DataFirst

DataFirst Technical Papers

Aiming for a moving target: The dynamics of household electricity access in a developing context

by

Tom Harris, Mark Collinson

and

Martin Wittenberg

Technical Paper Series

Number 37

About the Author(s)

Tom Harris: DataFirst, School of Economics, University of Cape Town, South Africa
Mark Collinson: MRC/Wits University Rural Public Health and Health Transitions Research Unit (Agincourt), School of Public Health, Faculty of Health Sciences, University of the Witwatersrand, South Africa; INDEPTH Network, Ghana; Umeå Centre for Global Health Research, Division of Epidemiology and Global Health, Department of Public Health and Clinical Medicine, Umeå University, Umeå, Sweden
Martin Wittenberg: Director, DataFirst, University of Cape Town, South Africa

Acknowledgments
This work is based on research supported by the National Research Foundation (ESRC-NRF International Centre Partnership, Ref ICPC150423117553). Any opinion, fi nding and conclusion or recommendation expressed in this material is that of the author(s) and the NRF does not accept any liability in this regard. We acknowledge the invaluable data and unreserved support of the Medical Research Council/ University of the Witwatersrand Rural Public Health and Health Transitions Research Unit (Agincourt), and the engaged communities in which the research has taken place. Funding is gratefully acknowledged from Economic Research Southern African (scholarship to T.Harris), the SARChI chair in Poverty and Inequality Research (scholarship to T. Harris), the University of the Witwatersrand; South African Medical Research Council and National Research Foundation; the Wellcome Trust, UK, (Grants 058893/Z/99/A; 069683/Z/02/Z; 085477/Z/08/Z), The William and Flora Hewlett Foundation, National Institute on Aging (NIA) of the NIH, and The Andrew W Mellon Foundation, USA.

This is a joint DataFirst Technical Paper and SALDRU Working Paper.

Recommended citation

Harris, T., Collinson, M., Wittenberg, M. (2016). Aiming for a moving target: The dynamics of household electricity access in a developing context. A DataFirst Technical Paper 37. Cape Town: DataFirst, University of Cape Town.

DataFirst, University of Cape Town, Private Bag, Rondebosch, 7701, Tel: (021) 650 5708,
Email: info@data1st.org/support@data1st.org

Aiming for a moving target: The dynamics of household electricity access in a developing context

Tom Harris, Mark Collinson and Martin Wittenberg

DataFirst Technical Paper 37
University of Cape Town
November 2016

Abstract

We investigate household electricity access in a poor rural setting in South Africa, showing that the acquisition of connections is not the simple monotonic process often assumed in the literature. We argue that changes in household electricity access are a complex and changing outcome of two key time-varying processes: (1) net connections (new connections less disconnections) and (2) household formation and dissolution dynamics. In particular, we show that migration can occur in ways which either improves or worsens access. Even for households that stay in place we observe many disconnections. Therefore, in their efforts to improve access to electricity, governments in developing countries may in fact be aiming for a moving target – if the infrastructure is provided in places from which people are migrating, if many new households are being formed in un-serviced areas, or if existing connections are being lost.

Keywords: Electricity access; energy; service delivery; household formation; South Africa

Highlights

- In developing contexts, long-run improvements in electricity access are not the result of consistent, monotonic increases in access rates.
- Changes in electricity access are a complex outcome of two processes: net connections and household formation and dissolution dynamics.
- The impact of electrification efforts can be constrained by household formation processes and household connection losses.
- Short-term declines (or stagnations) in electricity access are possible, even in periods of electricity rollout - as is evident for South Africa.

1. Introduction

Lack of access to efficient, reliable and modern energy is a prevalent issue across the developing world. One in five people lack access to electricity, and almost 3 billion people (about 40% of the world's population) rely on wood, coal, charcoal or animal waste for cooking and heating; the latter results in more than four million premature deaths a year (UN, 2016). The use of biomass fuels and other 'dirty' and inefficient fuels has severe negative implications, not only for public health, but for the environment and economic development too; transitions up the energy ladder (to electricity particularly) are accordingly associated with improvements in well-being and economic progress (Heltberg, 2005; Kimemia, Vermaak, Pachauri, & Rhodes, 2014; Rao & Reddy, 2007; Smith, 2000; van der Kroon, Brouwer, & van Beukering, 2013; Vermaak, Kohler, & Rhodes, 2009, 2014). This issue is encapsulated in the United Nation's (UN) 2030 Agenda, which designates universal access to affordable, modern, sustainable and reliable energy as one of its 17 Sustainable Development Goal (SDG) (UN, 2016). A recent study has also provided evidence of a causal relationship between electricity access transitions and improved labour market opportunities (Dinkelman, 2011). Electricity access is hence considered an important dimension of well-being and living standards, and there is an expanding literature which focuses on investigating and measuring changes in electricity access and use.

Much of this literature focuses on investigating changes in individual access to electricity. However, given that electricity (as with similar services) is delivered to household units rather than directly to individuals, from the perspective of service delivery coordination, there is a specific need for research that focuses on investigating changes in household access. In addition, most studies tend to portray the process of electricity roll-out as a simple, monotonic progression. Generally, long-run improvements in electricity access (and the remaining access deficits) are described using aggregate statistics, such as access rates or total connection numbers – either at national, provincial or district level (Balachandra, 2011; Davidson & Mwakasonda, 2004; Pachauri & Jiang, 2008; Parshall, Pillai, Mohan, Sanoh, & Modi, 2009; Winkler et al., 2011; Ying, Hu, & Dadi, 2006). Little attention is given to the short-term dynamics of electricity access, or to what important details may be concealed behind such aggregate electricity access statistics.

The use of inefficient and 'dirty' fuels, which is more prevalent among those in poverty, exacerbates the plight of the poor, and thus widens the gap between the rich and the poor (Heltberg, 2005; Kimemia et al., 2014; Rao & Reddy, 2007). Electrification and improvements in electricity access are therefore of considerable interest to policy makers within countries where wide-spread poverty and inequality the dominant issues.

In this regard, South Africa is a success story. In an effort to improve the well-being of its citizens, many of whom live in poverty, the country has made significant progress in extending electricity access. Access rates improved from well below 40% in the early 1990s to nearly 80% by 2002. Our own analysis of household electricity access, in Figure 1, confirms that this progress has continued in recent years, and shows national household access rates to have risen by a further 9% between 2002 and 2012. Certainly, these improvements are encouraging, and there is much that can be learned from the successes of the South African electricity roll-out process. However, our results also reveal a striking point not yet given much attention in the literature: the long-run improvement in electricity access is not the result of a consistent, monotonic increase in access rates. Instead, there are short-term deviations from the long-term upward trend. The most salient of these deviations are periods of declines in access, which are evident in both national and small-area data.

In an effort to understand what contributed to these declines in access, we introduce two novel approaches. Firstly, in order to explore the relationship between household formation and electricity access, we categorise households according to when they form and whether they continue to exist or not, and investigate changes in access among these different household categories. Secondly, to examine transitions in access among households that continue to exist, we apply longitudinal techniques to novel forms of the National Income Dynamic Study (NIDS) and Agincourt Health and Demographic Surveillance System (HDSS) data which allow us to track household units over time (Harris, 2016; Wittenberg & Collinson, 2014).

