‘Every decision is an energy decision’: sustainable development’s hottest topic

1. Introduction

A central driver for policy in South Africa is to redress the imbalance of apartheid and to promote the socio-economic development of poor and disadvantaged communities. Energy plays a central role in the socio-economic development of the country, while the negative environmental impacts of fossil fuels and distribution of energy from centralised generation plants is well known.

The Renewables 2005: Global Status Report (November, 2005) published by the Worldwatch Institute, estimates that nearly 40 million households worldwide heat their water with solar collectors, most of them installed in the last five years. Altogether, renewable energy industries provide 1.7 million jobs, most of them skilled and well-paying. The report assesses several renewables technologies that are now competing with conventional fuels in four distinct markets: power generation, hot water and space heating, transportation fuels, and rural (off-grid) energy supplies.

The report finds that government support for renewable energy is growing rapidly. At least 48 countries now have some type of renewable energy promotion policy, including 14 developing countries. Most targets are for a proportion of electricity production from renewable energy sources, typically 5-30 percent, by the 2010-2012 timeframe. Mandates for blending biofuels into vehicle fuels have been enacted in at least 20 states and provinces worldwide as well as in three key countries—Brazil, China and India.

Most notably, government leadership provides the key to market success. The market leaders in renewable energy in 2004 were Brazil in biofuels, China in solar hot water, Germany in solar electricity, and Spain in wind power. The fastest growing energy technology in the world is grid-connected solar photovoltaic (PV), which grew in existing capacity by 60 percent per year from 2000-2004, to cover more than 400,000 rooftops in Japan, Germany, and the United States. Second is wind power capacity, which grew by 28 percent last year, led by Germany, with almost 17 GW installed as of 2004[1]. Production of biofuels (ethanol and biodiesel) exceeded 33 billion litters in 2004, when ethanol displaced about 3 percent of the 1,200 billion litters of gasoline globally.

Against this backdrop, what is the current situation and energy future in South Africa?

2. Trends and Forecasts

2.1 Relevant and key historical and current trends that affect current and future dynamics in the energy sector in South Africa

2.1.1 Historical

The South African population is increasingly urban, with 57.5% and 53.7% of the population living in urban areas in 1996 and 2001, respectively[2]. The movement of people is increasingly towards the urban environment; and with a current population of 46.9 million people[3] at least 40%, or 18.8 million, remain with reduced infrastructure and services that characterize the rural environment.

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[1] This corresponds to approximately 50% of the **total** installed electricity generation capacity in South Africa. www.ner.org.za

[2] Stats SA Census 2001: Investigation into appropriate definitions of urban and rural areas for South Africa - Discussion document. Report no. 03-02-20 (2001)

[3] Stats SA: Key findings: P0302 - Mid-year population estimates 2005

These two demand sectors require differentiated planning, with the urban dwellers generally more able to pay for supplies and services, and the rural typically not able to do so. This is exemplified by generally good urban electrification, coupled with poor or non-existent rural electrification – widely acknowledged as one of the legacies of the former apartheid era. This energisation status quo is underpinned by a market-driven technology and service delivery approach in the urban context, while improving delivery in the rural context entails thinking through the entire development approach to include special measures such as subsidies, skills development, training, etc, and often via community based organisations, that might not be relevant in the urban environment.

Overall, this is a delineation in terms of energy supply and services delivery that needs to be at the forefront of policies and measures developed for meeting our increasing energy demand.

Traditionally, there has been a domination of the South African energy sector by the utilisation of cheap and poor quality coal. The cheap electricity was used as the basis for a focus for investment in heavy industry, and this looks set to continue with the Industrial Development Zones programmes eg Coega.

The low electricity cost – reportedly the lowest in the world per unit of electricity produced – is clearly the greatest barrier towards a more sustainable energy future in South Africa. The use of coal-to-liquid and gas-to-liquid technologies accounts for 30% and 8% respectively of our total liquid fuel supply in SA, which while ensuring some measure of independence from international oil price shocks still continues to lock us into a fossil-dependent mode in both the electricity and transport fuels sectors. Coal-to-liquid and gas-to-liquid in fact offer little protection against international oil price shocks, because the products follow an international crude oil pricing parity formula. However, they do offer some foreign currency reserve protection (less Dollars needed to buy crude oil), and indeed, any price increase accruing to the coal-to-liquid and gas-to-liquid producer in South Africa also most likely increases benefits to the South African economy, and through tax revenues, to the South African treasury.

