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An Empirical Estimation of Energy Poverty in Poor South African Households

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Abstract
This paper provides empirical evidence on the determinants of Energy Poverty on rural and urban informal households in South Africa using the National Income Dynamics Survey (NIDS, 2012). The paper provides evidence on the impact of Energy Poverty on these households while controlling for individual, household and demographic characteristics. This is formulated within the logistic regression framework, while defining Energy Poverty using the Economic/expenditure approach consistent with the definition by the Department of Energy (DoE) of South Africa. The logistic model of energy poverty reveals that household expenditure on transport, food, schooling, income level, age and education level of the head of the household, household size and home size are important factors in explaining the state of energy in rural and urban informal households in South Africa. This paper also discusses limitations regarding the dependent variable (Energy Poverty) as defined in the paper and by the DoE. Lastly, some recommendations are made for Regulators and Policy Makers.

1. Introduction
African households predominantly use traditional and unclean energy resources for many activities such as cooking, lighting and drying of farm produce (Statistics SA, 2008). The attainment of the Millennium Development Goals (MDGs) rests on the availability and access of affordable energy to all people (Kohler, Rhodes and Vermaak, 2009).

Access to energy is important as it leads to an eradication of poverty through improved education, health services and may eliminate structural employment (Department of Energy, 2009). Kohler, Rhodes and Vermaak, (2009) believe that in order to achieve the MDGs, policy needs to be developed to encourage the use of efficient energy at the household level, so that the use of unclean energy such as biomass and charcoal is minimised. South African policies echo the sentiment for energy access through the White Energy Paper (RSA, 1998) where it is stated that, "energy security for low-income households can help reduce poverty, increase livelihoods and improve living standards" (RSA, 1998).

The state of energy poverty needs immediate attention. The objective of this study is to analyse the state of energy poverty in rural and urban informal areas at the household level. Therefore the main goals of the paper are aimed at identifying the determinants of energy poverty in these South African households by:

1) Estimating Energy Poverty of households using the Economics/Expenditure approach as defined by the Department of Energy of South Africa (DoE).
2) Constructing a logistic (logit) regression model of the determinants of Energy Poverty using the measure of energy poverty developed in 1) as a dependent variable.

The data for the above two goals is drawn from the National Income Dynamics Survey (2012) since it provides detailed information of income and expenditures of households, as well as individual, household and demographic characteristics of rural and urban informal areas at the household level.

The paper is organised as follows: Section 2 provides a literature review. Section 3 describes the data used, including a description of the database and variables used in estimation, while Section 4 presents the econometric methodology for both Energy poverty and the logistic estimations. Section 5 presents the results of the estimation and tests to ensure the predictive power of the model. Section 6 talks about the limitations of the estimation, while section 7 provides policy recommendations for Regulators and Policy Makers. Lastly section 8 concludes.

2. Literature Review
The South African government believes that energy poverty deepens general poverty and contributes to an erosion of health and education outcomes (RSA, 1998). As a result of it being a policy focus, the country is one of few countries in Sub-Saharan Africa that has made strides in addressing energy poverty. This is evidenced in the Medium Term Strategic Framework (MTSF, 2009) which states that the government aims to, "include, amongst others, diversification of the energy mix in pursuit of renewable energy alternatives and the promotion of energy efficiency".

Broadly defined, energy poverty is viewed as the *lack of access to modern energy services,* be it electricity, heating or cooking fuels, necessary for human development (Kohler, Rhodes and Vermaak, 2009). Unfortunately there is a lack of consensus internationally on what the term "energy access" means. The IEA, in its World Energy Outlook 2009, identified three levels of access to energy services depending on household energy needs and the benefits energy services provide. These include:

1) The minimum level of energy access required by households to satisfy basic human needs. (Electricity for lighting, health, education and community services)
2) The energy access required by households to improve productivity. (Electricity and modern fuels to improve productivity)
3) The level of energy access required by households to satisfy modern society needs. (Modern services for domestic appliances, increased requirements for cooking and heating and private transportation)

***Source: IEA, 2009*

The literature has traditionally been dominated by a theory of transition in which households gradually ascend an "energy ladder (Kohler, Rhodes and Vermaak, 2009). The ladder, beginning with traditional biomass fuels (firewood and charcoal), moves through to transition fuels (kerosene, coal and charcoal) and then on to modern commercial fuels (Liquefied Petroleum Gas (LPG), natural gas, or electricity) as incomes rise and urbanisation grows (Kohler et al, 2010). Even though an increase in income dictates a higher demand for energy, the transition to more modern energy is not easy for many South African households. This is evidenced in empirical work done by the Energy Sector Management Assistance Programme (ESMAP, 2000), the International Economic Agency (IEA, 2002) and Heltberg (2004), including research on energy use patterns in South Africa by Aitken (2007) who all reveal that many South African households rely on multiple energy sources for their energy needs and this applies to both electrified and non-electrified households.