This investigation reveals four key findings. Firstly, even when many additional household electricity connections are added over a period, these positive transitions can be outweighed by connections losses. Secondly, net household formation tempers the impact that any additional connections may have on access rates. Thirdly, even in the absence of net household formation, household formation and dissolution processes can work against service delivery efforts – when newly formed households have lower access rates than the dissolving units they 'replace'; these processes can also work in tandem with service delivery efforts, when newly formed households achieve higher access rates than the dissolving units they 'replace'. Finally, the three processes described above are not particular to periods of declines in access: pervasive connection losses are observed even over periods in which aggregate access improves. Household formation and dissolution contribute to both positive and negative changes in aggregate electricity access. In this paper, we therefore suggest that in developing countries like South Africa, electricity access rates are unlikely to show consistent improvements, even in periods of rapid electricity rollout. Instead, we argue that household electricity access is a complex outcome of two key time-variant processes: (1) net connections (new connections less disconnections) and (2) household formation and dissolution processes.

The paper proceeds as follows. In Section 2 we present a discussion of the available literature on electricity access in South Africa. In Section 3, we discuss the details of the three data sources used in the investigation that follows, and the household definition used in the longitudinal household-level analysis; Section 4 outlines our methods. Section 5 starts with an updated analysis of the long-run dynamics of household electricity access in South Africa between 2001 and 2012, using multiple data sources to validate the long term trend, and with a focus on the period 2008-2012. Next, electricity access statistics are presented separately according to designated household formation categories. We then provide a longitudinal analysis of electricity access transitions for continuing households. Finally, we provide a more in depth discussion on South Africa's electricity access targets, and a disaggregated analysis of connection losses. Section 6 offers some conclusions and policy recommendations.

2. Background

2.1 The Energy Ladder

The energy ladder is a concept that was developed as a means to understand how people in developing economies transition from the use of one form of energy to another. Typically, it describes how people transition from the use of primitive fuels (e.g. firewood, agricultural waste), to transition fuels (e.g. coal), and finally, to advanced fuels (e.g. electricity, LPG) (Nansaior, Patanothai, Rambo, & Simaraks, 2011; van der Kroon et al., 2013). In many contexts, the final step in this process can be generalised as the transition into the use of electricity. Within the literature, the process of climbing the energy ladder is conventionally described as a simple, upward linear movement (e.g. from coal to electricity) (van der Kroon et al., 2013). However, in reality, this has proven to be an oversimplification of the energy transitions process in developing economies. A substantial literature has already shown that instead of energy transitions occurring as a sequence of simple phases, energy stacking (or multiple fuel use) is more common (Hiemstra-Van der Horst & Hovorka, 2008; Masera, Saatkamp, & Kammen, 2000; Nansaior et al., 2011; van der Kroon et al., 2013). In the investigation that follows, we aim to develop new insights on the energy transition process – by examining the prevalence of 'downward' energy transitions (i.e. connection losses) and their impact on aggregate electricity access.

2.2 South African Literature on Electricity Access

Despite significant progress in the last 20 years, public service delivery remains one of the largest development issues faced by post-apartheid South Africa. While the National Planning Commission's (NPC) National Development Plan highlights housing, water, electricity and sanitation as vital components of a decent standard of living; there is a distinct inequality in access to these services, and where they are available, their quality is often sub-standard – especially for those living below (or just above) the poverty line (Bhorat & van der Westhuizen, 2013; NPC, 2010). This inequality in service access is chiefly a result of the policies of the former apartheid system (1948-1994). During apartheid, many African households (particularly those in homeland areas) were denied access to basic public services, such as piped water, electricity and sanitation (Gaunt, 2003). However, as apartheid rule began to crumble, so government began to address these issues. Household electricity access rates consequently expanded by almost 100% between 1990 and 2001, from 35% to 69% (Gaunt, 2003; Van Horen & Eberhard, 1995). Similar successes were witnessed in other aspects of service delivery too, with access to piped water and sanitation also improving significantly over this period (Bhorat & van der Westhuizen, 2013).

After the fall of apartheid, the process of electrification was primarily coordinated under the National Electrification Plan (NEP) (1994-1999); but, this coordinating document has since been replaced by the Integrated National Electrification Plan (INEP) (2001-current). There is therefore a growing literature which explores trends in electrification in South Africa since the implementation of INEP (i.e. 2001). These studies have shown that the considerable improvements in access witnessed during the 1990s have continued into more recent years (StatsSA, 2013). However, most existing studies in this realm tend to utilise only a cross-sectional approach in the analysis of electrification trends, and more often than not use cross-sectional surveys which are many years apart. In addition, published data on electrification has been found to vary considerably depending on the source, and is therefore suggested to be somewhat unreliable (Bekker, Gaunt, Eberhard, & Marquard, 2008). An updated and consolidated review of electricity access trends is thus warranted.

A small pool of literature has investigated electricity access and energy ladder transitions in South Africa in a more applied sense. Vermaak et al. (2009) discuss the complexities of energy poverty in South Africa, and develop a new access-adjusted energy poverty measure – highlighting the contrast between their findings and those reported by the Department of Energy (DoE). Dinkelman (2011) explores the strong relationships that exist between electrification, migration and the labour market in rural areas, and finds that electrification increases female employment and raises male earnings. In a different vein of research, Bhorat and van der Westhuizen (2013) compile various components of service delivery (including electricity access) and asset holdings into an asset index to investigate the dynamics of non-monetary wellbeing. Kimemia et al. (2014) suggest that energy transitions that displace paraffin with liquid petroleum gas (LPG) and candles with electricity or solar power can help reduce the incidence and burden of accidents related to such energy sources (e.g. burns, scalds and poisonings). This literature highlights the links that exist between the movements up the energy ladder (with electricity use exemplified as the final rung) and household well-being in South Africa – adding weight to the argument for an analysis which can provide new insights into the details of, and processes behind, electricity access dynamics.

3. Data

3.1. Data Source 1: The General Household Survey (GHS)

The GHS is a nationally representative household survey that has been conducted annually by Statistics South Africa (StatsSA) since 2002, when it replaced its predecessor, the October Household Survey (OHS) (1993-1999). The primary concerns of the survey are health, housing, access to services, agriculture and food security, education, and social development, and the target population is all private households and workers' hostel residents in South Africa. The survey uses a two-stage sampling design process: the sampling of primary sampling units (PSUs) with probability proportional to size at the first stage, and systematic sampling of dwelling units at the second stage; the sample is stratified by geography and population attributes prior to the selection of PSUs (using Census 2001) (StatsSA, 2014a). Households were asked various questions regarding their access to and use of electricity, including whether they received free electricity (if connected to the grid). A question asking whether a household was connected to the "MAINS electricity supply" is used as an indicator of electricity access.

3.2 Data Source 2: The National Income Dynamics Study (NIDS)

South Africa's NIDS was commissioned by the national Presidency in an effort to track long-run poverty and well-being. The Southern Africa Labour and Development Research Unit (SALDRU) ran the baseline study in 2008. Successive waves have since been administered by SALDRU every two years. The core concerns of the study are incomes, expenditures, labour market participation, education, health (including anthropometrics) and household well-being (e.g. access to services).

The baseline sample was designed to be nationally representative: and consisted of a two-stage sampling design with 400 PSUs extracted from Statistics South Africa's 2003 master sample, with a target of 24 households per PSU. The final (realised) sample consisted of approximately 7 300 households and about 28 000 individuals (Leibbrandt, Woolard, & de Villiers, 2009). These individuals became the Continuing Sample Members (CSMs) for the subsequent waves, with babies born to CSM women also becoming CSMs themselves. At each of the subsequent waves, individuals co- resident with CSMs were also interviewed.

These individuals were classified as Temporary Sample Members (TSMs). A question asking whether a household "has electricity", which was asked in each wave, is used as an indicator of electricity access. The level of non-response on these variables is relatively low.

