SUSTAINABLE
ENERGY FOR ALL

Sustainable Energy for All

Rapid Assessment and Gap Analysis

TANZANIA

May 2013

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EXECUTIVE SUMMARY

The purpose of this Rapid Assessment and Gap Analysis is to identify the gaps to meeting the sustainable energy for all goals in the Republic of Tanzania, within the context of its economic and social development and poverty eradication. It assesses where the country stands with respect to the three SE4ALL goals of the UN Secretary General's initiative. The review provides an overview of the main challenges and opportunities relating to energy access, energy efficiency and renewable energy, with specifications of where the major investments, policies and enabling environments will be required. This analysis is to form the basis and background for an Action Plan that may follow as part of the SE4ALL activities in the country.

Within in its policy framework, Tanzania is aligned to the SE4All goals, particularly for energy access where it targets 75% electricity access by 2033. No other explicit targets for non-electricity modern energy services such as for heating are included in Tanzanian energy strategies, although efficiency and conservation of energy uptake by industry is mentioned in the MEM Strategic Plan for the period 2011 to 2016. However, the weakness of this target is that there is minimum focus on other forms of energy access such as cleaner cooking energy and other thermal applications, in favour of electricity despite the fact that users are unlikely to afford to use it for thermal applications. While commitment for cleaner cooking has been made at a regional level, it is not emphasised and focused upon in translating it to national strategies and goals and charting a course to embracing biomass energy as a contributor to the envisaged modern energy economy. In the policy arena, there is a clear need for renewable energy, energy efficiency and modern biomass policies, policy implementation strategies and accessible policy instruments.

In order to meet the SE4All goals, Tanzania will have to address a range of issues including attracting private financing. This will in part be achieved through the creation of a conducive legal and regulatory framework that allows for cost recovery and reasonable financial incentives in the energy sector. However, there is also the reality of high levels of poverty, which despite a conducive environment, will deter private investors as they are primarily interested in profits. In this sense, tariff design and diversification of solutions will assist in balancing economic viability and achievement of equity goals.

There is a need to establish, manage and allow public access to a database that tracks the impacts of energy policy, tracking trends against agreed baselines including energy intensities, renewable energy contributions, access to energy services and the social, gender, environmental and economic co-benefits. EWURA and MEM would benefit from additional technical capacity and systems to evaluate and promote policy advancing least-cost energy options. However, in the short term, a priority is the stabilisation of the electricity utility to ensure cost-recovery and a reliable supply, only then can electricity energy efficiency improvements be addressed with any firm resolution.

1 Section I: Introduction

1.1 COUNTRY OVERVIEW

1.1.1 Basic socio-economic data

Tanzania has an estimated population of 44 million persons, with a per capita GDP of US$512. The proportion of those living under the basic needs poverty-line is 33% on Mainland Tanzania and 49% on Zanzibar Island (MOFEA, 2010), Up to 51% of the Tanzanian population is female. An estimated 25% of households are headed by females and 33% of females headed-households live under the basic needs[1] poverty line (HBS, 2007). According to a World Bank report published in 2012, the urban population (as percentage of total population) in Tanzania was last reported in 2010, and was estimated at 25.5% with a growth rate at 4.6. Urban population refers to people living in urban areas as defined by national statistical offices. It is calculated using World Bank population estimates and urban ratios from the United Nations World Urbanization Prospects.

The country's economy mainstay is agriculture. According to 2013 CIA world Fact book and Tanzania national website and other sources, 27.1% of GDP is from agricultural products, the bulk of which is subsistent agriculture. Important exports include tea, coffee, cashew nuts, cotton and tobacco. However, minerals such as gold, as well as tourism are increasingly contributing a substantial proportion of the country's economy. Industry makes a relatively small contribution of 24.1% to GDP. The country has in recent years discovered higher gas reserves than previously assumed. Gas is therefore likely to be an important future source of revenue, and likely to play a key role in meeting energy needs into the future. National planning priorities are framed by the shared 2025 national development vision and strategies MKUKUTA II.

1.2 **ENERGY SITUATION**

1.2.1 Energy Supply

1.2.1.1 Primary energy sources

The Tanzania energy supply is highly dependent on biomass. Biomass represents about 90% of the total primary energy consumption (MEM, 2010). Electricity represents 1.2% while petroleum products provide 8% of the total energy consumed in Tanzania. Solar, coal, wind and other energy sources represent about 0.5% of total energy consumption. According to the IEA (2011), Tanzania consumed a total of 19.6 MTOE, of which net imports were 1.7 MTOE in 2009.The government of Tanzania estimates this to have increased to 22 MTOE in 2010. Energy imports represent 23% of total imports, and about US$1.5 billion in national expenditure and almost all of this is fossil fuels. Total energy consumption is 0.45 TOE per capita in 2010. More specific data and information on primary energy sources potential include the following:

(i) Biomass Resources

Tanzania has about 33.5 million ha of forests and woodlands (FAO, 2010). Of this total area, almost two thirds consists of woodlands on public lands, which lack proper management. According to Mwampamba (2007), Tanzania's forests consist of 13 million ha of forest reserves. Zahabu (2008) mentions 16 million ha of

[11]Basic needs are x$/capita/day

reserved forests (according to the Forest Act (URT 2002) "Forest reserve" means a forest area, either for production of timber and other forest produce or for the protection of forests and important water catchments, controlled under the Forests Ordinance and declared by the Minister. In addition, declared forests under village managements are also recognized as forest reserves. Over 80,000 ha of the gazetted area are under plantation forestry and about 1.6 million ha are under water catchment management. The forests offer habitat for wildlife, beekeeping unique natural ecosystems and genetic resources. Biomass energy is the main sources of fuel for rural and urban populations alike. However, it is estimated that the sector's contribution to the Gross Domestic Product is between 2.3%, and 10% of the country's registered exports. This contribution is underestimated because of unrecorded consumption of wood fuels.

According to REA records, there is about 15 million tons per year of agricultural, livestock and forestry residues. Some of which that may be available for use in power generation. These include sugar bagasse (1.5 million tons per year (mtpy)), sisal (0.2 mtpy), coffee husk (0.1 mtpy), rice husk (0.2 mtpy), MSW (4.7 mtpy), forest residue (1.1 mtpy)) with the balance from other crop wastes and livestock. Further supplies can be obtained through sustainably harvested fuel wood from fast-growing trees plantations. For example, a 50MW biomass power plant could obtain all its fuel wood needs from a 10, 000 hectare plantation.

There is also considerable unrealized scope for crop wastes supplying a larger portion of the nation's energy supply using commercially proven anaerobic digestion technology. Crop wastes make an ideal feedstock for biogas – either for electricity or for domestic use in lighting and cooking. At an industrial scale, crop wastes can be used both for anaerobic digestion for gas or electricity, and the residues from that process make excellent charcoal briquettes.

(ii) Geothermal

The potential for geothermal energy is significant, but has not yet been fully quantified. Estimations of geothermal potential of Tanzania are put at more than 650MW, with most of the prospects located within the East African Rift System (Government of Tanzania/SREP, 2013). Most of the geothermal prospects were identified by on-surface manifestation, mainly hot springs. Surface geothermal assessments started in 1976 and to-date more than 50 sites have been identified. These are grouped into three main prospect zones: the North-eastern Zone (Kilimanjaro, Arusha and Mara regions), the South-western Zone (Rukwa and Mbeya regions), and the Eastern coastal belt, which is associated with rifting and magmatic intrusions (Rufiji Basin).

Geothermal electricity, like most renewables, involve high capital costs and relatively low operating costs. Therefore the cost of capital is the crucial determinant of the economics of most geothermal developments. Fully exploring the geothermal resources in order to convert them to proven reserves is an expensive and uncertain task. If the risk is to be borne fully by commercial power companies the consequence will be that the costs and the cost of capital will increase. Thus either they will seek higher tariffs than can be afforded, or else the exploration will happen slowly or not at all. Scaling up Renewable Energy Programme (SREP) funding is planned through AfDB to catalyze the development of about 100 or more MW of geothermal power, principally by the private sector and establish enabling environment for large-scale geothermal development. It will do so by (1) creating the enabling environment and capacities; (2) reducing development risks by co-financing the riskiest stage of development – exploration through to test drilling at several promising locations. It is normally harder and more costly for the private sector to raise such funds where there are no geothermal power projects to set a precedence; and (3) providing risk mitigation or other forms of financing for the geothermal power development phase. While SREP funding alone will not suffice, it must catalyse significantly greater

resources from both public and private sectors. The Government of Tanzania plans to use SREP funding to reduce development risks at both the resource confirmation stage and the power development stage. This lower investor risk, should lower the cost of capital, and will therefore make more geothermal resources available at any given tariff level. The SREP funding will also be used to improve the legal and regulatory frameworks, improve power planning capabilities, and strengthen institutional and human capacities.

(iii) Hydropower

Large hydroelectric power has been the mainstay of the national electricity system. The assessed potential of large hydropower resources is about 4.7GW (MEM/Government of Tanzania 2003). An exploited resource is mainly from a small number of large dams and a few smaller plants. Total installed capacity so far is 562MW (MEM/SREP, 2013). However, intermittent river flows as a result of droughts have made this a much less reliable source of power in recent years.

Small hydropower assessed potential resources (up to 10MW) is 480MW (MEM/SREP, 2013). The installed grid connected small hydro projects contribute only about 15MW. Most of the developed small hydropower projects are owned by private entities and are not connected to the national electricity grid. Already in REA's pipeline/portfolio there are more than 60 projects seeking investors, which signal the existing larger potential for micro and small hydro in Tanzania.

(iv) Wind

Several areas of Tanzania are known to have promising wind resources. In areas where assessments have been conducted to-date, only Kititimo (Singida) and Makambako (Iringa) areas were identified to have adequate wind speeds for the grid scale electricity generation. The wind speeds average 9.9 m/s at Kititimo and average 8.9 m/s at Makambako, both measured at a height of 30 metres (REA, 2010). The MEM in collaboration with TANESCO is conducting further wind resource assessments in Mkumbara (Tanga), Karatu (Manyara), Gomvu (Dar es Salaam), Litembe (Mtwara), Makambako (Iringa), Mgagao (Kilimanjaro), Kititimo (Singida), and Usevya (Mpanda) for further more specific data (REA, 2010). REA is supporting wind measurements at Mafia Island (Coast region).

(v) Solar

Tanzania has high levels of solar energy, ranging between 2800 – 3500 hours of sunshine per year and a global radiation of between 4 to 7kWh/m2/day (MEM, 2013). Solar resources are especially good in the central portions of the country. This makes it naturally a suitable country for the application of solar energy as a viable alternative to conventional energy sources if efficiently harnessed and utilized. Both solar PV and solar thermal technologies are under development in the country.

(vi) Natural Gas

Available data with EWURA and TPDC indicate that the proven and probable reserves in the Songo Songo gas field are estimated at 810 billion standard cubic feet (BCF), while the proven, probable and possible reserves stand at 1.10 trillion standard cubic feet (TCF). The proven, probable and possible gas reserves in Mnazi Bay vicinities are estimated at 2.2 TCF. Proved reserves are those quantities of natural gas, which, by analysis of geological and engineering data, can be estimated with a high degree of confidence to be commercially recoverable from a given date forward, from known reservoirs and under current economic conditions. As soon as BG Group finalises its assessment for the commerciality of the deep-sea discoveries,

the proven reserves will change (EWURA, 2010). According to CIA world fact book dating 2011, proven natural gas reserves in Tanzania stand at 6.513 Trillion cubic meters for years 2008 through to 2011. Much of the variability in quotes is because of the probability ratios typically from 50 to 90% certainty being common in quoting gas, oil and other mineral proven reserves.

(vii) Uranium

Uranium deposits investigation is on-going in southern and central Tanzania regions. Already a number of pertinent companies are busy in the areas exploring and extracting samples for further investigation and possible mining of the same in Tanzania. Uranium is another potential resource for energy generation.

(viii) Coal

According to the National Energy Policy (2003), Tanzania has proven coal reserves estimated at 304 million tonnes and inferred reserves is estimated at about 1200 million tonnes.

1.2.1.2 Power sector – generation, imports and exports

The country's available electricity generation capacity as presented by MEM on March 2013 in a SREP workshop conducted in Dar es Salaam was 1,564MW. It is based principally on thermal (62% – 33% from natural gas and 29% from oil), large hydropower (35) and with the balance from small renewable energy power and imports (Table 1). The hydro-plants operated by TANESCO are interconnected with the national grid. The 20 townships in other regions served by TANESCO are dependent on isolated diesel (18) and natural gas (2) generators, and imports. Independent Power Producers (IPP) supplied 26% of the capacity. Emergency Power Producers (EPP) supplied 13%. In addition, there is an estimated 300MW of private diesel generation not connected to TANESCO grid, whose fuel cost alone is expected to exceed US cents 35/kWh.

Table 1: Power generation capacities in Tanzania, March 2013

Generation Capacities (MW) in March 2013						
Source	**TANESCO**	**IPP**	**EPP**	**SPP**	**Total**	**Percent**
Hydropower	553	-	-	-	553	35%
Small Hydro (<10 MW)	9	-	-	4	13	0.8%
Oil (Jet-A1 and diesel)	88	163	205	-	456	29%
Gas	252	249	-	-	501	32%
Biomass	-	-	-	27	27	1.7%
Imports	14	-	-	-	14	0.9%
Total	916	412	205	31	1,564	100%
Percent	59%	26%	13%	2.0%	100%	
IPP: Independent Power Producers, EPP: Emergency Power Producers, SPP: Small Power Producers, Imports from Uganda (10 MW), Kenya (1MW) and Zambia (3MW).						
Source: TANESCO, March 7, 2013 (provided to SREP)						

Diversification of generation sources is essential to avoid the risks of supply interruptions and price increases. A particular challenge facing Tanzania is the increasing unpredictability of hydroelectric power in face of changing weather patterns. This problem is exacerbated by having most of the hydropower on two river systems that are now prone to drought. This necessitated the country having to extensively shed load and run expensive thermal power plants as base load. The Government of Tanzania expects the addition of significant thermal capacity up to 2016, much of it natural gas, to overcome power shortages.

