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Knowledge network on sustainable household energy
in Southern and Eastern Africa

Scenario Analysis

South Africa

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An initiative of

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Abstract

This document sets out three scenarios for rural, and low income urban households in the year 2014 – for South Africa. The 'business as usual' case assumes that there is moderate economic growth, continuation of existing regional co-operation (which unfortunately means acceptance of some continued conflict and poverty in some neighbouring countries). The worst case scenario assumes that the economy is poor, and that regional and international co-operation is poor (significant regional poverty and political instability, no significant international support). The best case scenario assumes that the South African economy grows well, that international climate change and other development assistance is forthcoming on a significant scale, and that there is regional stability – which reduces existing inflows of refugees and illegal immigrants.

The scenarios are not presented in a highly quantitative form, and no attempt has been made to model trends. Although the authors have taken the liberty of putting numbers and percentages down for issues such as population, access, etc.- these are not the result of modelling, but simply postulates- put down primarily to stimulate thinking (and perhaps illustrate the value of carrying out more detailed modelling). For the most part, personal opinions have been used to derive predictions and pose options.

Electrification progress ranges from:

- in the **worst case scenario** an effective regress with access rates remaining at 2004 levels, and poor utilisation due to affordability constraints even for those who do have access, to
- in the **best case scenario**, practically full coverage, and wide utilisation even for thermal uses.

For thermal fuels:

- the **worst case scenario** predicts increased real prices, and a regression for many households down the energy ladder- with greater reliance on woodfuels, crop wastes and dung. This has severe consequences for livelihoods, as well as for the natural environment.
- In the **best case scenario**, woodfuel remains important, but other fuels (including electricity, LPG, ethanol-gel and others) are far more widely used by households, the resulting reduction in woodfuel use have a positive impact on resources. Quality of life is also significantly improved through better access and affordability of cleaner, more convenient fuels.

The text and summary table at the end specifically look at issues of fuel access and choice, Gender and energy, health impacts of the difference scenarios, and forestry impacts options. The final section of the paper starts a policy dialogue.

Acknowledgements

We wish to acknowledge the input of RAPS Consulting and Sparknet resource personnel. For this draft, we have not yet been able to consult more widely with other South African Sparknet associates. However, we hope that future versions of this paper will be able to acknowledge inputs of other members of the South African energy community (Sparknet associates), as well as from other Sparknet countries.

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1 Introduction

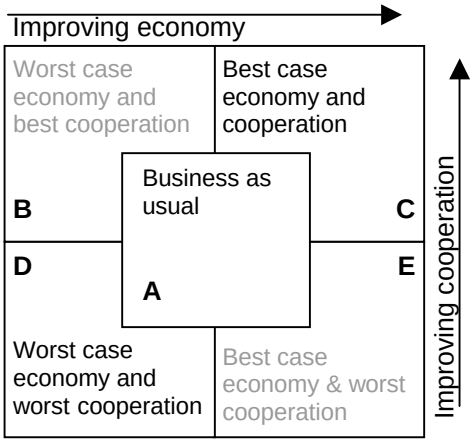
Sparknet is a multi-stakeholder interactive Knowledge Network focusing on how people, in the context of acute poverty, can gain access to better energy services and improve their livelihoods.

The network aims to make available resources for policy makers, companies, and civil society on energy poverty in Southern and East Africa. These are published through the network website www.sparknet.info. Sparknet focuses on three key themes – Health, Gender and Forestry – and the relationship of these issues with energy poverty. Outputs include detailed country reports, scenario analyses, and policy assessments. Two e-conferences will be held during the project – one on the scenarios, and another on policies.

Through a network of associates in Africa and Europe, Sparknet brings together 70 organisations and over 110 people from research institutes, NGOs, Governments and private companies.

1.1 Scenarios – what they are and why we have done them

Scenario analysis is simply a way of exploring realistic futures and predicting, based on our knowledge and experience how things could look in the future, how things could develop. As with all predictions we are likely to get it not entirely correct but the exercise is useful to stimulate debate on key issues. Scenario building is a *process* providing a structure for discussion and debate on what could happen within a timeframe of the next ten to fifteen years. We will explore how things could change and how these changes are likely to impact on access to household energy in each country and across the Sparknet region. From these discussions, we hope to be able to make policy recommendations for poverty alleviation through identifying the key areas where policy action needs to take place. The intention is not to produce definitive studies but to stimulate relevant policy dialogue and serve as a basis for further research. Using management jargon we are looking here for 'blue sky thinking'. To do this we need to know the status quo (work-package 2, the country reports – which are now available on the Sparknet web site) and also to have identified influential organisations and projects and key actors who will shape the future of household energy provision (work-package 3, the draft version also available online).



External influences, such as changes in economic growth and levels of regional cooperation, are circumstances over which we have limited control. By identifying what policies might be effective under varying best and worst scenarios we have a good basis for debating potential policy actions which are pro-poverty alleviation, take into account our three themes – health, gender and natural resources / forestry – and are realistic under a broad range of external circumstances. As defined in the original Sparknet proposal, the intention is to develop a number of scenarios based on levels of economic prosperity and regional cooperation. The five possible scenarios – A to E – are shown in the 'box matrix' figure alongside. We believe it is sufficient to deal only with scenario A (business as usual), C (best case economy and co-operation), and D (worst case economy and co-operation). The other two are variations of these main scenarios. Both variables relate strongly to globalisation and market developments. This is the reason for including regional co-operation, since the Sparknet proposal was submitted to a funding window, which explored impacts of globalisation on energy poverty.

Because of the limited time/funding resources, these analyses are based – to a certain extent – on a subjective interpretation (the opinion of well-informed researchers, organisations and individuals in each country) of the impact of key variables and on findings of earlier studies (if available). Although the authors have taken the liberty of putting numbers and percentages down for issues such as population, access to electricity, sanitation, etc.- these are not the result of modelling or formal predictions, but simply postulates- put down to stimulate thinking. For the most part, personal opinions have been used to derive predictions and pose options. The authors do feel that a more formal scenario exercise would be useful, and it is hoped that the current study will stimulate government or other funders to undertake a more structured rural and urban energy scenario exercise. It is focused mainly, but not exclusively on the issues identified by the three Northern partners on Health, Gender and Forestry (these papers are available online from the www.sparknet.info website.)

The scenario development follows the following process:

1. The development of peer reviewed scenario analyses for each country including 'business as usual'

and alternatives based on levels of 'economic prosperity' and of 'regional co-operation'. This current document is a working version of the scenario. Note that this version is at the start of the peer review process.

2. An international e-conference (through the Internet) will be held based on the scenarios for each country. The provisional date for this conference is the end of September, over a 2-week period (see the www.sparknet.info website for additional details).
3. Publishing of conference proceedings from the e-conference on scenarios

The scenario analysis will lead naturally to an analysis of *'what do we think will happen'* and *'what do we want to see happening'* (*or how best we can deal with it if it does happen)* in each country and the region, and leads directly into work-package 5 (how to get from one to the other – i.e. policy recommendations).

1.2 Background information on the Scenarios

Two reports have been prepared by the SPARKNET project that set out the current energy situation in low-income households in South Africa- a detailed 'country report' (Sparknet 2004), available in an online database format to allow comparison with other countries *www.sparknet.info*, and a synthesis report (also available from the same site) which provides a summary of key energy data, energy carriers, and energy policies in South Africa. At the time of writing background reports, the energy data from the 2001 Census was not available- some of the more recent data from this census has been included in Appendix A below.

Key factors relating to current energy usage in South Africa are:

- Extensive grid electrification- above 70% for the country as a whole, and just over 50% for rural communities
- Grid electrification continues to expand at a significant pace, leading to high expectations for most unelectrified communities
- Low-income urban communities recently gaining access to a 50 kWh/month 'free basic energy' grant, which makes electricity the cheapest option for cooking
- Continued use of multiple fuels (kerosene, candles, batteries, and to a lesser extent LPG) in most low income rural communities
- Rural grid and unelectrified communities still making significant use of woodfuel for thermal applications.
- In unelectrified settlements, paraffin (kerosene), and to a lesser extent LPG are very important.
- An off-grid electrification programme has commenced, with about 20 000 households gaining access to a fee-for-service type Solar Home System programme.
- There are also several thousand privately purchased solar lighting systems in rural areas.