Current South African oil refinery output is approximately 493,000 barrels per day (bpd) while our final demand is about 427,000 bpd. This surplus production, mainly in the form of diesel, is exported. With diesel sales growing in the region of 3 to 4% per annum, compared with a general annual decline in petrol sales of up to 1%, an increased need for diesel once the surplus is consumed is indicated. This points to an opportunity in the biodiesel sector, to meet the expected and quite certain demand.

Long-term and ongoing massive subsidisation of the nuclear industry undermines any other national policy and strategy objectives towards a cleaner energy future, and results in inconsistency between Treasury actions and public announcements, and environmentally-focussed policy declarations. The ongoing civil society focus, through Earthlife Africa, on the development of the controversial Pebble Bed Modular Reactor (PBMR) and its unknown environmental impacts are a logical step in a long sequence of resistance to the increased use of nuclear energy in South Africa.

At the same time, centralised electric power generation continues to dominate our energy landscape, with about 71% of total electricity being generated at coal-fired thermal power stations. These are based near the primary coal mines, in northern KwaZulu-Natal and Mpumalanga, and distributed across the country via an extensive and modern transmission network. The long transmission distances come at enormous cost, with an average of almost 10% of the total electricity generated in the country being lost during the process. These line losses and security risks associated with centralised generation capacity and extensive electricity distribution networks point to the need for a deliberate strategy to move towards a decentralised energy supply and distribution model[4].

Added to this scenario is the monopolistic ownership of generation, transmission and distribution of electricity infrastructure. This situation is under review, but the process is unclear and bogged

[4] Defined as energy production at the point of use, irrespective of size, fuel or technology, and either on- or off-grid. Typical applications would be the use of on-site RE, high efficiency combined heat and power (CHP) plants, and on-site industrial energy recycling.

down with uncertainty. The major review areas are those of generation, and distribution, which are discussed in detail in the following section.

To date there has been little or no contemplation of renewable energy (RE) generation sources, and energy efficiency (EE) measures. Much research has, however, been undertaken to understand the available resources, technologies, costs, and targets have been set – but this has not yet resulted in the realisation of a robust RE and EE sector in the country. This is largely due to the complete lack of incentives for RE or EE, discussed in more detail in the following section.

Lastly, but perhaps of greatest impact, is our heavy reliance on motorised personal transport linked with poor urban design that leaves us increasingly inefficient and reliant on imported crude oil. Motorised transport in Cape Town for example accounts for 54% of the total primary energy consumption there, while the national average is in the order of 45%. This situation is exacerbated by poor public transport infrastructure.

2.1.2 Current

Overall there is increasing interest in RE in South Africa, which lags yet parallels the uptake of cleaner technologies around the world. This has been largely hampered by a reduced capacity within the Department of Minerals and Energy (DME) to drive sustainable energy policy and legislation development, as well as the myriad developmental objectives with which the country has been faced. The former has been directly addressed through a DANIDA programme, the CaBEERE (Capacity Building in Energy Efficiency and Renewable Energy), while the imminent energy shortfall in the crisis will directly impact its development agenda, and has thus been cause for its moving up the priority list of national objectives.

South Africa is also a signatory to the Clean Development Mechanism (CDM), and stands to benefit from the transaction of such projects. Indeed, Kuyasa in Khayelitsha, Cape Town, is the site of an innovative and first African CDM project. However, the first period for the CDM under the Kyoto Protocol will end in 2012, and the future status of the CDM is being increasingly intensely debated. Of quite some concern should be the fact that, as one of the greatest emitters of greenhouse gasses in the world, South Africa may well be forced to comply with stringent international emissions-reduction targets in its own right, rather than being a beneficiary of offset targets developed for the developed countries of the world. This compliance would entail a major rethink of industrial processes, and energy supply in the country.

The country continues to witness an incomplete implementation of a move towards increased EE using the national utility (Eskom) to manage the demand side management (DSM) programme. This is a peak load shifting exercise which does not reduce the amount of energy consumed, but simply changes the time of day at which it is used. It is not in the utility's best interests to reduce the overall consumption of electricity across the country, and hence the programme is by definition a non-starter. This has had the effect of tying up some billions of Rands that if utilised could delay the need for new generation potential by years.