3.3 Data Source 3: The Agincourt Health and Demographic Surveillance System (HDSS)

The Agincourt HDSS monitors key demographic events and socio-economic variables in the Agincourt sub-district in north-eastern Mpumalanga Province, South Africa. A baseline census was conducted in 1992 and since 1999 there have been annual census rounds. The main variables measured routinely by the HDSS include: births, deaths, in- and out-migrations, household relationships, resident status, refugee status, education, antenatal and delivery health-seeking practices (Kahn et al., 2012; Tollman, 1999; Tollman, Herbst, Garenne, Gear, & Kahn, 1999). Circular migrants are accounted for by including on the household roster non-resident members who retain significant contact and links with the rural home (Collinson, 2010). The "Share common pot" definition of a household is thus expanded to include the temporary migrants who would normally share the same pot on return.

Several add-on modules have also been administered. For example, every second year since 2000 there has been a household asset module which includes information on household access to services, such as electricity. In the update rounds a trained lay fieldworker interviews the most competent respondent available at the time of visit. Individual information is checked for every household member. Revisits are undertaken when appropriate respondents are not available. Data quality checks include duplicate visits on 2% of households, and a number of validation checks, which are built into the fieldwork and data-entry programme. As households are not asked directly about whether they have electricity access, a question asking whether a household "used electricity for lighting", is used as an indicator of electricity access. Another question asks whether the household uses electricity for cooking. These questions were asked of each household in every successive census round, and the level of non-response on these variables is low.

3.4 Tracking Households Over Time

The longitudinal analysis of household outcomes presented in this paper rests on our ability to identify the same household in each wave / census round (every two years) of each data source (i.e. surviving/continuing households). As per Wittenberg and Collinson (2014) and Harris (2016), we identify surviving/continuing households by:

- Dwelling: continuing residence in the same location
- Overlapping membership: there must be at least one individual from the previous household still living in the dwelling

One of the implications of this definition is that if a family group moves from one dwelling to another (as a group) this will be classified as a household dissolution event followed by a household formation one. This definition was adopted partially for convenience, but it also makes sense in the context of a household service such as electricity access which is location specific, and it is useful to differentiate changes in access to a service for a given group of people at a location (a household.) from changes induced by those people migrating to a different location. Applying this definition to NIDS and HDSS data allows us to set up each panel of individuals as a panel of households. It is these transformed panels that are used to explore longitudinal changes in household electricity access in the investigation that follows.

While the household definition outlined above is particularly convenient for the analysis of service delivery, it does also have two key shortcomings. Firstly, as we track households and not simply dwelling units, we could overestimate the number of electricity connections in any given period. For example, there could be more than one household living within a single dwelling unit, or on one property/erf. Secondly, we could overestimate the household formation rate (and underestimate the number of continuing/surviving households) relative to the rate of household formation that would be estimated under a "member-based" household definition. For example, if an entire family moves out of a dwelling unit in Mpumalanga and into another dwelling unit in Gauteng, using a "member-based" household definition this would be classified as the same household, but using our household definition this would constitute the dissolution of the original household and the formation of a new unit. For further details on how households are identified longitudinally, or for a more detailed description on how the population of households is subdivided each period, see Harris (2016).

4. Methods

4.1 Conventional Cross-sectional Approach

Our analysis begins with a cross-sectional approach: we use GHS, HDSS and NIDS data to provide a broad image of the long-term trend in household electricity access ($\bar{y}_t$) between 2001 and 2011. We first report the proportion of households with access in each period, or the electricity access rate. We then also produce estimates of the number of connected households in each period between 2008 and 2012, using NIDS and HDSS data.

4.2 Limitations of a Standard Cross-sectional Approach

However, from the perspective of coordinating service delivery, it is insufficient to know merely how many new connections are added in each period, or how the aggregate connection rate changes. These estimates offer only a limited perspective of the electricity roll-out process, and conceal the fact that policy makers may in fact be aiming for moving target in the following three respects:

1) the number of households may be growing faster than the rate of growth in connections, as a result of rapid household formation;
2) people may be moving out of connected households and setting up new households in locations that lack access; and
3) certain connected households that survive from one period to the next may actually lose their electricity connection.

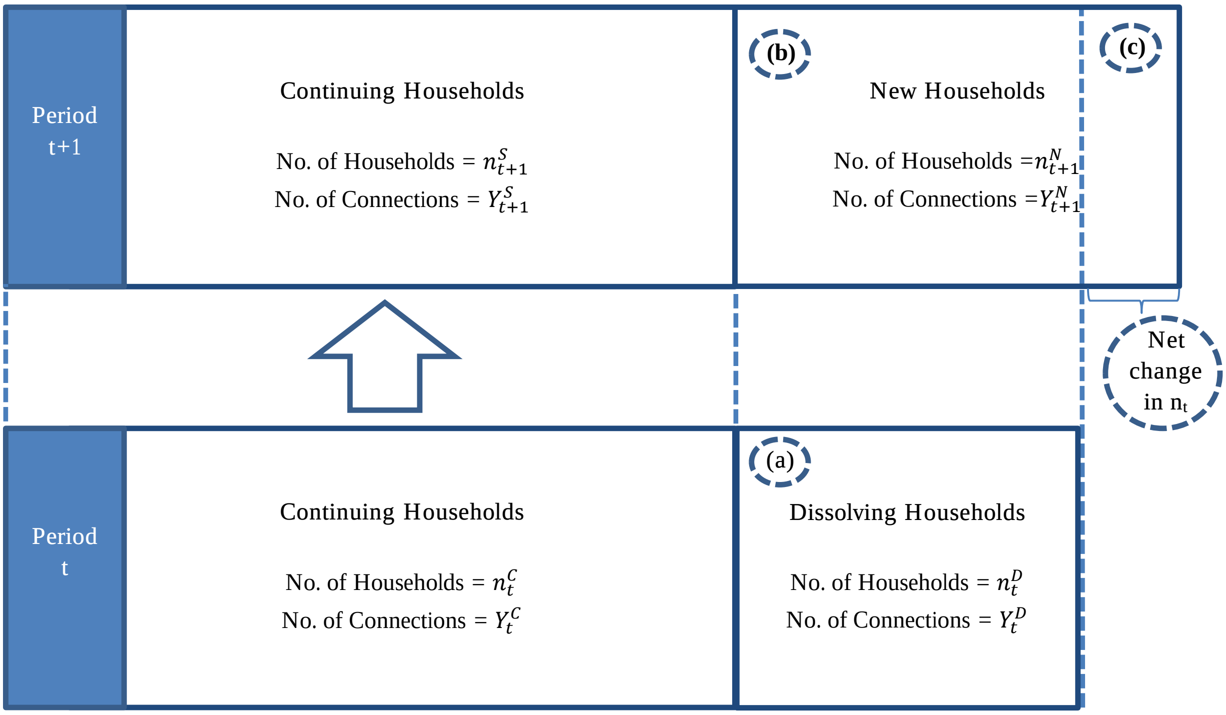
In order to fully understand electricity access dynamics, one therefore requires techniques which are able provide insight into household formation and electricity access transitions.

4.3 Household Formation and Dissolution Categorisations

In order to explore the finer details of changes in aggregate household electricity access, and how these may relate to household formation, we categorise households in each period according to when they form and whether they continue to exist or not.

We divide our population at time t into two groups: those households that will continue to exist in the next period and those that will dissolve between the current period and the next. In the following period (i.e. t + 1), there will be households that have continued from the previous period and new households. A graphical example of these categorisations is provided in Figure 1 below.

Figure 1: Household Population Transition Processes



As illustrated in Figure 1, every household that will continue (from the perspective of period t) therefore must be a household that has continued (from the perspective of period t + 1). The population of continuing households is thus constant across every set of consecutive periods, t and t+1. The aggregate population of households will grow when there is net household formation between period t and period t+1, or when the number of new households in t+1 is greater than the number of households that dissolved after period t (i.e. when Area b + Area c > Area a).