In considering scenarios for the future, it is also important to look at key policy and strategy developments related to South Africa. From a household[1] energy perspective, perhaps this most important policy developments and statements are:

- Grid electrification, President has declared that by 2012 all households would have access to electricity (Mbeki, 2004) (we understand this to be a combination of grid, decentralised grid and off-grid
- Off-grid electrification – government funded programme continuing with three active concessions and a further three in different stages of implementation planning
- Kerosene: retail prices have been regulated, and the fuel is VAT exempt. A dedicated safety association is operational, and there are strong moves afoot to improve the safety of appliances used.
- LPG: The Department of Minerals and Energy is working with UNDP and the private sector on the LPG Challenge initiative, with a view to improving the distribution infrastructure, and reducing prices.
- Low smoke fuels and reduced smoke combustions methods- particularly for communities that burn a lot of coal, government is aggressively tackling strategies that emit less smoke.
- Key strategy documents include:
    - DME White Paper on Energy
    - White Paper on Renewable Energy
    - INTEGRATED ENERGY PLAN FOR THE REPUBLIC OF SOUTH AFRICA
    - Integrated Rural Development Strategy

[1] There are also very significant energy initiatives underway regarding bulk energy supply, and electricity generation (renewable energy strategy, requirements for new power station capacity, and possible development of small scale nuclear). However, these have been excluded from the scope of this work.

In comparison to many of the other Sparknet countries, South Africa is relatively fortunate, particularly as regards access to electrification, and also regarding access to fuels such as kerosene and LPG. Furthermore, income levels tend to be higher than for many other Sparknet countries, allowing households greater freedom in choosing energy options. Nevertheless, there are considerable numbers of people that suffer energy poverty, and significant health, environmental and productive use or education related consequences

2 Development of the scenarios

Three scenarios are presented in a text form below. Key points are summarized in Appendix A. The scenarios are written in the 'past tense', as if we were looking back in the year 2014. Readers are asked to indulge the authors, in that time and resource constraints did not allow for a formal modelling exercise to be conducted (for example using LEAP) – our objective has been to try and think a little creatively, and imagine what life would be like for rural and low-income urban communities 10 to15 years in the future.

2.1 Business-as-usual scenario

The year, 2014, 20 years after the end of the apartheid era. There has been moderate economic growth since 2004 (average of 2.5%) and continuation of existing regional co-operation (which unfortunately means acceptance of some continued conflict and poverty in some neighbouring countries).

As of 2004, South Africa had in place a number of key policies and strategies that provided an opportunity for moderate transformation of rural and urban low-income livelihoods, and in some cases significant transformation of the energy options available (electrification being the most important).

As is often the case, the road has not been as smooth as hoped, and implementation of the policies was hampered by operational, institutional, financial and other limitations, therefore the business-as-usual scenario does not present as satisfactory a situation by 2014 as the 2004 policy makers may have hoped. Key energy issues are discussed in section 2.1.1 following. Here we present key related trends (not linked to energy).

The total population in the country has decreased slightly, from 47.2 million (2004) to 46.7 million (2014) (based on the ASSA 2000 model, no change scenario). AIDS has taken a significant toll on rural livelihoods, with total infections climbing to 7.7 million in 2006, and dropping to 6.4 million by 2014. The number of people sick from AIDS climbing up to 1.4 million, and AIDS related deaths peaking at 780 000/year (almost twice the number of deaths from other causes).

There has been an increased in the number of people acquiring higher levels of education. There are many people with tertiary education who have no jobs. As in the years before 2004, many recent graduates have left the country to search for work outside South Africa.

There has been a continued influx of refugees (political and economic), and although estimates for 2004 were vague (between 2 and 8 million), by 2014 the population of refugees increased to 10 million (many of whom are 'illegal immigrants mostly from our neighbouring Southern African countries') .

Urbanisation has continued, and as a result of this and AIDS, rural populations have decreased by 5%, resulting in a significant change in the rural dynamic (for the years up to 2000, rural populations increased, particularly during the apartheid years, when AIDS was not yet an issue, and forced removals resulted in populations being shifted in to rural areas)

Despite the costs of the AIDS pandemic (financial, social, etc.) government has continued to support rural and urban area development

- There have been significant changes in water supply (from 84.5% access to piped water in 2001 to 95% access in 2014). However, the status of rural water supply schemes has been problematic, and many are in disrepair – thus real access is of the order of 80%.
- Improvements in sanitation availability continued, from an approximately 81% access rate in 2001, to 95% access by 2014
- There has been continued housing development, and housing stock has increased from 7.1 million (formal houses, 2001 Census) to 8.5 million. The traditional dwelling stock of 1.7 million has remained unchanged – although repair of houses has become an issue because of AIDS impacts on rural labour availability. Of the 1.4 million new houses built in the last 10 years, 400 000 have incorporated energy efficiency measures.
- Employment levels have remained fairly static. The number of people actively seeking jobs has dropped (from 6.8 million according to the 2001 census to 4 million by 2014), simply because of the impact of AIDS on the economically active part of the population. However, there has also not been significant growth in the job market, and the percentage of people not economically active has thus increased. The total employed number has remained relatively static at the 2001 Census level of 9.6 million mark.

The communications revolution of the late 1990's has continued, and almost all households have access to telephone (typically cell-phone) – with basic email/ text messaging services. Even in rural areas, there is some access to internet- in urban areas internet café's are common, and middle income households can access the net over the mobile communications devices. This has also led to a banking revolution, and most transactions, even in rural communities are done electronically.

2.1.1 Fuel Access and Choice

As noted in Appendix A, the primary change in rural areas, and low income rural areas has been a significant increase in electrification access, from the 2002 levels of around 70% to an overall access level of 85% (95% in urban areas). In rural areas, grid access has increased to 70%, and a further 7% have off-grid supplies. This leaves 23% of rural homes with no basic electricity supply.[2] It should however be noted that in urban areas where credit meters are used, there have been several hundred thousand disconnections, and in rural areas there are some (15%) users who never purchase electricity.

A new generation plant was commissioned in the years 2008 onwards, and the significant capital investment required has necessitated a real increase in electricity prices, relative to 2004 figures. Furthermore, government has not been able to sustain the 'free basic energy' grants for the full 10 year period. As a result, use of electricity for cooking has not increased significantly (compared to the 2001 figures). Even while the 'free basic energy' grants were in place, these were only for electricity, and thus only benefited households connected to the grid (or with off-grid supplies), and customers could not choose to rather apply the 'subsidy' to thermal fuels such as LPG.

Woodfuel has remained the most important thermal fuel in rural areas. In about 30% of rural communities (and in some urban areas), woodfuel harvesting pressures, combined with other land use factors, has meant significant degradation of the biomass resource. Collection times have increased, and prices for purchased woodfuel have increased.

Coal has remained an important household fuel for those communities close to coal fields – and distribution networks have not changed significantly since 2004.

For low income urban communities, and most rural communities, paraffin (kerosene) is still a very important fuel, with good access in most areas. However the international increase in oil prices has meant that its financial burden on households has increased. There has been some increase in the use of alternative fuels (such as ethanol gel), but these have been constrained by lack of investment in production facilities, and only moderate market development.

The LPG industry has continued to promote LPG as a clean and modern fuel, and take up has increased significantly- however, the improvement in rural economy performance has not been enough to adequately support the distribution and bottle infrastructure required- so access remains constrained, about 50% of households use the fuel – and net expenditure on LPG has overtaken kerosene.

Productive use of energy has only increased moderately in rural grid areas, and partially in low-income urban areas, as the trends of the first decade (1994 to 2004) of grid electrification continued - with insufficient market and entrepreneur development support, and only moderate growth of the rural economic sectors.

Access to viable productive energy platforms in off-grid areas has not developed, as there has been insufficient Research and Development and technical support to realise the true potential.

Solar water heaters have had negligible impact in rural areas. In urban areas market growth has been fair, fuelled by high electricity prices and a government supported programme.

Other household energy technologies such as solar stoves and hayboxes have gradually become part of the 'mainstream', but market share is still measured in single digits, in part because costs of supply have not been reduced enough, and in part through lack of awareness.