Other current aspects of the energy sector in South Africa include:

- Ongoing Treasury support for PBMR
- Capped subsidy for RE and biofuels initiatives, with an overall budget of R14.2 million of 3 years.
- Establishment of a National Energy Research Institute
- Increasing interest in biofuels – bio-ethanol and biodiesel charters.

The change in the ***electricity supply industry*** structure, specifically the operational separation of generation, transmission and distribution of electricity in South Africa, is designed to encourage independent power producers by creating an atmosphere of fair competition as well as guaranteeing access to the grid. With access to the national grid, independent power producers can potentially negotiate their own power supply agreements, which they could sell at a premium to a willing customer. This is of particular value to power plants that generate renewable energy. Power plants that generate at peak times could also benefit in times to come, if pricing is structured to take into consideration the fact that peak generation is very costly since the power

plants for peak supply do not operate at constant output. An independent power producer who is able to generate relatively cheaply at peak times could benefit from premium prices.

However, at present, Eskom has restricted fair compensation to a value equal to the 'short-run marginal cost' of producing power with present plant. This stifling control of the price paid for electricity generation poses a serious threat to the development of a free market especially when seen in the context that the short-run marginal cost is virtually the lowest in the world as it is based on the costs of operating cheap coal fired power plants. Unless this pricing practice is addressed the development of any IPP markets and the adoption of cleaner power producing technologies will be severely restricted. One solution would be to tax the earnings from the coal fired power plants to compensate the amount paid to IPPs using cleaner technologies. This tax can easily be justified in the context of the present crisis around climate change and the environment in the light of the large volumes of health hazardous pollutants emitted from coal fired power stations.

In 2001 the Department of Minerals and Energy rolled out a 'multi-market model' strategy which states that any new capacity must be met with a contribution of 70% from Eskom and 30% from IPPs of which 10% must be BEE compliant companies. Small independent power producers who generate less than 1 GWh per year do not need a licence to supply power. The proposed model of divesting only 30% of the generation assets to the private sector has been critiqued as being insufficient to foster effective competition, if that is the aim of the whole exercise. Experience from countries that have restructured their electricity industries can provide invaluable policy lessons.

South Africa is restructuring its ***electricity distribution network*** to place every part of the country under one of six Regional Electricity Distributions (REDs). The REDs will buy and sell electricity, controlling the distribution network in their respective areas. They will replace the existing distribution networks which have historically been the responsibility of the hundreds of local municipalities and Eskom who have controlled 41% and 59% of this market respectively.

There will be some fine-tuning of the REDs system with time, as the details have not been worked out. Much learning should begin as RED1 (anchored in the Western Cape Province) becomes a reality during 2005 and 2006.

The REDs certainly promise solutions to a number of problems which have existed in the electricity generation industry, including:

- A lack of adequate investment in electricity infrastructure by municipal authorities who often used the margin from electricity sales to fund other activities of the locality.
- A standardisation of electricity pricing from hundreds of tariffs to essentially six main tariff structures.

However, potential problems arising from the introduction of REDs include:

- No legislation to compel local government or Eskom to hand over distribution to REDs.
- No legal requirement for municipalities or Eskom to hand over its assets to Reds
- Reluctance on the part of municipalities to relinquish control of a function which has traditionally generated surplus income from the sale of 80.8 TWh out of the total distribution market of 196.1 TWh.
- Reluctance on the part of Eskom to relinquish control of its profitable market base such as the industrial sectors. It is possible that Eskom may choose to pay lip service to the REDS process by handing over markets to REDs that have traditionally operated at a loss, such as its low the income residential market.
- An asymmetry of information between the distributor and the national grid as well as the bulk generating stations, which will be a factor in the former Eskom distribution domain, which previously had relatively seamless access to information from the generation plants and the network operators, all of whom are under Eskom.
- It is possible that policies of the RED could be in conflict with the vision of certain local authorities, causing inefficiency in the system.

- Reluctance of municipalities to loose the mechanisms of credit control that the termination of electricity supply had over householders failing to pay municipal rates and taxes.

Hence, there is overall confusion and lack of policy direction in both the generation and distribution of electricity in SA, which is a major barrier to investment in the RE sector. Coupled with this is the Eskom demand-side management (DSM) programme, which falls short of delivering real energy consumption reduction. These are clear barriers to any shift towards more sustainable energy supply and services.

2.2 Key forecasts for where past and current trends may be heading under a "business as usual" scenario

Due to lack of planned investment in energy generation, SA faces a peak electricity demand shortage, as early as 2006. As stated the DSM funds could be having a tangible effect in delaying this capacity shortage and allow for better planning to be undertaken.

