SUSTAINABLE ENERGY FOR ALL

[ZIMBABWE]: Rapid Assessment and Gap Analysis Draft final – 14 June 2012

OBJECTIVE

The purpose of Rapid Assessment and Gap Analysis is to provide:

- A quick brief look of the energy situation in the country (Section 1) within the context of its economic and social development and poverty eradication
- A good review of where the country is in terms of the three SE4ALL goals (Section 2), and
- A good estimate of the main challenges and opportunities vis-à-vis the three goals of SE4ALL where the major investments, policies and enabling environments will be required (Section 3)
- A sound basis and background for an Action Plan that may follow as part of the SE4ALL activities in the country

EXECUTIVE SUMMARY

Zimbabwe's economy has started to recover from a decade-long crisis that saw economic output decline every single year during the period 1999 to 2008, for a cumulative decline of more than 45 percent. Supported by a strong recovery of domestic demand and government consumption, real Gross Domestic Product (GDP) grew by 20.1% between 2009 and 2011. GDP was led by strong growth in mining (107%), agriculture (35%) and services (51%). Recovery in manufacturing sector (22%) has been markedly less vigorous. Strong external demand for primary commodities (platinum, gold, cotton and tobacco) has supported higher production levels, which have recovered pre-2000 levels in terms of values. Value of mineral exports increased by 230% over the 2009-2011 period, while value of agricultural exports increased by 101% over the same period. As production levels of tobacco, cotton and gold have not yet recovered to year-2000 levels, Zimbabwe has been unable to fully exploit the benefits of high international prices to boost exports further 2011. Zimbabwe has a very high fertility rate that may pose a problem on energy demand, and population dynamics must be taken into account when setting any realistic targets for energy access, energy efficiency and renewable energy.

Severe macro-economic and political crisis saw industrial capacity utilization drop to 8% in 2008, and it has now recovered to around 57%. GDP per capita decreased from USD 1,084.5 (current value) in 1981 to USD 354.7 in 2008 before recovering to USD 594.5 in 2010. Several programmes have been established to kick start and maintain the economic recovery of Zimbabwe. The first programme to be launched was the Short Term Emergency Recovery Programme (STERP) followed by the Three Year Macro-Economic Policy and Budget Framework (STERP II) and the Medium Term Plan (MTP).

Energy policy and planning is guided by the **National Energy Policy** that will be launched in July/August 2012. The Energy Policy is accompanied by an **Implementation Strategy** chiefly aimed at achieving socio-economic development, higher productivity in productive sectors and sustainability. For its modern energy (petroleum products and electricity), Zimbabwe is still highly depend on external supply. Zimbabwe imports all of its oil supplies, as well as around 44% of its electricity needs. Although Zimbabwe does not have proven sources of oil it is endowed with significant coal reserves, and there is prospects for Coal Bed Methane.

The major challenge remains access to ***modern energy for rural households***. Zimbabwe is characterized by a sharp discrepancy between rural and urban areas in terms of access to modern forms of energy. With regard to fuels for cooking, rural areas rely predominantly on traditional biomass and inefficient stoves. There are both environmental and health issues related to this baseline situation, wherein only 5.8% of rural households have access to modern energy sources, including electricity, for cooking. The rural electrification rate is somewhat higher at 13.3%. The main mandate of the Rural Electrification Agency is to provide institutions with access to electricity under the premise that once these 'hubs' are electrified, it

would be much easier to connect rural communities. Correspondingly, there is a higher penetration of solar home systems and generators in rural areas. Based on these figures, the prospects for increasing these rates of access to modern energy significantly would imply a significant increase in capital investments.

The energy security of Zimbabwe has a direct effect on energy access. Zimbabwe is heavily dependent on electricity imported mainly from Mozambique to meet its internal demand (~41% in 2009). Due to the large power supply gap in the SADC region, the price of imported electricity is increasing. The power balance shows that there was a shortage of power up to 30% in June 2012 after imports was taken into account.

Assuming that all electricity imported by Zimbabwe was derived from hydro-electric power, the share of **renewable energy** was only 8.7% of TPES in 2009. It is assumed here that the 65.6% of biomass in TPES was predominantly non-renewable, which is justified by the large discrepancy of fuel word harvested annually and reforestation. Hydro-power contributed 53.3% of total local electricity production in 2009. Assuming that all electricity imported in 2009 was from hydro, the share of renewable energy in the electricity mix was 72.8 per cent. The potential for hydro (large-scale and mini-hydro) remains largely untapped. Past experience shows that hydro-power generation is vulnerable to droughts, which calls for a strategy of balancing climate risks when planning future power generation in Zimbabwe. In the transport sector, E10 bio-ethanol blend is already in use in Zimbabwe. There are also a sizeable number of rural households (24.7%) that possessed solar home systems, with the national average being 18.1 per cent.

The overall **energy efficiency** of the Zimbabwe economy is relatively low with a TPES/GDP standing at 2.05 toe/thousand 2000 USD in 2009. After a period that saw energy intensity decreasing to its lowest in 1998 (the peak year for economic output), energy intensity has increased steadily to reach 1.727 toe/thousand current USD in 2008. This shows that there is no decoupling between energy use and GDP at the aggregate nation-wide level. Zimbabwe's rising energy intensity may be caused by:

1. Ailing equipment that are not energy efficient;
2. Equipment used at low-level and hence sub-optimal production capacity that increases the energy input for any unit of production. The industrial capacity utilization was 5% in 2008 and recovering to 57% in 2012. The strategic plan is to increase industrial capacity utilization to 80% by 2016 (Ministry of Industry and Commerce, 2012); and
3. High energy intensity would also be occasioned by a sparse rural population and trading centres that are usually accessed by road transport.

Annex 1 shows that there are several projects that are on-going in all the three areas targeted by SE4ALL. Nevertheless, **key barriers** remain for the achievement of SE4ALL in Zimbabwe. The key challenges faced by the country regarding SE4ALL can be summarized as follows:

- It is likely that the majority of Zimbabwe's rural population will continue to rely on traditional biomass for cooking and other thermal applications in the foreseeable future;
- Investment in energy efficiency and renewable energy is plagued by the prevailing macro-economic situation characterised by lack of liquidity in the country and the high cost of capital;
- There are currently a very limited range of economic and financial incentives given by government for the promotion of energy efficiency and renewable energy;
- Lack of knowledge about the benefits of modern energy in productive sectors;
- Lack of technical knowhow (including energy auditing) even when awareness is present;
- Lack of local manufacturing base for decentralised renewable energy and energy efficient equipment;
- Lack of a coordinating entity for energy efficiency and renewable energy projects;
- Lack of empowerment for the standards association institution in the energy sector;
- Lack of cost-reflective tariffs in the power sector that translate into disincentives for IPPs to invest in power generation;
- There is a negative perception around the indigenization law that is adversely affecting foreign investment;

- Lack of policy coherence regarding for example import duties and VAT on non-solar renewable energy or energy efficiency equipment that in the power sector translate into higher electricity tariffs. Coupled with the non-cost-reflective electricity tariffs leads to a disincentive for private investments;
- Current lack of capacity of the energy regulatory authority;
- Inefficient electricity billing and collection;
- Aged and obsolete equipment and poor state of infrastructure;
- Operational challenges including undercapitalization compounded by debt ridden financial positions;
- Inadequate specialized skills and tools required for planning and forecasting energy needs, and to design and implement energy efficient technologies, including carrying out energy audits;
- High cost of rural electrification through grid extension and due to the scattered nature of settlements; and
- Theft and vandalism of infrastructure.

Section I: Introduction

1.1 COUNTRY OVERVIEW

1. Basic socio-economic data: population, GDP/capita, key economic sectors, poverty rate (current and trend)

Zimbabwe is composed of 10 provinces spread over a total land area of 390,757 km^2. The last official census was carried out in 2002 and the population of Zimbabwe was measured at 11,631,657, with a sex ratio of 94 percent (CSO, 2004). In 2002, the total fertility rate was 3.6 children per woman. The population was mostly rural with only 35% living in urban areas. Also, the population pyramid was also highly skewed towards lower ages with around 64% of the population bearing ages 25 years and below. Only 4% of the population was older than 65 years. The Population Census 2012 Mapping is currently in progress. However, total fertility rate (TFR) can be obtained from the Zimbabwe Demographic and Health Survey reports. TFR has fallen from 4.29 in 1994 to 3.8 in 2005-6, and increased to 4.1 in 2010-11, reflecting trends in reduction of socio-economic development over the same time period. The relatively high TFR, coupled with a youthful population, is a concern from the point of view of energy access and rural development.

According to the World Development Indicators, GDP per capita decreased from USD 1,084.5 (current value) in 1981 to USD 354.7 in 2008 before recovering to USD 594.5 in 2010 (World Bank, 2011). Zimbabwe adopted the USD as local currency in 2009/10.

Zimbabwe's economy has started to recover from a decade-long crisis that saw economic output decline every single year during the period 1999 to 2008, for a cumulative decline of more than 45 percent. Supported by a strong recovery of domestic demand and government consumption, real Gross Domestic Product (GDP) grew by 20.1% between 2009 and 2011. GDP was led by strong growth in mining (107%), agriculture (35%) and services (51%). Recovery in manufacturing sector (22%) has been markedly less vigorous. Strong external demand for primary commodities (platinum, gold, cotton and tobacco) has supported higher production levels, which have recovered pre-2000 levels in terms of values. Value of mineral exports increased by 230% over the 2009-2011 period, while value of agricultural exports increased by 101% over the same period. As production levels of tobacco, cotton and gold have not yet recovered to year-2000 levels, Zimbabwe has been unable to fully exploit the benefits of high international prices to boost exports further.[1] The external debt of Zimbabwe was estimated at USD 6.081 billion at the end of December 2011.[2]

The level of human (or socio-economic) development has varied with the economic cycles over the past decades as evidenced by the variations in UNDP's Human Development Index shown in **Table 1**. The Gini coefficient was estimated at 0.39 at the national level in 2010-11, and revealing large asymmetries between urban (0.09) and rural (0.40) populations (ZDHS, 2011).

TABLE 1. Human Development Index, 1980-2011.

1980	1985	1990	1995	2000	2005	2009	2010	2011
0.241	0.278	0.284	0.262	0.232	0.159	0.118	0.140	0.376

Sources: World Bank (2011) & UNDP (2012).

Several programmes have been established to kick start and maintain the economic recovery of Zimbabwe. The first programme to be launched was the Short Term Emergency Recovery Programme, STERP (GOZ,

[1] http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/AFRICAEXT/ZIMBABWEEXTN/0,,menuPK:375746~pagePK:141132~piPK:141107~theSitePK:375736,00.html – accessed 1 June 2012.

[2] https://www.cia.gov/library/publications/the-world-factbook/geos/zi.html - accessed 1 June 2012.

2009), followed by the Three Year Macro-Economic Policy and Budget Framework, STERP II (STERP II, 2010) and finally The Medium Term Plan, MTP (MTP, 2011).

The recovery remains precarious as a number of issues stand in the way of sustainable economic growth. These relate to: (i) continued political uncertainty around the roadmap to elections resulting in low business confidence, (ii) lack of domestic liquidity and very high real interest rates on short-term credit; (iii) high wage costs and unrealistic wage demands driven by transportation, accommodation, utilities among others; (iv) ailing infrastructure (lack of resources to rehabilitate infrastructure); (v) unreliable power supply; (vii) indigenization policies and the uncertainty around their application, heightened by the recent controversial fast-track implementation guidelines for the mining and banking sectors (see footnote 1).

Table 2 summarizes key socio-economic indicators obtained from IEA (IEA, 2011 and 2012).

TABLE 2. Key socio-economic indicators, 2009.

