 shows that cooking is the most common end use across the samples. Between 82% and 88% of paraffin using households identify cooking as a primary application. Other end-uses include heating water for consumption and washing, lighting, space heating and ironing. Although data from the KwaZulu-Natal samples suggest something of a shift, it is still reasonable to assert that paraffin remains the 'fuel of the poor'. This position is supported by the fact that the distribution infrastructure is well established in rural areas, purchases can be made in varying quantities and the appliance set associated with paraffin use is reasonably priced and ubiquitously available.

**Table 5: Paraffin end-use applications**

|               | EC  |     | KZN |     | NW  |     |
|---------------|-----|-----|-----|-----|-----|-----|
| Cooking       | 322 | 88% | 34  | 87% | 123 | 82% |
| Heating water | 32  | 9%  | 30  | 77% | 86  | 57% |
| Lighting      | 11  | 3%  | 5   | 13% | 62  | 41% |
| Space heating | 2   | 1%  | 0   | 0%  | 4   | 3%  |
| Ironing       | 1   | 0%  | 18  | 46% | 66  | 44% |
| Total users   | 368 |     | 39  |     | 150 |     |

### Candles

Candles are the most common fuel source used for lighting across the sample groups, a point clearly illustrated in Table 6. This is not surprising as they are widely available and can be purchased in single or multiple units. The average monthly expenditure shows a small range with households across the sample spending between R20 and R25 a month. Households not using candles will rely variably on paraffin, LPG and to a lesser extent, wood for their illumination requirements.

### LPG

While not as prevalent as paraffin, LPG nevertheless features fairly prominently amongst the sample households. This is particularly true amongst the KwaZulu-Natal households where, as Table 7 indicates, approximately 50% of households within the sample use LPG. While these figures are markedly higher than the other sample groups, they do cor-

respond with other household energy audits undertaken in KwaZulu-Natal (Gothard, 2003)<sup>8</sup>.

**Table 6: Candle usage**

|                                   | EC   | KZN  | NW   |
|-----------------------------------|------|------|------|
| Sample size                       | 411  | 120  | 212  |
| Candle users                      | 357  | 119  | 209  |
| % of sample                       | 87%  | 99%  | 99%  |
| Ave. monthly expenditure (users)  | R20  | R22  | R 24 |
| Ave. monthly expenditure (sample) | R 18 | R 22 | R24  |

**Table 7: LPG usage**

|                                   | EC   | KZN | NW   |
|-----------------------------------|------|-----|------|
| Sample size                       | 411  | 120 | 212  |
| LPG users                         | 113  | 59  | 59   |
| % of sample                       | 27%  | 49% | 28%  |
| Ave. monthly expenditure (users)  | R135 | R77 | R 30 |
| Ave. monthly expenditure (sample) | R37  | R38 | R36  |

Cooking is by far the most common end-use application within LPG using households in the Eastern Cape and KwaZulu-Natal provinces. In the North West Province, (see Table 8), the situation is somewhat different in that refrigeration is the most common end-use with cooking a clear second. Other significant end-uses include heating water (consumption and washing) and ironing.

**Table 8: LPG end use applications**

|               | EC  |     | KZN |     | NW |     |
|---------------|-----|-----|-----|-----|----|-----|
| Cooking       | 107 | 95% | 50  | 85% | 28 | 47% |
| Heating water | 69  | 61% | 42  | 71% | 13 | 22% |
| Ironing       | 68  | 60% | 25  | 42% | 4  | 7%  |
| Refrigeration | 43  | 38% | 22  | 37% | 39 | 66% |
| Space heating | 2   | 2%  | 2   | 3%  | 2  | 3%  |
| Lighting      | 3   | 3%  | 1   | 2%  | 1  | 2%  |
| LPG using HHs | 113 |     | 59  |     | 59 |     |

### Dry-cell batteries

Table 9 indicates that dry cell batteries are commonly used across the three sample groups. While the proportion of users is slightly greater amongst the North West sample household, the extent to which these households rely on batteries – as determined by monthly expenditure – is somewhat lower than the other two provincial samples.

**Table 9: Dry cell battery usage**

|                                   | EC  | KZN | NW  |
|-----------------------------------|-----|-----|-----|
| Sample size                       | 411 | 120 | 212 |
| Dry cell users                    | 223 | 66  | 135 |
| % of sample                       | 54% | 55% | 64% |
| Ave. monthly expenditure (users)  | R30 | R27 | R21 |
| Ave. monthly expenditure (sample) | R16 | R15 | R14 |

The most common end-use for dry cell batteries amongst the samples is powering radios. Between seventy-nine (79) and eighty-nine (89) percent of dry cell battery using households power radios while other secondary end uses include Hi-Fi's, tape recorders, clocks and torches (see Table 10).