Kohler et al (2009) therefore explain that electricity is only one part of the problem. They also highlight that access to efficient and affordable cooking and heating fuels, like LPG or kerosene, are equally vital to alleviating the effects of energy poverty. This finding provides a strong empirical challenge to prevailing energy transition theories and the "energy ladder" model. Kohler et al (2009) explain several possible explanations for this. One is that unreliable supplies require households to rely on diverse sources of energy. Another is that different energy sources are more cost-effective in some uses than in others. For instance it may make economic sense to use electricity for lighting but LPG for cooking.

"Fuel poverty" is a distinct concept where users of energy have access to, but cannot afford the energy they require (Kohler et al, 2009; Dunga, Grobler and Tchereni, 2013). In terms of quantifying fuel poverty, a common indicator used in country studies is the "energy burden" of households within a region. This is based on the notion that poor households spend a greater proportion of their income on energy than their more wealthy household counterparts (Pachauri and Spreng, 2003). It is calculated as the share of total household income or expenditure devoted to energy (Pachauri and Spreng, 2003). The South African Department of Energy (DoE) is consistent with the general literature in deciding that a household is deemed fuel poor if it spends between 10-15 percent of its income on domestic energy needs, with 10 percent being the norm (Department of Energy, 2009). Households with energy expenditures above this threshold are considered energy poor and are likely to be confronted with difficult choices between meeting energy requirements and spending on competing goods.

According to Aitken (2007) the energy burden for South African households can amount to between 12-20% of their net incomes. This is the equivalent of a middle income household earning R10000 a month and spending up to R2000 a month on acquiring energy services.

This paper seeks to add to the Energy Poverty literature by measuring Energy Poverty as defined by the Department of Energy. More importantly, this paper takes the analysis further by empirically testing what factors are associated with energy poverty amongst households. This is discussed in detail in the sections that follow.

3. Data

The National Income Dynamic Survey (NIDS, 2012) is used for estimation at the household level. Households are each given a unique identification number so that they can be tracked in three separate waves during the course of a particular year. This allows for empirical research to be done in either a cross-section or panel data format. Household heads were interviewed, and where the head was not available, another member of the household was requested to respond to the questions. A structured questionnaire is given to the enumerators to be used for the collection of information. It has a set of questions on demographics (age, sex, and household size), socioeconomic aspects (employment, education, and knowledge), energy use, and income and expenditure patterns of the household (NIDS, 2012).

This paper only focuses on relevant information from rural and urban informal households needed to conduct this study. It follows the empirical work done by Dunga, Grobler and Tchereni, (2013) to estimate energy poverty and its determinants among rural and urban informal South African households. Firstly, Energy poverty is calculated for each of the households using the Economic/expenditure approach. This allows us to determine the number of households below the Energy Poverty line within the sample (households spending more than 10% of their income on acquiring energy as measured by the DoE definition of Energy Poverty). Secondly, a discrete choice analysis using logistic models for binary variables were adopted to analyse determinants of energy poverty. Below are some statistics which describe the dataset.

3.1 Descriptive Statistics

The sample is comprised of 5958 households who reside in rural and urban informal areas. Table 1 on the following page gives a list of all the variables used in the logistic regression analysis. Table 2 shows that of these dwellers, close to 78% of the sample live in Energy Poverty as defined by the Economics/expenditure approach which the Department of Energy adopts.