Among the previously scheduled generation projects due to come on-stream during 2012-2017 are 1,428MW gas, 160MW oil, 50 to 100MW wind, 60MW solar, 11MW small hydroelectric power, and 200MW coal. Of this, nearly 1,100MW of gas, solar, wind and coal projects are expected be IPP/SPP projects. A favorable investment climate is an essential requirement for significant private capital to be attracted to these investments.

Table 2: Below provides an overview of Power plants ownership, installed and planned capacities in Tanzania

Install	Plant	Retire	Fuel	Capacity (MW)	Remarks
1968	Nyumba ya Mungu	-	Hydro	8	
1975	Kidatu	-	Hydro	204	
1988	Mtera	-	Hydro	80	
1995	New Pangani	-	Hydro	68	
2000	Kihansi	-	Hydro	180	
	Dodoma	2015	IDO	7.44	
2002	Tegeta IPTL	2022	HFO	90	
2004	Songas 1	2024	Natural Gas	38.3	
2005	Songas 2	2025	Natural gas	110	
2006	Songas 3	2026	Natural Gas	37	
2007	Ubungo G-1	2027	Ubungo Gas	102	
2009	Tegeta G	2029	Natural gas	43.99	
2010	TANWAT	-	Biomass	2.75	SPP sales 1MW to the grid
	TPC		Biomass	20	SPP sales 2.5MW to the grid
2011	Aggreko-U	2012	GO	50	The two plants plants Ubungo 50MW and Tegeta 50MW are available and will be retired after expiration of the one year contract in October 2012
	Aggreko-T	2912	GO	50	
	Symbion I	2013	JET-A1	60	The 112MW plant is available and will be retired after expiration of the contract 2012
	Symbion II	2013	GO	52.5	
	Symbion205-DOM	2013	GO	55	Both 50MW plant at Dodoma and 50MW plant at Arusha are available (operating)
	Symbion205-ARS	014	GO	50	

	MwanzaIDO		IDO	60	All 10 units of generating sets have been manufactured, assembled and shipped; expected date of arrival at site is end of September 2012.
	Mtwara (18)		Natural Gas	18	
2013	Symbion205-DAR	2014	GO	100	
	Ubungo_G-2	2031	Natural Gas	105	Plant is fully in commercial operation, however Fichtner Consultant expert in turbine gen sets arrived on 22nd August 2012 to participate in the investigation of GTG3 breakdown
2014	Symbion205-DAR	2015	Natural Gas	100	
	Sao Hill		Biomass	10	SPP to sale 10MW to the Grid; delays due to review of capacity of forestry resources to support plant
	Kilwa Energy		Natural Gas	210	
	Jacobsen		Natural Gas	150	Project negotiation is ongoing between Government and lenders
	Kinyerezi 240-I	2033	Natural Gas	120	Contract has been signed and all project documents have been sent to the Ministry of Finance for Financial Closure Arrangement
2015	Kinyerezi 240-II	2033	Natural Gas	120	
	Ngaka I		Coal	120	Intra Energy has submitted Draft PPA to TANESCO for review and comments
	Wind I		Wind	50	Evaluation of the technical proposal for procurement of transaction advisor completed and revised evaluation report submitted to the secretary of the Tender Board for deliberations
	Mchuchuma-I		Coal	50	Own Use; Government of Tanzania and Chinese Company have signed MoU, and the project is now in the initial development stages
2016 (and beyond)	Mgololo COGEN		Biomass	30	
	Kinyerezi III		Natural Gas	300	TANESCO advised CMEC (Chinese EPC Contractor) to implement the project in two phases, first phase being 300MW dual fuel simple cycle power plant and 220 kV transmission line from Kinyerezi to Ubungo/Kimara. Phase two is to construct 400 kV transmission line from Kinyerezi – Chalinze – Morogoro – Dodoma. EPC contract has already been signed, and negotiations with lenders are at an advanced stage.
	Hale		Hydro	21	
	TANESCO Coal		Coal	500	
	Kiwira		Coal	200	MEM has tasked State Mining Corporation (STAMICO) to develop the project.

Source: TANESCO/MEM 2013

1.2.2 Energy demand (overview of main consuming sectors, industry, residential, agriculture, transport)

The Ministry of Natural Resources and Tourism believes that current annual forest reduction is between 120,000 and 500,000 hectares, against only 25,000 hectares planted. Charcoal production alone, causes loss of forest cover at a rate of more than 100,000 hectares a year, and this is on the increase. The accelerated harvesting of trees negatively impacts on soil, watersheds, biodiversity and climate change. According to the 2009 World Bank report on biomass, total annual charcoal consumption in Tanzania is estimated at 1 million tons. The annual supply of wood needed for this is estimated at 30 million cubic meters. To produce charcoal it is estimated that as many as 160,000 earth kilns are used each year, or 438 per day. An average annual loss of forest area of about 100,000–125,000 hectares can be attributed to the charcoal sector. From 2001 to 2007, the proportion of households in Dar es Salaam using charcoal as their primary energy source has increased from 47% to 71%. Use of liquefied petroleum gas (LPG) has declined from 43% to 12%. In other urban areas, the share of households using charcoal for cooking remained at 53%, while the share of fuel wood use increased from 33% to 38%. The use of electricity for cooking is below 1% (World Bank 2009).

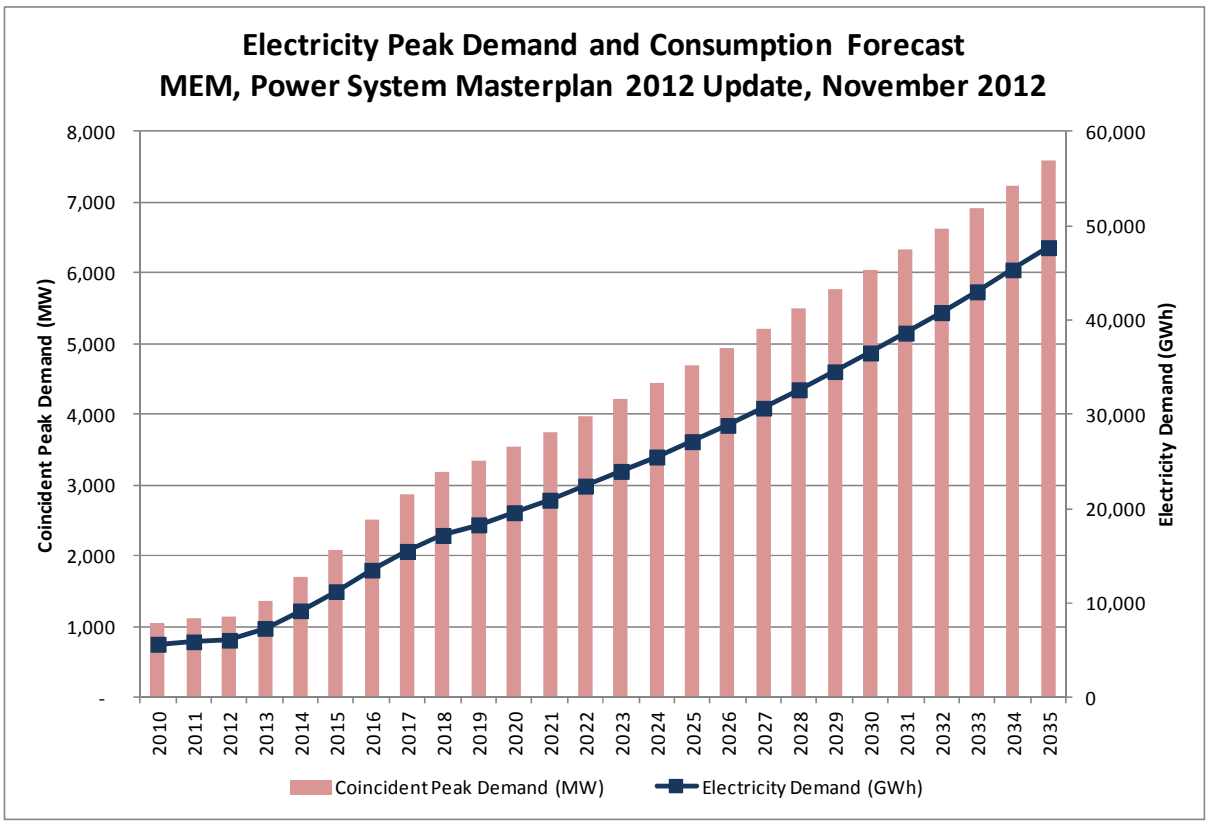
Electricity demand as per MEM strategic plan (2012-2016) increases at a rate of 12-15%, while generation increases at a rate of 6% annually. As such, increased supply and generation initiatives are necessary to cope with the existing demand.

Tanzania has very low levels of electricity consumption per capita – about 85kWh per person per year (IEA, 2010). This can be compared to the world average per capita consumption of 2,000kWh per annum and average consumption in developing countries in sub-Saharan African of 552kWh per annum. According to MEM presentation in the Dar es Salaam SREP workshop in March 2013, only about 18.4% of the country population has access to grid electricity. Some obtain access through stand-alone solar photovoltaic (PV) and several mini-hydro mini-grids operated by local NGOs and faith based groups.

Electricity demand in the country is increasing rapidly mainly due to accelerated productive investments, increasing population, and increasing access. There is also significant suppressed demand, partly met by private diesel generators. The Power System Master Plan (2010 – 2035) anticipates that Tanzania will increase electrification status from 18.4% of 2010 to at least 75% by 2035 while demand from connected customers will increase significantly as Tanzania becomes a middle income country as stipulated in Tanzania Vision 2025. A medium term goal of 30% access is stipulated in the MEM strategic plan for the period 2011-2016.

TANESCO anticipates major demand increases from several mining operations, LNG plant, factories and water supply schemes. Peak demand is projected to increase rapidly from about 1,000MW today to about 4,700MW by 2025 and 7,400MW by 2035.

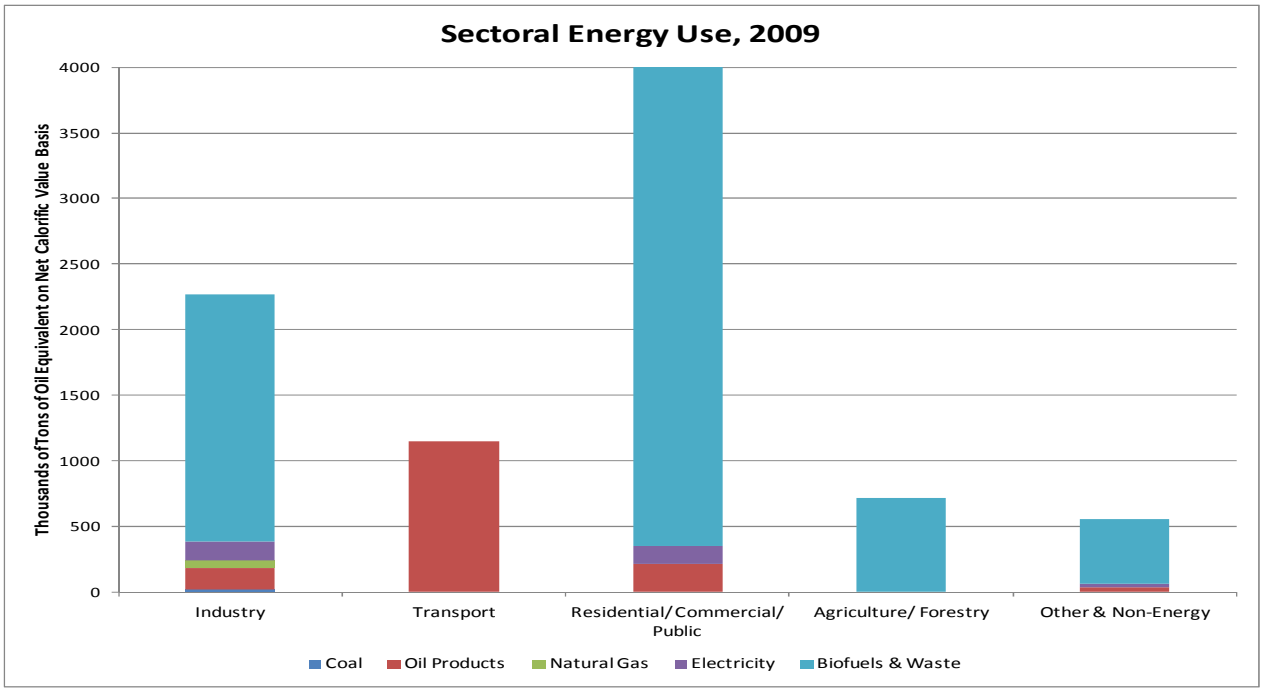
Figure 1: Electricity demand outlook 2010-2035



Source: MEM 2012

The main energy consuming sectors in Tanzania are industry, residential, agriculture, mining and transport. Residential consumes about 90% of the total primary energy consumption mainly in the form of biomass (firewood and charcoal). According to the National Energy Policy (2003), of the petroleum energy sources consumed in Tanzania, 56% was for transportation, 26% for industry and 10% for residential mainly kerosene for lighting and cooking. In terms of electricity, the industrial sector contributes the largest demand followed by the residential sector as shown in Figure 2 below.