**Table 10: Dry cell battery end uses**

|                            | EC  |      | KZN |      | NW  |      |
|----------------------------|-----|------|-----|------|-----|------|
| Radio                      | 178 | 80%  | 59  | 89%  | 117 | 87%  |
| Hi-Fi                      | 11  | 5%   | 2   | 3%   | 8   | 6%   |
| Tape recorder              | 13  | 6%   | 3   | 5%   | 24  | 18%  |
| Torch                      | 11  | 5%   | 11  | 17%  | 29  | 21%  |
| Clock                      | 8   | 4%   | 2   | 3%   | 2   | 1%   |
| Dry-cell battery using HHs | 223 | 100% | 66  | 100% | 135 | 100% |

**Car batteries**

Car batteries are used across the sample groups. The Eastern Cape sample shows (see Table 11) the highest car battery usage while the KwaZulu-Natal sample demonstrates the lowest proportionate reliance on car batteries. Average monthly costs for battery users range between R28 and R34<sup>9</sup>. These costs exclude the capital costs of purchasing the batteries<sup>10</sup>. The mean average frequency of battery recharging was every 17 days in the case of the Eastern Cape sample, 14 days in the KwaZulu-Natal sample and 15 days in the North West sample.

**Table 11: Car battery usage**

|                                   | EC  | KZN | NW  |
|-----------------------------------|-----|-----|-----|
| Sample size                       | 411 | 120 | 212 |
| Car Battery users                 | 165 | 34  | 77  |
| % of sample                       | 40% | 28% | 36% |
| Ave. monthly expenditure (users)  | R29 | R34 | R31 |
| Ave. monthly expenditure (sample) | R11 | R10 | R11 |

As indicated in Table 12, most households use their car batteries for powering television sets while

other end uses include radios and Hi-Fis. The lower reliance on car batteries for powering radios and Hi-Fis might be accounted for by the fairly widespread use of dry-cell batteries.

**Table 12: Car battery end uses**

|                       | EC  |      | KZN |      | NW |      |
|-----------------------|-----|------|-----|------|----|------|
| Television            | 134 | 81%  | 21  | 62%  | 62 | 81%  |
| Radio                 | 39  | 24%  | 14  | 41%  | 32 | 42%  |
| HiFi                  | 70  | 42%  | 10  | 29%  | 17 | 22%  |
| Car battery using HHs | 165 | 100% | 34  | 100% | 77 | 100% |

**Wood**

The quite extensive use of wood across the sample households is typical of rural households in South Africa (Davis, 1998). While most unelectrified households make use of other energy sources such as LPG and paraffin, wood nevertheless still plays an important part in the energy economy of the households. Between 76% and 98% of the sample claim to use wood (see Table 13). Expenditure on a particular fuel is in most instances a reflection of the extent to which a household relies on that fuel, however, wood does not accord with these assumptions. In many cases households collect wood free of charge, gathering this resource from within and around community areas. Yet it is becoming apparent that an increasing number of rural households are electing to pay for wood as opposed to collecting it (see, for instance, Davis and Ward, 1995; Davis, 1998).

**Table 13: Wood fuel usage**

|  | EC  | KZN | NW  |
|--|-----|-----|-----|
| Sample size                                    | 411 | 120 | 212 |
| Wood using HHs                                 | 341 | 117 | 163 |
| % of sample                                    | 83% | 98% | 77% |
| Wood purchasing HHss                           | 156 | 3   | 28  |
| % of wood users                                | 46% | 3%  | 17% |
| Ave. monthly expenditure (users that purchase) | R16 | R12 | R11 |
| Ave. monthly expenditure (sample)              | R6  | R0  | R1  |

As indicated above, approximately 45% of wood using households in the Eastern Cape sample purchase some or all of their wood supplies. There are a number of possible reasons for this, including the increasing scarcity of local wood resources<sup>11</sup> and the possible convenience benefit in purchasing as opposed to collecting wood. While there was some evidence of households purchasing wood fuel in the other provincial samples, the practice was