These categories can then be used as a useful tool to break down the aggregate electricity statistics. For example: the aggregate number of electricity connections in period t (Y_t) is equal the sum of the number of connections among continuing households (Y^C_t) and the number of connections among dissolving households (Y^D_t). Likewise, the aggregate number of connections in period t+1 (Y_{t+1}) is equal to the sum of the number of connections among surviving households (Y^S_{t+1}) and the number of connections among new households (Y^N_{t+1}). The change in connections between period t and period t+1 is thus equal to the sum of two components: (1) the change in connections among continuing households ($Y^S_{t+1} - Y^C_t$); and (2) the change in connections among new/dissolving units ($Y^N_{t+1} - Y^D_t$). Changes in the proportion of all households with electricity access can similarly be separated into changes among continuing, new and dissolving units.

We therefore categorise households as continuing, new and dissolving households and report the number of connections and the connection rate within each group for the periods 2008-2010 and 2010-2012 in the NIDS data, and 2005-2007 and 2007-2009 in the HDSS data. We focus on these periods, as they are periods over which declines and subsequent recoveries in electricity access are observed (i.e. short-term deviations from the long-term trend). These results provide insight into how changes in aggregate electricity access may be driven by changes among surviving households, relative to changes that are linked to household formation and dissolution. These electricity access rates reported using this approach differ slightly from those estimated using the standard cross-sectional approach as the household weights are adjusted to account for category-related attrition.

4.4 Longitudinal Approach

While these categorisations provide a useful tool to investigate net changes in access among continuing and dissolving/new households, they fail to provide insight into the number of connection gains and losses. A small net increase in the number of connections among continuing households could be the result of a small number of connection gains (and no connection losses), or a large number connection losses combined with an even larger number of connection gains. The techniques described in Section 4.1 and Section 4.3 thus conceal a degree of the volatility that underlies electricity access dynamics.

However, the categorisation tool outlined above has one key strength that has not yet been discussed: once continuing/surviving households are identified (along with new and dissolving households), one can use these categorisation to develop a panel of households, upon which one can apply longitudinal techniques. More specifically, one can use the panel of households to develop transition matrices which report electricity access transitions for continuing households - thus providing insight into the volatility of electricity access transitions.

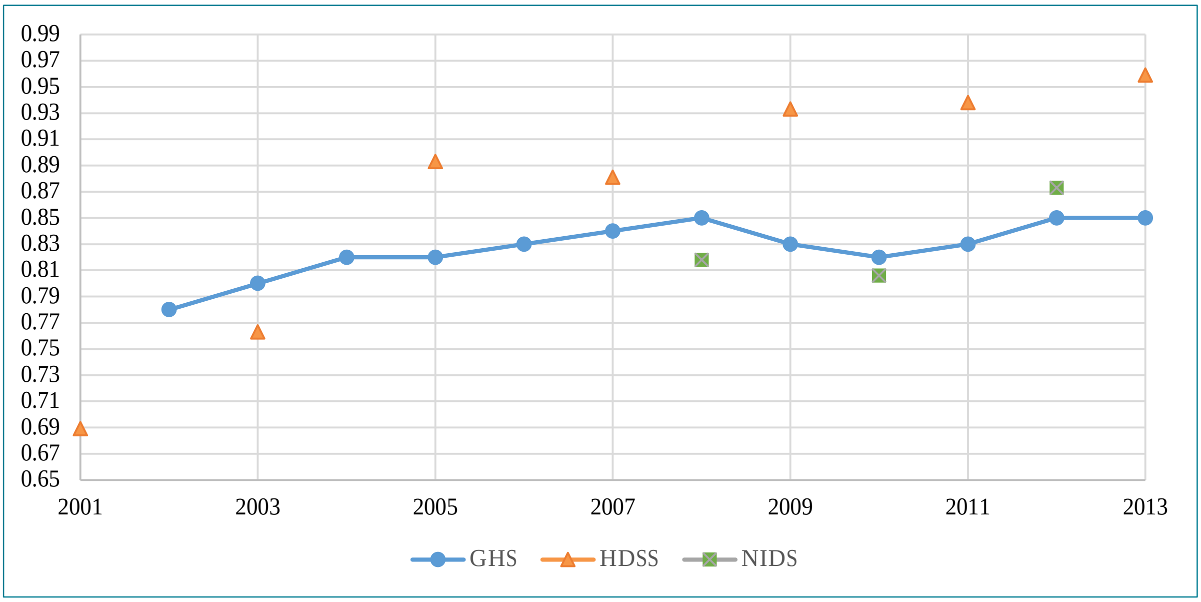
As the final component of our analysis, we therefore develop electricity access transition matrices for continuing households in NIDS and HDSS data for the periods 2008-2012 and 2005-2009, respectively. These transition matrices provide estimates of the number (and proportion) of households than gain and lose access in each period.

5. Results

5.1 Conventional Cross-sectional Approach

Figure 2 provides long-run estimates of household electricity access rates over the period 2001-2013, using GHS, NIDS and HDSS data in a standard cross-sectional form. Electricity access is currently relatively good in South Africa: more than 85% of households reported having an electricity connection in 2012/2013. Our results also suggest there to have been substantial improvements in household electricity access over the period of interest – and thus a great many more people are able to utilise electricity for lighting, cooking and other activities than was possible in the early 2000s. These improvements were even more striking in particular areas, such as Agincourt. While only 69% of the households in the Agincourt district had electricity access in 2001, more than 95% had access by 2013.

Figure 2: Proportion of Households with Electricity Connections, South Africa, 2001-2013



Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
GHS	-	0.78	0.80	0.82	0.82	0.83	0.84	0.85	0.83	0.82	0.83	0.85	0.85
HDSS	0.689	-	0.763		0.893		0.881		0.933		0.938		0.959
NIDS								0.818		0.806		0.873	