Table 2:
Frequency for Energy Poverty

Energy Poverty Dummy Variable	Frequency	Percentage
Energy Well-off	1,329	22.31
Energy Poor	4,629	77.69
Total	5,958	100

Source: NIDS, 2012

Table 1:
Frequency and percentage of variable used (NIDS, 2012)

Variable	Frequency	%
Individual Characteristics		
Gender		
Male	2797	62.76
Female	1660	37.24
Educational Attainment		
Tertiary Education	168	3.77
Completed Matric	69	1.55
Incomplete Schooling	4220	94.68
Household Characteristics		
Married	1258	28.23
Household size		
1	591	13.26
2	645	14.47
3	665	14.92
4	602	13.51
5	546	12.25
6	446	10.01
7	309	6.93
8	218	4.89
>8	435	9.76
Number of people in household		
1	531	11.91
2	717	16.09
3	827	18.56
4	782	17.55
5	539	12.09
6	387	8.68
7	258	5.79
8	193	4.33
>8	223	5.00
Demographic Characteristics		
Province of the Household		
Gauteng	385	8.64
Limpopo	522	11.71
KwaZulu Natal	1008	22.62
Eastern Cape	553	12.41
Northern Cape	200	4.49
North West	387	8.68
Western Cape	376	8.44
Mpumalanga	365	8.19
Free State	127	2.85
Sample size		5958

Source: NIDS, 2012

4. Methodology

4.1 Energy Poverty

Analysis of the determinants of energy poverty

This study adopts the approach used by, Dunga, Grobler and Tchereni, (2013) who estimated the determinants of energy poverty in Malawi and uses the energy expenditure methods to identify energy poor households. Energy poverty measures calculated in this way are referred to as Economics Measures (Pachauri, Mueller, Kemmler and Spreng, 2004). In expenditure terms, a household is considered to be energy poor if 10 percent or more of its expenditure is on energy facilities (Fahmy, 2011; Department of Energy, 2009). This definition therefore requires a clear explanation and data on energy expenditure at the household level and total income.

Expenditure approach of measuring energy poverty

As adopted by Dunga, Grobler and Tchereni, (2013); expenditure on energy is calculated by adding together all the money-metric costs incurred to fetch energy facilities. These include:

i) Transport cost to and from the place of fetching the energy facility;
ii) Actual purchase cost of the facility;

The formula for this calculation is given by:

$$EEX_{ij} = ETPT_{ij} + APC_{ij} \quad (1)$$

Where:

- EEX_{ij} is total expenditure on energy facility i by household j
- $ETPT_{ij}$ is transport expenses incurred towards the acquisition of energy facility i by household j
- APC_{ij} Is the actual purchase cost of energy facility i by household j.

Source: Dunga, Grobler and Tchereni, (2013)

Since the expenditure on transport as a recurrent activity mainly involves purchases of energy, $ETPT$ therefore includes transport expenses the household incurred per month. For those who commute, public transport fares are a direct function of the price of petrol and diesel on the energy market. Particularly, walking and cycling do not involve the use of energy whose cost can be quantified in monetary terms. For those who used cars for travel, the cost of petrol and diesel was added (Dunga, Grobler and Tchereni, 2013).

Respondents who were deemed to be energy poor were identified based on the energy expenditure budget of the household. Households whose energy expenditure budget exceeded 10 percent were regarded as being energy poor and therefore they were coded 1 and those who were spending less than 10 percent on energy facilities got a code of 0 (zero). Thereby allowing for the creation of a dummy variable for Energy Poverty in this manner (Gujarati, 2004).

4.2 Logistic Regression

Econometric Analysis of Energy Poverty

The logistic regression model is used in estimation. This model makes use of predictors to estimate probabilities that an event does or does not occur relying on similar inferential statistical methods as in Ordinary Least Squares (OLS) (Gujarati, 2004). Theoretically, a decision maker, n faces J alternatives. The utility that the household obtains from alternative j can be represented as (Gujarati, 2004):

$$U_{nj} = V_{nj} + \varepsilon_{nj} \quad (2)$$

Where, U_{nj} is total utility; V_{nj} and ε_{nj} represents unknown variables classified as stochastic utility (Gujarati, 2004). The logistic function is obtained by assuming that each ε_{nj} is an independently, identically distributed extreme value. The density for each unobserved component of utility is (Gujarati, 2004):

$$f(\varepsilon_{nj}) = e^{-\varepsilon_{nj}} e^{-e^{-\varepsilon_{nj}}} \quad (3)$$

And the cumulative distribution is given by (Gujarati, 2004):

$$F(\varepsilon_{nj}) = e^{-e^{-\varepsilon_{nj}}} \quad (4)$$

From the above, the probability that decision maker n chooses

Therefore, the empirical model is formulated as follows:

Equation (5)

$$f(Energy\ Poverty) = (exp_{tpt}, exp_{food}, exp_{sch}, exp_{elec}, gender, educ, hhsize, hmsize, marital, \varepsilon) \quad (5)$$

5. Results

The results in table 3 show that there is a positive and statistically significant relationship between energy poverty and transport expenditure at the 1% level. The results suggest that the odds ratio of 0.101 was in favour of transport expenditure to increase the energy poverty level. In terms of elasticity as reported in table 3 the relationship between transport expenditure and energy poverty was inelastic. A 1 percentage increase in transport expenditure could increase energy poverty by 0.792 percent.