**Table 14: Wood fuel applications**

| Priority level     | EC  |     |     | KZN |     |     | NW  |     |     |
|--------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|
|                    | 1   | 2   | 3   | 1   | 2   | 3   | 1   | 2   | 3   |
| Cooking            | 89% | 5%  | 8%  | 94% | 3%  | 0%  | 92% | 0%  | 0%  |
| Heating water      | 5%  | 48% | 19% | 19% | 50% | 42% | 5%  | 77% | 1%  |
| Lighting           | 0%  | 2%  | 4%  | 0%  | 2%  | 0%  | 0%  | 1%  | 0%  |
| Ironing            | 0%  | 9%  | 38% | 9%  | 10% | 37% | 4%  | 3%  | 45% |
| Space heating      | 8%  | 34% | 22% | 3%  | 10% | 37% | 1%  | 6%  | 13% |
| Woodfuel using HHs |     | 341 |     | 117 |     | 163 |     |     |     |

considerably less frequent than evidenced in the Eastern Cape. While the anomalous position of the Eastern Cape sample does suggest localised wood resource shortages, it is interesting to note in another recent survey undertaken in the Eastern Cape, (Aitken and Nkosi, 2003) observed that 37% of wood using households purchased wood at some time or other.

Each of the three provincial surveys asked respondent households to identify the priority applications of wood fuel. Priorities one to three were recorded and have been summarised in Table 14 below. Between 89% and 94% of woodfuel using households identified cooking as their priority one application. Other prominent uses included heating water, ironing and space heating. It should be noted that woodfuel accommodates multiple end-uses, enabling households to cook food while simultaneously benefiting from space heating. Similarly, once the cooking process is concluded, heat from the fire is still available for ironing, heating water, etc.

#### **Diesel and petrol generators**

A very small portion of the sample households owned and operated generators. While generator usage was the highest amongst households in the North West sample, the figures did not exceed 10% of the sample (see Table 15). The attraction of generators appears to be the higher level of end-uses that they offer, while the principle deterrents are the capital and operating and maintenance costs involved<sup>12</sup>.

**Table 15: Generator usage**

|                                   | EC   | KZN | NW  |
|-----------------------------------|------|-----|-----|
| Sample size                       | 411  | 120 | 212 |
| Generator users                   | 11   | 5   | 19  |
| % of sample                       | 3%   | 4%  | 9%  |
| Ave. monthly expenditure (users)  | R240 | R89 | R97 |
| Ave. monthly expenditure (sample) | R6   | R4  | R9  |

Households using generators do so to support

service requirements such as communications (TV, radio and Hi-Fi), illumination, food preservation and preparation (refrigerators and stoves/hobs). For the most part, these households do not fully utilise the power available from generators, instead tending to power low-medium household appliances such as TVs, radios and lighting applications. The reason given for this are the costs involved in powering larger loads such as that required by stoves and refrigerators<sup>13</sup>.

#### **Re-charging cellular phones**

Given the increasing use of cellular phones in rural areas, the household surveys included questions that probed the costs of operating cellular phones in unelectrified households (see Table 16). The need for communication has resulted in the proliferation of cellular phone ownership in rural areas which has, in turn, increased the energy 'burden' of these households. Cellular phones are typically taken to nearby towns, electrified shops, or to charging stations equipped with gensets or solar charging options, with a typical cost per charge being of the order of R5.

**Table 16: Cellular phone recharging**

|                                   | EC   | KZN  | NW   |
|-----------------------------------|------|------|------|
| Sample size                       | 411  | 120  | 212  |
| Households with cellular phones   | 186  | 19   | 61   |
| % of sample                       | 45%  | 16%  | 29%  |
| Ave. monthly expenditure (users)  | R 24 | R 22 | R 25 |
| Ave. monthly expenditure (sample) | R 11 | R 3  | R 7  |

Cellular phone usage is highest amongst the Eastern Cape sample group and lowest in the KwaZulu-Natal sample. One possible explanation is that the KwaZulu-Natal survey was undertaken two years prior to the Eastern Cape survey. Judging by the fairly rapid increase in the cellular market, the difference of two years may well prove significant in terms of the proliferation of cellular phones. A more

recent study undertaken by Gothard (2003) in similar areas of northern KwaZulu-Natal observed that 73% of households owned cellular phones.

### Other energy sources

Energy sources that are not common amongst the same groups as well as those that are marginal to the energy economies of the households have been omitted from this discussion. These include coal, which is used by 12% of the sample households in the North West Province but does not feature at all amongst the other samples, and animal dung which no longer appears to play much of a role in rural South Africa. No households reported using charcoal, a fuel generally confined to the (sub) urban recreational/hospitality markets<sup>14</sup>.