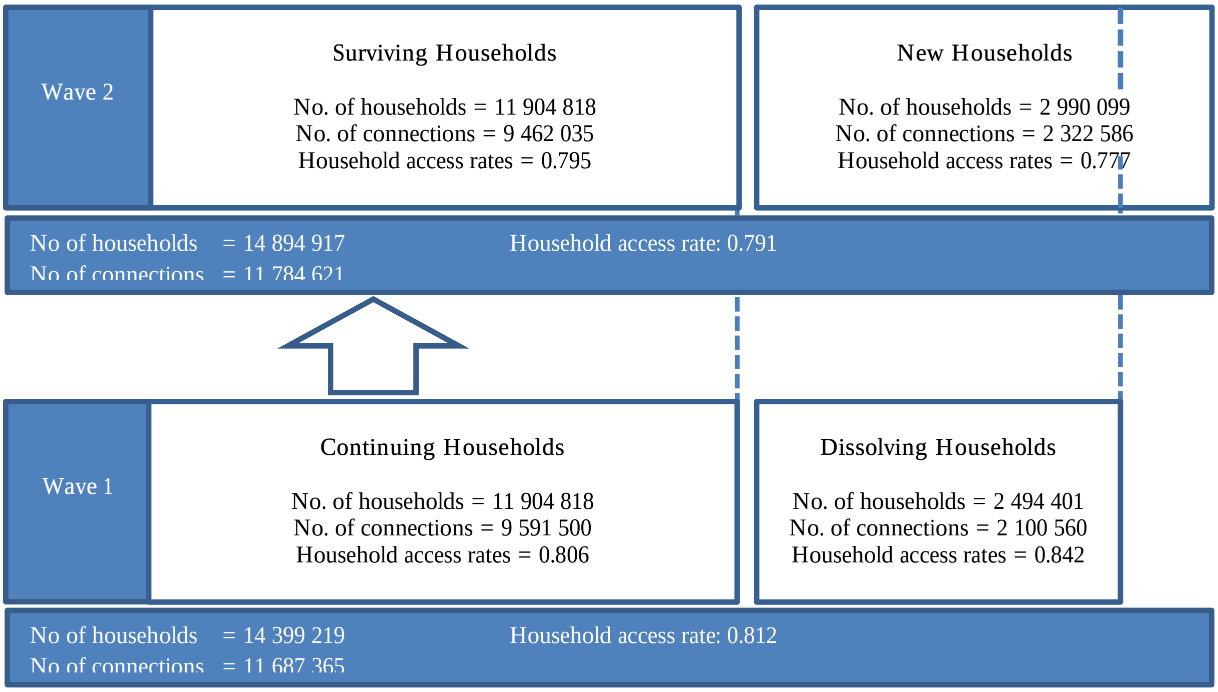
However, these improvements did not evolve as a linear or monotonic increase in access rates. Rather, while the national household electricity access rate rose from 0.78 in 2002 (GHS) to an initial peak of 0.82-0.85 in 2008 (GHS and NIDS), and a final peak of 0.85-0.87 in 2012/2013 (GHS and NIDS), a decline in access is also observed between 2008 and 2010 (of 1.22-3.52%) (GHS and NIDS). The results for the HDSS data confirm that the story of electricity roll-out has not been one of consistent year-on-year improvements in access. While the dynamics of electricity access in Agincourt do not align perfectly with the national picture in terms of timing, we see similar dynamics: an interim decline in access (2005-2007), followed by a short period of rapid recovery (2007-2009). Periods of slow growth (or stagnation) in electricity access are also observed across both the national and small-area results (2004-2005 and 2012-2013 (GHS); and 2009-2011 (HDSS)).

5.2 Household Formation and Dissolution Categorisations

In order to explore to what extent observed decline and improvements in access rates may be related to household formation, we investigate the number of connections (and the electricity access rates) over the periods 2008-2010 and 2010-2012 in the NIDS data, and 2005-2007 and 2007-2009 in the HDSS data – focusing separately on continuing/surviving households and new/dissolving households.

Figure 3 provides a graphical representation of the national estimates for the period 2008-2010, using the NIDS data.

Figure 3. Electricity Connections, South Africa, 2008-2010



Between 2008 and 2010, household formation and dissolution contributed to the decline in electricity access rates in two ways. Firstly, dissolving households (that ceased to exist after 2008) were more likely to have access to electricity than those that continued to exist, while new households (that formed between 2008 and 2010) were less likely to have an electricity connection than all those that were existence in 2008 (compared to both continuing and dissolving units). Since households are set up by individuals, this implies a trend of people moving away from electricity access, with almost 600 000 individuals losing access to electricity over this period as a result of them moving out of households with access and into households without access. Secondly, the household population increased by nearly 0.5 million units over the period. This equates to a 3.4% increase in the denominator of the household access rate (which is given by $\frac{Y_t}{n_t}$), which can be compared to the 0.8% increase in the number of connections (i.e. the 0.8% increase in the numerator of the electricity access rate) over the same period. Thus, while the number of electricity connections increased between 2008 and 2010, the higher proportional increase in the household population resulted in a net decline in the electricity access rate.

However, it is not only household formation and dissolution processes that contributed to the decline in access rates between 2008 and 2010. The trend in access rates for continuing households also follows the negative trend estimated from the full population. In 2008, 80.6% of continuing households had access to electricity, and in 2010 this dropped to 79.5%. Given that the continuing household population is constant across the period of interest, the only explanation for this decline in access is that a number of households that had access to electricity in 2008 somehow lost electricity access between 2008 and 2010. The connection numbers highlight this more directly, revealing a net reduction in connections of more than 100 000 among continuing households (from 9 591 500 to 9 462 035). Given an average households size of about 4, this equates to more than 400 000 individuals losing access to electricity in their homes. If one assumes that a number of continuing households also gained electricity connections over this period (a reasonable assumption, considering INEP's aim to address the backlog of un-electrified households), then the true number of households that lost an electricity connection can be anticipated to have been even higher this. While the negative relationship between household formation and electricity access over this period is enlightening, the net decline in electricity access among continuing households over a period of electricity roll-out is perhaps even more curious.

Table 1 presents the same results for the period 2010-2010 in the NIDS data.

Table 1.

Electricity Connections by Household Formation Category, South Africa, 2010-2012

	Continuing Households				Dissolving Households		New Households	
	2010		2012		2010		2012	
	Frequency	Rate	Frequency	Rate	Frequency	Rate	Frequenc y	Rate
No Access	2 574 513	0.216	1120	0.135	628 020	0.210	493 841	0.118
Access	9 334 635	0.784	10 192 126	0.856	2 357 749	0.790	3 697 600	0.882
Total	11 909 148		11 909 148		2 985 769		4 191 441	

Total Household Electricity Connections, South Africa, 2010-2012

	2010	2012
Number of connections	11 692 384	13 889 726
Electricity access rate	0.785	0.863

Net household formation is evident in this period too, and thus diluted the impact of the net increase in the number of connections on access rates. However, other household dynamics seem to have worked in the opposite direction to the previous period and contributed to the increase in connections. The access rates among dissolving and newly formed households imply a trend of people migrating out of households without electricity access and into households with electricity access. There is also a net increase in the number of connected households among continuing households. The increase in the total number of connections (and access rate) is thus a result of two components: an improvement in connection rates among continuing units, and a positive association between electricity access and household formation and dissolution processes.

Interestingly, we find similar dynamics at work in the dynamics of electricity access in Agincourt during the 2005-2007 and 2007-2009 periods. This is documented in Tables 2 and 3.

Table 2.

Household Electricity Connections by Household Formation Category, Agincourt, 2005-2007

	Continuing Households				Dissolving Households		New Households	
	2005		2007		2005		2007	
	Frequency	Rate	Frequency	Rate	Frequency	Rate	Frequency	Rate
No Access	1 066	0.100	1 093	0.102	652	0.801	1 921	0.806
Access	9 605	0.900	9 578	0.898	162	0.199	462	0.194
Total	10 671		10 671		814		2 383	

Total Household Electricity Connections, Agincourt, 2005-2007

	2005	2007
Number of connections	10 257	11 499
Electricity access rate	0.893	0.881

Table 3.

Household Electricity Connections by Household Formation Category, Agincourt, 2007-2009

	Continuing Households				Dissolving Households		New Households	
	2007		2009		2007		2009	
	Frequency	Rate	Frequency	Rate	Frequency	Rate	Frequency	Rate
No Access	1 398	0.112	558	0.045	445	0.739	2 159	0.826
Access	11 054	0.888	11 894	0.955	157	0.261	454	0.174
Total	12 452		12 452		602		2 613	

Total Household Electricity Connections, Agincourt, 2007-2009

	2007	2009
Number of connections	13 054	14 053
Electricity access rate	0.881	0.933

As with the national data, net household formation is evident across both periods; this is anticipated to have diluted the positive impact of any additional connections - thus contributing to the initial decline in access rates and moderating the subsequent improvement in access rates. Among continuing households, a slight drop in both the number of connections (and thus the access rates) is evident in the first period. Connection losses among households that continue to exist thus contributed to Agincourt's 2005-2007 decline in aggregate electricity access, just as connection gains among un-connected households contributed to the subsequent improvement in access rates. Household formation and dissolution processes demonstrate a positive association with electricity access across both periods, with households that form being more likely to have access to electricity than those that dissolve. These processes thus seem to have moderated the decline in electricity access rates in Agincourt between 2005 and 2007, and contributed to the improvement in access rates access between 2007 and 2009.