In the business as usual scenario, for the period 2004 to 2014, there have been no fundamental shifts in energy option access, (except for those households which have received electrification). Although government has supported the establishment of Integrated Energy Centres (in rural and peri-urban

[2] Government targets, set in 2004 are more ambitions than this, but for the business as usual case, allowance is made for delays in implementation.

communities), these have not rolled out as fast as planned, and have suffered several organisational and financial set-backs. The range and pricing of fuels has been in part constrained by economic imperatives. As a component of the off-grid programme, government required service providers to set up delivery options for thermal fuels. However, the fact that government did not give full support to these service providers meant that their roll out rate was limited[3], and they continued to operate in 'survival mode' rather than making the necessary investments to really put a sound, dispersed delivery infrastructure in place.

2.1.2 Gender

Given the above described increase in electrification, more rural women have access to electricity. In many households, electricity is considered too expensive to use as the main cooking fuel, but it has made a significant difference to certain high priority tasks (such as boiling a kettle for tea, or heating food up quickly, or even preparing meals that require short duration cooking).

Continued reliance by many households on woodfuel has meant that the responsibility of women to collect wood has remained unchanged. In areas were significant degradation of resource has occurred, this has led to significant hardship (long time spent collecting wood). Where woodfuel purchasing has become the norm, a shift in the status and relationships occurs, with an increase in the percentage of men participating in this new 'cash based' woodfuel economy.

A greater proportion of government projects are being implemented at local level, in rural villages (a consequence of the move in 2004 to decentralise many government delivery programmes). Many energy projects are implemented but relatively few take into account specific gender needs and goals and their impact to women and men. Nevertheless, there has been an increase in women participation in development projects, and especially energy projects. More women are starting to take up active roles in these projects. Some of the projects include the rollout of IEC's (Integrated Energy Centres) and Energy Stores in rural villages. Most of the rural communities now have better access to fuels as more and more IEC are being implemented in their rural communities.

There are many rural households that have been grid electrified. This has seen an increase in rural women entrepreneurs. They use their electricity to start up small businesses such as hair salons, take away food outlets and taverns. This in turn gives these rural women income to buy better fuels such as LPG instead of paraffin. This also allows gives them a different role in the household, because they now have the power to choose and purchase fuel. The asymmetries between men and women in the society as well as in the house have slowly shifted. Women are now starting to have a voice in the society as well as in the house.

Although the government has implemented many energy projects in the area to help communities have better access to fuels, there are still households that are living in extreme poverty. Most of those households are female headed. These energy projects are not reaching out the poorest of the poor. They are reaching out to those who could already afford the basic needs. There are still many women who still can't afford the fuels being supplied by the IEC's, who still have to travel long distances to collect wood for their families in order to prepare food and warm the home. These women are still exposed to harmful diseases that are caused by indoor pollution from the smoke that they inhale when cooking using wood.

2.1.3 Health

Those people who are living below the poverty line are still using traditional energy sources for cooking, boiling water and lighting (wood, paraffin, coal, and to a lesser extent cow dung). How these fuels are used exposes them to harmful diseases caused by indoor pollution such as acute lower respiratory infection (ALRI), chronic obstructive lung disease (COLD) and lung cancer and eye infections. In areas close to the coal fields, coal burning has also contributed to the health burden.

Although there has been research done on the risks of diseases that these people are exposed to, there is little that the government has been able to do to help them, especially as it has been difficult to draw people out of extreme poverty. Government's strategies to reduce poverty are primarily benefiting those who were able to afford the basic needs.

There are new technologies that are efficient and clean to reduce diseases caused by indoor pollution, but these technologies are too expensive for ordinary poor people to afford. Cleaner modern fuels have been made available in energy stores and in IEC's but not all are buying them at a rural level.

[3] During the period 2001 to 2004, the off-grid process suffered various set-backs, as the policy and institutional environment evolved, and the anticipated longer term budget commitments were not made.

The Department of Health and other departments such as Minerals and Energy as well as Social Services and Department of Housing, are working on a strategy to see to it that people have access to clean water, cleaner fuels and/or electricity, good health services and proper affordable formal houses. These they hope contribute to a healthy livelihood.

More and more clinics have been built closer to villages so that people can have better access to medical care. Doctors are distributed in rural clinics as part of their compulsory community service that they have to deliver to the rural communities of South Africa. This is part of the improvements that the government has done so far which is really helping the poor communities. Health services are free to the very poor people of South Africa.

As noted above, kerosene has remained an important fuel for poor households. Although safer appliances are now available, economic conditions have made it difficult to achieve a complete transition to the newer (more expensive) appliances. Multiple household fires started by paraffin stoves thus still remain amongst the most significant direct causes of fatalities and loss of property linked to energy.

People are still not well informed or educated on the safety use of fuels as there are still many cases of fire and poisoning. Woodfuel for many is still scarce as they have to walk long distances to collect wood. They use their backs and sometimes their heads to carry heavy wood loads. This strains their back and their necks which sometimes lead to spinal injuries and other head related injuries. Women are sometimes at high risk of being raped if the area is not safe, as they sometimes collect wood in the afternoon when it gets darker.

2.1.4 Forestry

As noted above, woodfuel has remained important for most rural communities, particularly in the last few years, when the FBE subsidy was no longer available. Following are the key trends in forestry/biomass resource developments over the 10 year period leading to 2014.

- The Working for Water programme (alien vegetation clearing) has continued, resulting in short term wood surpluses in areas of cutting, followed in some cases by wood deficits, as the remaining standing crop has not always been sufficient to keep up with demand. This has had significant effect in the Western Cape, where poor urban communities used to rely on alien vegetation for fuel.
- The period has been drier than average, possibly as a result of climate change. As a result, commercial forestry has not been able to expand significantly, and small growers have not been particularly successful.
- In about 30% of rural communities, woodfuel harvesting pressures, combined with other land use factors, has meant significant degradation of the biomass resource. Collection times have increased, and prices for purchased woodfuel have increased. In remaining communities where population levels have stabilised or dropped slightly, there has been some recovery of biomass resources.

The increased pressure on wood has meant that fuel efficient stoves have become more desirable – and towards the end of the period there has been some dissemination of stoves (resulting in reduced indoor air pollution, and lower wood consumption levels). However, given only moderate regional and donor co-operation, the rate of technology diffusion has been fair (about 15% take up).

2.2 Worst-case scenario

The year, 2014. In the past ten years there has been stagnation in the economy, and regional and international co-operation has been poor (significant regional poverty and political instability, no significant international support).

Although positive policies were in place by 2004, implementation of these was significantly constrained by lack of resources (capital, operational, and institutional). Key factors contributing to this worst case scenario were:

- continued tensions and conflict between the USA, its other allies and global terrorist network, as well as particular country 'hot spots'- this draining resources that might otherwise have been available for regional development aid support
- sustained breakdown in political and economic stability in the southern Africa region, which drained South African resources (due to needs to contribute to peacekeeping), and furthermore resulted in a significant refugee influx.

As a result, rural and urban energy situations remained relatively little changed, and in some cases there has been regression- as discussed in more detail in section 2.2.1 following. Key related trends (not linked to energy) are listed below.

The total population in the country has increased, due to an influx of 15 million refugees/illegal immigrants from neighbouring countries (about 4 million registered as refugees, the rest illegal immigrants). However, the number of South African citizens has decreased, as a result of AIDS related deaths, and continued difficulties with other mortality contributors (TB, Malaria, ARI). (From 47.2 million (2004) to 46.5 million (2014). Aids has taken a similar, if more extreme toll to that for the 'business as usual scenario'[4].