Key Indicators		**Compound Indicators**	
Population (million)	12.52	**TPES/Population** (toe/capita)	0.76
GDP (billion 2000 USD)	4.65	**TPES/GDP** (toe/thousand 2000 USD)	2.05
GDP (PPP) (billion 2000 USD)	19.78	**TPES/GDP (PPP)** (toe/thousand 2000 USD)	0.48
Source: IEA (2011, 2012)			

1.2 ENERGY SITUATION

The primary energy sector is dominated by conventional fuels: coal, with total reserves of 10.6 billion tonnes of which half a billion are proven, petroleum of which about 40PJ of finished distillates are imported every year, and hydroelectric power with a total potential of 4 200 MW mainly on the Zambezi river shared system. The liquid fuels supply is augmented by 40 million litres of ethanol which are produced at the Triangle Ethanol Plant annually in years of good rainfall. The ethanol is blended with petrol up to an ethanol content of 13% (Ministry of Mines, Environment and Tourism, 1998). Currently, ethanol produced by the Triangle Ethanol Plant is exported, and GreenFuel has invested in a plant that can produce 60 million litres of bio-ethanol per year. Production capacity is constrained for reasons discussed below.[3]

The commercial energy industry is dominated by electricity, while wood fuel provides energy for domestic use mainly in the rural communities and urban poor.

2. Energy supply (energy mix, export/import)

- Primary energy sources

In 2009, total primary energy supply (TPES) was 9.51 Mtoe with energy production and net imports being 8.53 Mtoe and 0.97 Mtoe, respectively (IEA, 2011&2012). The per capita TPES was 0.76 toe/person, and the carbon dioxide emission was 0.69 tCO_2/capita. The energy balance for 2009 is summarized in **Table 3**.

TABLE 3. Energy balance for Zimbabwe in 2009 (ktoe in net calorific value).

Production/Consumption	**Coal & peat**	**oil**	**hydro**	**Biofuels‡ and waste**	**Electricity**	**Total**
Production	1,032	0	361	6,237	0	**8,530**
Imports	27	611	0	0	473	**1,111**

[3] Discussions with Mr Derek Elliott and Mrs Jane Witz, GreenFuel – 14 June 2012.

Exports	-135	0	0	0	-5	**-139**
International aviation bunkers	0	-7	0	0	0	**-7**
Stock changes	-7	0	0	0	0	**19**
TPES	**1,844**	**604**	**361**	**6,237**	**468**	**9,514**
Source: IEA (2012). *‡ covers conventional biomass.* *Note: Sums do not necessarily add up due to rounding off errors.*						

All oil products used in Zimbabwe are imported.

- Power sector (installed capacity, annual generation, import/export)

Electricity generation is Zimbabwe is dominated by thermal power generation using coal as combustible, and hydro-electricity. In 2009, the two sources represented 46.4% and 53.3%, respectively of total power generated in Zimbabwe. The generation of electricity from oil was very small comprising around 0.3% of total domestic supply. These figures should be treated with caution since Zimbabwe is a net importer of electricity from SAPP. In fact, total production was only 59.1% of the total domestic supply in 2009, implying that Zimbabwe imported 40.9% of all its electricity needs in 2009. The statistics drawn from IEA are shown in **Table 4** for 2009.

TABLE 4. Supply of electricity in Zimbabwe in 2009, GWh.

Coal	Hydro	Oil	Total Production	Exports	Imports	Domestic Supply
3,652	4,202	24	7,878	53	5,497	13,322

Source: http://www.iea.org/stats/renewdata.asp?COUNTRY_CODE=ZW – accessed 1 June 2012.

The 2011 Annual Report of SAPP (SAPP, 2011) quotes that the total base load installed capacity was 2,045 MW (hydro – 750 MW; coal – 1,295 MW) as of March 2011, of which only 1,320 MW was available for power production. The peak load in 2010 was 2,100 MW.

The Zimbabwe Power Company (ZPC, 2012) currently operates 5 power stations, the operation characteristics of which as of 4 June 2012 are summarised in **Table 5**.

TABLE 5. Operation characteristics of power plants in Zimbabwe on 4 June 2012.

	Generating Units (MW)	Coal Stock (T)	No of days	Remarks
Hwange	350	385,984	44 at 600 MW	3 units (3, 4 & 6) in service
Kariba	700	N/A	N/A	6 units (1, 2,3,4,5 & 6) in service
Harare P/Stn.2	16	5,159	16 at 20 MW	Gen 6 Blrs 8 & 9
Munyati	36	7,200	15 at 30 MW	Gen 3&6 Blrs 6, 9,10,13 & 14 in service
Bulawayo	30	1,225	2 at 30 MW	Gen 3, Blrs 6, 8 & 9 in service
TOTAL	1132			

Source: ZPC, 2012.

The difference between electricity production and consumption is shown in Figure 1 between 2000 and 2009 (STERP II, 2010).

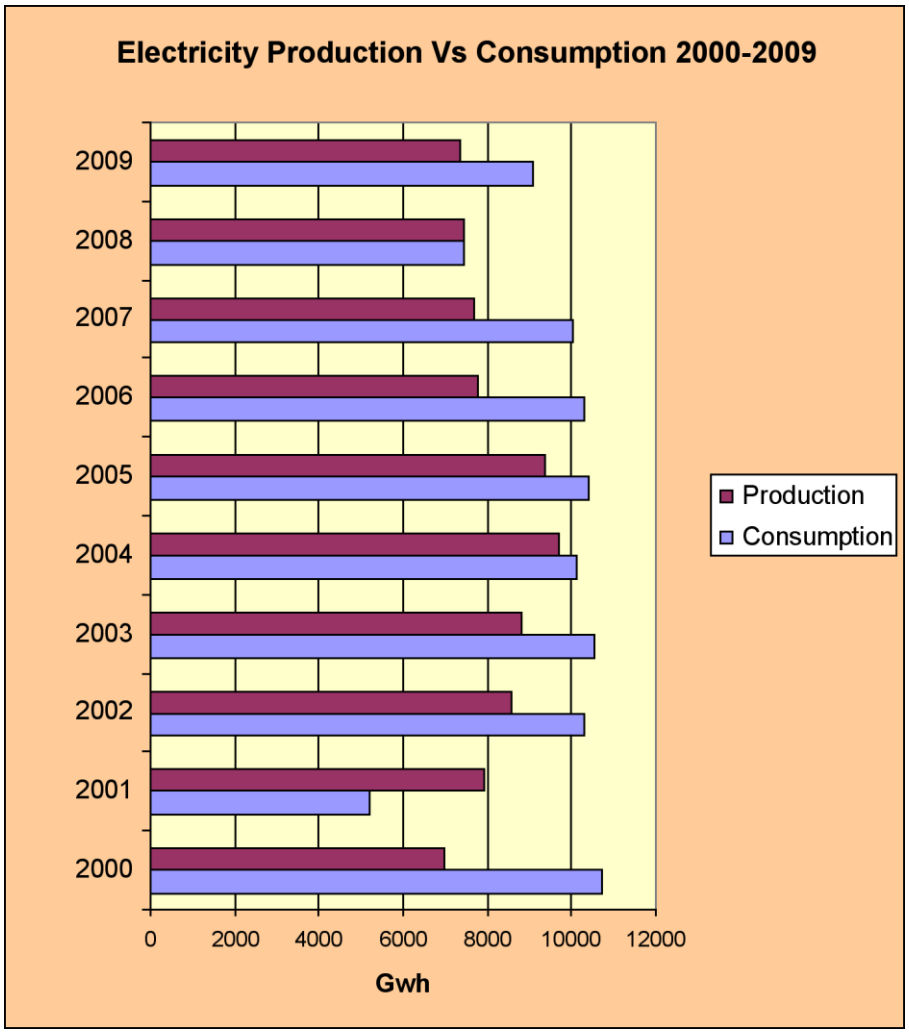

Figure 1. Eletcricity production and consumption in Zimbabwe, 2000-2009.

Electric power transmission and distribution losses have improved from a high 24.4% in 2002 to 6.5% in 2008 (World Bank, 2011).

3. Energy demand (overview of main consuming sectors, industry, residential, agriculture, transport)
Total final consumption (TFC) – i.e. final energy use by sector – was 8,367 ktoe in 2009 (IEA, 2012). The sectoral breakdown is shown in **Table 6**.

TABLE 6. Sectoral final energy use for Zimbabwe in 2009 (ktoe in net calorific value).

Sector	Coal & peat	oil	hydro	Biofuels‡ and waste	Electricity	Total
Industry	266	62	0	115	471	**914**
Transport	5	354	0	0	0	**359**
Residential	1	28	0	5,803	319	**6,151**
Commercial and public services	66	0	0	0	149	**215**
Agriculture/forestry	136	63	0	318	124	**641**

Other – not specified	0	66	0	0	7	**73**
Non-energy	0	13	0	0	0	**13**
TFC	**474**	**587**	**0**	**6,237**	**1,070**	**8,367**

Source: IEA (2012).
‡ covers conventional biomass.
Note: sums do not necessarily add up due to rounding off errors.

The residential sector had the highest energy use at 73.5% TFC. Over 94% of residential energy use was in the form of conventional biomass and waste. The share of industry, agriculture and transport in TFC were 10.9%, 7.7% and 4.3%, respectively. Industry was the highest user of coal & peat (56.1%) and electricity (44.0%). Transport consumed 60.3% of all imported oil. Electricity was the modern energy having the highest share in TFC at 12.8%, followed by oil (7.0%) and coal & peat (5.7%).

Zimbabwe imports all of its liquid fuel requirements and the estimated monthly demand (litres) with the economy at its peak for diesel, petrol and jet fuel was 105 million, 90 million and 15 million litres, respectively, with transport and agricultural sectors consuming 60 percent (MTP, 2011).

Comparison of data given in **Table 3** and **Table 6** reveal that 44.2% of electricity use in TFC was imported.

4. Energy and economic development: share of energy sector in GDP; share and absolute amount of public spending on energy, including for energy subsidies; energy security (share of energy imports in balance of payment)
The share of energy in GDP is not reported in national statistics. However, the share of electricity and water sector in GDP was 4.5% in 2009, and increasing to 5% in 2010. Projections given in the MTP 2011-2015 (2011) show that the contribution of electricity and water to GDP would be 6% by 2015.

5. Energy strategy and relevant targets (access, capacity, generation, energy security)
Figure 1 shows the deficit in power generation to meet consumption in Zimbabwe. In June 2012, ZPC generated 1,132 MW of power using mainly coal and hydro. Coal is sourced locally, while hydro is an indigenous renewable resource. However, the maximum demand was estimated at 1,765 MW, and with imports of 100 MW from Mozambique (5.67%), there was a shortage of 533 MW – i.e. 30.2% of unmet national power needs (ZPC, 2012). The power balance is shown in the pie chart (**Figure 2**).

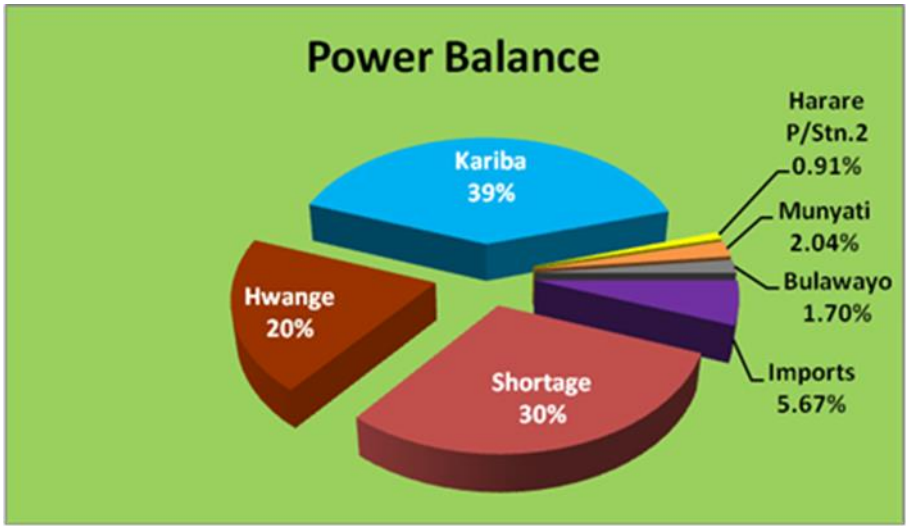

Figure 2. Power balance in Zimbabwe on 4 June 2012.

Figure 2 conveys a very important message. Although, Zimbabwe is connected with neighbouring countries through SAPP, and in theory it can import electricity from neighbouring countries, the reality is quite

different. Regional energy demand far outstrips supply hence sources of imports are diminishing. This situation poses an additional threat to access to electricity. The possibility or practicability of importing electricity is further compounded by the fact that several neighbouring countries like Mozambique and Zambia rely heavily on hydro-power that is vulnerable to the impacts of climate change and variability in precipitation. These observations may imply that increasing and diversifying local power generation is the safest option.