Figure 2: Sectoral Energy Use



Source: Government of Tanzania/SREP, 2013

The IEA estimates per capita use of electricity in Tanzania to be 85kWh (2009 Energy Balance for Tanzania). To enhance affordability to domestic users, electricity is subsidized with a block tariff design. Tariffs are lowest for users of up to 50kWh per month. However, the entire tariff system can be considered subsidized since TANESCO does not charge the full cost of the electricity service. Electricity Act (2008) specifies cost recovery in each of the tariff brackets, which by definition prohibits cross-subsidy to domestic electricity users.

Use of liquefied petroleum gas (LPG) in residences is low and only about 0.2% of the population uses it. The low use of electricity and LPG at household level correlates with an overdependence of firewood, which has detrimental effects on socio-economic wellbeing of households, particularly women and children who are primary collectors and users (women) of traditional biomass. Use of biomass energy source has significant negative gender consequences; is responsible for about 18,900 deaths (mainly women and children due to IAP; its collection exhausts women and leave them little time to engage in other important endeavours of education, production and politics).

1.2.3 Energy and economic development

As per IEA, 2011, the total primary energy per GDP for Tanzania is 1.21TOE/1000 USD. Proportion of energy in Tanzanian GDP is not reliably accessible through main official references. However, the World Bank in its 2010 report estimates charcoal business in Tanzania at $650m/annum. The percentage of the national energy budget in the financial year 2010/2011 decreased to 2.9% from 3% in the previous year (MOF, 2011). Of the total energy budget, 60.1% represents capital expenditures that include infrastructure construction, rehabilitation and studies supporting the energy sector. Despite a small share of energy allocations in the national budget, the energy sector was also singled out in the mid-term fiscal report as having low execution performance at 22.3% in 2010 (MOF, 2011). This low execution rate and under-spending is a persistent feature of the Tanzanian energy sector and was also reported in previous fiscal years.

Although energy access at household level is low, the national expenditure on energy access does represent a significant proportion of national expenditure. Actual costs of imports of energy in US$ and a proportion of total imports effect on balance of payments and forex reserves (EWURA 2011 fuel imports). In terms of economic development, this implies that substantial national resources only benefit a small number of Tanzanians, thereby contributing to broader inequalities. In addition to this imbalance, the electricity sector drastically affects economic development due to its low reliability. According to World Bank 2010, economic costs of electricity outages during the recent drought were equivalent to an estimated 4% of the GDP. Equally important, low reliability, poor quality and high prices of power in Tanzania impact adversely on economic development by negatively impacting on different sectors including industry, commerce, agriculture, transport, and mining.

Except for the improved cook stoves energy technologies and services, there exists limited energy equipment production and dissemination in the country. Most of the energy equipment is imported, adding pressure on the scarce forex of the country. Local manufacturing and dissemination would improve availability and sustainability of the energy contribution to the GDP.

1.2.4 Energy strategy and relevant targets (access, generation, capacity and energy security)

The Government of Tanzania has various policies/strategies, targets and implementation plans in place, aimed at meeting growing demand for electricity and modern energy in general. In the medium term, the 2010 Joint Energy Sector Review (JESR) sets the target for national electrification at 75% by 2033 (JESR, 2010). This would set the country at par with global levels of electrification in 2010. TANESCO has committed to connecting 250,000 customers per year to contribute to this goal. In terms of generation capacity, Tanzania plans to more than double capacity (from 2011 baseline of about 1100MW) by investing in an additional 1680MW by 2015. This would improve the country's ability to meet growing demand and improve energy security, but also meet some of its access goals.

Assuming an ideal situation in which Tanzania meets its 2033 objective, this target assumes that about 25% will have no access to electricity by 2033. Unless these people are specifically targeted with other forms of modern energy, Tanzania is unlikely to meet the goals of the SE4All.

The MEM Strategic Plan from 2012-2016 accommodates the following strategic initiatives to achieve the planned targets:

1.2.4.1 Increase Power Generation

According to MEM power generation in 2011 stood at 1,270MW. In order to meet demand growth expressed in section 1.2.2 above, the Ministry is under implementation of plans to increase power generation capacity by 1,788MW (2015). The plan is to increase generation by 160MW in 2012/13; 970MW in 2013/14; 300MW in 2014/15; and 358MW in 2015/16.

1.2.4.2 Natural Gas Development

By 2011, five gas fields had been discovered which are Songo Songo, Mnazi Bay, Mkuranga, Kiliwani and Off-Shore Deep Sea. Production of gas is currently taking place at Songo Songo and Mnazi Bay fields where gas

is used for electricity generation and in some industries. The plan is to expand the processing plant at these fields to increase distribution level of gas to the market. Gas discoveries at Mkuranga, Kiliwana, and Deep Sea will be developed through the constructing new processing plants and pipelines. In addition, construction of a new pipeline from Mtwara, Songo Songo to Dar es Salaam is underway which will increase gas supply for electricity generation and other industrial uses. The Ministry will also finalise the Gas Utilization Master Plan that will identify the most appropriate use for natural gas, when it comes on line over the next decade.

1.2.4.3 Develop New and Renewable Sources of Energy

With respect to the new and renewable energy resources, their share to the energy mix in 2011 was reported to be 14.5% (excluding biomass energy which is overwhelming non-renewable) though it is unclear what is included in this figure. The government has an ambitious programme to increase the new and renewable energy share of the energy mix (biofuel, solar, wind etc.) to 30% country-wide by 2016. This will reduce the dependence on hydropower generation.

1.2.4.4 Construction and Upgrading of Power Transmission and Distribution System

According to the Joint Energy Sector Review (JESR, 2012), the Government will construct and upgrade the following power transmission and distribution lines projects:

i) Makambako – Songea 132 kV Transmission Line

The project will include; design, supply, construction and installation of the transmission sub-project, a 250km 132 kV transmission line from Makambako to Songea, three 132/33 kV substations, and the distribution sub-project, 900km 33kV distribution lines with transformers, low voltage distribution networks and connections to about 8,500 customers and 650 street lights.

ii) North-West Grid extension 220 kV Line

This project involves extension of existing 220 kV line from Geita to Kigoma via Nyakanazi and extending it to Mpanda, Sumbawanga up to Mbeya in order to provide reliable power to the North Western parts of the country.

iii) Iringa – Shinyanga 400 kV Transmission Line

The objective of the project is to upgrade the transmission line between Iringa and Shinyanga and to improve power supply reliability to the North West Grid. This is a project financed by the World Bank, European Investment Bank, African Development Bank, JICA and the Government of Korea. Implementation of Resettlement Plan involving compensation to people affected by the project is the responsibility of the Government of Tanzania.

And, the JESR went further to suggest:

iv) Promote Energy Efficiency and Conservation

This aims at promoting energy efficiency and conservation in various sectors such as industrial, commercial, transport and household. About 40% of energy could be saved through energy efficiency in Government buildings according to energy audit conducted in 2006. Based on this audit, the plan is to develop guideline/standards that will be used to implement energy efficiency and conservation activities in various

sectors. The Ministry with collaboration with other institutions dealing with energy issues and will also continue to create awareness to the public on the procedures of conserving energy.

v) Restructure the Power sub-Sector

The restructuring of the power sub–sector will be undertaken by the Government in order to achieve the following: to put in place conducive environment for attraction of capital for development of the power sub–sector through private sector participation; vertical and horizontal unbundling of TANESCO for improving operational and financial performance of the utility; to promote regional electricity trading by interconnecting the national grid with the grids in the region. Generally, the strategy to restructure the power sub-sector will be undertaken in the spirit of modernising the sector to sustainably support the growth of the national economy.

1.2.5 Promote and expedite access to modern energy in rural areas

Access to modern energy in rural areas is key for improving growth, economic development and enhancing living standards. Therefore, access to modern energy services in rural areas will be scaled-up and expedited to cover district headquarters, townships, villages and commercial centres, thereby increasing the percentage of population with access to electricity from 6.5% (2011) to 15% (2016). The key interventions include:

1.2.5.1 Strengthening Rural Energy Agency and Rural Energy Fund (REA/REF)

This includes efforts to continuously increasing funds for REA/REF from the annual Government budgetary allocations, efficient collection of statutory levies to REF and mobilizing financial resources from other sources including donors and multi-lateral development banks.

1.2.5.2 Promoting and Expediting Rural Electrification

This include facilitating finalization of all projects in progress; electrification of district headquarters, townships, district councils and commercial centres; identifying, promoting and facilitating development of potential sources of new and renewable energy such as mini-hydro, geothermal, solar, wind and biogas. The low cost design electrification programme will be scaled-up with a view to ensuring electricity connection is costs reflective and affordable to majority low-income rural population.

1.2.5.3 Development of Rural Energy Master Plan

Detailed Rural Energy Master Plan (REMP) nearing completion is being prepared to serve as a blueprint for identification, promotion, facilitation and development of modern energy services in rural areas in a specific period. The REMP will enlighten priority energy projects; set a systematic implementation plan with specific targets, implementation methods, time schedule and budgetary requirements. It will also provide various approaches of involvement and collaboration with private sector. To begin with, REA with the support from NORAD, are working on a rural energy prospectus, which will have input to the REMP.

1.2.6 Improve revenue collection from energy and mineral sectors

Revenue collection from the energy sector is targeted at Tshs.84.41 billion in 2015/16. Main strategies that will be used to achieve this target include:

(i) Promoting up-stream activities to increase production and sales of natural gas; and

(ii) Promoting industrial and domestic use of natural gas to combat environmental degradation and to increase revenue.

It is worth noting that in 2010 the connection rate to the national grid was about 50,000 against the target of 100,000 customers (TANESCO, 2010). Other targets with actual installations in brackets are 2011, target 100 000 (68,000) and current target is put at 250,000 connections per year. This underperformance may be attributed to a number of reasons including suppressed demand, inadequate connecting equipment and appliances (LV and HV insulators, poles, transformers, etc.), poor governance (corruption, theft, inefficiencies etc.) and high connection fees faced by poor potential customers (TANESCO annual reports). The current target by MEM as per mid-term strategic plan is 30% electrification rate by 2015. The strategy for achieving the target from the current 18.4% includes grid extension, stand-alone systems, solar lanterns, isolated, mini grids and reducing connection fees since the beginning of 2013.

A number of related Energy Policies and Acts exist; some are under review to accommodate the current challenges and dynamism of the sector. Such policies, acts and strategies include:

- Energy and Water Utilities Authority Act 2001 and 2006 were promulgated to establish a regulatory authority – Energy and Water Utilities Regulatory Authority (EWURA).
- National Energy Policy of 2003 with a broad objective of ensuring availability of reliable and affordable energy supplies, their sustainable and rational use, to support national development goals.
- Rural Energy Act 2005 which established the Rural Energy Board, Fund and Agency
- Electricity Act 2008, which established a general framework for the powers of the Ministry of Energy and Minerals and EWURA.
- Public Private Partnership Act No. 18 of 2010 which sets out the responsibilities and obligations of the parties, penalties, remedies, financial management and control requirements.
- Other Policies and Legislation influencing biomass energy include the following: Guidelines for Sustainable Harvesting and Trade in Forest Produce 2007; New Royalty Rates for Forest Products 2007; Community-Based Forest Management Guidelines April 2007; Joint Forest Management Guidelines April 2007; Forest Act 2002; Subsidiary Legislation to the Forest Act 2002; National Forest Programme 2001; National Forest Policy March 1998; and Biofuels Guidelines 2010.
- Environmental and Land Policy and legislation influencing renewable energy development include the following: Environmental Management Act, 2004; National Land Policy, Ministry of Lands and Human Settlements Development, 1997; National Environmental Policy, 1997.
- Policies and strategies under review and preparations include national Energy Policy, Biomass energy strategy Tanzania (BEST), Biofuel guidelines, gas, uranium and renewable energy policies

1.2.7 Indicators and Monitoring for Energy at MEM

The implementation of energy policy is reduced to mid-term and annual plans. The current relevant plan is the Medium Term Strategic Plan, which contains the following targets for the energy sector:

(i) Total electricity increased from 1100MW in 2011 to 2780MW by 2016;
(ii) 1342MW generation added, 1591 Kilometres of transmission and distribution of power added by June 2016;
(iii) Energy Efficiency and utilization of diversified energy sources enhanced through reduction of transmission and distribution losses from 23% to 15% by June 2015;
(v) Reduction in petroleum consumption by 15% in industries, households and transport by 2015;
(v) Reduction in electricity consumption by 20% in manufacturing industries and households by 2015;
(vi) Contribution of non-hydro renewable sources of energy to power generation increased from 4% (2011) to 10% by June 2016;

(vii) Natural gas management and infra-structure completed and commissioned by June 2014; and
(viii) Access to electricity increased from 14.5% (2011) to 30% by June 2015.

1.2.8 MEM Outcome indicators for 2011-2016

The following are the mid-term energy outcome indicators:

- electricity in MW added to the grid;
- number of industries and households using natural gas;
- number of MW produced by natural gas;
- number of MW from solar;
- wind and small hydro;
- % reduction in wood-fuel and traditional fuels per capita;
- % power losses and rate of outages;
- number of production sharing agreements signed;
- % of industries adhering to energy conservation practices;
- number of public facilities connected to electricity;
- number of district headquarters electrified; and
- % of population with access to electricity in rural areas and nationally.