Urbanisation has continued, and as a result of this and AIDS, rural populations have decreased by 5%, resulting in a significant change in the rural dynamic (for the years up to 2000, rural populations increased, particularly during the apartheid years, when AIDS was not an issued, and forced removals resulted in populations being shifted in to rural areas)

Due to the significant economic burdens of AIDS and refugees, and decline in economic performance, government has not been able to continue major support of rural and urban area development

- Access to clean water supply has deteriorated in percentage terms, (from 84.5% access to piped water in 2001 to 80% access in 2014). The status of rural water supply schemes has been problematic, and the majority are in disrepair – thus real access is only of the order of 65% - the balance using unprotected sources and often walking long distances.
- Improvements in sanitation were not significant, and although the number of toilets increased, given the overall population growth, access went from 81% in 2001, to 75% by 2014.
- There was continued housing development for a few years, and housing stock has increased from 7.1 million (formal houses, 2001 Census) to 7.9 million. The traditional dwelling stock of 1.7 million has remained unchanged (decrease in South African communities, but increase in displaced persons camps) – although repair of houses has become an issue due to the AIDS impact on rural labour availability.
- More than 2 million people are considered homeless, living in cities, suburbs and towns, while a further 4 million of the refugees are in tents and other temporary accommodation in 'camps'
- Employment levels have deteriorated. The number of people actively and legally seeking jobs has remained constant (at 6.8 million, 2001 census figure) However, there has also not been significant growth in the job market, and the percentage of people not economically active has thus increased. Furthermore, the illegal immigrants and refuges are operating in the informal sector, and as labourers, with significant impact on low-skill-level employment opportunities for citizens of South Africa. The total employed number has remained relatively static at the 9.6 million mark (2001 Census)

Although the wealthy now have access to good voice and internet communication, the poor only have access to phone shops for SMS and voice services. Internet access is available in most urban communities, but the cost of the service means that it is not widely used for long duration tasks (such as entertainment and education). Rural internet access is primarily restricted to businesses, and one or two stations per school.

[4] Note, this AIDS scenario is not based on external references, it assumes a case worse than the ASSA 2000 'no change' scenario.

Although cell phone banking has allowed most transactions to be done electronically, in rural areas lack of facilities has meant that communities still use a cash economy. This coupled with unequal communications service access has resulted in an increased 'digital divide' and a greater gap between those who have, and those that 'have not' made the transition.

2.2.1 Fuel Access and Choice

As noted in Appendix A, there has been little change in grid access in rural areas over the last ten years. Even in urban areas, where grid investments have been made, the continued growth of urban informal settlements has meant that the electrification roll-out has not been able to keep pace. A lower proportion of households are thus now electrified than in 2004. The government led off-grid programme stuttered to a halt in 2005, when government stopped funding support, and private sector led initiatives, and direct purchases of system have seen a relatively small 5% of households get off-grid systems.

This leaves about 26% of homes with no basic electricity supply (about 50% in rural areas have no access). Even where households are connected, there has been a disturbing increase in the 'disconnection rate' as a result of non-payment. In areas where prepayment meters are used, an alarming 40% of meters are not purchasing electricity! Unemployment has forced people to use energy sources that they consider to be cheaper, or more controllable.

New generation plant was commissioning in year 2008, and this did push the price of electricity up. However, the slow down in economic growth meant that no further capacity was installed. Towards the end of the decade, when aging plant started to give more trouble, power failures become common. This, coupled with the higher prices meant that households all households using electricity as their primary cooking fuel needed some back up cooking option, and more relied significantly on other fuels for cooking and water heating and space heating tasks.

Woodfuel has remained the most important thermal fuel in rural areas. In about 40% of rural communities (particularly those affected by refugee populations), and in some urban areas, woodfuel harvesting pressures, combined with other land use factors, has meant significant degradation of the biomass resource. Collection times have increased, and prices for purchased woodfuel have increased.

Coal has remained an important household fuel for those communities close to coal fields – and distribution networks have not changed significantly since 2004.

For low income urban communities, and most rural communities, paraffin (kerosene) is still a very important fuel, with reasonable access in most areas. However the international increase in oil prices has meant that its financial burden on households has increased. The general increases in international oil prices, coupled with loss of sugar exports has forced the sugar industry to look for ethanol markets- however, this has primarily gone into the transport fuels sector, and thus prices of ethanol based domestic fuels use have remained higher than kerosene, resulting in little market penetration.

LPG take up has not been significant, as the price has remained higher than paraffin/kerosene, and the fuel requires capital investment to roll out to households. Kerosene, which is more easily transported and decanted/sold in small quantities has for reasons of access and its compatibility with a 'hand to mouth' economy been better able to retain and grow market share.

Productive use of energy has not developed in rural grid or off-grid areas, and only to a limited extent in low-income urban areas. There was insufficient market and entrepreneur development support, and no growth of the rural economic sectors.

Solar water heaters have had negligible impact in rural areas. In urban areas market growth has been disappointing, with the hoped for reduction in pricing from mass production not occurring, and insufficient government or utility resources allocated to standards development and buy down subsidies.

Other household energy technologies such as solar stoves have not been successful, although hayboxes have been reasonably successful. In the refugee camps solar stoves and hayboxes have played an important role.

In the worst case scenario, for the period 2004 to 2014, there have been no fundamental shifts in energy option access. Although government has supported the establishment of Integrated Energy Centres (in rural and peri-urban communities), these have not rolled out as fast as planned, and have suffered several

organisational and financial set-backs. The range and pricing of fuels has been in constrained by economic imperatives. The collapse of the off-grid concession process meant that service providers did not roll out energy stores on a significant scale.

2.2.2 Gender

This 'worst case' scenario results in many households continuing to rely on fuel wood, dung, crop wastes etc. There is limited access to electricity and other modern fuels. In the refugee communities economic conditions are particularly harsh. This has a number of well documented impacts for women, children- and men. More women spend their time collecting wood, and suffer the associate drudgery and health/security risks. Young children are forced to contribute to resource gathering, with impact on schooling. Lack of convenient cooking methods for morning meals mean that children go to school without proper breakfast. Poor quality evening lighting makes studying difficult, and limits opportunities for productive work.

The significant increase in unemployment has resulted in significant numbers of jobless men in rural communities. They have thus been unable to contribute financial to energy provision, leading in some cases to greater participation of men in woodfuel harvesting, and in other cases to a significant feeling of disempowerment.

More than 50% of rural women headed households live below the poverty line and it is assumed that they are living in energy poverty, typically meaning inadequate or no access to lighting services, poor or no access to power for radio, television and communications devices. Furthermore they are forced to use woodfuel, dung, crop wastes etc. for cooking, or limited quantities of thermal fuels such as kerosene. This means that they are more exposed than other groups to health impacts. There has been an increase in diseases caused by indoor pollution especially within women and children

The failure to develop a better rural energy service infrastructure (using IEC's or Energy Stores) has resulted in access constraints- which have also placed a greater burden on women as the principal 'energy gathers'.

The poor economic conditions have made it very difficult to support sick people – HIV/AIDS in particular has placed a significant burden on women in households, as the principle care givers. Some communities have however seen an increase in 'solidarity' as neighbours and able bodied men and women have rallied to help the community/households pull through. In other communities, those in hardship have been forced to rely on their own limited resources, with dire consequences.
In many households where HIV/AIDS has lead to the death of adults of economic age, energy related decisions are now being made by children (orphans), or by pensioners. Increased reliance on pensioners as a source of 'wealth' of course has an impact on power relationships in homes.

The lack of development resources has resulted in insufficient attention being focussed on gender aspects of energy development projects. Furthermore, the stagnation of existing electrification and thermal fuel delivery modes has allowed little opportunity for development of new enterprises and delivery infrastructure that could have played a role in women's empowerment. Thus, in general women in rural areas tend to be sidelined in terms of participation in energy projects, and the trend of women's empowerment noted particularly at the early part of the decade has unfortunately been reversed.

2.2.3 Health

There has been an increase in the electricity price and the government is not subsidising electricity to the poor communities, which has led to an increased number of disconnections in electricity as people cannot afford to pay for their electricity bills. More and more people are relying on wood and cow dung for their household fuels as the price of paraffin and other modern fuels has increased drastically. Very few people have access to cleaner modern fuels. This has led to a significant increase in harmful diseases caused by indoor pollution such as acute lower respiratory infection (ALRI), chronic obstructive lung disease (COLD) and lung cancer and eye infections. In areas close to the coal fields, coal burning has also contributed to the health burden.

Those who rely on traditional fuels because they have moved down the energy ladder, have not been well informed or educated about health hazards that these fuels expose them to. There are few government systems that are in place to see to it that people are well informed about health hazards posed by indoor air pollution. People are using unsafe wood and paraffin stoves that put them at health risks. This in turn has led into an increase in the number of people being admitted to hospitals for diseases caused by indoor air pollution.

The lack of electricity (grid or off-grid) access in many rural households has constrained education development, which has also resulted in people being less informed about HIV/AIDS and other health issues – with negative health consequences.

More than half of department of health's budget is allocated to fighting HIV/AIDS. Government health services have deteriorated drastically to the extent that people prefer to use private hospitals and clinics to get better treatment and service. Most rural health clinics are grossly understaffed with very little medical treatment to treat patients. This has led to an increase in adult and infant mortality rate from diseases caused by indoor air pollution, especially in poverty stricken areas of South Africa.