The key issues relating to energy supply include:

- There is a need to ensure energy security and supply to meet growth projections
- Opportunities exist to diversify the energy mix through innovative partnerships and projects, and diverse energy technologies
- Develop a clear strategy and programme of action

The key issues relating to energy management and demand-side issues include

- The lack of detailed energy data
- The transport sector is economically inefficient and environmentally unsound
- Unelectrified, informal housing persists, and are dependent on unsafe and unhealthy fuels. This situation is likely to persist in the long-term, and is worse in rural areas where the proportion of unelectrified households is greatest.

Facilitating and supporting research and development into energy supply issues will be crucial to ensuring long term energy efficiency and supply security.

2.3 Points of intersection between the trends addressed and other trends that may affect these trends, or which may be affected by these trends

Renewables scenarios indicate that RE may be able to provide up to 70% of SA's future energy supply, by 2050. Since massive investments in energy are needed in any event, we should be focussing on the quality of that energy supply with an eye on the future, and with clear regard to our status as the greatest emitter of greenhouse gases[5] when measured on a per-capita GDP basis than any other country in the world.

EE and RE systems are one of the most effective public and private investments for providing greater access and more sustainable energy services to poor people worldwide. Technologies exist to increase efficiencies, but they are not being used to anything like their full potential, largely because the public is not properly engaged in the energy issue.

What is the rationale for considering EE and RE?

- We all need energy services to live our lives and do our work
- Proportionately, poor people spend more cash on energy services than richer people

[5] There are a range of climate warming or greenhouse gases. The most abundant of these is carbon dioxide, CO_2. All other greenhouse gases are ranked in terms of their Global Warming Potential (GWP) relative to CO_2. For example, methane CH_4 has a GWP 23 times that of CO_2.

- Poor people tend to have much lower levels of *access* and *choice* in terms of energy services
- EE and RE services have the characteristics of spending money upfront and deriving the benefit over time at very low recurrent costs – hence lower risks associated with unknown future costs
- EE and RE services are available at the point of consumption – hence greater efficiency and security of supply

What is the role of RE and EE?

- Social
  - Nutrition - Food preparation, food storage
  - Hygiene - Personal hygiene, food hygiene
  - Space heating and cooling
- Economic – employment, production
- Environmental – biodiversity, resources, waste

Committing a significant proportion of the required energy service infrastructure investments (say 10 - 20%) for EE and RE will provide:

- Greater access to energy services
- Improved quality of economic development
- Greater competitiveness (or resilience) in the global economy
- Higher quality physical and social environments
- A legacy of a longer term view on public spending

Full cost accounting, and lifecycle cost accounting, will have to become the default methods of assessing the relative benefits of different energy supply scenarios. For example, the economics of nuclear energy are not clearly stated in being extremely risky given that the costs for decommissioning nuclear plants are not stated. The recent example in the United Kingdom where a recent decommissioning plan for twenty sites indicates a budget of GBP56 billion (ZAR670 billion) over 100 years. The uncertainty in these estimates over such a long timeline is clearly evident. Further ammunition in the uncertainty and risk associated with nuclear energy is the insurance industry's refusal to insure these facilities.

In essence, nuclear energy is a short-term solution but with political will it is neither necessary nor desirable to meet our energy supply and climate change targets. It involves huge economic, military and environmental risks that should be avoided, with the primary risk factor being those relating to spent fuel storage. No government has yet solved the problem of safe long-term storage.

The economy and people need energy services to operate / live. These energy service needs are a function of specific activities and of patterns of living / working.

In the past, the energy service needs of countries have been dealt with in terms of a quantification of the energy carrier demands (e.g. electricity) as a proxy for the actual service needs. This results in a supply side paradigm or approach to planning and misses opportunities for building efficiencies into the provision of services. Energy service provision is more sustainable if the full life-cycle costs are as low and as predictable as possible. In practice, this means that the future recurrent costs are the key area for attention.

3. Summary list of relevant policies and strategies

3.1 Key National Policy, Regulatory and Strategic frameworks that directly govern, or are relevant to or impinge on the sector.

Integrated Energy Plan, which underpins all energy legislation in the country.

National Integrated Resource Plan (NIRP1, 2003-2004) and NIRP2 (current) which look to understand and provide information about the economics of new electrical generation in South Africa.