These results reveal three stylised facts about how household formation and dissolution processes can work either for or against the efforts of those involved in improving service delivery. Firstly, net household formation will dilute the number of connections among a larger population of households, and thus either moderate improvements in access rates or contribute to declines in access rates. Secondly, even in the absence of net formation, household formation and dissolution processes can contribute to declines in connections and access rates – when these processes are associated with infrastructure downgrading. This will occur when households with access dissolve (e.g. due to out-migration), and households without access form in their place. Thirdly, access-related household formation and dissolution can also contribute to increases in connections and access rates. This will occur when un-connected households dissolve (e.g. due to out-migration), and new households are set up in locations which already have electricity access - or at least are set to gain access by the end of the period.

5.3 Longitudinal Approach

In order to further investigate the net decline in connections among continuing households, longitudinal techniques are applied to the panel of continuing households in the NIDS data. Table 4 and Table 5 present electricity access transitions for continuing households over the periods 2008-2010 and 2010-2012, respectively.

Table 4.

Panel Analysis: Transitions for Surviving Households, South Africa, 2008-2010
(Number (and proportion) of Households)

		Wave 2		
		No Access	Access	Total
Wave 1	No Access	1 608 484 (0.694)	705 834 (0.306)	2 313 318 (1.000)
	Access	836 298 (0.087)	8 755 202 (0.913)	9 591 500 (1.000)

Panel Analysis: Transitions for Surviving Households, South Africa, 2010-2012
(Number (and proportion) of Households)

		Wave 3		
		No Access	Access	Total
Wave 2	No Access	1 526 349 (0.477)	1 676 184 (0.523)	3 202 533 (1.00)
	Access	606 997 (0.052)	11 085 387 (0.948)	11 692 384 (1.000)

As suggested earlier (in Figure 3), a number of continuing households are identified to have lost access to electricity between 2008 and 2010. However, what is most interesting is the scale of these negative transitions: despite a substantial number of added connections, these are still outweighed by the number of connection losses. More specifically, while more than 700 000 continuing households (about 30% of the 2008 un-connected continuing household population) gained an electricity connection between 2008 and 2010, about 840 000 households (about 9% of the 2008 connected continuing household population) lost a connection. Yet mass connection losses are not only evident over periods in which declines in access rates are observed. Between 2010 and 2012 – a period which is marked by a large net increase in connections – substantial numbers of connections losses are also observed. More than 600 000 continuing households (more than 5% of the 2010 connected continuing household population) are identified to have lost an electricity connection over this period. These results demonstrate that while extensions of the electricity network to previously un-connected households are crucial to improvements in access, the connection losses also play an important role in determining the development of electricity access in South Africa.

Tables 5 presents similar transition matrices for Agincourt over the periods 2005-2007 and 2007-2009.

Table 5.

Panel Analysis: Transitions for Surviving Households, Agincourt, South Africa, 2005-2007
(Number (and proportion) of Households)

		2007		
		No Access	Access	Total
2005	No Access	756 (0.709)	310 (0.291)	1 066 (1.000)
	Access	337 (0.035)	9 268 (0.965)	9 605 (1.000)

Panel Analysis: Transitions for Surviving Households, Agincourt, South Africa, 2007-2009
(Number (and proportion) of Households)

		2009		
		No Access	Access	Total
2007	No Access	417 (0.298)	981 (0.702)	1 398 (1.000)
	Access	141 (0.013)	10 913 (0.987)	11 054 (1.000)

In Agincourt between 2005 and 2007, while about 300 households (almost 30% of the un-connected continuing household population) gained access to electricity, just over 350 households lost access to electricity. There is a reversal in the transition patterns in the subsequent period; however, despite a net increase in connections among continuing households, a noteworthy number of connection losses are still evident between 2007 and 2009. These results validate the dynamics observed in the NIDS data (i.e. that connection losses have contributed to aggregate changes in household electricity access in South Africa).

These findings highlight three important points. Firstly, volatility in electricity access among continuing households is substantially greater than what is conveyed through net connection numbers. Secondly, an aggregate improvement in access rates among continuing households is not always simply a result of an increase in the number of un-electrified households that gain electricity connections, but can also be attributable to a reduction in the number of households that lose electricity access. These two processes work in tandem to determine net connection changes among continuing households across any two periods. Thirdly, households do indeed move both up and down the energy ladder in all periods; thus, some of those individuals who have access to electricity in an observed period are vulnerable to losing this access in a subsequent period.

5.4 South Africa's Electricity Access Targets

Under the Integrated National Electrification Programme (INEP), it has been the government's aim to address the "electrification backlog of permanently occupied residential dwellings" (DoE, 2015). Significant ground seems to have been gained in this respect between 2002 and 2013, with household electricity access rates increasing by 9.0%. While we do see a dip in national access between 2008 and 2010, access rates had more than recovered by 2012. Therefore, despite the deterioration observed between 2008 and 2010, the national electricity access rate expanded by more than 6 percentage points over the four-year period between 2008 and 2012 – or a net improvement of almost 200 000 households. If the extension of electricity access is to continue at the rate displayed over the entire 2002-2013 period, 93.4% of households will have electricity access in 2025 – thus falling short of INEP's stated goal of achieving universal electricity access by 2025 (DoE, 2013). Alternatively, if access rates are to expand at the rapid rate observed over the more recent

2008-2012 period, universal access could be achieved by 2023. However, given the inconsistent progression of historic access rates, it is more-than-conceivable that electrification rollout will fall short of INEP's target.

5.5 Disconnections in South Africa

With constant efforts being made to extend the electricity network, it is both interesting and concerning for the electricity sector that we find short periods in which electricity access rates actually decline (or, at other times, stagnate). An even more substantial concern for those involved in coordinating service delivery is the fact that these deteriorations occur partially as a result of a large number households seemingly losing access to electricity.

These connection losses of 2008-2010 were widespread and seem to have occurred across all nine provinces. It is, however, worth noting that more than one quarter occurred in KwaZulu-Natal, while the highest proportional contributors to the disconnection statistic were Kwazulu-Natal, Limpopo, Free State and Mpumalanga (i.e. highest disconnections relative to number of surviving household in province).[1] The majority of these connection losses occurred in urban areas (54%), but this may have been expected, since urban households constituted 61% of the population of surviving households in 2008. Conversely, rural areas displayed a more than proportional number of disconnections (46% vs. 38%), while disconnections were seemingly unrelated to dwelling type.[2] As may have been expected, poor households were more likely to be lose a connection than non-poor households (StatsSA, 2014b).[3]

Connection losses are evidently an important determinant of aggregate access in South Africa. It is therefore not surprising that while an increase in the number of new connections between 2010 and 2012 contributed to the improvement in electricity access, a decline in the number of "lost" connections also constituted a substantial proportion of the aggregate change in access.[4] Given the scope of this analysis, it is not possible to explore any further details regarding why loss of access occurs, why the loss of electricity access is so widespread – or what "losing" a connection actually entails for a given household unit.[5] Yet, it is fair to assume that given the volume of negative transitions across different periods, these results do provide an indication of service delivery failure at a broad level in South Africa, and this is something that should be noted by policy makers.

---

[1] Tables showing the number of disconnections by province, area type, dwelling type, and poverty classification of household, are located in Section 1, Section 2, Section 3 and Section 4 of the Appendix, respectively.

[2] The number of disconnections within each dwelling type category is proportional to the number of dwellings of that type within the population of surviving households.