The combination of IAP related illness and HIV/AIDS, has taken a tremendous toll, not only in terms of lives lost, but also in terms of capacity to work, and contribute to household and national economies. This has lead to a vicious circle, which has been almost impossible to break.

There has also been an increase in the cases of fire as well as paraffin poisoning, particularly in crowded informal settlements.

2.2.4 Forestry

As noted above, woodfuel has remained important for most rural communities. Following are the key trends in forestry/biomass resource developments over the 10 year period leading to 2014.

- The Working for Water programme (alien vegetation clearing) continued (changing into a poverty relief programme), resulting in short term wood surpluses in areas of cutting, followed by wood deficits, as the remaining standing crop has not always been sufficient to keep up with demand. This has had significant effect in the Western Cape, where poor urban communities used to rely on alien vegetation for fuel.
- The period has been drier than average, possibly as a result of climate change. This coupled with poor economic conditions has meant degradation of a percentage (10%) of commercial forest reserves, and failure of several outgrowers schemes
- In about 40% of rural communities, woodfuel harvesting pressures, combined with other land use factors, has meant significant degradation of the biomass resource. Collection times have increased, and prices for purchased woodfuel have increased. In some parts, lack of resource has become so critical that households are not able to cook food properly. Given the poor economic state, they are not really able to purchase alternative fuels. Deforestation has been particularly severe along the northern and eastern borders with Zimbabwe and Mozambique, as a result of the refugee/illegal immigrant population.

The increased pressure on wood has meant that fuel efficient stoves have become more desirable – and towards the end of the period there has been some dissemination of stoves (resulting in reduced indoor air pollution, and lower wood consumption levels). However, given the poor regional co-operation (sharing of ideas), and lack of donor or government resources, the rate of technology diffusion has been slow.

2.3 Best case scenario

The year, 2014: Economic growth has continued at an average rate of 6%, and regional stability has significantly improved in the last 10 years. Several countries in the region have moved from a very poor economic situation (Angola, Zambia, Malawi, Zimbabwe, Mozambique) into sustained periods of growth- from which South Africa has reaped significant benefits in terms of exports, (goods and services). South Africa has continued to build on the tourism growth experienced at the start of the millennium. Increased use of renewable energy, as well as regional gas and coal reserves have sheltered the country from the worst of the global fuel crisis, and the ratification of the Kyoto Protocol by Russia and the USA in 2005 facilitated significant investment in cleaner electricity generation technology, and maximum use of renewable energy.

As of 2004, South Africa had in place a number of key policies and strategies that provided an opportunity for moderate transformation of rural and urban low-income livelihoods, and in some cases significant transformation of the energy options available (electrification being the most important). Given the strong economic position, and good collaboration both regionally and internationally, continued development expenditure, and continued policy and strategy refinement have been possible. Furthermore, rural and low income urban communities have engaged positively with the process, making the best of the development opportunities offered, and actively working to improve their own situation.

Key energy issues are discussed in section 2.3.1 following. Here we present key related trends (not linked to energy).

The total population in the country has increased slightly from 47.3 million to 48 million. Although AIDS has taken a significant toll on rural livelihoods, with total infections climbing to 6 million in 2004, the number of infections dropped to 5 million by 2014. The number of people sick from AIDS climbed to a peak (2010) of 1 million, but AIDS related deaths peaked at 550 000.[5]

The influx of refugees and illegal immigrants has reduced significantly, as regional stability and economic growth have improved. By 2014 the population of illegal immigrants and refugees was estimated at 2 million.

Urbanisation has continued, and as a result of this and AIDS, rural populations have effectively stabilised, allowing infrastructure programmes to catch up.

Despite the costs of the AIDS pandemic (financial, social, etc.) government has continued to support rural and urban area development

- There have been significant changes in water supply (from 84.5% access to piped water in 2001 to 98% access in 2014). Resources have also been made available to support operational costs of water supply schemes, and communities have played an active role in supporting infrastructure, thus effective access is also high at 95%.
- Improvements in sanitation availability continued, from an approximately 81% access rate in 2001, to 95% access by 2014.
- There has been continued housing development, and housing stock has increased from 7.1 million (formal houses, 2001 Census) to 9.5 million. The traditional dwelling stock of 1.7 million has remained unchanged.
- Employment levels have improved. The number of people actively seeking jobs has dropped (from 6.8 million according to the 2001 census to 3 million by 2014), partly because of the impact of AIDS on the economically active part of the population, but primarily because more people have been able to find work. There has been significant growth in the job market, and the percentage of people not economically active has thus reduced. The total employed number has climbed – but below GDP, at an average of 4% per annum, from the 2001 Census level of 9.6 million mark up to 16.2 million.

The communications revolution of the late 1990's has continued, and almost all households have access to telephone (typically cell-phone) – with basic email and internet services available on low cost hand held devices. Even in rural areas (where communications services are highly valued), about 30% of households have 'in home' access to internet (using devices similar to the TV's of the 2004 era). Schools have computers available, linked to specialist education web sites using 24 hour broadband access. As a result, education has significantly improved.

[5] Note – this is an imaginary AIDS scenario, not based on ASSA model- and is optimistic, assuming significant lifestyle changes, and success with Antiretroviral or other treatment.

This has also led to a banking revolution, and most transactions, even in rural communities are done electronically.

2.3.1 Fuel Access and fuel choice

As noted in Appendix A, the primary change in rural areas, and low income rural areas has been a significant increase in electrification access, from the 2002 levels of around 70% to an overall access level of 95% (99% in urban areas). In rural areas, grid access has increased to 80%, and a further 14% have reasonable off-grid supplies.[6] Most connected consumers make some use of electricity (at least for lighting and TV, communications devices), and disconnections due to non-payment have not been a major issue.

New generation plant was commissioning in the years 2008 onwards, and the significant capital investment required, and better accounting of externalities costs, has necessitated a real increase in electricity prices, relative to 2004 figures. However, CDM resource flows for recent renewable energy grid connect power plants did help. Government has been able to sustain operational subsidies to low-income grid-connected households and remote off-grid supplies. This, coupled with a 'basic services grant' for the very poor, and generally improved rural and urban incomes, has meant that energy expenditure by households could increase. The nature of the 'basic services grant' means that consumers have been able to choose which form of energy (or other recognised service) they wish to spend it on. As a result, use of electricity for cooking has increased significantly (compared to the 2001 figures), about 60% of the households use electricity as their main fuel.

Although woodfuel has remained an important thermal fuel for poorer households in rural areas, overall consumption has dropped (as less people are using the fuel, and fuel efficient stoves are more common), and biomass resources have not deteriorated significantly (compared to 2004 levels), in certain areas they have started to recover.

Coal has remained an important household fuel for those communities close to coal fields – and distribution networks have not changed significantly since 2004.

For low income urban communities, and most rural communities, paraffin (kerosene) is no longer an important fuel, as it has been replaced by lower cost LPG and/or new options such as ethanol gel, with subsidized (or credit financed) appliances.
There has been some increase in the use of alternative semi-liquid fuels (such as ethanol gel) – particularly in areas close to the restructured sugar industry.

Investments in distribution infrastructure, combined with lowering of prices, and improved economies has resulted in compound benefits for LPG and cleaner liquid fuel distribution operations. LPG has tended to dominate the urban markets, while ethanol-gel has played more of a role in rural areas (it was possible to set up smaller distribution and decanting outlets for the semi-liquid fuel).

Productive use of energy has increased significantly in rural grid areas, and in low-income urban areas. The strong economy allowed government to not only electrify communities (using grid and mini-grid or off-grid technologies), but to allocate resources to targeted SME development. This market development support yielded positive results, and the resulting contribution to the economy was one of the key factors contributing to the sustained economic growth achieved by the country as a whole.

Solar water heaters have had significant impact in rural areas (30% of households). In urban areas market growth has been good with almost 60% of households using SWH. This success has been driven by slightly higher electricity prices, and aggressive government and utility supported programmes to promote (and fund) demand side management.

Other household energy technologies such as solar stoves, hayboxes, fuel-efficient wood stoves have gradually become part of the 'mainstream', and market share is measured in double digits. One of the contributors to this success has been targeted co-operation between utilities and SME support agencies, resulting in medium scale production facilities for these simple technologies being set up in rural areas.