Power generation is constrained by technical difficulties and ailing generators, and selected examples are summarised in **Table 7** for the thermal power plants (ZPC, 2012).

TABLE 7. Generation constraints at 4 thermal power plants in June 2012.	
HWANGE	Unit 1 - Forced outage due to generator rotor earth fault. Rotor in South Africa booked for balancing at Rotek. Target for RTS 18 July 2012; Unit 2 Forced outage. Rotor Earth Fault. Rotor is back on site, awaiting Generator stator repairs. Target RTS is 27th July 2012;
HARARE	Station 3 plant repairs continuing; Generators 1&2 rotors, boiler1 on major overhaul, boilers 2&3 on standby under dry storage;
MUNYATI	Boiler 5 grate overhaul in progress and Statutory outage. spares for boiler 5 were moved boiler 7 which has shorter turnaround time; Boiler 7 grate overhauls and economizer tube leak repairs in progress. Target completion date is 21 June 2012; Boiler 8 external cleaning, economizer tube and Crown valve repairs; Boiler 11 generating tube burst outage. Awaiting procurement of new tubes; Gen 4 is on Remnant Life Assessment; Gen 5 on standby; Gen 7 Oil coolers replacement pending
BULAWAYO	Gen.5 under Remnant Life Assessment; Boiler 5 refractory lining repairs in progress; Boiler 10 failed hydraulic test on 29/05/12, repairs on failed tube are in progress;
Source: ZPC, 2012.	

Section 2: Current situation with regard to SE4ALL goals

2.1 ENERGY ACCESS vis-à-vis GOAL OF SE4ALL

6. Overview and assessment

With regard to the type of energy mainly used for cooking, it was observed that 64% of the households in the province used wood, while about 30% of them used either paraffin or electricity. Less than 1% of households used gas, coal and other forms of energy (CSO, 2004). The most recent statistics on thermal energy use is provided in the Zimbabwe Demographic and Health Survey. Slightly less than 7 of 10 households in Zimbabwe use some type of solid fuel. Almost all households using solid fuels cook with wood. In rural areas, 94% of households use wood for cooking, compared with 20% in urban areas (ZDHS, 2012). The evolution of type of energy used for cooking is given in **Table 8**.

TABLE 8. Types of energy used for cooking in Zimbabwe: 2005-06 and 2010-11.

Cooking fuel	**2005-06 (%)**			**2010-11 (%)**		
	Urban	**Rural**	**Total**	**Urban**	**Rural**	**Total**
Electricity	*87.9*	*3.5*	*32.6*	*73.2*	*5.6*	*28.4*
LPG/NG/biogas	*-*	*-*	*-*	*0.4*	*0.0*	*0.2*

Kerosene/paraffin	*0.6*	*na*	*0.2*	*5.2*	*0.2*	*1.9*
Sub-total	***88.5***	***3.5***	***32.6***	***78.8***	***5.8***	***30.5***
Jelly	-	-	-	0.1	0.0	0.0
Coal/lignite	na	0.2	0.1	0.0	0.0	0.0
Charcoal	na	0.2	0.1	0.2	0.1	0.1
Wood	11.2	95.3	66.3	19.8	93.9	68.9
Straw/shrubs/grass	0.1	0.6	0.4	0.0	0.0	0.0
Agricultural waste				0.0	0.0	0.0
Other	na	0.1	0.1	0.9	0.0	0.3
No food cooked in household	-	-	-	0.1	0.0	0.0
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0
Source: ZDHS 2005-06 and 2010-11.						

The potential for exposure to harmful effects of smoke from using solid fuels for cooking is increased if cooking occurs within the home itself rather than outdoors or in a separate building. Seventeen percent of Zimbabwean households report that someone smokes at the home daily, 3 percent report that someone smokes at least once a week, 2 percent report that someone smokes monthly, and 2 percent report that someone smokes less frequently than once a month. In 76 percent of households, smoking never occurs in the home. Overall, smoking inside the home is less frequent in urban areas than in rural areas; smoking never occurs in 72 percent of rural households, compared with 83 percent of urban households. This is a positive sign since 94% of the rural population uses either wood or coal as combustible for thermal applications (ZIMSTAT, 2012). As expected, highest levels (4.7%) of acute respiratory infection (ARI) were observed among children under age five exposed to wood/straw as cooking fuel (ZIMSTAT, 2012).

7. Modern energy for thermal applications (cooking, heating)

Table 8 shows that modern fuels – i.e. electricity, liquid fuels, or gaseous fuels – constitute 30.5% of all energy used in Zimbabwe for thermal applications. The relative breakdown between rural and urban is more telling since it provides better insight as to where resources have to be invested to catalyse sustainable energy transfer and diffusion for sustainable development. In 2012-11, only 5.8% of the rural population has access to modern fuels for cooking and heating, while it was a relatively high 78.8% in urban households. According to ZDHS 2005-6 (CSO, 1995), 96.6% of all households using solid fuels for thermal applications used open fire/stove without chimney or hood, and hence **did not** have access to improved cooking stoves There was no substantial difference between urban (92.6%) and rural (96.9%) households.

There is unexploited potential for using LPG or kerosene to address the cooking fuel challenges for the majority of the population who either have no access to electricity or are not able to afford the cost of using it for cooking and heating. In order to preserve natural forests some countries, notably Mauritius in the SADC region, have successfully made a transition from fuel wood to LPG as a household fuel. The following table (**Table 9**) demonstrates the competitiveness of LPG as a household fuel. The electricity cost for cooking is subsidised for low income consumers and yet the LPG cost, which is based on market prices, is lower. Nevertheless, the upfront cost of gas cooking stoves remain quite high, and the cost of LPG, though being competitive with electricity, is still expensive relative to fuel wood in rural communities. There is also a perception that the use of LPG is unsafe, although it is clear that the market has to be regulated for standards and safety precautions need to be enhanced.[4]

TABLE 9. Comparison of low-income household fuel use.			
Household energy need	**Monthly Energy Source**	**Monthly cost US$ (April 2010)**	**Monthly Cost US$ (September 2011)**
COOKING (2 meals a day)	Electric stove (250 kWh)	17.48	23.00

[44] Discussions with Ms Josephine Mapako, Secretary, CADAC – 14 June 2012.

TABLE 9. Comparison of low-income household fuel use.			
Household energy need	**Monthly Energy Source**	**Monthly cost US$ (April 2010)**	**Monthly Cost US$ (September 2011)**
	Gas Stove (6 kg LPG)	**14.00**	**18.00**
	Paraffin (30 l)	30.00	34.50
	Gel stove (20 kg)	41.50	39.50
	Fire wood (60 bundles)	60.00	180.00
LIGHTING (3 rooms, 4 hours a day)	Energy savers (4kWh)	0.30	0.08
	Incandescent (20 kWh)	1.40	0.40
	Candles (40 or 400g)	11.33	16.80
ENTERTAINMENT (radio, 8 hours a day	Electric (12 kWh)	0.84	0.24
	Radio (4 torch cells)	4.60	19.40
Source: MEPD (2011).			

Electricity sector prices are set to increase to reflect the cost of development of new facilities. Shortages of fire wood are evident in the significant increase in price. It is estimated that more than 6 million tonnes of wood fuel are consumed annually when the sustainable output of natural forests is 4.6 million tonnes. This translates to a loss of 330000 ha of forest area or over 60 million trees per year. At present the annual tree planting rate is only 10 million trees (MEPD 2011).

Given the abundance of indigenous renewable energy resources for power generation, and in the interest of addressing energy related gender issues, it should be the policy to encourage low income families to use electricity for cooking by maintaining the current 300 kWh lifeline consumption level. This is also a strategy to deal with the wood fuel shortages and gender issues.

Most rural households who are unlikely to be connected to the grid or to have access to LPG (determined by the availability and affordability) could use biogas as an alternative fuel. The government is planning to roll out the use of biogas in rural institutions (schools and hospitals) for heating and cooking. Biogas digesters could also be used in urban areas.

8. Access to electricity:

The proportion of households not using electricity in the country was 62 percent. The proportion of households occupying dwelling units with electricity ranged from 17% in Masvingo to 96% in Bulawayo (CSO, 2004). The latest Household Demographic and Health Survey shows that the overall situation had improved. Thirty-seven percent of households in Zimbabwe have access to electricity that is connected via power lines. The difference in access to electricity between urban and rural areas was still significant. In urban areas, 83% of households have electricity, compared with 13% in rural areas (ZIMSTAT, 2012). It is pointed out that a significant proportion of urban households (~73%) use electricity for cooking compared to only 6% of rural households (ZIMSTAT, 2012). **Table 10** shows the changes in access to electricity between 1994 and 2010-11.

TABLE 10. Household access to electricity in Zimbabwe between 1994 and 2010-11.			
Year	**Urban**	**Rural**	**National**
1994	80.4	3.4	28.1
2005-06	91.4	8.7	37.2
2010-11	83.2	13.3	36.9
Source: Zimbabwe Demographic and Health Survey 1993-94, 2005-06 and 2010-11.			

Households in Zimbabwe are also fitted with alternative means of power generation such as generators and solar panels. In 2010-11, 18% of Zimbabwean households owned a solar panel, which may be a convenient means to power or charge electrical devices, especially in the absence of access to grid electricity (ZIMSTAT, 2012). Ownership of solar panels is much higher in rural areas (24.7%) than in urban (5.1%) areas, which is consistent with the observation that access to electricity is much lower in rural areas (see **Table 10**). The

total installed capacity in solar panels and stand-alone generators is not known. The possession of generators was fairly similar for both rural (13.2%) and urban (11%) areas (ZIMSTAT, 2012), which probably reveals the low reliability of electricity even in urban areas.

As shown in **Table 10**, the economic crisis has had a detrimental impact on electricity access in urban households. However, electrification of rural households has almost quadrupled between 1994 and 2010-11. Notwithstanding the political and economic crisis, electrification in rural areas would have been even higher.

The characteristics of the transmission and distribution infrastructure in Zimbabwe as of 2010 are summarized in **Table 11**. The country boasted 119,784 Km of distribution lines, and a total transformer installed capacity equal to 51,984 MVA for power distribution. The figures are 7,408.8 km and 8,829 MVA, respectively, for power transmission.

TABLE 11. Transmission and distribution infrastructure in 2010.

Voltage level (kV)	**Year installed**	**Line length (km)**	**Transformer installed capacity (MVA)**
400	1995	161.1	750
400/330*	1997	218.3	-
330	1959-1987	3014.1	4193 (excl 330/220)
220	1989	126	200 (330/2200
132	1960-2010	2084.6	3027
132/88*	1994-99	130	-
110	1965	62.5	30
88	1944-1988	1559.7	589 (excl 88/66)
66	1961	52.5	40 (88/66)
TOTAL Transmission & sub-transmission		**7408.8**	**8829**
33		18244	2623
22		11	-
11		47710	49361
0.4		53819	-
TOTAL Distribution		**119784**	**51984**

Source: MEPD (2011)
****Notes: denotes lines constructed at the higher voltage but operated at the lower voltage.***

The Rural Electrification Agency Strategic Plan 2011-2015 (REA, 2010) plans to extend the distribution lines (i.e. 33 kV and 11 kV) by 7,500 km between 2011 and 2015.

In general, the power generation capacity in Zimbabwe is too small to meet demand from the industry and private house holdings. Import of electricity from surrounding countries has eased the situation somewhat, but load shedding is used on a routine basis and some rural areas do not have electricity over long periods. Zimbabwe's difficult economic situation causes part of the problems, as coal for power stations may at times not be produced in sufficient amounts. On the other hand, the economy is hampered by the unforeseeable energy situation. Recently the revival of the economy has increase demand.[5] The downtimes at power plants typically constrain power supply that lead to widespread load shedding (STERP II, 2010).

Mines continue to lose production time through unscheduled electricity outages, as the country grapples with power shortages. This becomes a vicious circle since reduced coal production further constrains power generation and other economic activities (MTP, 2011).