[3] A household was classified as poor in period t if the per capita household income in period t was below the poverty line of R507 per person (StatsSA, 2014b). Household income in every period was converted into real 2008 Rands, and then divided by the number of residents in the household to arrive at a value for per capita income

[4] While there was a significant (and interesting) increase in the number of disconnections displayed in Gauteng, and a smaller increase in the number of disconnections in Western Cape and North West, this was outweighed by a very large decline in disconnections within KwaZulu-Natal, Mpumalanga, Limpopo and Free State.

[5] Due to the nature of the question, a recorded loss in electricity access is likely a result of one of the following: an administrative disconnection (a household that considers itself to be permanently disconnected, for administrative reasons i.e. payment), an infrastructural disconnection (a failure in electricity distribution infrastructure which has led to a connection loss), an economic disconnection (where an electricity connection remains, but the household considers itself to no longer have access due to unaffordability), or finally due to measurement error (i.e. a misunderstanding, or incorrect reporting, of the question or response).

6. Conclusions

This study is unique in two respects. Firstly, it is the first example of an analysis of the relationship between household electricity access and household formation dynamics in South Africa; to achieve this, households are categorised according to when they form, and whether they continue to exist or not, and changes in electricity access are then investigated within these different household groups. Secondly, this study provides a first attempt at applying standard longitudinal techniques (i.e. transition matrices) to investigate transitions in household electricity access in a developing country – making use of novel forms of the NIDS and Agincourt HDSS data that allow us to track household units over time.

We find that household electricity access in South Africa improved by 9.0% between 2002 and 2012 at a national level (78% to 85%), and by 39.2% in Agincourt between 2001 and 2013 (69% to 96%). Yet, these net improvements in access did not result from consistent monotonic increases in access; we instead observe short-term deviations from the long-term trends, including periods of declines in aggregate household electricity access. In our analysis of these declines in access, we confirm that households do in fact transition both up and down the energy ladder in this regard, and consequently urge that any comprehensive analysis of electricity access dynamics in a developing context should look to investigate transitions in both directions (rather than merely focusing on the number of connections added). Further studies should also look to use the longitudinal techniques applied here to explore other elements of service delivery - such as sanitation or piped water – or to assess electricity access in other developing countries.

The policy and theoretical implications of our findings are applicable to those working in developing contexts well beyond the borders of South Africa. We have shown that aggregate electricity statistics conceal a considerable degree of the complexity and volatility that is inherent in the development of electricity access. In this light, it is evident that policy makers involved in the realm of electricity roll-out are likely to be aiming for a moving target in the following three respects:

1) the number of households may be growing faster than the rate of growth in connections, as a result of rapid household formation;
2) people may be moving out of connected households and setting up new households in locations that lack access; and
3) certain connected households that survive from one period to the next may actually lose their electricity connections.

The extension of household electricity access is thus not the simple, monotonic process that it is often portrayed as within the existing literature. It is instead a more complex outcome of two time-variant processes: (1) net connections (new connections – connection losses), and (2) household formation and dissolution processes. In order to fully understand the dynamics of electricity access within any context, one must first aim to understand the details of these two time-variant processes.

Contributors

Tom Harris co-initiated the idea of the paper, designed the paper, led the writing of the paper, and led the analysis. Mark A. Collinson participated in the conceptualisation of the research, prepared the Agincourt HDSS data for analysis, contributed to the writing of Section 3 and reviewed the final version of the paper. Martin Wittenberg co-initiated the idea of the paper, reviewed various drafts of the paper and provided the analysis of the GHS and Agincourt HDSS data.

References

Balachandra, P. (2011). Dynamics of rural energy access in India: An assessment. *Energy, 36*(9), 5556-5567.

Bekker, B., Gaunt, C., Eberhard, A., & Marquard, A. (2008). Uncertainties within South Africa's goal of universal access to electricity by 2012. *Journal of Energy in Southern Africa, 19*(2), 4-13.

Bhorat, H., & van der Westhuizen, C. (2013). Non-monetary dimensions of well-being in South Africa, 1993–2004: A post-apartheid dividend? *Development Southern Africa, 30*(3), 295-314.

Collinson, M. A. (2010). Striving against adversity: the dynamics of migration, health and poverty in rural South Africa. *Global health action, 3*.

Davidson, O., & Mwakasonda, S. A. (2004). Electricity access for the poor: a study of South Africa and Zimbabwe. *Energy for Sustainable Development, 8*(4), 26-40.

Dinkelman, T. (2011). The effects of rural electrification on employment: New evidence from South Africa. *The American Economic Review, 101*(7), 3078-3108.

DoE. (2013) IEP Planning Report: Overview of Universal Energy Access Strategy. Department of Energy, Pretoria, South Africa.

DoE. (2015) Strategic Plan, 2015-2020. Department of Energy, Pretoria, South Africa.

Gaunt, C. (2003). *Electrification Technology and Processes to Meet Economic and Social Objectives in South Africa.* (PhD), University of Cape Town, Cape Town.

Harris, T. (2016). *Household Electricity Access and Household Dynamics: Insights into the links between electricity access and household dynamics in South Africa between 2008 and 2012.* (M.Soc.Sci), University of Cape Town, Cape Town.

Heltberg, R. (2005). Factors determining household fuel choice in Guatemala. *Environment and development economics, 10*(03), 337-361.

Hiemstra-Van der Horst, G., & Hovorka, A. J. (2008). Reassessing the "energy ladder": household energy use in Maun, Botswana. *Energy Policy, 36*(9), 3333-3344.

Kahn, K., Collinson, M. A., Gómez-Olivé, F. X., Mokoena, O., Twine, R., Mee, P., . . . Khosa, A. (2012). Profile: Agincourt health and socio-demographic surveillance system. *International journal of epidemiology, 41*(4), 988-1001.

Kimemia, D., Vermaak, C., Pachauri, S., & Rhodes, B. (2014). Burns, scalds and poisonings from household energy use in South Africa: Are the energy poor at greater risk? *Energy for Sustainable Development, 18*, 1-8.

Leibbrandt, M., Woolard, I., & de Villiers, L. (2009). Methodology: Report on NIDS wave 1. *Technical paper, 1*.

Masera, O. R., Saatkamp, B. D., & Kammen, D. M. (2000). From linear fuel switching to multiple cooking strategies: a critique and alternative to the energy ladder model. *World development, 28*(12), 2083-2103.

Nansaior, A., Patanothai, A., Rambo, A. T., & Simaraks, S. (2011). Climbing the energy ladder or diversifying energy sources? The continuing importance of household use of biomass energy in urbanizing communities in Northeast Thailand. *Biomass and Bioenergy, 35*(10), 4180-4188.

NPC. (2010) National Development Plan (2030). The Department of the Presidency, Republic of South Africa.

Pachauri, S., & Jiang, L. (2008). The household energy transition in India and China. *Energy Policy, 36*(11), 4022-4035.

Parshall, L., Pillai, D., Mohan, S., Sanoh, A., & Modi, V. (2009). National electricity planning in settings with low pre-existing grid coverage: development of a spatial model and case study of Kenya. *Energy Policy, 37*(6), 2395-2410.

Rao, M. N., & Reddy, B. S. (2007). Variations in energy use by Indian households: an analysis of micro level data. *Energy, 32*(2), 143-153.

Smith, K. R. (2000). National burden of disease in India from indoor air pollution. *Proceedings of the National Academy of Sciences, 97*(24), 13286-13293.

StatsSA. (2013) Energy 2002-2012: In-depth analysis of the General Household Survey data. *GHS Series: Vol. V*: Statistics South Africa, Pretoria, South Africa.

StatsSA. (2014a) General household survey, 2013. *Statistical Release P0318*: Statistics South Africa, Pretoria, South Africa.