It is worth noting that the necessary infrastructure and supply capacity required for power to accommodate envisaged targets, will have to be rapidly increased. Efforts are required to put in place a policy, detailed implementation plans and investment environment to enable the planned development and targets in the power sector. Such improvements include amongst others:

(i) Standardized Power Purchase Agreements (SPPA), Feed-In-Tariffs (FITs), need improvement (disaggregated for technologies/energy resources) for IPPs. The current Grid FITs is based on hydro and that of off-grid based on avoided diesel costs. Efforts by EWURA and TANESCO are underway to develop tariffs, which are technology specific to attract diversity of potential private investors. It is being unrealistic to assume same level of investment and expected rate-of-return for solar PV project developer and micro-hydro developer. Clear targets for each energy sub-sector contribution should be put in place and communicated extensively to potential developers accompanied by possible incentives for participation.

(ii) Ensure availability of effective communication strategy of opportunities available with REA/REF and other development partners at all levels of the community in a language understandable by potential entrepreneurs/investors in rural areas. This would substantially impact on the level and rate of rural electrification interventions. Availability of REA/REF district offices could add to the efficiency of the Agency and Fund in achieving its targets and that of the nation in relation to universal modern energy access for all.

(iii) The current installed capacity coupled with aging transmission and distribution infrastructure does not provide adequate guarantee for increasingly reliable access. Large-scale extension and strengthening of the existing transmission and distribution infrastructure are vital for improved access. This may require institutional reforms for generation, transformation and distribution to improve efficiency and performance. Sound governance in the energy sector is also strategic in ensuring commitment of personnel to their functional obligations.

(iv) Efficiency targets/policy/strategies could be more specific (e.g. cogeneration). Efficiency standards and policy requirements are vital for improving the energy access situation in the country. For example, it could relax the burden on the national grid by allowing for self-generation of some industries. Sugar industries, cashew nuts and rice agro processing could make use of bagasse and husks respectively, for powering principal factory energy requirements and export to the grid. More specific targets and strategies on such abovementioned resources contribution in the MEM strategic plan for the period from 2011 – 2016 could direct and focus significantly most efforts and initiatives from the government.

(v) Scaling-up engagements of the private sector with the government through PPP Act of 2010. Public Private Partnership Act of 2010 stands could provide a framework for private sector engagement in modern energy generation and distribution. However, implementation tools including capacity building, relevant awareness creation and creation of conducive environment and incentives for partnership, is necessary in the first place. Private sector, for example, is not in favour of unnecessary bureaucracy both in decision-making that the public sector requires and is more interested in timely reaction to business opportunities. However, there are no targets and indicators for PPP in the energy sector. Equally important, there are no targets for the number of SPPAs that are planned within a certain time frame.

2 Section 2: Current situation with regard to SE4ALL goals

2.1 ENERGY ACCESS vis-à-vis GOAL OF SE4ALL

2.1.1 Overview and assessment

What do we mean by access?

Energy access refers to the need to increase the number of people with access to higher-quality energy and to improve the quality of the energy for those who already have it. While much international discussion remains focused on energy access, decades of experience and scholarship indicate that maximum flexibility is retained if policies focus not only on increasing the quantity of energy delivered, but also the services that energy provides and providing these at least-cost to the economy. Therefore, energy efficiency is a fundamental element of expanding energy access.

Are households, industry, food processing addressed explicitly?

There exist no clear/specific targets and strategies for addressing energy for industry, households and food processing in Tanzania. Such issues are important and would improve focus and tracking of changes resulting from set interventions, strategies and approaches for attaining set targets on universal energy access.

What is the government doing?

The government is keen to address the energy access issue. It has put a number of initiatives in place that aims at improving electricity access in Tanzania. Some examples include reduction of customers' connection fees to the national utility grid network by 60% (from about Tsh 500,000 to Tsh 199,000). The Government through its REA is motivating and supporting the private sector to participate in small-scale isolated mini-hybrid rural electrification initiatives. It has embarked on supporting the finance industry of Tanzania with a guarantee scheme for a long-term private sector loans for up to 15 years intended for energy projects. It is currently working on a RE policy, biofuel guidelines, petroleum and gas policy, biomass energy strategy, the SREP initiative and many others. However there is no dedicated energy efficiency policy in place yet.

2.1.2 Modern energy for thermal applications (cooking, heating)

Of all modern energy sources (e.g. modern biomass-biogas, gasification, etc., LPG, CNG, PNG, electricity), electricity is the most common modern energy source in households. Up to 73% and 22.7% of the population on Mainland Tanzania use firewood and charcoal respectively for cooking (HBS, 2007). Another 0.2% use coal while 0.1% uses farm residuals and waste. LPG gas and biogas, is used by about 0.1% (HBS, 2007).

Are there policies/strategies for biomass and other thermal energy access?

Regardless of the fact that 90% of the primary energy consumed in Tanzania is biomass related, there is neither biomass energy policy, nor explicit biomass energy strategy, and the sector is left informal with a budget allocation from MEM at less than 1%. Total MEM budget allocation for year 2007/2008 was US$354 million, of which US$194.9 million was allocated for the energy sector; and of that amount only US$300,000 was allocated for RE and EE, of which, biomass energy is a small part. MEM's total budget for 2012/2013 was Tsh 6.41 billion with the percentages/proportions of RE and biomass in the energy sector budget reflective of 2007/2008 aforementioned trend. In order to make sizable changes in modern energy access, efforts should

be made to increase allocations to this subsector. Equally important, there are no explicit strategies for other thermal energy access. The challenge that is increasingly pressing is to include biomass energy in the modern energy access agenda and to formalise the biomass and charcoal energy subsectors.

GIZ with support from EU are currently supporting development of a Biomass Energy Strategy (BEST), but the pace of its development and its possible implementation after completion, is another challenge. The team is still collecting stakeholders' views to complete the draft strategy document. Elevating the biomass sector to a status it deserves among policy/decision makers and the population at large, both economically and socially, is equally another challenge. The World Bank report on biomass (2009), estimates total annual revenue generated by the charcoal sector for Dar es Salaam alone is US$350 million and it generates employment and cash income for several hundred thousand people. The total annual charcoal revenues for Dar es Salaam alone is substantially higher than annual income from coffee and tea estimated to contribute only US$60 million and US$45 million to the national economy, respectively.

Unregulated and unregistered activities in charcoal production and utilization lead to an estimated revenue loss of about US$100 million per year to the national economy. The Forestry and Beekeeping Division (FBD) of the Ministry of Natural Resources and Tourism (MNRT) has a financing gap between expenditures and revenues of about US$2 million and these could easily be covered through income from taxing formal sustainable charcoal activities. However, initially an increase in the MEM budget share going to biomass is required. Budget additions in MEM allocations will allow for both technological advancement and efficiency improvement of existing biomass technologies and services.

The existing mid-term strategies have indicators of reduced biomass usage per capita, yet no viable alternatives are available.

What about PNG, LPG and water heaters?

Alternative thermal services to biomass need extra attention if non-renewable biomass consumption is to be reduced. Efforts could range from establishing supportive policies/strategies and regulatory frameworks, which are currently non-existent, to the development of promotional programmes and provision of more incentives for private sector to participate and develop dealer networks with capacity to disseminate technologies and services such as LPG, CNG, solar water heaters, efficient cookers and many others. Such technologies and services could relax some of the intensive biomass uses in SMEs, schools, health sector, local brewing, and agro-processing heating services. While CNG and LPG are unlikely to replace biomass to significant level due to their price linkages to oil making them unaffordable to the majority of Tanzanians. Well-planned CNG and LPG initiatives could result in reduced biomass usage from the middle-income populations in urban areas.

2.1.2.1 Physical access to modern energy services

Availability of reliable information on physical access of farms, SMEs, commercial undertakings, agro processing industries, schools, clinics, mines, transport etc. to modern efficient heating services and technologies is difficult to obtain and unreliable. However, such access information packaging and dissemination is important for planning, growth of the economy, sustainability and well-being of Tanzanians. Equally important, there is limited readily available information and standards, publicly known among majority of key players and stakeholders regarding modern cooking/heating appliances, technologies and services.

There are no reliable data on solar water heaters and cookers, and their contribution is minimal in thermal applications of modern energy services.

2.1.2.2 Availability/quality of supply: status of domestic supply chain

Biomass, widely used in households is highly unsustainable. The UNFCCC CDM allows for 96% to be used as the proportion of non-renewable biomass used for energy. The unsustainable use of biomass is not only as a result of inefficient household use, but more importantly (but less focussed on), is the unsustainable use of biomass in agriculture (e.g. for curing crops) and small industries (e.g. brick making, local brewing and fish smoking etc.).

Biomass is used in the form of firewood and/or charcoal. Technologies employed include inefficient charcoal and firewood stoves with efficiencies as low as 3%. Most families use three stone fires, which are very inefficient. On the other hand, metal charcoal stoves without clay liners inside are also inefficient, with efficiency ranging between 10-15% (TaTEDO, 2010). The improved cook stoves for both firewood and charcoal have efficiencies between 20-35%. Access to efficient heating and cooking systems such as LPG and biogas, currently is limited to better-off families and communities that can afford them.

Upstream in the charcoal supply chain it is important to note that it takes between 7 and 10kgs of wood biomass to produce a kilogramme of charcoal using traditional earth kilns. Efforts are needed to increase the use of improved kiln technologies such as IBEK, half orange, etc. though this is unlikely in such an informal sector. The main source of all firewood and charcoal used for heating and cooking are from public and restricted government forests. The biomass used for charcoal results in harvesting that is unsustainable. Forest management techniques and fuel wood crops are vital to achieving forest and biomass energy sustainability.

According to GVEP's 2012 report on biomass (GVEP, 2012), a lot of charcoal stove production is done in the informal artisan sector and quality is often of variable quality. SECCO is reported to be amongst the largest formal producers of quality household stoves in Dar es Salaam.

The following selection of stoves available in the Tanzanian market is from the above-mentioned 2012 GVEP's report on biomass in Tanzania.

Table 3: Biomass stoves available in Tanzania

(A) Improved Charcoal Stove	Type 1	Type 2	Type 3
Manufacturer	SECCO/TaTEDO, Dar es Salaam	CAMARTEC, Arusha	
Cost Range	$6.25-$7.5(subsidized)	~$40 medium	
Efficiency	35%	25%	
Key Features	Ceramic liner with metal cladding. SECCO make complete stove. Subsidized by about $3, will generate Carbon revenue	Ceramic liner made from bricks with outer metal cladding and metal charcoal grate. Metallic parts sourced elsewhere.	

	through Voluntary Carbon Market.		
Production Capacity	Currently around 700 stoves a month. Sold over 6000 stoves so far.	Sold over 500 so far but capacity to make more	
Distribution Channels	Sell through network of 48 agents around Dar es Salaam	Sell through agricultural fairs and contacts	
(B) **Envirofit Imported Stove**		**Rocket wood stoves**	**Fixed Maasai Wood Stove**
Manufacturer	Envirofit (Distributor L's Solution)	M&R Appropriate Technology Engineering	ICSEE (manufactured locally)
Cost Range	$12 (subsidized)	$20	$45 (subsidized)
Efficiency	33%	30-35%	24%
Key Features	Highly engineered wood stove manufactured in China.	Liner made from clay and sawdust, with metal cladding and insulation material	Stove brings hot gases around the pot before escaping through chimney.
Production Capacity	Demand Driven. 16,000 sold to date through L's Solution	500 – 800 annually. Currently seeking investment for expansion	300 installed so far. Factory capacity currently 150hydropowermonth
Distribution Channels	Through road shows and network of distributors	Mainly direct sales and exhibitions	Sold within Maasai community, installed through local women

The GVEP report on Institutional Stoves (GVEP, 2012), indicates most institutions in Tanzania using firewood as their primary cooking fuel. Improved institutional stoves have targeted schools, food vendors and restaurants, but uptake has been low mainly due to lack of awareness and financial mechanism to make them more affordable.

- Improved Institutional stoves have efficiencies over 40% and can save up to two thirds on fuel consumption.
- Improved institutional stoves can cost between US$1200 – 1900 depending on cooking capacity.
- They vary in size from 20 litres up to 250 litres.

Challenges

- Lack of end-user financing makes the stoves unaffordable to many institutions.
- Lack of government policy to encourage the transition to energy efficient cooking practices in institutions.
- There is a lack of awareness around the technologies.
- End-user training is needed so that cooks get maximum performance from the stoves.

Value Chain

GVEP report on cook stoves in Tanzania (GVEP, 2012) identifies several value chain options existence for the dissemination of cook stoves in Tanzania. The majority of producers sell through retailers within the local areas and countrywide distribution is rare. Producers may outsource the manufacture of ceramic and metal components separately and assemble the stove whilst others make the complete stove themselves. Quality

raw materials such as clay may be transported over large distances to reach producers. Donor programmes promoting objectives such as nutrition, water boiling and conservation occasionally procure stoves in large volumes. As such, the chain includes suppliers of raw materials, producer of components, cook stoves assemblers of various components, manufacturers of complete cook stoves, intermediary brokers, stockist, vendors and retail, and organizations promoting stoves, and end-users. On the other end of the supply chain, international manufacturers involve importers, distributors, retailers to end-users. Distribution costs can be high and smaller producers struggle to actively seek the market unless supported by external programmes**.**

Stakeholders

A variety of stakeholders exist in the cook stoves sector although experience and commitment in promoting improved cook stoves may vary. Government Departments include Ministry of Energy and Mineral, Ministry of Natural Resources - Division of Forestry and Beekeeping, Ministry of Community Development, Gender and Children, Ministry of Industry and Trade, Vice President's Office – Division of Environment, and Prime Minister's Office – Regional Administration and Local Government. Parastatal Organisations include Rural Energy Agency (REA), Small Industries Development Organisation (SIDO), Centre for Agricultural Mechanization and Rural Technology (CAMARTEC), Tanzanian Commission for Science and Technology (COSTECH), Tanzanian Industrial Development and Research Organisation (TIRDO), Tanzanian Bureau of Standards (TBS), and Tanzania Engineering and Manufacturing Design Organisation (TEMDO).