[5] http://en.wikipedia.org/wiki/Zimbabwe_Electricity_Supply_Authority - accessed 1 June 2012.

The price of electricity is below economic costs of generation, distribution and supply (STERP II, 2010). In this respect, electricity is affordable in Zimbabwe. However, STERP II (2010) has called for the dispensation to allow electricity tariffs to reflect economic pricing, in line with regional best practices, enhanced overall revenue generation in support of improved supply of electricity.

As shown in **Table 4**, the share of renewable energy source, constituted entirely of hydro-power, was 31.5% in 2009. A word of caution concerning the high level of dependency on hydro-power is timely here. Zimbabwe's water supply is particularly vulnerable to the impacts of climate change and climate variability. The country derives around 80% of its hydro-power needs from Lake Kariba Dam. Climate change modeling shows that Zimbabwe will have lower precipitation in the future, and the variability of precipitation may increase. Hence, future decreases in rainfall will have implications for the contribution made by Lake Kariba to the Zimbabwean economy. The potential impacts can be gauged from the drought of 1991-92 that culminated in an estimated loss of some US$101 million in GDP, US$36 million loss in export earnings and the loss of 3,000 jobs (Chagutah, 2010).

9. Modern energy for productive uses:

In recent years the mining industry has faced challenges such as frequent power outages, inefficient infrastructure, flight of skilled workers, and shortages of funds for working capital and recapitalization. The manufacturing industry also has suffered constraints such as deindustrialization, inadequate and erratic supply of key economic enablers (namely electricity, fuel, coal, and water), and the high cost of establishing business (ZDHS, 2012).

The economic crisis has had a dramatic impact on sectoral electricity use. By 2008, electricity consumption patterns had shifted with domestic users consuming more energy than commercial users due to the reduced economic activity. With the recovery of the economy, this pattern is expected to change (see Figure 3, taken from MTP(2011)).

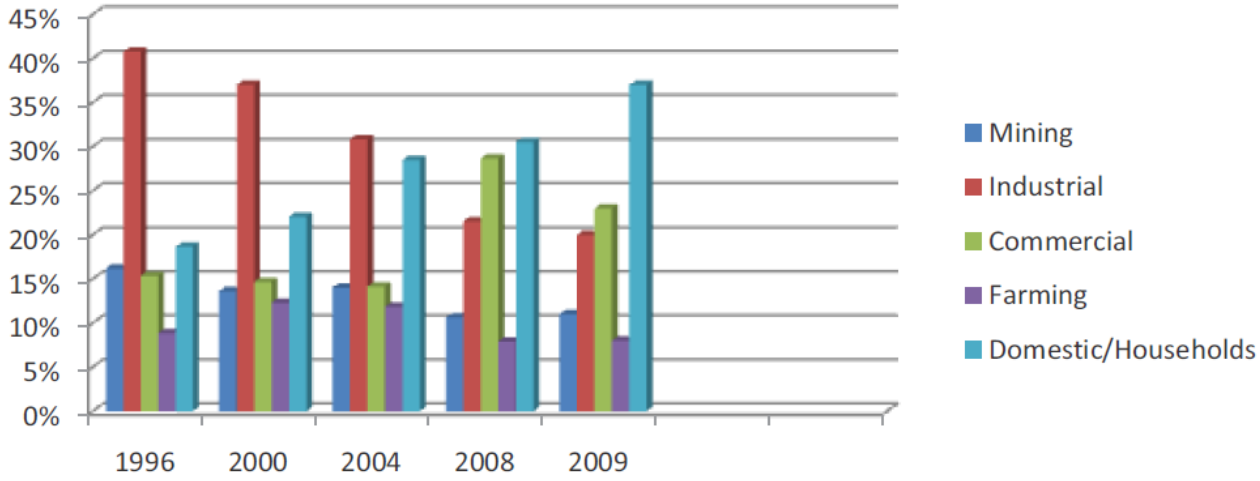

Figure 3. Sectoral electricity use in Zimbabwe, 1996-2009.

As discussed earlier, coal is the main energy source for Zimbabwe, and the mining industry plan is to increase coal production from 3,000,000 tonnes in 2011 to 7,146,000 tonnes in 2015 (MTP, 2011). In order to increase the availability of energy sources, especially liquid fuels that are imported, the government has planned to convert coal into liquid fuels. The technology is currently not available in Zimbabwe, but it is available in the SADC region, namely South Africa. The MTP (2011) also proposes to increase regional cooperation with SADC countries, which should also cover technology transfer.

Coal-bed Methane (CBM) recently discovered in the north-west of the country provides an alternative energy source to coal. The discoveries are considered to be comparable to those in the USA (according to Paul Tromp, an American who was involved in early exploration for CBM in Zimbabwe). Several exploration companies have reported viable resources awaiting further development and investment. This resource

could be used for power generation, production of pharmaceuticals, ammonia-based fertilisers and other chemicals. Many downstream industries could be developed resulting in greater employment levels and a variety of new products.[6]

Given the macro-economic situation prevailing in Zimbabwe, access to capital remains one of biggest challenges regarding technological innovation or technological transfer. The lack of liquidity on the local market translates into a high cost of capital. Discussions with stakeholders in the private sector like the Confederation of Zimbabwe Industries and Nyamhingura have revealed that interest rates for loans can be as high as 20% per annum.[7] These stakeholders also mentioned that the Indigenisation Law had a detrimental impact on foreign direct investment in productive sectors. The lack of liquidity and high cost of capital are recurring issues for all the three components of SE4ALL.

2.2 ENERGY EFFICIENCY vis-à-vis GOAL OF SE4ALL

10. Overview and Assessment

All SAPP member states have initiated energy efficiency initiatives which include the introduction of energy saving bulbs known as Compact Fluorescent Lamps (CFLs), Solar Water Heaters, Industrial and Commercial load shifting, Hot Water Load Control (HWLC), Technical Audits, commercial lighting and power correction factor. The aim is to save 1,650 MW by 2014 (SAPP, 2011).

Through the draft national energy policy, the government plans to ensure efficient utilization of energy resources. The International Energy Initiative has previously run programs to promote the efficient use of energy, most notably the Zimbabwe Energy Efficiency Project (ZEEP). Under the ZEEP, industrial efficiency has been increased, and efforts were undertaken to produce government standards for efficient appliances and equipment, for example, lighting, water heaters and refrigerators (MEPD, 2008).

11. Energy intensity of national economy:

The economy-wide energy efficiency can be gauged by looking at the energy intensity of the economy. According to IEA statistics, the energy intensity of the national economy was 2.05 toe/thousand 2000 USD (see **Table 2**). The figure is lower (0.48 toe/thousand 2000 USD PPP) when the PPP unit is used to measure GDP. In general, the higher the value of energy intensity measured by TPES/GDP would indicate that the economy were less energy efficient. There could be several reasons for this increase in the energy intensity of the Zimbabwean economy, namely:

1. Ailing equipment that are not energy efficient;
2. Equipment used at low-level and hence sub-optimal production capacity that increases the energy input for any unit of production. The industrial capacity utilization was 5% in 2008 and recovering to 57% in 2012. The strategic plan is to increase industrial capacity utilization to 80% by 2016 (Ministry of Industry and Commerce, 2012);
3. High energy intensity would also be occasioned by a sparse rural population and trading centres that are usually accessed by road transport.

Improvements in the energy efficiency of the economy can only be gauged by looking at time series data. Time series data was obtained from WDI to calculate the energy intensity of the Zimbabwe economy in terms of toe/thousand Local Currency Unit (current value) as shown in **Table 12** for selected years. The data shows that after a period of decreasing energy intensity of the economy up to 2000-2002, there has been a reversal in the energy efficiency of the economy. This shows that there is no decoupling between energy use and GDP at the aggregate nation-wide level.

TABLE 12. Energy intensity of Zimbabwe, 1980-2008 (toe/thousand current Local Currency Unit).									
1980	1985	1990	1995	2000	2002	2004	2006	2007	2008

[6] http://www.chamberofminesofzimbabwe.com/geology/energy-minerals.html - accessed 1 June 2012.

[7] Meetings were held are follows: Mr Kudakwashe Matare, Membership Services and Marketing Manager, Confederation of Zimbabwe Industries – 13 June 2012; Mr Ian McKersie, Director, Nyamhingura.

1.126	1.044	1.048	1.045	0.960	1.018	1.262	1.446	1.432	1.727
Source: World Bank (2012).									

2.3 RENEWABLE ENERGY vis-à-vis GOAL OF SE4ALL

12. Overview and Assessment

A review of opportunities and barriers to the deployment and diffusion of renewable energy technologies (RETs) in Zimbabwe has been carried out (South Centre, 2001). It showed that successful projects were enabled by key factors such as, addressing the basic needs of the people, participatory approach, awareness creation and enabling income generation activities. On the other hand, failures were due to barriers like poor institutional framework, limited financial resources, lack of appreciation of associated benefits and technology failure. Several of these barriers will be further discussed below. This analysis has shown that the penetration of renewable energy was more significant in grid and off-grid applications, when compared to the use of renewable energy sources (RES) for thermal or productive activities (non-grid tied).

13. On-grid and off-grid renewable energy

According to the IEA (**Table 4**), gross hydro-electricity generation in 2009 was 4,202 GWh, which represented 53.3% of all electricity generated in Zimbabwe. In 2009, Zimbabwe imported 41.3% of its total electricity use in 2009, and was mostly imported from HCB, Mozambique. Hence, it can be assumed that the imported electricity was mainly from hydro-power generation.

As discussed in section 8, 18% of Zimbabwean households owned a solar panel in 2010-11. Ownership of solar panels was much higher in rural households (24.7%) than in urban households (5.1%), which is consistent with the observation that access to electricity is much lower in rural areas. The total installed capacity of solar panels is not known. This statistics clearly shows the socio-cultural acceptance of the technology in rural communities. Indeed, Mapako and Aframe-Okese (2002) reported that 85,000 solar home systems were in place in Zimbabwe at the end of 2001, and most of the systems were available in do-it-yourself (DIY) kits imported from South Africa and Botswana.

DIY kits consist of a pre-engineered package that comprises the lights (3 to 6) complete with switches (fluorescent or halogen), the wiring, a charge regulator, a battery and a solar module. The cost of a 4-light system is approximately US$ 300 cash, but varies with the type of solar module supplied. In the commercial credit scheme, a 25 % down payment is required, followed by equal monthly payments. These payments can be made over a period of 6 to 24 months, depending on the customer's income and credit rating. Interest is at the commercial bank rate, currently about 30% in Zimbabwe. Civil servants may purchase without a deposit because their payments are paid direct to the store by the government Salary Service Bureau. Ownership transfers to the customer on completion of payment.[8] The customer himself is responsible for installation, operation and maintenance and there are no additional regulations on the use of the system. A booklet "All about solar" comes with each kit to give guidance, and no prior electrical skills are required.

14. Use of renewable energy sources (RES) for thermal applications (cooking/heating)

Final thermal energy consumption from primary solid biofuels was 261,162 TJ in 2009,[9] which was distributed between residential (93.0%), industry (1.9%) and agriculture/forestry (5.1%) segments.

After a period of rapid growth in the eighties and nineties, the number of installations of solar water heating systems in both the institutional and residential sector dropped to almost zero. All but a few manufacturers or installers of solar hot water systems went out of business as the house owners lost their

[8] http://resum.ises.org/documents/DIYZimbabwe.pdf - accessed 7 June 2012.
[9] http://www.iea.org/stats/renewdata.asp?COUNTRY_CODE=ZW – accessed 1 June 2012.

money to the inflation and some donors withdrew their support to the institutions. Solar industry in Zimbabwe has to a large extent been donor-driven and will in future even be more dependent on outside funding as wide sectors of the economy work below full capacity. Until 2000 the capital injected by aid organisations and private benefactors generated enough orders to keep four manufacturers of complete systems busy. The hyperinflation and the exodus of many aid organisations led to a slump in orders which nearly wiped out the solar industry in Zimbabwe.[10] Statistics on the number of installed solar water heaters is not forthcoming in Zimbabwe. However, a meeting with an importer and installer has shown that the market for SWH is growing, especially for non-household applications.[11]

A survey done in the first six months of 2007 showed that nearly 10 % of the households in Harare were using solar heated water. This is a great achievement of the various solar programmes under way for many years. In the ten years since the **Austrian Solar Project** has been on, several plumbing firms have been trained in manufacturing, installing and maintaining solar hot water systems and more than 400 hundred solar hot water systems were built and installed by local companies in this period. In order to prevent these achievements from being obliterated the project was extended by another three years. The Austrian subsidies to the institutions and private house-owners evidently reanimated the demand which in turn brought back one manufacturer into production and and kept one installer busy full-time. However, a major goal is to see more manufacturers back in business, and more orders for the installers.