Targets: Examples in South Africa, none of which are enacted

- SA Government
  - 10,000 GWh by 2013 (about 4% of total) (in the White Paper on Renewable Energy, November 2003)
  - 12% reduction in energy consumption by 2014, EE Strategy
- City of Cape Town
  - 10% of energy from RE by 2020
  - 10% of households with solar water heating (SWH) by 2010

Air Quality Act (2005), which will no doubt tighten up emissions from generation sites

A positive note is the formation of the National Energy Research Institute, which will allow for integration of the key research and development agendas. Decentralising the studies into different research groups located at different academic institutions, in collaboration with the public and private sector, will result in advancing local technological development and applications in the field of energy – thereby exploring opportunities in research and development, and practical implementation, of alternative sources of and supply topologies for energy, including solar power, wind power, pumped storage and hydropower schemes, as well as cleaner coal technologies, efficiency of energy supply and usage and indigenous technologies.

3.2 Key international agreements and policy frameworks that are relevant to the sector, and extent of adoption at the national policy level

Clearly the CDM is a powerful mechanism that South Africa is just beginning to gain experience in, that has been fully endorsed and supported by the DME through the establishment of a Designated National Authority (DNA) for overseeing the CDM project processes, and registration of CDM projects.

Countries around the world are increasingly signing up to increasing targets for the increased use of RE and EE, and not only do we lag behind but stated targets are not enforced through legislation. There is thus the obvious risk that these targets can simply shift, or disappear – not least because we do not know the baseline against which they are being measured.

There are myriad bi- and multi-lateral agreements with other governments, with trade as their focus and with security of oil supplies as a subtext. Some frameworks that directly affect the energy sector are the Renewable Energy and Energy Efficiency Partnership (REEEP), the Global Village Energy Partnership (GVEP) and the International Energy Agency's IEA Bioenergy. South Africa is a member of these three institutional frameworks[6].

3.3 Relevant policies, regulatory and strategic frameworks at Provincial and Local Government level that differ from national

[6] References are provided at the end of the document

approaches or highlight particularly innovative interpretations of national approaches or reveal problematic interpretations or non-applications of national approaches

Provincial Land Transport Frameworks

Energy Status Quo Reports e.g. Western Cape

Energy Strategy Plan e.g. City of Cape Town

4. Key Challenges and Policy Implications

4.1 Key challenges from a "sustainability" perspective

Bridge the fossil era thinking of a centralised energy supply chain removed from the demand side, towards a new way of thinking towards decentralised, distributed and embedded generation coupled with EE measures that involves people. In effect, moving from an energy supply scenario to an energy services scenario.

Developing the understand that the use of RE and EE offers diverse means to deliver better quality energy than fossil fuels. An example of this lies in solar water heating (SWH): for each R100m invested 100,000 people (25,000 families) will have reliable hot water supply. Thus an investment in **people** to the tune of R1,000/person via the installation of a SWH will quickly improve the quality of life, health and hence ultimately macro-economics. This is assured, as opposed to ongoing subsidisation of eg PBMR, where every additional R500m thrown at that research programme has no impact on the wider population.

Understanding the job creation potential of RE and EE, which is greater than any fossil technology. From a policy perspective this would entail building on work done in this area, and developing a macro-economic model of the relative costs per job created in each sector of the energy industry. This bundled together with the well known social and environmental benefits (that can be quantified) would provide a simple measure of ranking of each technology in terms of overall sustainability impacts, but from an economic perspective.

Rural energisation, links with poverty and gender, and development of SMEs to support the energisation process. Similarly, meeting the growing energy needs of a growing GDP and more affluent society.

The great interest in biofuels and the associated production of energy crops puts the country at risk of impacting negatively on our natural biodiversity. There are also concerns relating to the impact on food production, with some worrying that a biofuels use target will lead to increasing food security problems in the poorer parts of the country.

One of the key areas for meeting our energy requirements in a sustainable manner is that of awareness, at all levels of government and in each home, industry and person.

4.2 Policies and Strategies that should be developed that will address the challenges

One of the clearest gaps in energy policy in South Africa today is the use of incentives to reduce the gap between the cost of fossil-generated power and renewable sources of power. In the case of electricity, there are two clear policy measures that can be undertaken (and on which the DME has been deliberating for some years): that of a feed-in tariff policy that mandates the utility receiving the electricity from an independent power producer to pay a premium price; and that of a quota system, which essentially forces energy companies and utilities to generate a minimum of their total power output from renewables. The value of the energy generated or bought in can be bought at a premium price using a variety of Renewable Energy Certificate (REC) schemes, and non-compliance with the allocated quota leads to penalty payments.