### Total household energy expenditure

Household expenditure on particular fuels and energy sources is detailed in Table 17. For each energy carrier and/or source, expenditure for the users of that particular fuel type as well as the general sample averages have been included.

Average monthly expenditure for the three sample groups shows some range, with monthly expenditure amongst the Eastern Cape and North West samples in the region of R150 – R160 per month, while households in KwaZulu-Natal spend approximately 30% less at around R100 per month (summarised in Table 18). In accounting for these differences, one should not have to look much further than paraffin use and expenditure amongst the KwaZulu-Natal sample. The sample average for paraffin is approximately R40 less in the case of KwaZulu-Natal as opposed to the other samples. It may be that in addition to a higher prevalence of LPG amongst this sample, the virtual absence of woodfuel purchasing suggests an abundance of this resource that may have displaced a significant portion of paraffin usage at no extra cost. It is also interesting to note that despite the higher prevalence of LPG usage in KwaZulu-Natal, the average

expenditure for the sample is the same as in other areas.

**Table 18: Total monthly energy expenditure**

|                          | EC        | KZN      | NW      |
|--------------------------|-----------|----------|---------|
| Ave. monthly expenditure | R159.44   | R102.90  | R152.42 |
| Ave. monthly income      | R1 790.86 | R1560.90 | R842.50 |
| % of monthly income      | 8.9%      | 6.6%     | 18.1%   |

### Conclusion

It is not too surprising that patterns of energy consumption exhibit similar profiles across the different sample groups. While climate and proximity to employment opportunities do differ, the political histories of the respective regions have, in turn, provided a strongly unifying influence. Without active government participation in issues such as access to modern energy services, poverty will dictate patterns of household energy use. And while incomes vary to some extent, all sample groups fall broadly within the same socio-economic categories.

It needs to be reiterated that the intensions behind these household surveys were not identical in each case, and therefore, there must be some caveats issued against the representivity of the data. While the North West household survey was designed and administered to represent the off-grid areas of that province and covered a large geographical area, the surveys from the Eastern Cape and KwaZulu-Natal had a more localised focus. The two villages which comprise the Eastern Cape sample were identified for the purposes of establishing a mini-grid in that area. While we have no reason to believe that these communities were anything but 'typical' of the region, this was not a consideration in identifying the villages. With reference to the

**Table 17: Household energy expenditure by fuel**

|                             | EC        |             | KZN       |             | NW        |            |
|-----------------------------|-----------|-------------|-----------|-------------|-----------|------------|
|                             | User ave. | Sample ave. | User ave. | Sample ave. | User ave. | Sampleave. |
| Paraffin                    | R63.07    | R56.47      | R37.18    | R12.08      | R77.42    | R54.52     |
| Candles                     | R20.38    | R18.03      | R22.23    | R22.05      | R24.38    | R23.92     |
| LPG                         | R135.49   | R37.25      | R77.00    | R37.86      | R129.82   | R35.96     |
| Dry cell                    | R30.19    | R16.38      | R26.90    | R14.80      | R21.36    | R13.51     |
| Car Battery                 | R28.56    | R11.46      | R33.66    | R9.54       | R30.78    | R11.27     |
| Wood                        | R16.27    | R6.14       | R11.66    | R0.29       | R10.63    | R1.40      |
| Generators                  | R240.16   | R6.43       | R89.00    | R3.71       | R97.32    | R8.68      |
| Cellular phones             | R23.66    | R10.71      | R22.00    | R2.57       | R24.96    | R7.18      |
| Average monthly expenditure | R159.44   |             | R102.90   |             | R152.42   |            |

KwaZulu-Natal study, the study was designed to assist with determining the feasibility of establishing the Nuon-RAPS concession in the northern regions of the province of KwaZulu-Natal. As such we would argue that the data is representative of that region but arguably not of the province as a whole.

Despite these limitations, we believe that the data presented here makes a useful contribution to understanding household energy use patterns in unelectrified households in South Africa. There are a number of interesting patterns that emerge through the data that require further attention. While there is insufficient scope here to analyse these, a task that will be undertaken in future publications, a number of the more prominent issues have been identified and are briefly discussed below.

- Unelectrified rural households are spending considerable sums of money on a range of household energy sources. This suggests, amongst other things, a level of market preparedness. For households spending in excess of R100 per month on energy, this would translate into 200 kWh of grid electricity at a tariff of R0.50 per kWh<sup>15 16</sup>. In addition, the fact that households are utilising a range of different fuels suggests a level of optimisation, of matching fuels with applications. This may further suggest that social and/or cultural factors are not playing a significant role in the choice of fuel types, but rather factors such as access and affordability would seem more influential.