[6] Government targets, set in 2004 are for universal access, but the pace of electrification could not quite achieve this (primarily planning and institutional development constraints, including establishment of Regional Electricity Distributors)

A consequence of, and a contributor to the above changes in energy practice, has been the development of a robust energy service infrastructure in rural and low-income urban areas. Retail outlets (of one description or another) are situated in most villages. Households thus have easy access to the fuels, and facilitated access to the appropriate appliances. The improved communications and education options mentioned above have also contributed to a greater awareness of energy issues- which has helped considerably. The change is particularly noticeable in off-grid areas, where integrated energy service providers service the off-grid electricity systems, as well as supplying other energy fuels and appliances.

2.3.2 Gender

The success of the gird and off-grid electrification programme under this scenario, coupled with a greater availability and affordability of modern thermal fuels has led to changes in the home cooking, lighting, entertainment, and education situation. For the most part women, and children have benefited from the changes:
Less exposure to indoor air pollution
Less time spent collecting wood
More convenient cooking
Better access to communications/educational material on TV/radio

There has been an increase in employment rate within rural women, primarily as a result of a growth in rural enterprises, feeding products into decentralised manufacturing processes. The majority of IEC's and Energy Store personnel are women. They have been trained to educate their communities about household fuels that are available and the energy choices that they have. Most rural women can now afford to buy and pay for better energy fuels and energy appliances that are efficient.

The flexibility of the Free Basic Energy (or basic Income Grant) – allowing this subsidy to be used on thermal fuels as well/instead of electricity has had a particularly important benefit for very poor (often women headed) households.

The good economic conditions have made it far more possible for government and other parties involved in rural and urban energy delivery project to take proper account of gender goals and needs. Furthermore, the range of new energy related activities taking place has provided scope for greater empowerment of women (and men) as they have been able to participate in the emerging energy delivery businesses.

The decrease in time required by women for woodfuel collection has resulted in a shift in power balances. For some, the extra time has enable more focus on education, or productive use activities, enabling them to contribute more strongly to the household economy, and through this gain a measure of power. In other cases, women have reported a sense of loss, and particularly a reduction in opportunities for social interaction with peer groups- as both water and woodfuel collection have fallen away as social functions. Gradually, other activities are emerging to help fulfil this role (sewing groups, adult education classes, group business development, etc.)

2.3.3 Health

The increase in rural electrification has led to an increase in the number of people moving up the energy ladder. This has seen a decrease in diseases caused by indoor air pollution.

Those who still do not choose to use electricity for cooking are using cleaner alternative modern efficient fuels, and as noted above even woodfuel users tend to use stoves which reduce IAP levels. In the communities close to coal fields, the top down lighting method has helped significantly. However, government has been forced to consider banning coal use – a decision is immanent, some are arguing that domestic use of coal should be phased out by 2020.

The reduction in kerosene usage, coupled with tighter safety standards on appliances sold, has resulted in a significant decrease in the number of fires caused by cooking and lighting devices – particularly in low-income urban settlements.

An important development (made all the easier as a result of good economic conditions), has been a significant improvement in health care services, particularly in the field of primary and preventative health care. Students and households are now exposed to good training on safety and health matters related to energy use (e.g. indoor air pollution, paraffin and LPG safety). This has reduced the health burden at rural clinics, and allowed staff to deliver a better service to those that do come in for treatment.

2.3.4 Forestry

As noted above, woodfuel use has decreased, in part because of better availability of cost effective alternatives, and in part because of the FBE subsidy.

- The Working for Water programme (alien vegetation clearing) has continued, resulting in short term wood surpluses in areas of cutting
- Business (and particularly the growing biofuels industry) has been able to support training and plantation establishment, thus sustainable biomass management is becoming the norm. Some of this has been funded by CDM projects looking to 'sink' carbon.
- Although weather patterns have been more turbulent (as a result of climate change), the good economy is in part thanks to reasonable rainfall for most of the 10 year period, and as such biomass standing crops have benefited.
- The commercial forestry outgrowers programme has been successful, with several thousand small 'outgrowers' established in rural areas. These woodlots produce a significant surplus which can help meet household energy needs.
- Biomass based power generation (primarily using gasification) has been successful in a number of communities – this not only results in better access to electricity, but also leads to an increase in local job creation.

Lastly, the positive co-operation in the region, coupled with climate change motivated funding has resulted in several highly efficient, clean burning stoves becoming available on the market. This has reduced woodfuel consumption, helped to make woodfuel a more pleasant and clean fuel to burn, and significantly improved indoor air quality in the several hundred thousand households that have purchased the stoves.

3 Policy Options

Informed buy our observations of the future scenarios illustrated above, we have compiled a preliminary list of policy options and areas – these will be the subject of more detailed in analysis in the next phase of the project. *At this stage we would value it if readers could add to the list, comment on the appropriateness of particular suggestions, and provide brief motivations as to why they feel particular policy options are more or less important.*

3.1 Access and choice

- Support establishment of retail outlets for energy services
- Support electrification (grid and off-grid)
- Understand supply chains for priority thermal fuels (kerosene, LPG, ethanol gel, woodfuel, others) and support development of better delivery mechanisms
- If 'free basic energy' subsidy maintained (alternative is Basic Income Grant), then it is structured in such a way that households can choose the most effective way in which to utilise it.
- Unsafe appliances removed from market
- Focus attention on stimulating opportunities for benefits of electrification and better energy supply to be realised, in particular productive use, and education
- Particularly for worst case scenario, focus attention on biomass resources, and appliances

3.2 Gender

- Projects and delivery strategies to be designed with better understanding of gender and energy issues
- In all cases, but particularly worst case, energy vulnerability of the poor needs to be addressed
- In BAU and best case, try to ensure fair access to different socio-economic and gender groups to the growing energy services business opportunities
- As energy market transforms (probably with higher private sector involvement), ensure fair participation in energy delivery market by all parties
- As purchased fuels become more important, support development of mechanisms for women to retain (or improve) the economic role in household which was previously realised through woodfuel collection and cooking fire preparation/management.

3.3 Health

- Effectiveness of HIVAIDS related policies will have significant impact on energy/health/livelihoods
- Research on Indoor Air Pollution required (especially for rural communities, there is some ongoing urban work)
- Polices and strategies to reduce IAP need to be developed- in particular better acknowledgement of the importance of woodfuel to rural livelihoods
- Policies to promote switching from unsafe/unhealthy fuels important (particularly paraffin and coal). This will be especially critical if natural market development does not promote shift away from this fuel. May need to legislate against certain fuels, include externalities in pricing, but if so, would need support measures for alternatives.
- Promote regional dissemination of health/energy related information.
- Develop better understanding of the costs of energy/health vectors – possibly justifying more resource allocation to preventative measures

3.4 Forestry

- Development of outgrower schemes to be monitored, in particular assessing impact on natural biomass resources, and on household woodfuel access.
- Working for Water programme to be monitored from a household energy perspective, and where necessary linked mechanism put in place so that communities retain adequate energy access
- Regional co-operation fostered on social forestry and community resource management
- Social-forestry/community resource management supported at local levels.

- Fuel-efficient and low emission stoves developed and promoted
- Biomass resource levels monitored (using satellite imagery) and key areas of degradation identified and measures put in place to remedy.

4 Closure

The above scenarios illustrate the potential range of household energy situations that could emerge in South African during the next decade. From this we have drawn a few key issues:

- The progression of HIV/AIDS, and regional stability are key factors that could have major impact on household energy in South Africa (primarily through effects on urban and rural population)
- General economic development (or lack thereof) could have a major impact on health, affordability and fuel choice/access for households
- Changes in relative pricing (for example LPG vs. kerosene, and biofuels vs. petroleum fuels) could strongly affect household energy choices.
- Electrification of one form or another is likely to reach most households, resulting in a significant change in access to quality lighting, media and even education opportunities
- However, in all cases, it is not expected to be the only energy fuel- and particularly for the important thermal energy needs, households will still rely on a range of other fuel options (with the particular fuel mix depending on relative prices, technology, policy and economic developments)
- In a worst case scenario, it is feasible that nearly 50% of rural communities will not have access to electricity, and poor urban household constituencies will effectively not have access (due to disconnections/non-payment).
- This coupled with higher petroleum fuel prices, and poor economy will severely strain livelihoods, and forest resources.