It is estimated that there are 250,000 to 300,000 geysers in households. If all these are retrofitted with solar collectors the saving in peak demand could be as much as 350 to 500 MW. Industries could also save a lot of power by using solar for pre-heating water (MEPD, 2011).

15. Use of RES for productive activities

A market survey on the demand of solar water heaters in the institutional sector was carried out in the first six months of 2006. The outcome of the survey can be summarized as follows:[12]

- About 20 percent of the institutions can pride themselves on using solar water heaters even though not all units are in working condition;
- The solar water heating systems were either donated to the institutions or paid with institution-generated funds;
- A large majority regards the increased use of solar water heaters as wise but cannot afford the investment;
- Amongst the few disadvantages of solar water heating systems the high forward payment needed for the initial purchase is considered the most serious drawback;
- Most of the institutions use electric geysers for water heating which in many cases are useless in times of lengthy power failures;
- Maintenance of water heating systems only practiced at a few places;
- Knowledge about how solar systems work is quite wide spread in the country but grasp is rarely followed by implementation;
- People value highest that “Solar energy is inexhaustible” and that “The sun does not send a bill”;
- The respondents are indifferent to the claim that “SWHs use clean energy” and don’t believe that “SWHs pay back quickly”;
- The main sources of information are the print and electronic media, followed by public conversation and advice provided by traders and manufacturers of solar components;
- It has become apparent during the interviews that some respondents have unrealistically high expectations of solar water heaters; and
- Others have a very bad opinion due to their own or third party experience with low-efficiency and cheap installations.

[10] http://www.thesundrum.org/solar_energy_zim/solar_energy_zim.htm - accessed 7 June 2012.

[11] Information obtained from Mr Peter Kureva, Finance and Administrative Officer, Solahart (Zimbabwe) Ltd on 13 June 2012. Mr Kureva said that the cost of a commissioned 180L flat panel SWH was around USD2,800, making it unaffordable for most households (without any financial and economic incentives).

[12] http://www.thesundrum.org/solar_energy_zim/solar_energy_zim.htm - accessed 7 June 2012.

16. Consolidated Summary: problem statements with regard to energy access, energy efficiency and renewable energy

Energy Access

Zimbabwe is characterized by a sharp discrepancy between rural and urban areas in terms of access to modern forms of energy. With regard to fuels for cooking, rural areas rely predominantly on traditional biomass and inefficient stoves. There are both environmental and health issues related to this baseline situation, wherein only 5.8% of rural households have access to modern energy sources, including electricity, for cooking.

The rural electrification rate is somewhat higher at 13.3%. The main mandate of the Rural Electrification Agency is to provide institutions with access to electricity under the premise that once these 'hubs' are electrified, it would be much easier to connect rural communities. Correspondingly, there is a higher penetration of solar home systems and generators in rural areas.

Based on these figures, the prospects for increasing these rates of access to modern energy significantly would imply a significant increase in capital investments.

The energy security of Zimbabwe has a direct effect on energy access. Zimbabwe is heavily dependent on electricity imported mainly from Mozambique to meet its internal demand. Due to the large power supply gap in the SADC region, prices of imported electricity are increasing.

Energy efficiency and energy intensity:

The overall energy efficiency of the Zimbabwe economy is relatively low with a TPES/GDP standing at 2.05 toe/thousand 2000 USD in 2009. After a period that saw energy intensity decreasing to its lowest in 1998 (the peak year for economic output), energy intensity has increased steadily to reach 1.727 toe/thousand current USD in 2008. This shows that there is no decoupling between energy use and GDP at the aggregate nation-wide level. Some of the reasons that may explain this rise in energy intensity are:

1. Ailing equipment that are not energy efficient;
2. Equipment used at low-level, and hence sub-optimal, production capacity that increase the energy input for any unit of production; and
3. High energy intensity would also be occasioned by a sparse rural population and trading centres that are usually accessed by road transport.

Through the implementation of the National Energy Policy, the government plans to ensure more efficient utilisation of energy resources. Several initiatives are already on-going to this effect, and energy efficiency can be had on both the supply side and the demand side, as well as in power transmission and distribution.

The use of energy efficient cook stoves is very low among rural households, revealing the large potential for reducing use of fuel wood.

Renewable energy:

Assuming that all electricity imported by Zimbabwe was derived from hydro-electric power, the share of renewable energy was only 8.7% of TPES in 2009. It is assumed here that the 65.6% of

biomass in TPES was predominantly non-renewable. Hydro-power contributed 53.3% of total local electricity production in 2009. Assuming that all electricity imported in 2009 was from hydro, the share of renewable energy in the electricity mix would have been 72.8 per cent. The potential for hydro (large-scale and mini-hydro) remain untapped. Past experience shows that hydro-power generation is vulnerable to droughts, which calls for a strategy of balancing climate risks when planning future power generation in Zimbabwe. In the transport sector, E10 bio-ethanol blend is already in use in Zimbabwe. There are also a sizeable number of rural households (24.7%) that possessed solar home systems, with the national average being 18.1 per cent.

Considerable carbon mitigation potential exists in the energy sector particularly with the deployment of additional hydro-power capacity, bio-fuels in transport, and energy efficiency measures.

2.4 SE4ALL GOALS

17. Goals

- Energy access

In the National Energy Policy Implementation strategy (MEPD, 2011), the Government has aligned its plan for universal access to modern energy with that of the SADC Regional Energy Access Strategy and Action Plan of 2010 (SADC, 2010) which is *"to harness regional energy resources to ensure, through national and regional action, that all the people of the SADC Region have access to adequate, reliable, least-cost, environmentally sustainable energy services. The operational goal is to endeavour to halve the proportion of people without such access within 10 years for each end use and halve again in successive 5 year periods until there is universal access for all end uses."*

Using data given in **Table 8** on households having access to modern energies in 2010/11, the above goals have been translated into the timelines shown in **Table 13** in terms of % households using 2010 as the baseline year. Adopting the SADC Action Plan would result in near-universal in Zimbabwe. However, the targets shown in **Table 13** have to be treated with caution and need to be further qualified. The SADC Action Plan is ambitious and the most challenging part is that achieving the target of near-universal energy access is not budgeted. Consequently, achieving the targets for near-universal access would require the following steps to be completed:[13]

- Completion of the Population Census 2012 Mapping in order to establish the number of persons and households in Zimbabwe;
- Establish the level of energy access in households;
- Formulate the budget needed to achieve the targets in the SADC Action Plan;
- Leverage the required funding to implement the Action Plan.

TABLE 13. Targets for access to modern energies based on SADC Action Plan.

Year	2010	2020	2025	2030
Target (% households not having access to modern energy services)	69.5	34.8	17.4	8.7
Target (% rural households)	94.2	47.1	23.6	11.8
Target (% urban households)	21.2	10.6	5.3	2.7

[13] The steps were formulated following discussions with Mr B. Munyaradzi, Director, Policy and Planning Department, MEPD. The steps were also discussed with the Mrs Gloria Magombo, Chief Executive Officer, ZERA.

- Energy efficiency

The MEPD is currently developing sectoral energy demand forecasts for Zimbabwe, and the simulations will be finalized around the end of July 2012. ZERA will then utilize these sectoral demand forecasts to formulate medium-to-long-term sectoral energy efficiency targets for Zimbabwe.[14] Energy efficiency through DSM is being implemented in the short-term as shown in **Table 14**. As shown in **Annex 1**, there are numerous other energy efficiency initiatives that are ongoing and that may yield a higher energy saving that is given in **Table 14**.

TABLE 14. Targets for energy efficiency.

EE activity	2013	2015	2020	2025	2030
Demand side management (DSM)	Energy savings of up to 300MW (MEP, 2011)				

- Renewable energy

Table 15 summarizes the renewable energy targets for Zimbabwe.

TABLE 15. Targets for renewable energy sources.

Type of RES	Baseline (%)	2015	2020	2025	2030	References
Biofuels	Bio-diesel plant with capacity 35 million litres per annum already exists; plants to produce 40 million litres of bioethanol per year already exist in the Triangle and Hippo Valley	20% bioethanol blend	5% biodiesel blend			MEPD (2011)
Share of renewables in the electricity mix	55% in 2011	Maintain at 55%	60%			MEPD (2011)
mandate the installation of solar geysers in all new		By 2015				

[14] Discussions with Mr B. Munyaradzi, Director, Policy and Planning Department, MEPD and Mrs G. Magombo, CEO, ZERA – 12 June 2012.

homes						

Regarding the targets set for biofuels it should be noted that biofuels blends are not yet mandatory in Zimbabwe. This poses a significant challenge to investment or return on investment in this sector. For instance, GreenFuel has invested in a wholly-owned Zimbabwean bio-ethanol plant that can produce 5 million litres per month that would be equivalent to an E10 blend. However, demand is only 550,000 litres per month in the absence of the mandatory use of E10 blend, which is having adverse effects on its business operations and jobs.[15]

Section 3: Challenges and opportunities for achieving SE4ALL goals

3.1 INSTITUTIONAL AND POLICY FRAMEWORK

18. Energy and development:
All of the recent economic recovery programmes (STERP, STERP II and MTP) have emphasized the increased energy access and electrification in Zimbabwe, especially in the rural areas, as well as diversifying the national energy mix. Selected excerpts from these programmes are provided below. Further, the National Energy Policy Implementation Strategy, NEPIS (MEPD, 2011) deals directly with the Energy-Development nexus. Various elements of NEPIS are discussed in more details in the remaining sections.

STERP (2009)
275. Addressing the challenge of the resultant environmental degradation will require urgent steps to combat irresponsible behaviour by some sections of the community, unsustainable grazing practices and lack of alternative energy sources in the rural areas.

279. The Ministry will work closely with the Ministry of Energy and Power development to introduce alternative sources of energy for rural population including use of energy savings stoves, biogas, solar and wind.

380. "Getting Zimbabwe Moving Again", requires that the country has adequate and reliable energy supplies at all times. Raising the overall capacity utilisation in our industries and mines as well as agriculture will require increased energy consumption, significantly, necessitating emergency measures in support of maximising on the existing energy supplies as well as on the strategies over new alternative sources.

381. Against the background of the SADC regional power deficit, it is critical that Zimbabwe upgrades its electricity generation and transmission capacity. Thus the following are critical imperators:

- Completion Stage 1 of the Hwange rehabilitation Power Station;
- The expansion and increase of capacity at Kariba;
- The rehabilitation of the transmission and distribution infrastructure in Zimbabwe
- Securing long term import lines in respect of the country's power deficits.

394. The Inclusive Government is also exploring the development of new and renewable sources of energy such as hydro-power, wind and solar energy. Greater use of these environmentally friendly resources will reduce the current high dependence on energy imports.

[15] Discussions with Mr Derek Elliott and Mrs Jane Witz, GreenFuel – 14 June 2012. This prevailing situation has led to GreenFuel placing 4,000 of its employees on leave, while retaining a skeleton staff of 500 persons. The company has the capacity to invest in 4 additional bio-ethanol plants that would cost around USD 1.4 billion for a total production capacity of 1.5 billion litres per year. GreenFuel has also trialled flexi-vehicles that can run on E85, and it is expected that for large scale production the cost of bio-ethanol can be as low as USD1 – 1.08 per litre.

396. It remains critical that communities in rural areas enjoy increased access to electricity in order to empower them in undertaking agricultural production and other industrial ventures.

397. It is, therefore, essential that under this Programme, rural electrification be put back on course, taking advantage of the stock of available materials, such as poles, cables, and other fittings with a view of completing targeted grids and end use projects.

STERP II (2010)

153. Electricity generation benefited from the removal of the subeconomic tariff regime prevalent under the pre-STERP period.