- Related to the above, it is evident that modern fuels such as LPG are penetrating the market in the absence of electricity. With 50% of the sample household using LPG in KwaZulu-Natal and slightly less than 30% in the other two samples, LPG is clearly a significant household fuel within unelectrified rural households. There is clearly a market for the fuel and this needs to be matched by a suitable distribution infrastructure – preferably one which is able to significantly reduce the costs of access.

- In terms of the market for solar home systems (SHS) amongst currently unelectrified rural households, it is interesting to note current expenditure on displaceable fuels (i.e. those energy sources that would be displaced by the introduction of SHS). The average displaceable spend is R72.02<sup>17</sup>. This includes money spent on candles, dry-cell batteries and cellular phone charging<sup>18</sup>. Importantly, this is a quantitative translation which does not factor in the qualitative value of the different service options. For instance, one or two candles may be replaced by 3 – 4 compact fluorescent lights of considerably greater brightness. Nevertheless, it is clear that the current energy expenditure suggests considerable scope for SHS amongst unelectrified rural house-

holds. For instance, current tariffs applied by the off-grid concession companies in South Africa are in the region of R65/month for a basic system (4 lights, 185 Wh/day).

- The proliferation of cellular phones across South Africa, and indeed the continent, has introduced a new demand for a high-value energy service in rural households. With the technology leap that has characterised sub-Saharan Africa's shift to cellular phone technology, leapfrogging the terrestrial/land-line technologies, there is an urgent need to address the new energy requirements. Cellular phones are becoming an increasingly important communications/information platform and care should be taken to avoid energy requirements for cellular phones becoming a barrier to communications access.

- The vast majority of unelectrified rural households still rely to some extent on woodfuel. While these surveys did not quantify the amount and/or frequency of use, the fact that woodfuel remains so prominent in the energy mix of rural households, suggests that we cannot ignore woodfuel even when the national agenda is very much taken up by 'modern energy'. Further attention is critical, in part because of changes in woodfuel availability and environmental impacts of woodfuel harvesting, but also because of the very significant health impacts of smoke exposure (depending on the way it used).

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## Notes

1. PSOM is an international development fund managed by Senter, a technology and research institute funded by the Dutch Government.
2. STATS SA's website: <http://www.statssa.gov.za>
3. STATS SA's website: <http://www.statssa.gov.za>
4. In this and subsequent tables, the following abbreviations for provinces have been used; Eastern Cape (EC), KwaZulu-Natal (KZN) and North West (NW).
5. STATS SA's website: <http://www.statssa.gov.za>
6. The income corresponding to particular income categories represent the average for households active within that category. Average household income for all sample households is included at the bottom of the table.
7. These figures concur with Gothard's study in northern KwaZulu-Natal where she observed that only 14% of

- the sample group (150) used paraffin for cooking while 60% used LPG.
8. Gothard found that 59% of her sample of unelectrified households in Northern KwaZulu-Natal used LPG.
  9. These figures include the costs of recharging the battery and transport costs.
  10. The data to this end was inconclusive as information relating to battery life was not sufficiently clear. From the information we were able to gather, capital expenditure on batteries represented a cost range of between R10 and R16 a month depending on the new/used status of the battery and the pattern of usage.
  11. Between 40% – 60% of respondents across the sample groups complained that they were spending more time collecting wood than they did in the past. This was clearly linked to a decrease in local supply.
  12. The higher monthly expenditure recorded amongst generator users in the Eastern Cape sample can be attributed to three households spending in excess of R450 per month on fuel and maintenance. If these households were accorded the average amount spent by the remaining 7 generator users then the user average would be a more reasonable R150 a month.
  13. The three households identified as spending more than R450 a month are exceptions, supporting larger loads including refrigerators and electric stoves.
  14. Used mostly for braaing (barbeque) meat on open fires.
  15. This would be more if the Free Basic Electricity Tariff was factored in. At present the FBE amounts to 50kWh of free electricity each month.
  16. Lloyd et al (2004) estimated that the average kWh consumed by lower income households is in the region of 150 kWh.
  17. This figure is based on households that use candles, recharge cellular phones and use dry-cell batteries. It is the average spend on these three items of all households which rely on these energy sources. It does not represent the sample average (which is R43.05) but rather the user average.
  18. A more detailed analysis may include a portion of the household spend on paraffin where paraffin is used for household illumination as well. We were not able to disaggregate this figure for the purpose of the three studies although the breakdown in energy applications does include 'lighting' under paraffin applications.

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