There is also a positive and statistically significant relationship between energy poverty and electricity expenditure at the 1% level. The odds ratio of 0.103 was in favour of electricity expenditure to increase the energy poverty level. The relationship between electricity expenditure and energy poverty was inelastic. A 1 percentage increase in electricity expenditure could increase energy poverty by 1.567 percent.

Table 3:
Results of the Logit Model and elasticities
NIDS (2012)

Energy Poverty Variable	Odds Ratio	Elasticity	Std. Error
Socio-Economic Characteristics			
Expenditure on transport	0.101***	0.792	(0.005)
Expenditure on schooling	-0.005***	-0.013	(0.002)
Expenditure on food	0.002*	0.034	(0.001)
Expenditure on electricity	0.103***	1.567	(0.003)
Individual Characteristics			
Gender	0.089	0.011	(0.097)
Educational Attainment			
Tertiary Education	-0.549*	-0.004	(0.332)
Completed Matric	-0.044	-0.001	(0.423)
Household Characteristics			
Married	0.179*	0.001	(0.119)
Household size	-0.011***	-0.037	(0.009)
Number of people in household	-0.049	-0.053	(0.019)
Demographic Characteristics			
Province of the Household			
Gauteng	0.158	0.005	(0.211)
Limpopo	0.026	0.001	(0.220)
KwaZulu Natal	0.285*	0.019	(0.179)
Eastern Cape	0.362*	0.012	(0.207)
Northern Cape	-0.002	-0.001	(0.235)
North West	-0.139	-0.003	(0.217)
Western Cape	(omitted)	(omitted)	(omitted)
Mpumalanga	-0.116	-0.002	(0.244)
Free State	-0.387	-0.007	(0.251)
Constant	-2.725***		(0.255)
N	4457		
Log-Likelihood	-799.4		

Significance levels *10%, **5%, ***1%

Source: NIDS, 2012

A positive and statistically significant relationship exists between energy poverty and food expenditure at the 10% level. The odds ratio of 0.002 was in favour of food expenditure to increase the energy poverty level. This predicts that households which spend more on food will sacrifice spending on energy and allocate the extra income on food. A 1 percentage increase in the food budget will increase energy poverty by 0.034 percent.

There was a statistically negative relationship between education expenditure as represented and energy poverty. At the 1 percent level of significance, the odds ratio predicts that households which spend more on schooling are likely to have better energy access. As table 3 shows, for every 1 percentage point increase in the schooling budget, there is likely to be a 0.013 percentage decrease in energy poverty. Said differently, low energy poverty levels are likely to be associated with higher expenditures in education for members of household as funds are released from spending on energy and the gains are moved towards improved and quality education.

There was a positive relationship between Gender and energy poverty although the association was statistically insignificant to reject the null hypothesis. The odds ratio however shows that one is likely to be more energy poor if they are male than female. According to Dunga, Grobler and Tchereni, (2013), culturally men do not go to the forest to fetch firewood the way women do in parts of Africa. The gender elasticity of energy poverty is inelastic at 0.01 percent.

At the 10% level, education of the head of household was statistically significant if the head of the household had a tertiary level education. However it was statistically insignificant if the head of household only possessed a matric or incomplete schooling. There is a negative relationship between level of education and energy poverty. This is expected, since higher education levels are associated with higher income levels and therefore the energy share in the expenditure budget should be smaller. The odds ratio obtained in the regression output, supports this finding. Furthermore, it shows that a head of households' completion of tertiary education reduces energy poverty by 0.004 percent. The findings also indicate that having a matric only and incomplete schooling does not significantly reduce energy poverty.

On marital status, the relationship was negative suggesting that homes with married couples were less likely to be energy poor than those who were not. The reason for this could be that married couples combine their income and share the expenses of the household, including energy. However, this relationship is not significant.