StatsSA. (2014b) Poverty Trends in South Africa: An examination of absolute poverty between 2006 and 2011. *Report no: 03-10-06*: Statistics South Africa, Pretoria, South Africa.

Tollman, S. M. (1999). The Agincourt field site--evolution and current status. *South African medical journal= Suid-Afrikaanse tydskrif vir geneeskunde, 89*(8), 853-858.

Tollman, S. M., Herbst, K., Garenne, M., Gear, J., & Kahn, K. (1999). The Agincourt demographic and health study--site description, baseline findings and implications. *South African medical journal= Suid-Afrikaanse tydskrif vir geneeskunde, 89*(8), 858-864.

UN. (2016). Goal 7: Ensure access to affordable, reliable, sustainable and modern energy for all. *Sustainable Development. Goals: Energy.* Retrieved from: http://www.un.org/sustainabledevelopment/energy/

van der Kroon, B., Brouwer, R., & van Beukering, P. J. (2013). The energy ladder: Theoretical myth or empirical truth? Results from a meta-analysis. *Renewable and Sustainable Energy Reviews, 20*, 504-513.

Van Horen, C., & Eberhard, A. (1995). Energy, environment and the rural poor in South Africa. *Development Southern Africa, 12*(2), 197-211.

Vermaak, C., Kohler, M., & Rhodes, B. (2009). Developing energy-based poverty indicators for South Africa. *Journal of Interdisciplinary Economics, 21*(2), 163-195.

Vermaak, C., Kohler, M., & Rhodes, B. (2014). Developing an energy-based poverty line for South Africa. *Journal of Economic and Financial Sciences, 7*(1), 127-144.

Winkler, H., Simões, A. F., La Rovere, E. L., Alam, M., Rahman, A., & Mwakasonda, S. (2011). Access and affordability of electricity in developing countries. *World development, 39*(6), 1037-1050.

Wittenberg, M., & Collinson, M. (2014). *Household formation and household size in post-apartheid South Africa: Evidence from the Agincourt sub-district 1992-2003.* A DataFirst Technical Paper 27. DataFirst, University of Cape Town, Cape Town.

Ying, W. Z., Hu, G., & Dadi, Z. (2006). China's achievements in expanding electricity access for the poor. *Energy for Sustainable Development, 10*(3), 5-16.

APPENDIX

Section 1: Disconnections (or loss of access to electricity), by Province

Panel Analysis: Disconnections by Province, South Africa, 2008-2010

Province	Total Households	Proportion	Households Disconnected	Proportion	Proportion of Province Disconnected
Western Cape	1 115 583	0.09	33 698	0.04	0.03
Eastern Cape	1 520 621	0.13	84 966	0.10	0.06
Northern Cape	298 943	0.03	4 129	0.00	0.01
Free State	734 071	0.06	112 546	0.13	0.15
KwaZulu-Natal	2 229 505	0.19	206 873	0.25	0.09
North West	739 218	0.06	37 420	0.04	0.05
Gauteng	2 925 773	0.25	119 094	0.14	0.04
Mpumalanga	1 101 208	0.09	103 379	0.12	0.09
Limpopo	1 239 897	0.10	134 193	0.16	0.11
Total	**11 904 819**		**836 298**		**0.07**

Panel Analysis: Disconnections by Province, South Africa, 2010-2012

Province	Total Households	Proportion	Households Disconnected	Proportion	Proportion of Province Disconnected
Western Cape	1 062 906	0.09	54 987	0.09	0.05
Eastern Cape	1 493 295	0.13	63 759	0.11	0.04
Northern Cape	278 174	0.02	11 033	0.02	0.04
Free State	770 171	0.06	26 578	0.04	0.03
KwaZulu-Natal	2 270 564	0.19	82 096	0.14	0.04
North West	758 253	0.06	67 215	0.11	0.09
Gauteng	2 945 449	0.25	217 441	0.36	0.07
Mpumalanga	1 043 694	0.09	66 673	0.11	0.06
Limpopo	1 286 642	0.11	17 216	0.03	0.01
Total	**11 909 148**		**606 997**		**0.05**

Section 2: Disconnections (or loss of access to electricity), by Area Type

Panel Analysis: Disconnections by Area Type, South Africa, 2008-2010

Area Type	Total Households	Proportion	Households Disconnected	Proportion	Proportion of Area Type Disconnected
Traditional	3 766 787	0.32	333 346	0.40	0.09
Urban	7 244 139	0.61	450 625	0.54	0.06
Farms	893 892	0.08	52 328	0.06	0.06
Total	**11 904 818**		**836 299**		**0.07**

Panel Analysis: Disconnections by Area Type, South Africa, 2010-2012

Area Type	Total Households	Proportion	Households Disconnected	Proportion	Proportion of Area Type Disconnected
Traditional	3 919 484	0.33	161 324	0.27	0.04
Urban	7 165 410	0.60	395 987	0.60	0.05
Farms	824 254	0.07	49 687	0.07	0.05
Total	**11 909 148**		**606 997**		**0.05**

Section 3: Disconnections (or loss of access to electricity), by Dwelling Type

Panel Analysis: Disconnections by Dwelling Type, South Africa, 2008-2010

Dwelling Type	Total Households	Proportion	Households Disconnected	Proportion	Proportion of Dwelling Type Disconnected
Formal dwelling	8 361 047	0.70	592 745	0.71	0.07
Informal Dwelling	2 147 652	0.18	131 297	0.16	0.06
Traditional Dwelling	1 396 118	0.12	112 256	0.13	0.08
Total	**11 904 818**		**836 298**		**0.07**

Panel Analysis: Disconnections **by Dwelling Type, South Africa, 2010-2012**

Dwelling Type	Total Households	Proportion	Households Disconnected	Proportion	Proportion of Dwelling Type Disconnected
Formal dwelling	8 363 544	0.71	430 001	0.71	0.05
Informal Dwelling	2 199 465	0.18	112 073	0.18	0.05
Traditional Dwelling	1 346 139	0.11	64 923	0.11	0.05
Total	**11 909 148**		**606 997**		**0.05**

Section 4: Disconnections (or loss of access to electricity), for Households above and below the Poverty Line

Panel Analysis: Disconnections by Poverty Classification, South Africa, 2008-2012

	Total Households	Proportion	Households Disconnected	Proportion	Proportion of Poor/Non-Poor Disconnected
Non Poor	7 222 381	0.61	445 677	0.53	0.06
Poor	4 682 437	0.39	390 621	0.47	0.08
Total	**11 904 818**		**836 298**		**0.07**

Panel Analysis: Disconnections by Poverty Classification, South Africa, 2008-2012

	Total Households	Proportion	Households Disconnected	Proportion	Proportion of Poor/Non-Poor Disconnected
Non Poor	7 343 268	0.62	373 142	0.61	0.05
Poor	4 565 880	0.38	233 855	0.39	0.05
Total	**11 909 148**		**484 597**		**0.05**

About DataFirst

DataFirst is a data service dedicated to making South African and other African survey and administrative microdata available to researchers and policy analysts.

We promote high quality research by providing the essential research infrastructure for discovering and accessing data and by developing skills among prospective users, particularly in South Africa.

We undertake research on the quality and usability of national data and encourage data usage and data sharing.

DataFirst

www.datafirst.uct.ac.za
Level 3, School of Economics Building, Middle Campus, University of Cape Town
Private Bag, Rondebosch 7701, Cape Town, South Africa
Tel: +27 (0)21 650 5708
info@data1st.org / support@data1st.org

University of Cape Town · iYunivesithi yaseKapa · Universiteit van Kaapstad

SPES BONA