There is an urgent need to define the relationships between IPPs and utilities, and they in turn with the REDs, in conjunction with one of the above mechanisms in order to move the country into a more modern energy environment.

There are sufficient potential projects, project developers, and finance that can be coupled to deliver more sustainable development projects while meeting our energy needs. National government simply needs to provide the policy and regulatory environments that will unlock the potential for this to occur, and the key areas outlined above must be addressed as a matter of priority.

As far as biofuels are concerned, clear and concerted effort is required to investigate the available resources and the feasibility of different crop production in different part of the country – and how these would impact on water and biodiversity. This is most important when viewed in the context of poverty alleviation, since it is hoped that sufficient government focus can be brought to maximise the rural benefits of what is in major part an agricultural proposal.

Local governments needs to conform to clear policy and strategies for implementing more efficient cities, with a focus on urban design with mixed-use neighbourhoods and integrated public transport networks.

4.3 Lacking or inadequate policy nexus

One of the most obvious policy gaps is a candid review of the risks, costs and benefits associated with differing energy supply and efficiency technologies and scenarios. The formal unemployment is around 28%, while RE and EE provide far greater number of jobs and range of skills in delivering sustainable energy growth compared with conventional energy sources[7]. There is the need to quantify, by technology and scenario, the risk, cost and number of jobs created associated with each. This data can be utilised using a portfolio risk analysis methodology which, where it has been undertaken in countries around the world, points to an overall reduced risk and cost associated with an increased use of RE and EE in a portfolio of supply and demand side interventions. This approach should inform the long-term national planning process.

Regarding biofuels and bioenergy more generally, the integration and recycling of resources is not fully understood nor adopted as a policy for promotion of appropriate technologies. While some bioenergy technologies come close in their own right in competing financially with fossil fuel technologies, they can often be a better solution when viewed through a lifecycle cost analysis lens, which accounts for the entire chain of supplies, wastes, material flows and emissions.

5. References and Resources

5.1 List of references that may be useful for future reference as the policy process unfolds, including policy documents, academic publications, websites, institutes, research projects that may be under way, etc.

5.1.1 Policy

Air Quality Act, February 2005

Integrated Energy Plan, March 2003

Energy Efficiency Strategy of the Republic of South Africa, March 2005

Electricity Basic Services Support Tariff (Free Basic Electricity): Policy, July 2003

Electricity Distribution Industry Restructuring Draft Bill April 2003

[7] Employment potential of renewable energy in South Africa. AGAMA Energy, for Sustainable Energy and Climate Change Partnership, 2003.

Energy Policy White Paper, December 1998

National Energy Draft Bill, September 2004

Promotion of Renewable Energy and Clean Energy Development White Paper: Part One: Promotion of Renewable Energy, August 2002

Renewable Energy Policy of South Africa White Paper May 2004

5.1.2 Government and parastatals

www.ner.org, National Electricity Regulator

www.nnr.co.za, National Nuclear Regulator

www.dme.gov.za, Department of Minerals and Energy

www.eskom.co.za, Eskom

www.environment.gov.za, Department of Environmental Affairs and Tourism

www.housing.gov.za, Department of Housing

5.1.3 International Frameworks

www.reeep.org, Renewable Energy and Energy Efficiency Partnership

www.gvep.org, Global Village Energy Partnership

www.ieabioenergy.com, IEA Bioenergy (South Africa has full membership of Task 39, and observer status for Task 29)

www.localpower.org, World Alliance for Decentralised Energy

www.iclei.org, International Council for Local Environmental Initiatives

5.1.4 Local organisations

www.sessa.org.za, Sustainable Energy Society of South Africa

www.sustainable.org.za, Sustainable Energy Africa

www.erc.uct.ac.za, Energy Research Centre, University of Cape Town

www.earthlife.org.za, Earthlife Africa

www.southsouthnorth.org, SouthSouthNorth

www.pasasa.org, Paraffin Safety Association of Southern Africa

5.1.5 Local industry associations

www.sapia.org.za, South African Petroleum Industry Association

5.1.6 Other resources

www.hedon.info, HEDON Household Energy Network

www.sparknet.info, Knowledge Network on Energy for Low-income Households in Southern and East Africa