154. The dispensation to allow electricity tariffs to reflect economic pricing, in line with regional best practices, enhanced overall revenue generation in support of improved supply of electricity.

155. Improved revenues in 2009 also allowed importation of electricity to meet increasing domestic demand.

152. STERP prioritised provision of adequate and reliable energy supplies as critical for enhancing capacity utilisation in industries and mines, among others.

156. Furthermore, economic pricing for coal in support of improved coal supplies and delivery arrangements, coupled with settlement of some of the debts between Hwange Colliery Company and ZESA, should support thermal electricity generation.

158. Deregulation and liberalisation of fuel procurement, marketing and pricing under STERP has overcome previous challenges related to distribution and availability of fuel throughout the country.

MTP 2011-2015 (2011)

- "The MTP will pay particular attention in addressing the key enablers, that is, Electricity, Water, Transport and ICT among others."

- "The availability of adequate and reliable energy is critical for the attainment of economic recovery, growth and transformation. The commercial energy industry is dominated by electricity, while wood fuel provides energy for domestic use mainly in the rural communities and urban poor. Electricity supply is a key determinant for output across all industries of the economy, in particular, mining, manufacturing and agriculture. Persistent power outages over the past years have contributed to continual economic decline. If this problem is not addressed it will be difficult to achieve the envisaged growth rates. The MTP will ensure that the energy sector does not restrict economic development but fully supports economic development as an enabler."

Table 16 summarizes the main energy policy objectives and targets prescribed by MTP (2011).

TABLE 16. Main energy policy objectives and targets for Zimbabwe.

Sector	Policy objectives	Policy target	Implementing agency
Liquid fuel sector	-To ensure adequate supply of fuel for both domestic and industrial use; -To produce and use biofuels.	-Establish an independent regulator by 2011; (*Please note that ZERA was established in September 2011*) -Beira pipeline capacity utilisation to be over 90% by 2011; -Produce and use ethanol blend and bio-fuels by 2012;	Ministry of Energy & Power Development

Energy sector	To restore and increase power generation capacity to meet national demand for the attainment of economic recovery and growth	-Restoration of generation capacity at Hwange to installed capacity by 2012; -Lease of small thermals to increase electricity supply by 290MW by 2011; -Installation of prepaid meters by 2012; -Institute demand side management to energy savings of up to 300MW by 2013; -Electrify rural areas and reduce fuel wood consumption;	-Ministry of Energy & Power Generation; -Zimbabwe Electricity Supply Authority;
Water and sanitation sector	Utilise water bodies for hydro electricity schemes		Ministry of Water Resources Development and Management
Source: MTP (2011)			

The following institutions are in charge of energy sector within the context of economic and social development in the country:

- ✓ Ministry of Energy and Power Development (MEPD)
- ✓ Rural Electrification Agency (REA) (which is expected to be replaced by the Rural Energy Agency – see section 24)
- ✓ Zimbabwe Electricity Supply Authority (ZESA)
- ✓ Ministry of Mines (for coal used in thermal power plants)

19. Thermal energy for households:

Currently there are no targets, policies, strategies and plans for addressing modern energy access for thermal applications for households. The restructuring of the Rural Electrification Agency into the Rural Energy Agency will bridge this gap.

20. Power sector:

The National Energy Policy (MEPD, 2008) and its Implementation Strategy (MEPD, 2011) define the policies, strategies, actions plans, including targets for power sector development in Zimbabwe (**see Table 17**).

TABLE 17. Medium-to-long term power sector development plan and targets, 2012-2020.

Energy Resource			**Projected 2011**	**Medium 2012-2015**	**Long Term 2016-2020**
RENEWABLE ENERGY	Large scale hydro	Kariba	650 MW; 5000 GWh	750 MW; 5000 GWh/a	1050 MW; 5000 GWh/a
	Small-scale hydro	Eastern Highlands; inland dams	1 MW; 2.5 GWh	30 MW; 123 GWh/a	No data
	Bagasse		14 MW; 2 GWh	16 MW; 34 GWh	No data
	Solar PV		No data	No data	No data
	TOTAL	**Known data**	**665 MW; 5005 GWh**	**798 MW; 5157 GWh**	**1096 MW**
FOSSIL ENERGY	Coal	Hwange	500 MW; 3680 GWh	750 MW; 4000 GWh	1350 MW

TABLE 17. Medium-to-long term power sector development plan and targets, 2012-2020.					
Energy Resource			**Projected 2011**	**Medium 2012-2015**	**Long Term 2016-2020**
		Small thermals	90 MW; 650 GWh	180 MW; 798 GWh	180 MW
	Petroleum	Self-generation	No data	No data	No data
	TOTAL	**Known data**	**590 MW; 4330 GWh**	**930 MW; 4768 GWh/a**	**1530 MW**
OTHER ENERGY	Electricity	Firm Imports	100 MW; 1595 GWh	100 MW; 1581 GWh	No data
		Exports	150 MW; 1074 GWh	150 MW; 1314 GWh/a	No data
		Net firm imports	**-50 MW; 521 GWh**	**-50 MW; 267 GWh/a**	**No data**
		Non-firm imports	600 MW	100 MW	700 MW
TOTAL	**All known firm sources**		**1205 MW; 9856 GWh**	**1678 MW; 10102 GWh**	**2626 MW**
Source: MEPD (2011).					

Renewable energy provides 55% of firm electricity capacity, fossil energy 49% and net exports comprise 4%. The mid-term electricity supply mix is projected to be 47% renewables, 56% fossil and 3% net exports. By 2020, renewable energy drops to 42% and fossil energy increases to 58% due to the Hwange Power Station extension project adding twice the capacity of Kariba South Extension. The vision in the Medium Term Plan is to increase power generation so that the country becomes a net electricity exporter. This can be fulfilled by prioritising renewable energy development through the development of the Batoka hydroelectric power station for commissioning before 2020. Regional cooperation with Zambia and other members of the Southern African Power Pool can facilitate the development of this scheme (MEPD, 2011).

The Ministry of Energy and Power Development is responsible for energy policy and planning under four directorates: **Policy and Planning** (which manages the policy making and planning process); **Power Development** (electricity sector policies and plans); **Petroleum** (petroleum sector policies and plans); and **Energy Conservation and Renewable Energy** (conservation and renewable energy policies and plans). Government will restructure the Ministry of Energy and Power Development to ensure accountability for policy and planning for all energy resources and cross-cutting issues. This is a specialised task that requires the engagement of consultants. It is proposed to have this work completed by September 2012 (MEPD, 2011).

Currently in Zimbabwe, electricity is generated, transmitted and distributed by the state-owned Zimbabwe Electricity Supply Authority, (**ZESA**), which is officially called ZESA Holdings (Pvt) LTD. ZESA is the only electricity generator and supplier for the national grid. ZESA has a subsidiary that generates power (Zimbabwe Power Company, ZPC), and another one that transmits and distributes electricity (Zimbabwe Electricity Transmission and Distribution Company, ZETDC). ZESA also has an investment subsidiary called **ZESA Enterprises** (ZENT). ZESA is also an Operating Member of the Southern Africa Power Pool (SAPP), which has as its aim to provide the least cost, environmentally friendly and affordable energy and increase accessibility to rural communities in the Southern African Development Community (SADC). The national grid of Zimbabwe is interconnected with those of Mozambique, Botswana and Zambia. ZESA operates under the aegis of the Ministry of Energy and Power Development.

The Zimbabwe Energy Regulatory Authority (ZERA) was established in September 2011 by the Energy Regulatory Authority Act of 2011 *"to regulate the procurement, production, transportation, transmission, distribution, importation and exportation of energy derived from any energy source"* (***ERA Act, section 4(1)(a)***). Its main role is to carry out policy monitoring and enforcement (MEPD, 2011). Accordingly, ZERA is required *"to create, promote and preserve an efficient energy industry market for the provision of sufficient*

energy for domestic and industrial use … to promote and maintain effective competition within the energy industry" (***ERA Act, section 4(1) (b) and (g)***).

Power tariffs do not reflect the economic cost of generating and delivering electricity. STERP II (2010) has called for the dispensation to allow electricity tariffs to reflect economic pricing, in line with regional best practices, enhanced overall revenue generation in support of improved supply of electricity. ZERA is entrusted to review the pricing of electricity.

21. Modern energy for productive sectors:
At its peak the economy consumed 4.5 million tonnes of coal per year. About 3.5 million was used for electricity generation, 0.5 million for coking coal and the remainder for industrial heating and agricultural crop processing, especially tobacco curing. The market is currently down to 3 million tonnes that are mostly used for power generation. The challenge is the lack of clear principles for the pricing of coal. It is essential that the price is related to both quantity and quality, in particular the energy content. Zimbabwe does not have any specific sectoral energy policies and strategies. MEPD is currently developing sectoral energy forecasts, and ZERA will have oversight over the implementation of necessary energy policies for achieving the sectoral energy demands.

22. National monitoring framework for SE4ALL:
Table 18 gives the proposed list of indicators for measuring and monitoring achievement of SE4ALL goals in Zimbabwe.

TABLE 18. Proposed indicators to measure and monitor achievement of national SE4ALL goals.

Energy Access	Energy Efficiency	Renewable Energy
- Access to electricity (rural & urban breakdown) – ZDHS - Types of fuels used for thermal application (rural & urban breakdown) – ZDHS - Number of stand-alone generators - Number of solar home systems and sizes - Number and size of solar water heaters used by households - Type of cook stoves used by households	- Economy-wide Energy intensity (toe/unit of total GDP) - sectoral energy intensity (toe/sectoral GDP) - power loss in transmission and distribution of electricity - efficiency of power generation (toe/MWh) - grid emission factor (tCO2/MWh) - Number of energy efficient cook stoves used by households & weight of fuel wood used by household	- Share of renewable energy in TPES (%) - Share of renewables in electricity mix (%) - Share of renewables in liquid fuels used in transport (%) - Number and size of solar home systems - Number and size of solar water heaters used by households

In order to be able to monitor and evaluate progress made towards SE4ALL, the following would be required:

Households – ZDHS should also include statistics on type, size and usage of solar home systems, generators/battery (applicable for any non-grid electricity generating technologies);

Energy resources – The government has carried out a gaps analysis regarding the potential for various renewable energy sources in Zimbabwe. The table below is reproduced from the National Energy Policy Implementation Strategy (MEPD, 2011), and shows the gaps (**Table 19**) that need to be addressed in order to achieve the targets given above.

TABLE 19. Energy resource potential and data gaps.				
Energy Resource			**Potential**	**Currently exploited**
RENEWABLE ENERGY	Large scale hydro	50% share of Zambezi	3400MW; 18600 GWh/a	750 MW; 5000 GWh/a

TABLE 19. Energy resource potential and data gaps.				
Energy Resource			**Potential**	**Currently exploited**
	Small-scale hydro	Inland dams & run of river schemes	430 MW; 88.4 GWh/a	2 MW; < 3 GWh/a
	Biomass	Wood fuel	4.6 Mt/a	6 Mt/a
		Bagasse	1.5 Mt/a	No data
		Forest residue	70000 t/a	No data
	Liquid Biofuels	Ethanol	40 Ml/a	No data
		Biodiesel	100 Ml/a	Nil; no feedstock
	Animal	Draught power	No data	No data
		Waste (biogas fuel)	13 M m^3/a	No data
	Solar	PV	20 MJ/m^2/day = 5.7 kWh/m^2/day	No data
		Thermal		No data; ~ 1% of potential
	Wind		3 m/s	No data
	Geothermal		Unknown; ~ 50 MW	No data
	Other	Municipal waste, etc	No data	No data
FOSSIL ENERGY	Coal		12 billion t/a	3-5 million t/a
	Gas	Coal-bed methane	Unknown; ~ 1132 billion m^3/a	Nil
		Natural gas	Unknown; ~ 614 billion m^3/a	Nil
	Petroleum	Local	Unknown	Nil
		Imported	Not applicable	5.3 Ml/day
OTHER ENERGY	Nuclear	Uranium	No data	No data
	Electricity	Imports	Policy dependent	1595 GWh/a
		Exports	Policy dependent	1074 GWh/a
		Net	Policy dependent	521 GWh/a
TOTAL ENERGY	**All (in ktoe)**		**No data**	**No data**
Source: MEPD (2011).				