The higher the number of people residing in the household, the lower the incidence of energy poverty. The odds were that it was more likely for a household with few members to be energy poor than those with more members. This could be because as the number of household members increases, there are more potential income earners thus reducing energy poverty. However, this relationship is statistically insignificant.

There was a negative relationship between the size of the dwelling unit and energy poverty. This relationship is statistically significant at the 1% level. The negative relationship suggests that households dwelling in larger houses were less likely to be energy poor compared to those living in smaller units. One reason to explain this, is that the larger your income, the larger your household, therefore one has more access to energy.

In terms of the demographic characteristics, the Western Cape was dropped in the regression due to collinearity with the other variables in the regression. Gauteng, Limpopo, KwaZulu-Natal and Eastern Cape all exhibited a positive relationship with energy poverty. This means that households situated in these provinces are more likely to be energy poor. However, of these four provinces, only the Eastern Cape and KwaZulu-Natal displayed statistical significance at the 10% level. This finding is supported by Kohler, Rhodes and Vermaak, (2009) who find that these two provinces have the lowest electrification rates in South Africa.

The Northern Cape, North West, Mpumalanga and the Free State all exhibit a negative relationship with energy poverty. This means that households situated in these provinces are less likely to be energy poor. However, of these four provinces, none displayed statistical significance.

5.1 Evaluation of the Energy Poverty Regression Model

Logistic analysis relies on other statistics to analyse the reliability of any model (Gujarati, 2004). The Log-Likelihood Ratio test which is distributed as a Chi-Square is computed to test the overall performance of the model (Gujarati, 2004). Table 4 presents the results of the Log-likelihood ratio test. The Chi-Square statistic was 3832.69 and it was statistically significant. Thus the null hypothesis that the overall explanatory power of the model could not be relied upon was rejected. The predictors in the logistic regression were collectively important in explaining the behaviour of energy poverty in the South African household data used.

Table 4:

Log-likelihood Ratio Test of the Logistic regression

Logistic Regression	Number of observations	4457
	LR chi2(11)	3832.69
	Prob>chi2	0.000***
	Pseudo R2	0.7056
Log Likelihood		-799.4

Source: NIDS, 2012

The Pseudo Pseudo R-squared) was 71 percent implying that the model explained about 71 percent of the deviations in the probability of energy poverty.

A further goodness of fit test that is recommended for logistic regressions in the literature is the Hosmer-Lomeshow (HL) Chi-square statistic (Ping, Lee & Ingersoll, 2002) (Gujarati, 2004). The statistic is distributed as a Pearson Chi-square and evaluated through a log-likelihood estimation calculated from a 2 x g table of observed and expected frequencies. Where g is the number of groups formed from expected probabilities of each one of the observations (Gujarati, 2004). As table 5 shows, the null hypothesis that the model was a good fit to explain the deviations in the behaviour of energy poverty is accepted even at the 10 percent level of significance. The value of the HL statistic was 60.54 with the probability to accept the null hypothesis of about 98 percent.

Table 5:
Results of Chi-Squared test of goodness of fit

Number of observations	4457
Hosmer-Lemeshow chi2(11)	60.54
Prob>chi2	0.977

Source: NIDS, 2012

6. Limitations when defining Energy Poverty

The measure of energy poverty based solely on household expenditures can be problematic because poor households in countries such as South Africa typically rely on cheap but inferior biomass for their energy needs. As a result, estimating Energy poverty in the way above can underestimate the extent of energy poverty in households (Kohler, Rhodes and Vermaak, 2009).

Kohler, Rhodes and Vermaak, (2009) put forward the following example:

If households A and B both spend 15% of their income on energy, then the way in which the economic/expenditure is defined above will classify both households as being equally poor. However, they explain that when taking into account the type of energy used: If it was found that A uses paraffin and candles, while B uses electricity, then B obtains a better use of quantity which is more useful since electricity is a more efficient energy source. Therefore, A must be classified as poorer than B, by taking into account the quantity of energy used by the household, rather than just its cost. Furthermore, if household A now gains access to free basic electricity (FBE), it should be classified as less poor than it was before but its poverty status would not change if energy poverty is defined according to the economics/expenditure approach.

The reader should note that even though this study is consistent with the Department of Energy's interpretation of Energy Poverty, more efficient results can be achieved if quantity of electricity is taken into account in household expenditure/income data as well as information on free-basic electricity at the household level. Neither the General Household Survey (GHS) nor the NIDS data as used in this study allow for this information to be incorporated. This then leads to recommendations in the following section.