Overall, we feel that a scenario exercise such as this could play a very useful role in policy and strategy development for countries such as South Africa. We trust that the ideas presented here might stimulate thinking and the contribution of data and predicted trends. As a first priority we would like to review the specific scenarios, testing out the assumptions, gaining inputs from experts, and in so doing helping to make these more robust. Following this, one could then review them, with a view to drawing out policy and strategy recommendations.

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Appendix A Summary Table of Scenarios

Current situation – short summary: What are the key issues / constraints which you have identified within your country regarding provision of household energy at the current time – particularly with regard to health, gender and forestry? Accessibility, affordability, availability and diversification of energy sources in the rural communities are key issues that cut across health, gender and forestry	**2001 Statistics of South Africa and current energy use situation** • 49.10% electrified rural households in 2001 • 77.20% electrified urban households in 2001 • As per 2001 Census: 51.4% of the 11.2 million h/h use electricity for cooking and 69.7% use electricity for lighting. Paraffin is the second most used fuel for cooking followed by wood. • 21.4% of SA h/h use paraffin for cooking and 14.6% use it for heating. • 20.5% of SA h/h use wood for cooking and 24.6% use it for heating. • From focussed surveys, in rural areas, wood is used by 70% to 90% of h/h • Poor communities rely strongly on multiple fuels – particularly paraffin, wood, coal, LPG, candles, dry cell batteries (see country report) • The key energy related safety concerns are fires, kerosene poisoning, and vulnerability during wood collection especially in rural communities • Indoor air pollution is a key concern in low income households that rely on coal (especially communities closer to coal fields), and to a lesser but still significant extent in other areas where woodfuel is widely used. • Affordability is a problem (in poor communities energy expenditure is often 10 to 30% of the budget) • The cost of energy is to be considered in terms of time spent collecting woodfuel, as well as inconvenience of using certain energy forms. • In many areas, fuelwood harvesting has reduced available biomass resources with environmental implications, and requiring increased time on collection or forcing a shift to purchasing wood from further away. • Fuelwood collection is usually done by women (not exclusively) • In unelectrified communities, lack of electricity constrains access to entertainment/education media • Energy remains a constraint to enterprise development in off-grid areas (although provision of energy alone will not necessarily result in enterprise development)

Criteria/Issue	A: Business as usual[7] Year 2014	D: Worst case economy and co-operation[7] Year 2014	C: Best case economy and co-operation[7] Year 2014
General background information on scenario assumptions HIV/AIDS is one of the major issues that impacts on everything and everyone on South Africa. The Actuarial Society of South Africa has formulated a model based on our current HIV/AIDS scenario. The model is divided into two, there is no change model- meaning if there is no change in the way HIV/AIDS is spreading, the second one looks at the change scenario of HIV/AIDS status in the country. This model is the one that we use to set our basis for our population scenarios. The model is called the ASSA2000 Suite of Models Aids Model (no change) • HIV prevalence by age group and calendar year (the model projects prevalence percentage in 2014 for the 15 to 59 age group across the entire South African population to be 26.1%) • HIV+ births (in 2014 the model projects, without interventions, some 64 thousand HIV+ births) • New AIDS sick (in 2014 the model estimates 721.2 million people will be AIDS sick) • Non-AIDS deaths (in 2014 the model anticipates 404 500 deaths) • AIDS deaths (in 2014 there are projected to be 721 700 AIDS deaths) • Cumulative AIDS deaths (by the year 2014, there are expected to be 8.3 million AIDS deaths) • Population decreases slightly by 2014 (from to 47.2 to 46.7 million)	**Population** Rural population stabilised or dropping – but under significant stress (HIV/AIDS, TB, urban migration) Urban population increasing. The Actuarial Society of South Africa model, indicates a decrease in population by 2014. Note, still significant refugee population in RSA (approx 8 to 12 million)	**Population** Total population has increased due to the influx of refugees/illegal immigrants. Rural population highly stressed (economic, HIV/AIDS, TB, IAP). (higher proportion of children, elderly, ill people) which leads to a decrease in rural population In some areas (urban and rural) significant refugee communities (due to problems in regional co-operation) (approx 15 million) Urban population significantly increased, with millions of refugees from other countries, as well as rural migrants	**Population** Population has increased slightly through natural growth, as the total number of HIV/AIDS infection has dropped. Rural population reasonably stable. Urban population not increasing as fast (better economy, more education) Refugees repatriation ongoing, with good economy in neighbouring countries attracting people back to their homes. Rate if influx into the country significantly reduced

[7] Unless specifically stated, all figures/percentages are simply estimates- they have not been derived using a model or scientific trends analysis and are simply provided to provide a base for discussion.

Criteria/Issue	A: Business as usual[7] Year 2014	D: Worst case economy and co-operation[7] Year 2014	C: Best case economy and co-operation[7] Year 2014
At the time of Census '96, of 9.1 million households 7.1 million (81, 2%) had access to piped water. In 2001, out of 11. 2 million households, 9.5 million (84.5%) had access to piped water.	**Water** 95% of h/h have access to piped water Rural – expect RDP standards of water delivery available at most communities, but several in disrepair Urban – water generally available, but in informal settlements not at each house.	**Water** Access to clean water supply has deteriorated Rural- more than 50% h/h relying on unprotected/ unsafe water sources, often with long collection times Urban -Informal settlements have access to water, but often unsafe, and long queue times	**Water** 98% of h/h have access to piped water Rural water projects being maintained – RDP standards are met Urban Water available with reasonable access
In 1996, out of the 9.1 million households living in housing units, 5.2 million lived in formal* housing, while 1.6 million lived in traditional dwellings and 1.5 million lived in informal housing (shacks). Census 2001 shows that of the 11.2 million households, 7.1 million lived in formal housing, while 1.7 million lived in traditional dwellings and 1.8 lived in informal housing. (Census 2001)	**Housing** The number of formal houses has increased by 1.4 million, of which 400 000 include energy efficiency measures. **Rural housing-** little has changed; most people have access to some land, and have built their traditional homes. **Urban Housing**- although increase in housing stock, increased population means still millions of people in informal settlements	**Housing** Increase of only 600 000 formal houses **Rural** Same as BAU, but lack of labour means some shelter is inadequate **Urban** Significant increase in the number of informal settlements. There is a large number of homeless people in cities and suburbs, sleeping without adequate shelter	**Housing** Increase of 2.4 million formal houses, of which 1.2 million incorporate energy efficiency measures **Rural** Combination of traditional and formal housing **Urban** Additional urban household construction has resulted in less informal settlements

Criteria/Issue	A: Business as usual[7] Year 2014	D: Worst case economy and co-operation[7] Year 2014	C: Best case economy and co-operation[7] Year 2014
In 1996, of 9,1 million households, 4.6 million used flush or Chemical toilets and 2.9 million used pit latrines. In 2001, of 11.2 million households, 6.0 million used flush or chemical toilets and 3.2 million used pit latrines. (Census)	**Sanitation** There has been improvement in sanitation availability with 95% access in 2014 compared to 2001 with 81% access	**Sanitation** There has been some improvement, but it has not been of particular significance.	**Sanitation** Same as BAU
At the time of Census 2001, there were 28.4 million people aged 15 to 65 years. Persons reported to be employed numbered 9.6 million. A further 6.8 million were unemployed and 12 million were not economically active. The latter includes students, homemakers, the disabled, those too ill to work and anyone not seeking work.	**Jobs** Employment levels have remained fairly static. Due to HIV/AIDS, the number of people seeking employment has decreased and there has also been no growth in the job market.	**Jobs** The employment levels have decreased. There has also been no significant growth in the job market. There has been a drastic decrease in the in number of people who are economically active.	**Jobs** The employment levels have increased. There has been significant increase in the job market. The total number employed has increased but below the GDP at an average of 4% per annum.
What are the impacts on Energy Carrier Choice and access for household energy under BAU and worst case / best case scenarios for the economy and regional co-operation over the next 10-15years? From Census 2001, the overall proportion of households using electricity for lighting had increased from 57.3% (1996) to 69.7%. The percentages of people using electricity for cooking and heating had also increased, but by smaller margins.	**Electrification** Government committed to universal access, with 85% overall achieved. **Urban** 95% access to grid **Rural** 70% access to grid 7% h/h have off-grid access 23% no access Electricity price increases above inflation	**Electrification** Programme draws to a halt before universal access achieved due to lack of generation capacity, and compromise of utility roll out capability (lack of cross-subsidy resources) **Urban –** 85% access **Rural** 50% grid (retracting in rural areas – as government/Eskom stops subsidising rural grid) 5% have off-grid electrification- with	**Electrification** Target set by President in 2004 basically achieved, with 95% access to electricity **Urban** 99% grid **Rural** 80% grid 14% off-grid Electricity price increases (as for BAU) However, rural incomes