A variety of international and regional NGO's are involved in the cook stove sector through training cook stove artisans on technical and business skills, disseminating improved cook stoves or providing education on related issues. They include GIZ, CARE International, GVEP International, SNV, UNCHR, Millennium Village Projects, World Vision, UNDP, World Food Programme (WFP), Partners for Development, ICSEE, ARTI Tanzania, Canadian Physicians for Aid and Relief (CPAR) and E+Co.

Donors include European Union (EU), DGIS, World Bank, DFID, Southern African Development Community (SADC), HIVOS, German Government, Global Environment Facility (GEF), NORAD, USEPA, Shell Foundation, and UNDP/SGP,

There are several private sector individuals and businesses involved in the cook stove sector. Carbon developers are also entering the Tanzanian Improved Cook stove Sector. Private Sector members include Envirofit, Ecozoom, L's Solution, Zara Solar, Alternative Energy Tanzania Ltd, Kiwia & Lausten, SECCO, Envotech, Green Star, Morogore metal clusters, and M&R Appropriate Technology Engineering. Carbon mitigation project developers include CO2 Balance, Uganda Carbon Bureau, and E+Carbon. Envotech, M&R and Sunseed Tanzania. National NGOs include, The Family Alliance for Development and Cooperation, Karatu Development Association, Sunseed Tanzania Trust, Women Development for Science and Technology (WODSTA). Others include Tanzania Renewable Energy Association (TAREA), Camco and Round Table Africa.

Research organizations include University of Dar es Salaam, Sokoine University of Agriculture, and Berkeley Air Monitoring Group.

2.1.2.3 Affordability: fuel prices, cost of efficient cooking stoves and fuel supplies

In consideration of the poverty levels of most rural Tanzanians, most technologies associated with significant prices, are not affordable especially when compared to other priority issues such as food, health and

education competing for the same scarce resource. ICS in Tanzania have prices ranging from US$5 – US$40. This is already too much for most households, which can afford only a single meal per day. However, this is only about 36% of the population. The remaining 64% at least can afford some type of improved cooking technology. Equally important, biomass resource pricing does not reflect the full cost. At current pricing biomass is perceived as the cheapest heating and cooking option.

Over the past 10 years the LPG prices per a cylinder of 15kg have evolved from the price Tsh 23,000 to the current Tsh 54,000. This increment is of more than 100%. Although the number of dealers has increased, the gas and cylinders are imported with its price dependant on the oil price, US$/Tsh stability, and most of the dealers are located in urban areas only. Increased access and use depends much on innovative Government strategies to increase its availability at all levels of target potential communities through support on dealer network development and cost/price stabilization.

According to GVEP Assessment report (GVEP, 2012) on cook stoves in Tanzania, the following specific prices and costs for different stoves were collected and presented. The total existing market for improved stove ownership is around 400,000 households. According to the Tanzania Household Budget Survey 2007, 2.8% own a stove – the vast majority are traditional stoves. SNV in a report prepared in 2011 collated figures from a range of NGOs and SMEs and they estimated 3 million stoves had been 'disseminated' over the years 2000-10 period. This might suggest that as many as 400,000 households use an improved stove. Another study by Palmula and Baudiin in 2007 found 20% of all households in Dar es Salaam who use charcoal owned an improved stove (about 50,000 households) and 80% of charcoal users had traditional metal stoves. Assuming slightly lower levels of ownership in other urban areas approximately 300,000 households might be estimated to own an improved stove nationally. In the Shell Foundation research, no firewood users had bought an improved stove, 17% of peri-urban charcoal users had a stove, around 48% of urban charcoal users (earning US$1-3) and 67% (earning above US$3) had a stove. This equates to approximately 400,000 improved stoves in the country.

These figures may overstate true market size as some stoves were not purchased. The quality of many of the stoves in use is likely to be poor. The potential market will be larger than the number of households currently owning stoves, though it is difficult to quantify given currently available data. Increasing urbanisation and rising charcoal prices is likely to push up demand for efficient stoves in areas where people pay for fuel. In rural areas, penetration of stoves is almost non-existent and the Shell Foundation survey above suggests limited to no demand. Stove producers/retailers report significant challenges trying to sell quality stoves (SECCO, L's Solutions.)

Traditional cooking methods such as the three stone fire and traditional metal charcoal stoves are prevalent. Improved cook stoves have been promoted in the country since the early 80's but uptake is still low. Improved cook stoves are more readily available around urban centres particularly Dar es Salaam, Morogoro, Arusha, Mwanza and Dodoma, Kilimanjaro, Arusha and Tanga. Many of the stoves on the market are cheap and of low quality and many consumers are not willing to pay a higher price for quality, improved stoves. Wood stoves have been promoted by several NGO's but have failed to achieve commercial success. Innovation has occurred in the improved cook stove sector introducing new stoves types such as the KUUTE, Sazawa stove, however commercialization has been slow. Imported stoves such as the Envirofit wood stove have also been introduced to the market but the number of distributors is low since its distribution is a resource intensive

activity. Other imported stoves from Stovetech and Phillips have also been tested in the market with not much success.

Cooking with biogas is being promoted under the Tanzania Domestic Biogas Programme with the aim to install 12,000 biogas digesters in 5 years. According to SNV, by the end of 2012, already more than 5000 domestic biogas digesters had been installed with 50 biogas enterprises registered as companies. Uptake of LPG is low due to high up front cost of stove and gas cylinder and their limited availability outside urban centres.

Stoves and fuel wood costs

According to a GVEP International study report on cook stoves in Tanzania presented in March 2012, individual prices of cook stoves were as follows. The three stone fire attracted US$0, Traditional Metal Charcoal Stove about US$4, Jiko Bora (charcoal) about US$7, Basic Mud Wood Stove about US$5, Portable domestic rocket stove (wood) about $20, Envirofit (wood) stove about $12, LPG stove (one burner) about $20.

Whilst cost is a significant factor, availability and purchasing quantity are also important along with social and cultural factors. Wood is used primarily in rural areas whereas in urban areas people use mostly charcoal and firewood use is limited. Significant increases in the price of fuel have been experienced in the past five years. Many households in rural areas can collect firewood for free although it is becoming increasingly scarce. The price of fuel is higher in urban centres and increases during the rainy season. LPG use has increased in urban areas over the past 5 years but uptake is still low. It is often perceived as a dangerous fuel and availability outside urban centres is low. Kerosene is used by a small percentage of the population for tasks requiring rapid heating. Alternative fuel such as biomass pellets and briquettes are being introduced into the market but uptake is still low. Average price (in brackets) of charcoal in Dar es Salaam over past decade for a 40 kg sack is averaged as follows, years 2003 (US$2,5), 2007 (US$13.75) and 2012 (US$25).

Other cooking fuel costs as per GVEP International presentation in March 2012 are indicated in the following table below:

Table 4: Costs of cooking in Tanzania

Fuel	Purchase Unit	Usage	Cost	Cost per week (US$)
Firewood	3 pieces	1 day	500 Tsh/US$0.31	2.19
Charcoal	40kg sack	25 days	30,000 Tsh/US$19	5.25
LPG	13kg cylinder	30 days	56000 Tsh/US$35	8.12
Kerosene	1 litre	2 days	2500 Tsh/US$1.6	5.46

Source: GVEP International, 2012 Global Alliance for Clean Cook stoves: Tanzania Market Assessment (usage vary depending on family size, location and stove)

2.1.2.4 Sustainability

The price of modern heating and cooking technologies and fuels seems to be beyond affordability of most Tanzanians. This raises concern on its sustainability potential within poor communities in Tanzania. Deliberate efforts are necessary to increase affordability and hence influence sustainability on acceptance and uptake. Technical know-how on construction and manufacturing of these modern energy technologies and fuels such as pellets, biogas and briquettes is limited. Distribution networks are also not well established.

With the already mentioned figures by the MNRT on non-renewable forest reduction in section 1.2.2 and inefficient harvesting technologies, inefficient end-use technologies, limited coordination since it is left in the informal sector, the sustainability of heating and cooking technologies in Tanzania is at stake. Sustainability considerations in the heating and cooking industry need to be considered in the form of policy and regulation for the entire biomass fuel chain. Sustainability is at stake due to high rate of deforestation being experienced. Demand for biomass fuels is more than supply. Charcoal and cook stove technologies are persistently inefficient and damaging to health. In its report of 2007, the World Health Organization (WHO) estimated about 1.2 million deaths annually in Tanzania, attributed to indoor air pollution (IAP). Sustainability of such a technology is questionable and it cannot be left to go on like that. An intervention is necessary.

Involvement of the medium to large private sector players in the biomass-cooking sector is still limited, attributable to association with the primitive nature of biomass cooking and being outside the formal sector. The target in MKUKUTA II is on reducing the use of biomass and not on improving, making it sustainable and/or formalizing it so as to attract more investment.

Commercialization is adversely affected with limited financial capacities of most potential users, which further negatively impact on corresponding distribution channels rendering more challenges to the sector growth. It is also worth noting that there limited budget allocations for biomass sector (less than 1% of MEM budget), making it even harder for adequate capacity development, coordination, regulation and modernisation possibilities.

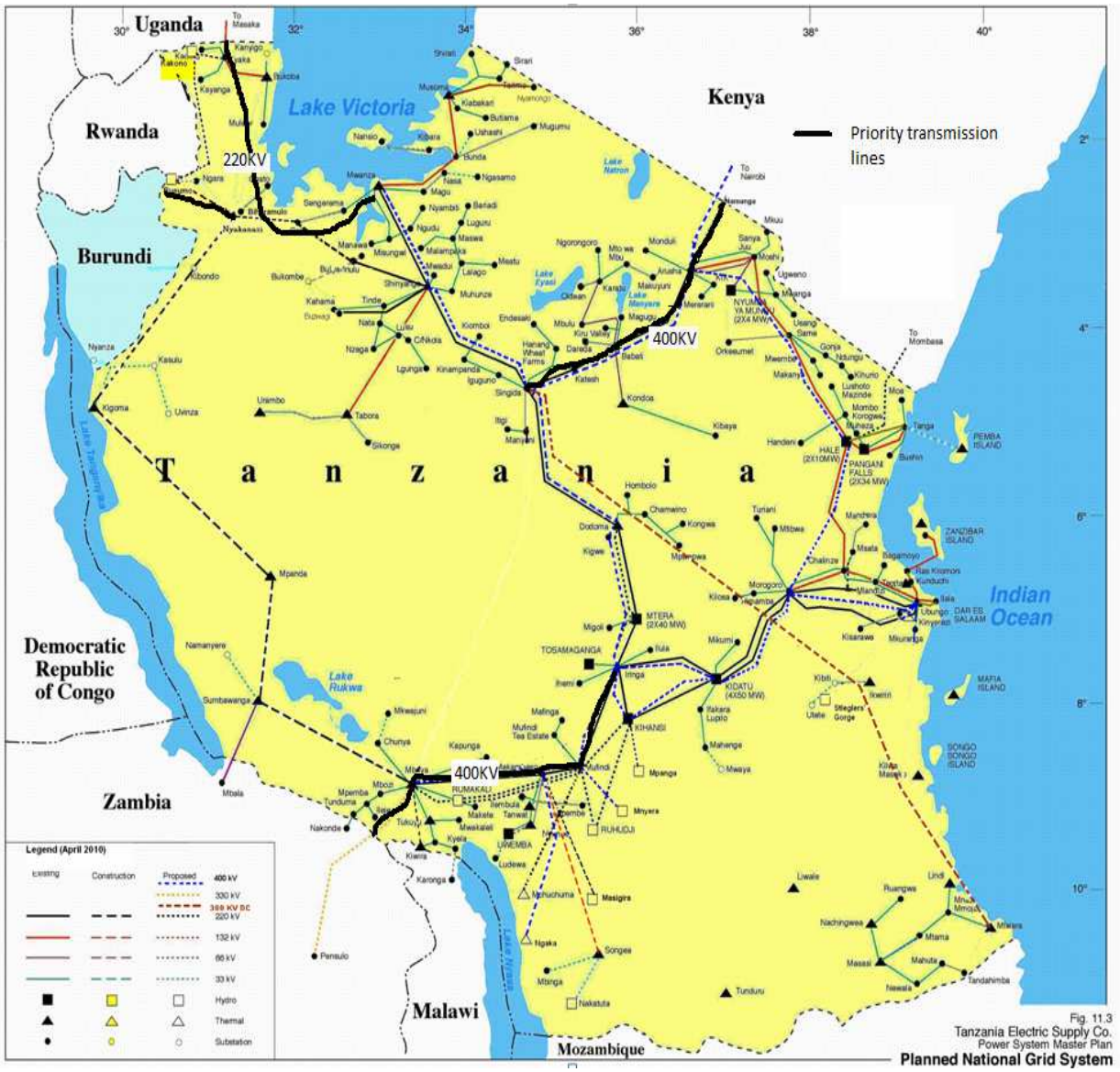
2.1.3 Access to electricity

2.1.3.1 Physical access (including: grid, mini-grid, off-grid and solar lanterns)

The current access to electricity in Tanzania is 18.4% of the population with rural areas access about 6.4% (MEM midterm strategy, 2012). Dar es Salaam is most advantaged with over 60% (TANESCO, 2010) electricity access (HBS, 2007) while the average for urban electrification is about 12%. Although electrification has improved since 2007, the ratios of electricity access among rural to urban is likely reflective of 2007 levels.