7. Recommendations

The policy recommendations are based on the results found in section 5.

Households can be made less poor by simply making all energy cheaper.

The National Energy Regulator of South Africa (NERSA) can play an important role in this, for the following reason. A study done by Thopil and Pouris (2013) showed "actual sales and revenue" figures of Eskom over the 2012/13 period. The study indicated that two sectors- industrial and mining (the largest two sectors in South Africa) - contributed 77% of the sales but generate only 67% of the revenue, with the industrial sector showing the largest disparity. This trend can be better observed in the revenue to sales ratio of the percentage contribution, shown in table 6:

Table 6: Revenue-to-sales ratio of electricity in South Africa, per sector

Sector	Revenue: sales ratio
Residential	1.56
Commercial	1.13
Industrial	0.82
Mining	0.96
Agriculture	1.75
Traction	1.5

Source: Thopil and Pouris (2013)

The largest reverse parity (where revenue is greater than sales) occurs in the agricultural sector, which is a vital sector of the South African social make-up. More importantly for this study, is that the residential sector also shows a degree of reverse parity. This finding suggests that the industrial sector, in spite of being the largest sector in terms of sales, is underpriced[28] (Thopil and Pouris, 2013).

[28] One of the primary reasons for which is standing contractual agreements between Eskom and large industrial users such as mines. These contracts are equally beneficial for both entities: large industrial users contribute to the largest section of

This leads to the question, why does Eskom increase prices equally in the residential and industrial sectors, when the benefits that these sectors receive are not proportional? Is it the best approach to equally increase the prices among all sectors or is a discriminatory pricing approach across sectors more beneficial for both the economy and Eskom (Thopil and Pouris, 2013)? Therefore a primary recommendation is for the DoE in collaboration with NERSA, to look into differential pricing across sectors. This might alleviate Energy poverty amongst households.

The next recommendation of the paper is based on infrastructure expansion, particularly at the household level, so as to ensure that households have access to cleaner and more efficient energy. Given many of the poorest households are located in remote rural areas, expansion of the electricity grid may be prohibitively expensive. It is recommended that, in such cases, access to renewable energy sources, such as solar and wind power be expanded. Such energy sources can be located close to the areas that are the most energy poor, and may therefore prove more cost-effective than connection to the National electricity grid.

Kohler, Rhodes and Vermaak (2009) also suggest that further research should be done into the cost-effectiveness of small-scale renewable energy project and that any type of renewable energy expansion be accompanied by an education programme, so that households do not view alternative energy sources as being inferior to electricity.

The final recommendation regards the problems associated with estimating Energy Poverty using the expenditures approach. It is recommended that future rounds of the household expenditure surveys such as the GHS and NIDS data sets should collect information on the prices per kWh that households pay for their individual energy sources, in addition to the total cost. This will enable researchers to calculate more accurately the quantity of energy used, and thus to identify more precisely the degree of energy poverty experienced by households.

8. Conclusion

This paper used the National Income Dynamics Survey (2012) to achieve two main objectives. First it estimated the Energy Poverty line using the Economic/Expenditure approach for rural and urban informal South African Households. Thereafter, it estimated the determinants of Energy poverty of these households by means of a logistic regression model. It was found that when these households increase their expenditure on food and transport, it significantly increases the incidence of energy poverty since more of a household's budget is allocated away from energy spending. Education of the head of household and spending on education was found to significantly decrease energy poverty since education increases income. Married Head's had a lower incidence of energy poverty probably due to extra income from their spouses or that their spouses helped with energy gathering. This paper also found that larger households were less likely to be poor. Lastly it seems that the provinces with the highest significant Energy Poverty rates are KwaZulu-Natal and the Eastern Cape.

This paper also acknowledges the limitations to estimating Energy poverty using the Economic/expenditure approach as it does not incorporate energy efficiency or free basic electricity. This paper was unable to incorporate these elements because of unavailability of data at the household level. Therefore, this paper ends with recommendations to government as well as Regulators. Regulators and government agencies should look to decrease prices for households by looking into differential pricing across sectors. Furthermore, accessibility of efficient energy sources should be made available to all South Africans. This is an expensive notion, therefore this paper suggests instituting education campaigns around renewable energy options to poorer households. Lastly in order for a more accurate estimation of Energy Poverty household data sets should incorporate data on pricing and quantity of different energy sources and information on free basic electricity, so that more accurate results can be obtained in the future.

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