Capacity building: The above would require institutional capacity building in data collection and analysis.

3.2 PROGRAMS AND FINANCING

This section should provide an overview of on-going/planned programs, further details such as project titles, financing and partners should be provided in Annex 1(see matrix below).

23. Thermal energy: programs and financing to improve access, efficiency and use of RES for cooking and other household needs

It is estimated that about 70% of Solar Home Systems sold are sold through credit, and only 30% on a cash basis.[16] The systems are available in credit stores, directly from the producer's shop and from other solar suppliers. By using credit stores, a distribution network of approximately 120 branches countrywide was established. It was not found cost effective to set up their own branches. The credit stores have their own infrastructure, each covers an estimated radius of about 100 km radius. The stores stock a limited quantity of consumables such as tubes and halogen capsules. It was not found necessary to stock complete lights and charge regulators. Should these fail, they are replaced by the supplier, if still under guarantee, or the customer must purchase a replacement if not covered by guarantee. Advantages of DIY Solar Home systems are:

[16] http://resum.ises.org/documents/DIYZimbabwe.pdf - accessed 7 June 2012.

- ✓ The cost of the systems is greatly reduced (by up to 50%) because no installation and travel costs are involved. Government is providing incentives for local production of Solar Home systems in order to further reduce cost of equipment;[17]
- ✓ The sales staff in the credit stores and other outlets are trained by the system supplier on system operation and use in order to advise their customers;
- ✓ Because credit customers will not pay installments for a non-working system, the supplier is instantly aware of any problem. Also the supplier is not dealing with a possibly unsophisticated rural buyer but with the management of the credit store, so must rectify the problem or reimburse the store.
- ✓ Shoddy suppliers cannot remain in business for long.

Demonstrations in villages have proven to be very effective advertising measures. Contract negotiations then take place in the credit store, or in the shops. The procedure includes a discussion of how many lights, whether or not the customer has a TV, and how many hours per day he expects lighting.

There is no import duty on solar products and companies can claim back VAT on all input products.

Since traditional biomass is expected to remain the dominant source of energy for thermal applications in the near-future, there are efforts to increase the stock of forest biomass through afforestation projects. However, such initiatives appear to fall short to bridge the mass balance of supply and demand for fuel wood as explained in section 7. Further, as shown in **Table 8**, charcoal represents an insignificant share of combustibles in the emery mix for thermal applications at the household level. This clearly shows that alternative options such as sustainable charcoal production is not practiced in Zimbabwe. Further, the diffusion of energy efficient cook stoves remains very weak. These observations collectively show that much more has to be done for achieving sustainability in energy use for thermal applications. Also, there was no evidence that financial and economic schemes were available to incentivize households to adopt energy efficient and/or renewable energy sources.

24. Power sector: programs and financing to improve access, efficiency and use of RES for power supply

The Rural Electrification Fund (managed by the Rural Electrification Agency) has provided a successful model for promotion and funding of renewable energy projects for electrification by charging a levy on electricity services. The Fund's objects include the need to "give particular attention to off-grid, stand-alone technologies for the supply of electricity to rural communities". The definition of rural electrification project specifies that this includes "construction or extension of works for the distribution of electricity and the financing of its end-use infrastructure, including the construction of isolated mini-hydroelectricity, solar and wind generators for centres away from the national electricity grid" (MEPD, 2011). It is pointed out that NEPIS (MEPD, 2011) has proposed restructuring the Rural Electrification Fund into a Rural Energy Fund that will cater for all the rural energy needs of the nation. The Rural Energy Fund will be capitalised in two ways:

a) The ***Electrification Account,*** with respect to levies and other fees charged on electricity services; this will continue to be used for electrification projects.
b) The ***General Energy Account***, with respect to levies and other fees charged on non-electricity licensees and customers; this will be used to support all non-electricity rural energy services projects and programs.

The Rural Energy Agency will supersede the Rural Electrification Agency, and it will manage the Rural Energy Fund.

The timeline for planned generation projects is shown in **Table 17**. Please see Annex 1 for details about new power projects. The website of the Zimbabwe Power Company (ZPC) mentions the following power development projects:[18]

[17] http://www.energy.gov.zw/index.php/investment-opportunity - accessed 7 June 2012.

Kariba South Extension Project Description: Engineering, Procurement and Construction of intake structure, power tunnel and two turbines with 150 MW power generation capacity each, underground powerhouse, surge chamber, tailrace tunnel and outfall structure.

Hwange Stage 3 Expansion Project Description: Engineering, Procurement and Construction of 2 x 300MW additional coal fired units and related auxiliaries at Hwange power station in Hwange, Zimbabwe. Integration with some of the current facilities on the existing Hwange Power Station is required.

The Zimbabwe Power Company appointed Hatch Africa (Pty) Ltd as Consultant (Owner's Engineer) for the development of the Hwange Coal Thermal Power Plant and Kariba Hydro Power Plant Expansion Projects. The appointment will be for the total project execution and will entail the project review, through engineering, construction, and commissioning, until the end of the warranty period. The scope of these projects is to build 2 x 300MW thermal power plant units on the open area at Hwange Power Plant on the southern side of the existing unit 6. The extension project at Kariba South Power Station will add 300 MW additional generating capacity. The units will be housed in a separate underground powerhouse, with new intake tunnels from Lake Kariba, for utilizing the water of the Zambezi River to generate peaking power.

ZPC is currently developing its Vision 2040, and the planned power generation to 2040 is given in **Table 20**.

TABLE 20. Options identified to supply 10,000 MW of power by 2040.

	PROJECT	OUTPUT (MW)	ESTIMATED COST (million USD)	PROJECTED COMPLETION DATE
1	Kariba South 7 & 8	300	771	2016
2	Hwange 7 & 8	600	1 830	2015
3	Coal Bed Methane	300	580	Depends on gas availability
4	Gokwe North	1 200	2 800	2020
5	Batoka Gorge Hydro Plant	800	2 200	2020
6	Hwange life extension	920		
7	Existing Kariba South Power Station	750		
8	Small thermals re-powering	340	250	
9	Gairezi mini-hydro	30	90	
10	Western Coal Field Power Plant	1 200		
11	Kondo Hydro power plant	100	300	
12	Devil's Gorge hydro power plant	620		
13	Mutapa Gorge hydro power plant	500		
14	Kahora Bassa North	550		
15	ZPC solar	250		
16	Lusulu Power Plant	2 400		

[18] http://www.zpc.co.zw/index.php/2012-02-18-02-07-43 - accessed 4 June 2012.

17	Essar power plant	600		
	TOTAL by 2040	**11 210**		
Source: ZPC (2012).[19]				

Concerning grid maintenance and upgrade, REA has planned to extend the distribution network by 7,500 km by 2015 (REA, 2010).

The biggest challenge remains financing of these large infrastructure projects.

25. Modern energy for productive use: programs and financing to improve access, efficiency and use of renewable resources in productive sectors

To date there are no targeted programmes in the form of financial support schemes to assist the productive sectors to invest in energy efficiency and/or renewable energy projects. Comparatively, there are more projects targeted at households as shown in Annex 1. Discussions with ZERA have revealed that it will be in a position to formulate targets for energy efficiency in the productive sectors once their demand power loads have been forecasted by MEPD. Through its Electricity End Use Infrastructure Development (EEUID) scheme, REA is promoting the utilisation of electricity for productive uses (REA, 2010). The EEUID is expected to create a virtuous circle of increasing the use of electricity for productive uses thereby improving the livelihoods of Zimbabweans. In turn, an increased utilisation of electricity will increase the capitalization of the Rural Electrification Fund – i.e. improving the financial sustainability of enhancing modern energy for productive uses. This is very important since the sustainability of any programme will rest on the availability of funds that remains arguably the biggest big bottle neck in Zimbabwe.

3.3 PRIVATE INVESTMENT AND ENABLING BUSINESS ENVIRONMENT

26. Thermal energy for households:

The number of private sector players involved in supplying technologies for thermal energy for households such as SWH remains low, making the market relatively uncompetitive.[20] There is also much less emphasis on the transfer of technologies and their diffusion for cooking and other thermal applications. For instance, the majority of projects related to the deployment of energy efficient cook stoves have been at the pilot level, and have suffered from up-scaling due to lack of funding.[21]

27. Power sector

To date, the power sector is serviced by the state-owned Zimbabwe Power Company. In order to promote private investment in the power sector to meet the objectives of the MTP 2011-2015 (2011), the Government will invite the Private Sector to become an important partner either in PPPs or in independent projects, commission sectoral projects in the areas of electricity, transport, water, and ICT. The PPPs will be effectively facilitated and promoted with the implementation arrangements guided by a transparent and competitive process. This will tap into financial resources and expertise from the Private Sector for the rehabilitation and development of key infrastructure projects outlined in this Plan.

The MTP (2011) has identified a series of measures to enhance investment in the power sector. Through these measures, the current critical gaps and barriers to electricity access, energy efficiency and renewable energy can be derived.

<u>Promoting investment in the power sector</u>

i. Setup of an independent Energy Regulatory Board (ZERA was set up in September 2011);

[19] Table was provided by ZPC following meeting with the Managing Director on 11 June 2012.
[20] Discussions with Mr P. Kureva, Solahart – 13 June 2012.
[21] Discussions with Mrs Joyline Tawha, Energy Coordinator, Practical Action – 13 June 2012. Some pilot projects were undertaken at Gwanda, Hurungwe and Chimanimani using mud stoves (Jengetahuni, Qedudubo or Chingwa stoves).

ii. Implement cost reflective tariffs to ensure sustainability. This will be complemented and matched with quality service delivery;
iii. Review the systems and processes within commercial operations to enhance billing, revenue collection, cash management and customer service;
iv. Leasing of the small thermal power stations to the Private Sector for their direct consumption to increase productivity or for sale to other consumers/utilities;
v. Explore various technologies and support appropriate investments, including providing for the necessary incentives for the promotion of Low Carbon Economy (LCE), e.g., renewable energy technologies in solar and wind energy. These will include reduction of import duties, as well as provision of other tax incentives;
vi. Continue to explore the viability and capacities to produce LCE renewable energy alternatives: bio fuels which are environmentally friendly and have potential to reduce high dependence on fossil fuel energy generation and imports. Viability of these projects will also be beneficial to farmers who produce bio fuels feedstock;
vii. Eliminate the market for stolen equipment (such as cables, transformers, metres) through enforcement of good corporate governance (provision of key economic, cultural, institutional and information conditions) and surveillance by utilities and law enforcement authorities; and
viii. Create an enabling environment for a competitive power market through the participation of IPPs;

28. Modern energy for productive sectors:
Discussions with private sectors stakeholders revealed the presence of some key barriers for investment in modern energy for productive uses (please see footnote 5):

- ✓ Lack of liquidity in the country;
- ✓ High cost of capital;
- ✓ Lack of knowledge about the benefits of modern energy in productive sectors;
- ✓ Lack of technical knowhow (including energy auditing) even when awareness is present;
- ✓ Lack of cost-reflective tariffs in the power sector that translate into disincentives for IPPs to invest in power generation;
- ✓ Lack of policy coherence regarding for example import duties and VAT on non-solar renewable energy or energy efficiency equipment that in the power sector translate into higher electricity tariffs. Coupled with the non-cost-reflective electricity tariffs leads to a disincentive for private investments;
- ✓ Lack of medium-to-long-term loans with preferential conditions (i.e. dedicated credit lines) by financiers to allow investors to take risks to recover costs over a longer time period;
- ✓ There is the perception that the indigenization law is preventing foreign investment in productive sectors;

Nevertheless, there is an example of innovative market-based system for supporting productive activities at the rural level. For instance, SNV is planning to train and capacitate young entrepreneurs in the design and manufacturing of bio-digesters, and linking these entrepreneurs to productive end-users like pig farmers, abattoirs and dairy farmers who have a need for such technologies. Since these end-users need a viable environmentally-friendly means to deal with their polluting wastes, the bio-digester becomes a commercially viable option.[22] The bio-digesters can be used to: (1) generate heat; (2) provide lighting; and (3) electricity for productive uses.
Also, the Business Council for Sustainable Development (Zimbabwe) that has 200 members (of which some a very large energy consumers) has aligned itself with the Vision 2050 of the World Business Council for

[22] Discussions with \Mrs Chandi Mutubuki-Makuyuna, Senior Advisor Renewable Energy, SNV – 13 June 2012. Mrs Mutubuki-Makuyuna also provided the example where pig farmers are fined by the enforcement authority for not dealing with the pig excrements. In such cases, investment in a bio-digester is financially viable waste management option.