There is also variation in electricity access by geographical regions and as the transmission map (Figure 3) shows, grid infrastructure in Tanzania is concentrated in on two corridors; one that is from Mbeya in the South West and across to Dar es Salaam to the east through Morogoro, and another that cuts across to the north in Mwanza. Other areas are largely without adequate electricity infrastructure.

Figure 3: Electricity transmission map of Tanzania



Ref: Grid infrastructure in Tanzania (TANESCO, 2010)

2.1.3.2 Availability and reliability

Tanzania has a low quality of electricity supply. In between 2003 and 2012, the country experienced severe power rationing with electricity users experiencing daily black-outs, peaking in 2005/2006 and again in 2011. Electricity outages lasted 12 to 14 hours and were a daily occurrence (CDKN, 2012). Another study, based on experiences of the manufacturing sector, estimated that firms experience 63 electricity outages per year while an earlier study had estimated up to 75 electricity outages per year (World Bank, 2010). Low electricity reliability is a result of both load shedding and unplanned outages. Quality of electricity in Tanzania is further affected by voltage fluctuations, unbalanced phases and phase failures. Thus reliability is brought about by a range of factors including low water levels in hydro power reservoirs, and ageing infrastructure. The unreliability of electricity has been quoted as businesses one largest constraint to doing business in Tanzania. Most businesses that can afford it have stand-by generators for times when grid power is not available,

increasing the input costs to businesses, which in turn would be passed on to purchasers of goods and services.

The Government, through its development strategy and the Ministry of Energy and Minerals via its policies, strategies, short and medium term energy plans, have pledged to increase access to electricity and increase generation capacity through support to the national utility, and by creating an environment that is conducive for independent power producers to invest in. It further commits to exploring all viable renewable energy sources, which would in turn diversify supply and reduce its vulnerability to one single energy source. Available renewable energy sources with their potentials in brackets include large hydro (4700MW), small hydro (480MW), forest (33.5 million hectares), solar radiation (between 2800 – 3500 hours of sunshine/year and global radiation between 4-7kWh/m^2/day), agricultural/livestock/forestry residues (15 million tons/year) natural gas (about 6.513 trillion cubic metres), geothermal 650MW) and wind (up to 9.9m/s both measured at a height of 30m). In the electricity sector, TANESCO has set itself a range of key performance indicators, which if attained would improve the overall reliability of Tanzania's electricity sector. The performance of TANESCO is currently guided by the Capacity Investment Plan, which includes a Loss Reduction Programme. The Government of Tanzania/MEM in its midterm strategic plan has committed to reducing distribution and transmission losses from 23% in 2012 to 15% by 2015.

The following government initiatives are aimed at improving modern energy access to in Tanzania:

- First, the authorities aim at shifting the energy mix away from the expensive emergency oil-based power supply to more efficient and lower cost generation with a view to reducing the cost of electricity supply and to mitigate the risks of major shocks to the power system, such as droughts or oil price increases. The focus is presently on gas, coal and renewable energy in the near term, with coal and large hydro in the longer term.
- The second set of measures emphasizes the need to restructure sector institutions and strengthen investment planning, procurement and contracts management. This would include leveraging private investment through IPPs, procured through solicited and competitive bidding processes, and increasing market competition in power generation.
- Third, the Government of Tanzania will address TANESCO's financial gap through financing arrangements and through revenue-enhancing measures (Government of Tanzania/SREP, 2013).

2.1.3.3 Affordability (for users and public institutions for new access)

The low use of electricity for thermal applications as opposed to lighting suggests that most households find electricity unaffordable. As such, the use of charcoal and firewood which users perceive to be more affordable is high. While the price of electricity includes a subsidy for low energy users as shown in Table 5, there has been a decrease in the range of electricity users who are eligible to the subsidy since the low energy use tariff band was decreased from 0 to 100kWh, to 0 to 50kWh. However, in real terms the trend is unclear since new, mostly low-income households, are being electrified each year. These new consumers are likely to be low electricity users that would fall within the category eligible for a subsidy. Thus the reduction in the range of users entitled to the 50kWh subsidy does not necessarily mean a decrease in total subsidy.

Table 5: Domestic Electricity Tariff Level and Growth Rates in Tanzania 2007-2012 (Tsh)

	Tariff	Component	2007 approved Tariff	2011/2012 Approved Tariff	Growth rate per annum
D1	Domestic Low Usage	Energy Charge	40	60	8.4%
	Penalty – high usage	Energy Charge	128	273	16.4%
T1	General Use	Basic Charge	1,892	3,841	15.2%
		Energy Charge	106	221	15.8%
T2	Low Voltage	Supply Basic	7,012	14,233	15.2%
		Energy	70	132	13.5%
		Demand (kVA)	7,680	16,944	17.1%
T3	High Voltage	Supply Basic	7,012	14,233	15.2%
		Energy	65	118	12.7%
		Demand (kVA)	7,123	14,520	15.3%

Sources: TANESCO and EWURA application and order documents, OPM calculations (JESR, 2012)
NOTE: All the charges above exclude VAT and EWURA levy

While reducing the amount of subsidy is seen by some as being good for the economic performance of TANESCO, it is likely to have led to an increase in the number of households that cannot use electricity for cooking and other applications. Such a change must therefore be supported by measures to improve access and affordability of other forms of modern energy.

In addition to subsidization, TANESCO's tariffs are not based on cost of service, suggesting a blanket and hidden subsidy. A cost-reflective tariff has therefore been proposed as one of the reforms that TANESCO needs to implement to improve financial viability. While charging cost-reflective tariffs is advantageous to TANESCO, it is likely to increase the cost of electricity use among consumers. Part of the rapid increase in electricity costs has been due to the engagement of emergency electricity supplies to fill the hydro gap. These emergency supplies have become an ongoing part of the energy landscape as hydro power contributions have not been close to capacity. Already in January 2012, electricity tariffs increased by an average of 40% (except for users under 50kWh), and future increases are expected. Information on clear demarcation of tariff build-up: what part is capital, fuels, salaries, vat and levies could not be easily established.

Renewable Energy and Feed-in-Tariffs (REFIT)

TANESCO's power is largely hydropower comprising about 51% of installed capacity while only about 15% of its own generation is thermal. Of the total generation capacity, about 53% is from renewable energy sources comprising hydro- and biomass-based energy. The utility has also signed a range of power purchase agreement with other renewable energy producers, which will increase the share of renewable energy in the generation mix (Table 4). Further, off-grid renewables are being considered and include solar installations, mini-hydro and others. Few early movers are expected until TANESCO's financial situation brightens.

Table 6: Renewable energy contracts for sale to TANESCO

SPP Name	Technology	Export Capacity (MW)	Grid Connection	SPPA/LOI Date	Commission Date
SPPA Signed					
TANWATT	Biomass	1.5	Main	17-Sep-09	15-Jun-10
TPC, Moshi	Biomass	9.0	Main	6-Oct-09	13-Sep-10
Mwenga, Mufindi	Hydro	4.0	Main	19-Jan-10	21-Sep-12
Ngombeni, Mafia Is.	Biomass	1.5	Isolated	19-Jan-10	Mar-13
Sao Hill, Mufindi	Biomass	6.0	Main	26-Feb-10	Jun-14
Symbion-KMRI, Tunduru	Biomass	0.3	Isolated	17-Jul-12	Jul-14
Symbion-Kigoma	Biomass	3.3	Isolated	31-Dec-12	Mar-14
St. Agnes Chipole, Songea	Hydro	7.5	Isolated	11-Jan-13	Jul-14
NextGen Solawazi, Kigoma	Solar	2.0	Isolated	16-Jan-13	Apr-13
Total SPPA		**35.1**			
Letter of Intent Signed					
Mapembasi, Njombe	Hydro	10.0	Main	25-Jun-10	-
AHEPO, Mbinga	Hydro	1.0	Isolated	22-Sep-10	-
EA-Power, Tukuyu	Hydro	10.0	Main	7-Feb-11	-
Kikuletwa II, Kilimanjaro	Hydro	7.0	Main	28-Oct-11	-
Darakuta, Manyara	Hydro	0.9	Main	10-Jan-12	-
Mofajus, Mpanda	Hydro	1.2	Isolated	27-Apr-12	-
Tangulf, Nakatuta	Hydro	10.0	Main	16-Nov-12	-
Windpower, Mpanda	Solar	1.0	Isolated	21-Nov-12	-
Go On Tosa, Iringa	Hydro	0.8	Main	Lease from TANESCO	-
Total LOI		**41.9**			

Source, TANESCO, March 2013

2.1.3.2 Sustainability (Grid (TANESCO), Mini-Grid (IPPs), and off-grid)

Economic sustainability – Dependence on thermal power during low-water flow periods has led to high costs of power to the utility. In order to address the power crisis, TANESCO entered into power purchase agreements with independent power producers but ended up buying power at very high rates and selling at lower rates in many cases. Although this situation can change with the replacement of some heavy fuel thermal capacity with gas, the need for emergency short-lease power poses a threat to economic sustainability of TANESCO and eventually the Government itself, which periodically takes on financial burdens of public services providers. A change in the electricity act could alter the cost recovery from each tariff band and allow for cross-subsidy. IPPs could contribute to sustainability if their contracts were to be honoured by TANESCO[2].

The economic sustainability of energy supply is further affected by the earlier-mentioned tariffs that are not reflective of costs of service. An example of this financial threat is that TANESCO has delayed paying suppliers such as the Independent Power Producers, for goods and services rendered. This could in turn affect financial viability of IPPs and hence their ability to supply power. At a national level, power outages during the drought period are said to have reduced projected economic growth by about 4% of the GDP (World Bank, 2010). In January 2012, the energy and water utility regulator, EWURA, approved a 40.29% increase in electricity tariffs for all categories except those consuming less than 50kWh. This, however, is less than the 155% requested by TANESCO. The increase was achieved through government rescheduling some loans as grants, etc. More on this with respect to current and future tariff negotiations in pursuit of cost

[2] It is worth noting that, from time to time TANESCO has received delayed/deterred payment of electricity bills from some government institutions.

recovery are presented in JESR 2011/12 derived from calculation made from EWURA Orders. TANESCO has been urged to consider cost reflective tariff and a cost of service study was commissioned in 2012 to assess the appropriate level of tariff required. However, it is difficult in a situation of high cost emergency power purchases.

Environmental sustainability - Tanzania depends on hydro and thermal power and hydropower make up to 60% of generation capacity. However, its hydropower capacity has since 2005 been affected by low flows due to persistent and cyclic droughts. Thus, although hydropower is a renewable energy resource, it is a source that is susceptible to climate change and variability, and in this sense is not necessarily sustainable. Small hydropower, although more environmentally benign compared to large hydro, is also susceptible to climate change and variability, a situation that is unlikely to improve in the short term (based on climate change scenarios for Tanzania).

In terms of thermal use, Tanzania currently uses gas for the bulk of its fossil-based electricity generation. The use level is however currently too low to have any marked impact on the environment, when compared with the social and economic benefits.

The use of biomass for energy purposes have resulted in severe deforestation even in water catchment areas impacting adversely on the hydrological performance of rivers and other water sources in such areas. These rivers and catchment forests are habitats for various biodiversity and hence its destruction results into eco system destabilization. Forests are also used as carbon sinks. Deforestation activities impact negatively on sequestration capacity of forestry carbon sinks.

It is also worth noting that during power outages, petrol and diesel generators are switched on to power businesses in cities and urban areas. They result in significant noise and the generation volatile carbon, sulphur dioxide and other particulates at street level.

Social sustainability – Social sustainability of energy supply encapsulates goals related to job creation and improvements in gender, welfare and empowerment. While these are included in policies, their inclusion is very broad and lacks specific targets and monitoring frameworks. As an example of lack of monitoring frameworks, there is no data on electricity access differences between female and male-headed households. Low social sustainability is also displayed in the differences in electricity access among the very poor, the poor and the non-poor, which stands at 3%, 4% and 16% respectively. This shows that the non-poor are over 5 times likely to have electricity access than the very poor, and 4 times likely than then poor.

2.1.4 Modern energy for productive uses

2.1.4.1 Energy needs and access

Demand for modern energy and especially electricity is high in the productive sector both formal and informal, although good data on this demand is not available, electricity, gas, liquid fuels are being used by formal productive uses in agriculture, industry, and commerce. Informal sector demand is difficult to ascertain because it is intertwined with domestic demand, and sometimes with that of the formal sector. Demand for modern energy services in Tanzania is driven by a growing economy and population. Access to modern

energy in SMEs and agriculture is also unclear although it likely reflects patterns of household energy access, with urban and high-revenue SMEs and agribusinesses having a higher level of access.