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	(new generation capacity required) Free Basic Energy subsidy not maintained (10 years too long for significant operational subsidy to be continued)	maintenance problems, as there is insufficient income to keep it operational Price of grid electricity increases significantly in rural areas (less operational subsidy, and increase in base cost) 45% of h/h have no access to basic electricity.	are better, and there is some form of support from the state for very poor people (FBE or Basic Income Grant) Urban communities make significant use of electricity for thermal energy.
Off-Grid	Off-grid electrification has continued to grow, to7% of rural hh, but the institutional, theft, non-payment and planning difficulties experienced in the early years (2001 to 2004) have not been properly resolved, so the estimated potential off-grid electrification has not been achieved.	Small percentage of rural households electrified using PV (5%), others rely on dry cell batteries and some lead-acid battery usage. There is limited access to TV, communication, lighting	Off-grid households have sufficient electricity for lighting, entertainment and IT needs – 14% of rural households use off-grid electricity supply options
Woodfuel	Woodfuel is still the most important thermal fuel in rural areas, but resources are getting scarcer in about 30%of communities. Too much time is spent collecting woodfuel. Prices for purchased woodfuel has increased	Woodfuel scarcity is an issue in about 40% of communities. Effects as for BAU	Woodfuel still important, however Ethanol-gel and/or other renewable /clean fuels (including sustainably grown woodfuel) contribute to 50% of thermal energy needs.

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Paraffin (Kerosene)	Paraffin is still an important urban and rural fuel – although its cost has increased. Dangerous paraffin stoves still form part of a significant portion of the market	Paraffin distribution still good, but remains reliant on unsafe appliances. Paraffin widely used in urban as well as rural communities	Paraffin not very widely used, and if it is used, it is done in safe appliances (unsafe appliances no longer available in the market)
LPG	LPG – usage has increased toy 50% of rural h/h LPG price has increased	LPG distribution has not significantly expanded LPG price is still high	Access to LPG has increased to 50% of rural hh, and is preferred alternative to electricity in urban households,
Ethanol Gel and other biomass derived thermal fuels	Ethanol gel and other 'new' modern fuels have become popular and are currently being mostly used	Ethanol gel and other modern fuels have not taken off, partly because the sugar industry has not been able to transform adequately.	Ethanol gel, and other 'new' fuels have significantly increased in terms of use, particularly as a result of diversification of the sugar industry
Energy Applications for enterprise/productive use	Productive use of energy opportunities in grid areas remain under used (Little change from first 10 years of electrification) There has been some productive use of energy applications in 'off-grid' areas.	Little productive use of grid electricity in electrified areas. Very limited productive use of energy applications in 'off-grid' areas Markets for PU products/services have been severely constrained.	In grid areas, electricity widely used to support enterprise growth. Technologies such as fuel cells, gensets (diesel or biofuel), and larger PV or hybrid systems are used for productive use applications in off-grid areas – in 50% of the communities.

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Solar Water heaters	In urban areas the market growth has been fair, fuelled by high electricity prices and good government commitment. Solar water heaters have had negligible impact in rural areas.	No market growth in rural areas, and very little growth in urban areas	Solar water heaters have become a standard feature of urban households, with programmes to assist purchase in place (Demand side management). In rural areas there has been increased availability of piped water supply, coupled with low cost devices Availability has facilitated a 15% market penetration.
Solar Stoves	Solar Stoves are used by 10% of h/h	Slightly more use (than BAU) in rural areas, as a result of extreme need	Solar stoves used by 20% of h/h – strong marketing, low cost production
Hay boxes	Hay boxes/thermal storage cookers are gradually being used by only 10% of the h/h. They are becoming part of the mainstream.	Hay boxes/thermal storage cookers used by 20% (to save expenditure). These have been reasonably successful and are being mostly used in the refugee camps.	Communications and marketing have brought these to attention of women's groups, being used by about 15% of hh.

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Key issues related to health, gender and forestry affected by scenarios	**Points on the relevance, developments, implications of each of the scenarios on the issues raised in the left hand column.**		
Health Issues - impacts on health • indoor air pollution • fire risk (paraffin, candles, others) • poisoning • generic link between poverty and health • woodfuel transport/collection (spinal injury, snakebite, rape) • access to information about health	DME is working together with other government departments to address health and environmental issues that are caused by energy sources. About 40% of coal users take up top down stove lighting method (in response to DME campaign) Paraffin safety is still a significant issue, with loss of housing, burns are a regular occurrence LPG safety still raised as concern, kept high on agenda, but risks have been reasonably managed Woodfuel scarcity – has a negative impact on women's health as they have to travel long distances by foot and carry heavy loads of woodfuel, which strains their necks and backs	Urban poor in metro's significantly affected by poor economy – as little to fall back on, lack of subsidy will also limit use of electricity. Levels of knowledge regarding paraffin, woodfuel, coal not all that widely available (NGO and government resources for information dissemination constrained) Poverty means that smoky cooking methods, and unsafe paraffin appliances still prevalent, possibly even increased usage compared to 2004 Paraffin and candle induced fires significant cause of mortality, injury Lack of lighting in rural areas affect literacy, with health related impacts	As for BAU, but DME receives good co-operation, and communities are responsive Information on IAP, paraffin and LPG safety, fire-prevention widely available at energy distribution points, as well as educational/health institutions About 70% of coal users take up top down stove lighting method (in response to DME campaign). Also, many coal users either switched to other fuels, or using stoves with chimneys. Fuel efficient stoves which improve air quality in rural homesteads are used. Unsafe paraffin appliances no longer legal/in use and they are also not available in the markets

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Gender Issues Key Issues in Gender and Energy (taken from J. Clancy – Gender Issues) • Reduction in drudgery • Reduction in women's time for fuel, water collection and reduction in time for staple food preparation • Improvements in women's health from lower reliance on biomass fuel chain • Women's empowerment	Woodfuel is still widely used which means that there are women and children who still carry the drudgery of collecting wood, who are at health risk of getting diseases associated with indoor pollution. Not all energy projects initiated by government and other organisations take into account gender needs and goals. There has been an increase in women participation in development projects especially energy projects. There are still female headed households that are living in extreme poverty who have no or very little access to household fuels.	There has been an increase in h/h that rely on woodfuel, dung, crop waste and etc which has a negative impact on women and children who spend most of their time collecting woodfuel which exposes them to health hazards. Shortage and lack of development resources has resulted in gender issues being sidelined and seen as a luxury more than a necessity.	The success of the grid and off-grid electrification programme has had a positive impact on women and children as they have better access to lighting for evening relaxation, working, study. are less exposed to indoor air pollution, which does not put them at risk of diseases associated with indoor air pollution. Women have more time to spend with their families as they need not to spend many hours collecting woodfuel, but have lost social interaction with their peer groups. There has been an increase in government projects especially energy projects that take into account gender needs and goals.

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Forestry Issues Impacts on commercial forestry Resource sustainability/deforestation Woodfuel likely to remain an important fuel for most of the rural communities.	Lack of Basic Energy (or similar) subsidy for thermal fuels has made wood an important energy source for the poor There has been an increased pressure on wood which has led to more efficient stoves being designed and made for use, but have not been that widely disseminated Biomass resource management has been fair but there is still some pressure which is due to cost of other fuels Alien vegetation clearing has led to temporary surpluses, but subsequent shortage. In about 30% of areas, deforestation is serious issue	Woodfuel consumption has increased in important for may hh. In areas with high refugee populations, biomass resources have severely depleted Generally, reliance on woodfuel, without access to fuel efficient stoves, or active resource management process has led to resource depletion.	Fuel efficient stoves are being widely used and they are widely available in markets Biomass resource management is actively supported There has been reduction in woodfuel consumption as result of shift to other fuels Alien vegetation clearing remains important source of woodfuel in some areas, but programmes in place to replace with sustainable forestry