Sustainable Development (WBCSD). WBCSD also has proposed an action plan for energy access, energy efficiency and renewable energy, among others, that is in consonance with SE4LL.[23]

3.4 GAPS AND BARRIERS

The African Development Bank (2011) points that among other things Zimbabwe's economic recovery is affected by the persistent liquidity shortages, lack of fiscal space and limited access to offshore lines of credit. Thus given this obtaining scenario the financing of these well-crafted and well-meaning policies could prove to be the main challenge to their implementation. In Zimbabwe, the energy sector is dominated by the power sector, and government has laid correspondingly more emphasis on dealing with gaps and barriers in the power sector.

29. Thermal energy for households:
The Consumer Council of Zimbabwe has explained that the high upfront capital investment of modern energy technologies, lack of awareness about the benefits of modern energies, and lack of technical capacity and quality standards remain high barriers for the diffusion of modern energies for household application. It also mentioned that there was the socio-cultural barrier of the prevailing practice of using fuelwood for thermal applications, especially in rural areas.[24]

The Energy Technology Institute (ETI) is in the process of developing indigenous renewable energy (solar water heaters), energy efficient (e.g. a 33% efficient cook stove) and modern fuels (e.g. briquettes and gels) in order to lower the cost of these technologies.[25] However, ETI would require the necessary financial assistance to bring the prototypes to market. The manufacturing of these technologies also has the potential of job creation. ETI is also employing a stage-gate process whereby it is mapping out the entire supply chain in order to bring the products to the end-users in the most efficient and effective way.

The restructuring of the REA into the Rural Energy Agency will bridge the institutional gap that exists to promote modern energies for thermal applications in households.

30. Power sector:
The main challenges faced in the generation and distribution of electricity include the following (MTP, 2011):

i. Billing and collection;
ii. Lack of financial resources;
iii. Aged and obsolete equipment and poor state of infrastructure;
iv. Operational challenges including undercapitalization compounded by debt ridden financial positions;
v. Inadequate specialized skills and tools required for planning and forecasting energy needs;
vi. High cost of rural electrification through grid extension and due to the scattered nature of settlements; and
vii. Theft and vandalism of infrastructure.

The MTP (2011) has also identified policy means to overcome legal and regulatory barriers, as well as measures required to increase much needed investment in the power sector. The legal and regulatory measures aim to overcome a host of enforcement deficiencies that should enhance the liquidity on the supply side.

[23] Discussions with Mr Tendayi Marowa, Vice-chairman, Technical Committee on Energy, BCSD (Zimbabwe) – 14 June 2012.
[24] Discussions with Mrs Rosemary Siyachitema, Executive Director, The Consumer Council of Zimbabwe – 12 June 2012.
[25] Discussions with Dr S. Ziuku, Senior Scientist, Energy Technology Institute, SIDRC (and colleagues) – 14 June 2012.

Legal and regulatory framework

i. Review of the legal and regulatory framework governing the energy sector and adoption of the Draft Energy Bill that will pave way for the liberalisation of the sector;

ii. Strengthening of the energy regulator to deal with setting of viable electricity tariffs and the regulation of independent power producers and consumers;

iii. Institute stiffer penalties to the whole chain of offenders through the review of the existing legislation against theft and/or vandalism of national assets;

iv. Establish legislation to enforce environmental impact certification for all infrastructure projects before project commencement; and

v. Take necessary actions so that the Standards Association of Zimbabwe is empowered as a regulator of standards regarding energy-related technologies (in this particular case).

31. Modern energy for productive sectors:

The Ministry of Economic Planning and Investment Promotion is responsible for providing the enabling regulatory framework for investment. However, MTP (2011) has sought to enhance the enabling conditions for modern energy use in productive sectors by: (1) setting up an Independent Energy Regulator; and (2) restructuring the National Oil Company of Zimbabwe (NOCZIM) to eliminate conflict of roles/interests by separating service provision and operating the infrastructure. The government also wishes to increase the production of liquid bio-fuels (ethanol and bio-diesel). Zimbabwe already produces ethanol at the Triangle Ethanol Plant and by GreenFuel. However, the regulator should investigate the possibility of making biofuel blends mandatory so that private investors have more visibility about their investments.

The biggest constraints for the further diffusion of modern energy for the productive sectors are:

i. Aged equipment and poor state of infrastructure; and

ii. Undercapitalization compounded by debt-ridden financial positions.

32. Summary: key gaps, barriers and additional requirements

The biggest challenge for Sustainable Energy for All in Zimbabwe remains the lack of funding and capitalization following the recent macro-economic downturn. This poses challenges for both the replacement of aged equipment in the productive sectors, increasing the generation capacity in the power sector and providing fiscal and economic incentives for energy efficiency and renewable energy at all levels. There are also institutional barriers related to incentivising the private sector to generate electricity. For instance, the active involvement of IPPs in power generation remains to be realised.

There is also a shortage of technical skills and expertise to develop and adopt energy efficient and renewable energy technologies. Local financiers and developers often cannot design and or implement appropriate financing packages adapted to these technologies mainly due to low liquidity levels prevailing in the country. This leads to a vicious circle of increasing the cost of capital with taxes being relatively high between 14-18% per annum.

The non-cost-reflective tariffs and inadequate revenue collection might be a big challenge in the context of rural electrification.

To date there has been a lack of institutional framework to oversee energy access in rural communities. However, this is expected to be overcome by the setting up of the Rural Energy Agency.

Zimbabwe does not have any medium-to-long term targets for energy efficiency and renewable energy that make it hard to plan for low carbon development. Further, the costs associated with implementing the energy access targets of the SADC Action Plan is not known making it hard to know whether the targets would be realistic for Zimbabwe.

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Annex 1 –Matrix of existing programs and required financing for achievement of SE4ALL goals

1.1 On-going initiatives by the Government and development partners

This table was completed following face-to-face meetings with key stakeholders as noted in footnotes. As such it is not meant to be an exhaustive review of on-going projects but serves to give an indication of the range of initiatives that are taking place in Zimbabwe.

Title	Lead Agency	Financier	Relevant SE4ALL Goal(s) (Access/Efficiency/Renewable Energy)	Brief description and time frame	Value, US$
Roll out the use of biogas in rural institutions (schools and hospitals) for heating and cooking.	REA[26]	Government of Zimbabwe	Access and Renewable Energy	Deployment of bio-digesters to 100 institutions on a cost recovery basis. The main use will be for thermal applications; 2012-2013	1.5 million
Solar lanterns	REA	Government of Zimbabwe	Renewable Energy and Access	Distributions of solar lanterns in rural communities on a pilot basis; 2012-2013	1.5 million
Restoration of generation capacity at Hwange power plant	ZPC[27]	ZPC + intensive electricity users	Access	Restoring generation capacity of Hwange thermal power plant to 920 MW; by 2017	~480 million
Increase oil pipeline capacity by 50%			Access	Increase the carrying capacity of oil of 120 million litres per month by 50% by installing booster pumps; 2012	
Rural energy Master Plan	Rural Energy Agency	Electricity and general energy levies	Access, Efficiency and Renewable Energy	Develop a master plan for rural energy access, including deployment of small-scale renewable energy technologies	
Renewable Energy Feed in Tariffs	ZERA		Renewable Energy	establish cost-reflective renewable feed in tariffs (REFIT) with appropriate subsidy mechanisms and other incentives to promote grid and off-grid power generation using solar and other renewable energy resources; 2012	
Bio-ethanol	Green Fuels	Green Fuels	Renewable Energy	Production of at least 80 million litres of bio-ethanol per year	

[26] Discussions with Mr F. Nyikayaramba, Alternative Energy Technology Manager, REA – 12 June 2012.

[27] Projects related to ZPC and the Zambezi River Authority were covered during a meeting with Mr N.F. Gwariro, Managing Director, ZPC, and ZPC staff on 11 June 2012.

Gairezi	ZPC	ZPC	Renewable Energy	30MW turbine; by 2015	~90 million
Batoka hydro	Zambezi River Authority	World Bank (expected)	Renewable Energy	1600MW shared equally between Zimbabwe and Zambia; by 2025	~3.6 billion
Kariba South Extension	ZPC	Export Credit Agencies (75%-80%) + ZPC (20-25%)	Renewable Energy	2 X 150 MW; by 2017	~771 million
Demand side management - Energy efficient lighting	ZETDC[28]	ZETDC	Energy Efficiency	Distribution of 5.5 million CFLs to households (450,000 in total) for an expected power saving ob ~180 MW/year; 2012-2013	11 million
Demand side management - Ripple relays control system	ZETDC	ZETDC	Energy efficiency	Project consisting of 2 phases to: (1) Phase 1 – refurbish ripple relays on existing electrical household geysers & switching stations; (2) Phase 2 – extending project to households not already fitted with ripple relays; Phases I and II are expected to save 30MW and 180MW / year; 2012-2013.	3.2million
Demand side management - Pre-payment metering	ZETDC	ZETPC	Energy efficiency	Distribution of 580,000 pre-payment meters based on successful completion of a pilot project (15,000 meters). Expected power saving is 60-80MW; 2012-2013	53 million
Statistical metering	ZETDC	ZETPC	Energy Efficiency	Carrying out statistical metering on transmission and distribution networks to assess losses; 2012-2013	
Greening industry in Zimbabwe: promoting renewable energy for productive uses	UNIDO[29]	Renewable Energy Fund to be capitalized by private overseas companies and companies in the timber industry	Energy Efficiency and Renewable Energy	Avoid greenhouse gas emissions by developing and promoting a market environment that will stimulate investment in renewable energy for productive uses in Zimbabwe; 5 years from start of project	25 million

[28] Projects related to ZETDC were covered during a meeting with Mr E.A. Ncube (Commercial Director, ZETDC) and Mr H. Choga (Transmission and Distribution Director, ZETDC) on 11 June 2012.

[29] Details about UNIDO projects and concepts were provided by Mr T. Mushayandebvu, Head of Operations, UNIDO, Harare on 11 June 2012.

Improvement of industrial energy efficiency in Zimbabwe	UNIDO	To be decided	Energy Efficiency	To improve EE in the industrial sector by implementing energy management system (ISO 50001, energy system optimization and process optimization with possible combination with solar energy utilization; 4 years from project start	8.77 million
Green industry initiative for Zimbabwe	UNIDO	To be decided	Renewable Energy	The objectives of this programme are to: (i) acquire knowledge on Green Industry; (ii) create and capacitate a government committee o lead a Green Industry strategy and policy formulation process; (iii) disseminate information and stakeholder framework involving business and labour; and (iv) develop, source funding and implement a comprehensive Green Industry Programme ;2012-2015	
Extending distribution network Electricity access to institutions Decentralized PV plants Solar Home Systems Establish productive electricity end uses (EEUID) Mini-hydro	REA	Rural Electrification Fund	Access Access Access and Renewable Energy Access and Renewable Energy Access Access and Renewable Energy	Extend the distribution network of 11kV and 33kV lines by 7,500km;2011-2015 2,500 institutions electrified by 2015 8 X 10 MW PV plants connected to the grid by 2015 150 off grid solar home systems installed by 2012 support the establishment of 580 irrigation, agro-processing and cottage industries by 2015 install 4 mini hydro plants by 2015	855 million
Regional hydro project	Practical Action (in collaboration with REA)	EU	Access and Renewable Energy	6 X (20-30 kW) small hydro plants for productive users and institutions; 2012	720-840 thousand

Micro-hydro and solar water pumping	Practical Action (in collaboration with Oxfam)	EU Energy Facility	Access and Renewable Energy	Solar water pumping will reach 420 households in Gutu, while 240 households will be reached with micro-hydro in Himalaya; 4 years starting in 2011	
Hwange-Western Areas power plant	ZPC	Loan from China Railways International	Energy Access	Construct a coal-fired power plant of 1,000 MW; 3-4 years from September 2012	