According to UNIDO publication on carbon footprints reduction opportunities of 2011, energy intensities of main agricultural industries employing biomass energy sources include brick baking, fish smoking, baking, charcoal making, food preservation, agriculture and agricultural processing, milling and tobacco curing. Tobacco processing is the most energy intensive using about 160,000 MJ of energy per ton of tobacco produced. Charcoal production is the 2nd most energy intensive industry using about 100,000 MJ/ton of charcoal produced. Other industries include tea processing (over 40,000 MJ/ton), coffee processing (over 20,000 MJ/ton) and cashew processing at about 10,000 MJ/ton). The preservation of food can result in considerable spoilage, in some instances as high as 30% where dried food is stored in villages in small storage barns (F. Dowell, USDA).

2.1.4.2 Quality of local supply chain and availability of required technology and energy for productive applications (separate formal and informal energy value chains)

Formal sector

Supply of electricity for productive applications faces similar challenges as those faced by the broader society reliant on grid electricity. Poor supply reliability and voltage fluctuations are among some of the main issues that productive services face. Blackouts are frequent and of long duration in part resulting in an estimated 50 factories closing down and laying-off their employees. Low quality of supply also translates into high costs for small enterprises which have to find alternatives to electricity, lost production time during power outages and sometimes have to replace equipment damaged by to voltage fluctuations.

Petroleum products are widely available in urban areas and main rural centres. However, access in rural villages they are more costly as many households and business owners have to travel some distances to main trading centres to get them. In other cases, they depend on local shops for supply. This supply is susceptible to contamination and adulteration that is rarely accounted for in national assessments.

Adulteration is also common in the formal supply chain although this has improved significantly in the last 5 years. Of 432 outlets inspected in 2010, 48.6% of all the sampled retail outlets had products that were below the specifications of the Tanzania Bureau of Standards (TBS)(EWURA, 2010). Up to 36% of retail outlets, 29% of depots and 55% of tankers had products that were below the TBS standards. However, there has been an improvement in that percentage of outlets with adulterated petroleum products has decreased from an average of 78% in 2007 to about 40% in 2010 (EWURA, 2010). The high levels of adulteration of fuels in the supply chain (tankers) means a much higher level of sub-standard products are supplied to informal productive users.

Biomass Energy Strategy Tanzania (BEST) has been established to address biomass value chain in need of formalisation. BEST is expected to build awareness among policy makers of biomass as Tanzania's main source of primary energy and its relevance to poverty alleviation. BEST envisages supporting the government to develop and implement national biomass energy strategies that set out rational and implementable approaches to manage the biomass energy sector. Measures would include improving sustainability of supply chain, more efficient charcoal production and distribution, improving end-user efficiency of biomass use,

promotion of alternative sources of energy where appropriate and addressing negative perceptions of biomass energy aligned as a positive contributor to a modern energy economy.

Food drying value chain

Current food drying in Tanzania is done in open sun and using biomass. No reliable data of sustainably dried food value chain is available; however, traditional drying techniques are mostly used. Few initiatives from NGOs, research centres and universities are recorded, including TaTEDO, Sokoine University of Agriculture (SUA), AMKA, SIDO and others. Biomass is the main fuel used in drying processes.

Although the availability of renewable energy technologies such as solar dryers and Solar Water Heaters has not significantly improved over the years, their quality as well as the quality of after-sales service varies. Similarly there is generally low but varied availability of efficient stoves for small-scale industries. Programmes such as the World Bank's Lighting Africa programme, are leading in improving quality and availability of portable off-grid lighting solutions. There are a number of social entrepreneurs offering small lighting and phone charging solutions with various interesting marketing and financing strategies. Similar programmes could also focus on improving efficiency, quality and standards in the biomass sector.

2.1.4.3 Affordability and access to capital for productive use technologies

Tanzania has received significant support from its Development Partners for the energy sector, including renewable energy and electrification. Development Partners offer increasingly well-coordinated assistance to Tanzania that is aligned with the national priorities and strategies. The multi-year energy sector commitments of the Development Partners are about Tsh 1.5 trillion (US$1 billion), including renewable energy. The Development Partner funding commitment for renewable energy is approximately US$350 million. In addition to the technology-specific assistance described later, sector-wide support is also provided. UNDP is supporting Tanzania to mobilize actions in support of the three interlinked objectives of the "Sustainable Energy for All" initiative of providing, by 2030, universal access to modern energy services; doubling the global rate of improvement in energy efficiency; and doubling the share of renewable energy in the global energy mix. NORAD and SIDA are expected to provide significant funding to the Rural Energy Fund. There has recently been a grant of US$120 million to the Rural Energy Fund (JESWG EDPG, 2013), and many other contributions to grid transmission extensions. USAID is establishing a fund for financing rural and renewable energy. AfDB is establishing a €20 million credit line that can be accessed through domestic commercial banks for renewable and rural energy. DFID has a £30 million regional soft loan facility that could finance renewable energy investments.

The Government of Tanzania, through the Tanzania Energy Development Access Programme (TEDAP) provides subsidies and matching grants that aim to make it more affordable for the private sector to provide energy products and services. This subsidy is available from the Rural Energy Agency (REA) and commercial banks for small energy businesses to access. Various companies and services providers have also set up project clusters that can access financing from commercial banks such as Stanbic Bank.

The analysis of energy affordability and access to capital for energy for productive uses, however, shows some limitation. Some of the financing sources are limited to selected technologies and services stipulated by donors or financiers and some on specific geographical boundaries. Micro-financing institutions (MFIs) and

banks can provide a service in such an area but are limited by experience and technical know-how in the sector. Only solar products have been tried and in many cases, not succeed. Support of development agencies in financing and in reducing risk for banks and their energy portfolios is crucial in assisting them to lend for energy-specific products and services. However, providing finance only is inadequate and must include long-term support for the technical and financial products themselves as banks lack expertise in this area. A large network of Village Banks, Micro-Finance Institutions, saving schemes and co-operatives all make loans for small-scale energy investments and are being seen as possible local lenders for energy access projects such as the Low Carbon Sustainable Energy Access project of the UNDP, MEM and REA.

Other financing initiatives, which could benefit productive uses if well disseminated include:

Off-grid Solar Photovoltaics (PV) projects

To date about 6MWp of solar PV electricity has been installed countrywide for various applications in schools, hospitals, health centres, police posts, street lighting, telecommunication small enterprises, and households. More than 50% of the capacity is being utilised by households in peri-urban and rural areas. The Government of Tanzania is carrying out awareness building and demonstration campaigns on the use of solar systems for domestic and productive uses, as well as supporting direct installation in institutions. In order to make solar PV more attractive, the Government of Tanzania has removed VAT and import tax for main solar components (panels, batteries, inverters and regulators); this has allowed end-users to get PV systems at a more affordable price.

The Government of Tanzania, through REA, as well as donors have supported solar PV programmes targeting off-grid areas where it is lower cost than using generators or kerosene for lighting. Projects include the following:

- REA: Sustainable Solar Market Packages (SSMP) provide off-grid solar electricity for public facilities and households: SSMP in Rukwa Region under implementation to benefit 80 villages; new SSMP packages are being prepared for five more regions; financing and bulk procurement assistance were provided for solar home systems for members of associations (coffee, tea, cashew) with financing through NMB/Stanbic banks.
- REA: Establishment of a number of Vocational Education Training Centres (VETA) to provide technical support and training for systems design, installation, maintenance and repair.
- REA: The Lighting Rural Tanzania competitive grant programme supports private enterprises in developing and delivering a wide array of modern solar lighting products for rural households, businesses, schools and clinics.
- Oikos East Africa (NGO): Solar PV systems are being installed in all primary and secondary schools in OldonyoSambu and Ngarenanyuki wards in Arumeru district to promote the use of renewable sources of energy.
- Millennium Challenge Corporation: Solar PV systems are being installed in 45 secondary schools, 10 health centres, 120 dispensaries, municipal buildings and businesses across 25 village market centres currently without access to the electricity grid in the Kigoma Region.
- SIDA and UNDP: Business development services are provided to solar companies in 16 regions. These include technical and marketing training for solar retailers, technicians and vocational school instructors); marketing and awareness, networking among solar industry stakeholders; and policy and institutional support for the implementation of national quality control standards.

- European Union: 15,000 solar home systems are being financed through association members in Lake Victoria Region with micro-financing through Stanbic with subsidy from REA.

Renewable energy financing opportunities on different levels have been made available for productive uses in the past through financing by different summarised in the Table 7:

Table 7: Past experiences with financing of renewable energy technologies

Finance provider	Target products	Target group	Programme duration	Issues faced
FINCA Tanzania	Solar	-	2 years	Collateral Management problems as product was new Short lived
Promotion of Renewable Energy in Tanzania (PRET) With financial support from BMZ and technical support from GTZ (now GIZ)	Solar	-	n/a	Capacity of supply network including installers and maintenance services Lack of enforcement of guarantees Short lived
CRDB Bank with UNDP support	Solar	Salaried employees Well managed SACCOs Small businesses	n/a	Lack of collateral Poor business plans Very few subscribers (only one in first year, and a total of 5)
Tujijenge Micro Finance with support of Micro Energy International	Solar	Salaries employees Qualifying groups and individuals Also provides technical support for installation and sizing	Testing on-going in one branch	Lack of technical expertise on product
KAKUTE LTD	Solar	Rural households and institutions	Up to 3 years-Ongoing	Over subscribing
SCULTZ	Solar	Members of teachers association	Ongoing	Reliable finance from membership fees
E&CO	Solar, Improved cook stoves	Private companies and MFI	Ongoing	Successful in lending many renewable energy forms in Tanzania, repayment in USD
ARTI	Solar, Improved cook stoves	Small consumer financing	Ongoing	Small consumer loans
USAWA NETWORK	Solar, Biogas	Saccos network members	Ongoing	Large network
VICOBA	Solar	Vicoba members		Small consumer loans
CRDB Bank/REA	Micro hydro	Renewable energy project developers	Up to 15 years-ongoing	Long term Support for the private RE sector in Tanzania
TUNAKOPESHA	Solar	Salaried employees/consumer financing	Ongoing	Solar System Leasing
SIMGAS	Biogas	Regular income customers/consumer finance	Ongoing	Consumer loans for simgas plants through MFI
Umeme Nuru	Solar	Church members and related Sacco's members	Ongoing	Consumer loans for solar lanterns and SHS

Sources: GVEP, 2010, SEI, 2010; UNDP, 2009,

As Table 7 shows, loans are often limited to civil servants because they have monthly incomes and stable jobs. In addition, although cooking technologies have a critical role in energy access efforts, the majority of consumer lending efforts to date, as shown in the table, have focused on lighting. Other Issues limiting the financing productive use services include:

- Lack of collateral among target group;
- Lack of technical support which makes the products appear to be a risky investments;
- Reluctance of formal banks to provide small loans;

- Low-income households perceive formal banks and loan procedures as complicated and lengthy;
- Lack of credit history by potential borrowers;
- SMEs are seen as high risk customers;
- Limited competition and good performance of bank (within the context of Tanzania), which makes them risk averse;
- Dependence on informal lending facilities who are unlikely to understand the energy market[3]; and
- Lending gap that offers loans that are either too big for households SMEs or too small for medium sized enterprises.

Other challenges facing the modern productive uses include lack of awareness of the financial institutions in Tanzania on the potential businesses in the productive use sector, technologies and services. Equally important is the limited awareness and technical know-how of entrepreneurs on various productive use energy technologies. A clear focus and target would assist the government in specific strategizing.

[3] A study by FSDT shows that access to financing varies depending on location of population. Although the population without access to loans is comparable in rural and urban areas (33% vs 34%), rural populations are more dependent on informal financing compared to urban populations (36% vs 32%) and only 5% of the rural population can access formal loans compared to 18% of urban population. The low access to formal financing means that Tanzanians are subjected to high interest rates of informal and unregulated finance providers (World Bank 2010).

2.1.5 Overview and Assessment

The importance of energy efficiency lies in that it ensures provision of same quality and quantity of energy service using less fuel. Energy efficiency can also be achieved through fuel switching for specific energy services. Owing to the increasing demand and limited availability of fossil fuels, the importance of efficient use of energy has been realized all over the World. The measures of energy efficiency are useful in multiple ways reducing costs to households, productive activities and the national economy. Reduced use of fossil fuels is essential in lowering the emission of anthropogenic greenhouse gases contributing to global warming but also draws-down scarce foreign exchange for imported fuels contributing to improvements in balance of payments. The policies and policy instruments targeting improvements in energy efficiency aim to minimize the use of fossil and other fuels, thereby improving competiveness and affordability of energy services and reducing local and global pollutants. Energy efficiency reduces fuel consumption, saves capital costs in energy system sizing and operational costs in the use of fuels. Energy efficiency has both technical (hardware dimensions) and behavioural dimensions (software dimensions). Policies must address both of these through promotion and increasing awareness of increasingly energy efficient equipment and providing energy pricing signals and by finding the necessary instruments to get fuel suppliers to achieve demand side energy efficiency.

The concepts of renewable energy and energy efficiency go hand in hand. These two concepts are considered to be the “twin pillars” of the policies regarding sustainable energy. To make the most of the sustainable energy policies, there needs to be simultaneous application of strategies regarding renewable energy and efficient use of energy in the achievement of least cost energy services.

The two terms, energy efficiency and energy conservation, appear to be similar, though in actual terms they are different. Energy efficiency essentially implies making use of latest technology that assures production of same level of output or service using significantly less energy, this relates to energy intensity or the amount of energy per unit of service. An ideal example of an energy-efficient appliance is compact fluorescent lamp (CFL) or light emitting diode (LED). Energy requirements of these technologies are many times lower compared to that of incandescent lamp. However, light output quantity and quality is comparable. The concept of energy conservation on the other hand, implies reducing the total amount of energy in a system.

In Tanzania, energy efficiency is included in a number of the policies, acts, strategies and targets that frame the energy economy, however, there is no dedicated energy efficiency policy, nor explicit policy instruments. As a result the energy economy has much room for increasing energy efficiency in each of the fuel or energy service value chains. No assessments of the potential savings in the energy economy, subsectors nor energy services exist in literature reviewed in the preparation of this document. This constitutes a gap that can be filled as energy policy is developed and implemented.

TANESCO estimates for total losses from transmission and distribution amount to 21-24% of the electricity generated. Distribution losses in 2008 were at an estimated 18% and 19.7% in 2009. Transmission losses in 2009 were estimated at 6% compared to 5% in 2008. One reason for this is low investment in maintenance (Ridgway Capital Projects Limited, 2010). TANESCO allocates an average of 2.8% of revenues annually

(2005-2008) compared to recommended best practice of 12% of revenues annually. TANESCO is already involved in improving efficiency of its upstream electricity activities. It has embarked on a Loss Reduction Programme that aims to reduce losses to 14.6% by 2014 (MOFEA, 2011; Ridgway Capital Projects Limited, 2010). TANESCO has also partnered with Statnett of Norway in an effort to improve its performance through knowledge exchange.

The potential for energy efficiency in Tanzania is not known. Nor is there information of what is the extent of energy efficiencies within the economy and how this can be achieved. Such information is the starting point for the development of an energy efficiency strategy that is targeted at economic sub-sectors and rural and urban populations and productive activities.

Downstream energy efficiency

Downstream of the energy sector activities to improve efficiency are carried out by a range of actors including MEM, TANESCO, Tanzanian Bureau of Standards and NGOs. Development partners such as the World Bank are also critical partners in these efforts. Energy efficiency activities in Tanzania include:

a) **Energy Audits and investments in Public Buildings** – Energy audits have been carried out in a number of public building including University of Dar es Salaam and the Post Office Headquarters. However, energy auditing is not common or routine practice.

b) **Consumer engagement and awareness creation –** There are programmes promoting efficient cook stoves and behaviour changes. Although government has supported these, they have largely been implemented by NGOs. In addition, the timescales and geographical scope of these projects remains limited.

c) **Promotion of energy efficient appliances -** These include energy efficient lighting products such as CFLs, energy efficient cook stoves, efficient biomass ovens and kilns. CFLs have been promoted by international bilateral and multilateral agencies, while cook stoves are promoted by NGOs such as TATEDO. TATEDO estimates that between 2000 and 2006, the production and uptake of improved charcoal stoves was 1.2 million (TATEDO, 2012). However, whether these are still in use, and what percentage are replacements for older stoves, is unknown. In addition, there appears to be no independent monitoring and verification of their performance.

   Artisans and women's groups in the informal sector have been the main actors in the household energy efficient stoves sub-sector. There is increasing interest from the formal private sector to enter the stove market, particularly introducing second and third-generation improved cook stoves. Partly because there is no regulation in this market, the growth of retailers of improved cook stoves has been high. At the same time, the performance of these stoves cannot always be guaranteed as it can vary substantially depending on stove quality and supporting approaches (e.g. behaviour change interventions, cooking pot sizes etc.), a situation that has affected the stove sub-sector since its inception.

   Tanzania still lacks a dedicated energy efficiency agency. It also lacks sustained energy efficiency and its mainstreaming in government activities across sectors. There is a significant role for the TBS to play in the processes for the appraisal and/or measurement of performance in collaboration with stakeholders (amongst others, appliance manufacturers, importers, retailers, government import, manufacturing, energy agencies and ministries, EWURA, NGOs and other representatives of consumers). The

development or adoption of performance standards and labelling that is recognisable by Tanzanian users. The energy performance standards and labelling protocols will then need to vested in the Ports and Customs authorities so as to achieve compliance and avoid dumping.

d) **Energy conservation targets –** the Mid Term Energy Strategy (2011-2016) includes an outcome of the % of industries adhering to energy conservation practices. However, there is little if anything said about the policy instruments that enable this.

e) **Boilers and insulation -** There appears to be little work that has been done on boiler efficiency and thermal performance improvements of structures. Both are technologies where considerable savings can be made.

f) **Transportation energy –** There is nothing in energy policy supporting improvements in energy efficiency in transportation through city densification plans or increased public transport. Rapid Bus Transport systems are being introduced in Dar es Salaam is not driven by energy policy, but will have energy efficiency impacts. .

2.1.6 Energy Intensity of National Economy

The energy intensity of Tanzania averaged 1.21TOE/1000 GDP (2000 US$) in 2009. This is above both the world and African average energy intensity of 0.31TOE/1000 and 0.75TOE/1000 GDP respectively on a per capita basis it is well below the average. While the National Energy Policy (2003) acknowledges the need for energy efficiency as a cross cutting measure, it does not specify the need for decoupling energy and GDP. Neither does the national growth strategy paper – MKUKUTA. This is likely because at a Total Primary Energy Supply (TPES) of 20MTOE, Tanzania is a comparably low energy consumer. However, with increasing mining activities and economic growth, decoupling efficiency from GDP will increase in its importance. In addition, with recurrent energy shortages and the relatively high financial burden of the energy sector on the economy, energy efficiency presents a critical mitigation measure that can free energy capacity as well as finances. MEM is currently developing a range of energy efficiency measures but a comprehensive energy efficiency strategy is yet to be formulated. Particular attention in the development of an energy efficiency strategy is in harnessing the behavioural attributes of poor Tanzanians as they gain access to modern energy for the first time as well as in the utilisation of the recently located natural gas.

2.1.6.1 Industry energy use and potential for energy savings

Common to industries throughout the world are pumping, thermal and lighting energy services, so motors and boilers have received much attention internationally. A recent study considered energy efficiency possibilities in Industry, analysing costs and benefits of efficiency measures from a utility (TANESCO) and users' perspectives rather than a National Economic perspective. However, the Hatch study quoted here, evaluates a number of efficiency measures that could also benefit the national economy.

2.1.6.2 Industrial Electrical Equipment in Tanzania and its Usage - Motors and VSD

As per available literature and field visits conducted, most electric motors and Variable Speed Drives (VSDs) in Tanzania are to be found in the industrial sector and mainly in large companies. Some motors are also installed in large commercial buildings and hotels, mainly on ventilation and air conditioning (AC) systems. In

January 2008, a survey on operating motors, VSDs, AC units and lighting fixtures in Tanzanian facilities was conducted by Dr. Eng. Saanane Bonaventure of the Dar es Salaam Institute of Technology. To date, it is the most comprehensive study found to assess the penetration and existing market of electric motors in the industrial and commercial sectors. A total of 4,234 motors were audited as part of this survey in various regions, including Dar es Salaam, Morogoro, Tanga, Moshi, Arusha, Mbeya, Shinyanga and Mwanza. The sample of visited buildings was quite representative of the main Tanzanian market sectors such as cement, sugar, textile and metal facilities, breweries, hospitals and offices.

The motor survey showed that the majority of motors in Tanzania were manufactured between the 1970s and the early 1990s, making them less efficient than models available nowadays on the market. Similarly, most of the electric motors audited during HATCH study (2010) site visits were old and had been rewound several times. This was confirmed by local vendors of motors who mentioned that sales of new equipment are low because of the preference of industries to rewind old equipment up to ten times. New electric motors with improved efficiency are purchased particularly by large energy consumers, such as cement, water or tobacco industries. Smaller industries are used to rewinding existing motors several times instead of purchasing new equipment due to the low cost of rewinding. In the commercial and tourism sector of Dar es Salaam, very few central AC and ventilation systems are installed. This explains why only a small amount of electric motors, rather than those included in AC units, are in use in these two sectors.

The HATCH report (2010) estimates the following statistics to represent the new motor market, based on equipment efficiency:

- For small motors, 90% of motors sold are “standard-efficiency” (IE1). The remaining motors in this category are “high-efficiency” (IE2).
- For larger motors (whose nominal power is equal to or larger than 40kW), the percentage of high-efficiency (IE2) motors sold may be as high as 90% while standard-efficiency motors might account for only 10%.
- For both small and large motor market segments, the penetration of premium-efficiency (IE3) motors is almost nil in Tanzania.

It is estimated that, the incremental purchase cost of high-efficiency motors instead of standard-efficiency motors is approximately 5%. Premium-efficiency motors (IE3) were not available in the Tanzanian market. However, a number of international manufacturers, which are already distributing premium-efficiency motors in other countries, mentioned that they could import premium efficiency motors in Tanzania if the local demand for such equipment increases.

Another key finding from the HATCH study report is that most managers are not aware of the benefits of VSDs. Similar observations were made by experts following site visits to industries. Nevertheless, the VSD manufacturers interviewed confirmed that the VSD market is growing fast, mainly due to the high energy saving potential related to the installation of such systems. Finally, very little information was accessible on the actual market for power factor correction units. Despite its large potential for cost savings, it seems to be a small market both for electricity consumers and TANESCO.

More Energy Efficient Options

When compared to capital costs, operating costs (including energy) of typical electric motors are very relevant. Calculations show that the operating costs of heavy loaded motors over a one-year period could be as high as ten times the initial cost of the equipment. In addition, the capital cost represents only 1% to 2% of the total life-cycle costs of such equipment. Considering these insights, the choice between models of different efficiencies becomes very important.

Electric motor consumption in industries worldwide is estimated at 50% to 65% of total electricity consumption in the industry sector. In Tanzania, this percentage may be even higher with the presence of less auxiliary equipment (electrical heating, cooling, and others) than in other countries. In fact, Dr. Eng. Saanane's motor survey shows that the electricity consumption of motors in the Tanzanian industrial sector could be as high as 90%.

The main barrier to the penetration of high-efficiency motors is the current motor rewinding practice without considering the long-term energy usage of the motor. The HATCH report (2010) observes old rewound electric motors, especially in small- to medium-scale industries and commercial buildings. Rewinding failed motors seems to be a common practice in Tanzania mainly due to its related low cost when compared to the purchase and installation costs of new electric motors. When it comes to choosing between replacing and rewinding a failed motor, maintenance managers will elect to rewind the equipment regardless of the potential loss of efficiency.

Another barrier to market transformation is the typical payback period related to retrofitting an existing motor with a more efficient model only for the sake of saving energy. Unless the electricity price is very high or the conditions of existing equipment make it very inefficient, retrofitting electricity motors may be hardly cost-effective. Nevertheless, the incremental cost is paid back in three to five years in most situations in a replacement scenario (i.e., when the existing motor needs to be replaced and managers can choose between a standard, high-efficiency or premium-efficiency motor). A payback period of 3 to 5 years also applies to the purchase of new equipment. The first cost versus operating cost (of life-cycle costs) is a problem not unique to Tanzania, but common to business and public sector institutions where the budgets and oversight for procurement and operation are separated.

Other than knowledge of benefits, no major technical barrier to VSD implementation was found in both commercial and industrial facilities. Several VSDs are currently used in industrial areas. However, the awareness and knowledge of facility managers on VSDs is limited, especially in small industries and commercial buildings. Overcoming this barrier would require educating industry about the opportunity to replace a motor and benefit from long-term savings when a motor fails. Payback requirements are very short in retrofit situations, this constraint is relaxed in new-build of industrial facilities where a longer payback is acceptable.

Selected Energy intensive Industrial Sites

Industrial customers include the vast majority of T3 and a significant portion of T2 electricity consumers[4]. Small industries may also be supplied under the T1 rate with a three-phase connection. These industrial customers include largest mines of the country. The HATCH study report (2010) noted that a significant number of large T3 customers had recently made significant investments in new production lines. This money

[4] The T1, T2 and T3 refer to electricity consumer tariffs.

was also intended for the renovation of existing production lines with associated increases in productivity, product quality and energy efficiency. The newly added equipment has distinct characteristics as well as a lower potential for improvement than other production lines installed several years ago and which have never been renovated to improve efficiency.

The management of a number of these larger companies take investment directives from headquarters located abroad. These foreign-owned companies generally have access to corporate engineering support that gives them more opportunities to identify and install the most up-to-date technologies. Additionally, several locally or regionally owned companies invested significantly in new or upgraded plants and/or production lines. Most specifications for the lines added or renovated were provided by the engineering department of the home office abroad or by international consulting firms specialized in industrial engineering. Several of the new production lines visited were world-class.

The HATCH study included findings from a selection of companies, which are illustrative of progress made and practical barriers to efficiency improvements. A short summary of some of the interventions are included in the table 8 below:

Table 8: Summary of energy efficiency interventions in selected industries in Tanzania (Hatch 2010)

Site description	Measure	Status/Reason
Barrick Gold (Bulyanhulu, Buzwagi, and North Mara) Ore is processed through three large grinding mills (1,500 hp, 1,750 hp, 2,500 hp) and there are many motors on site ranging from 1 hp to 500 hp.	Most of the motors on site are "high-efficiency," purchased in Europe or North America. Approximately 85% of them have variable frequency drives.	• Already procured and installed
Barick Gold and other Industry players	Ventilation, compressed air systems, lighting, power factor correction, AC and monitoring	• Under examination for potential savings
Alaf: Zinc Aluminium	Integrated efficiency measures installed Efficient motors	• The marginal gain from switching to higher-efficiency motors could not be justified economically at the time of HATCH study (2010)
Alaf: Galvanization line	electrically-heated annealing cells switch to natural gas	• Retrofitting process transformation might be expensive and need significant technical expertise and financial support to bring the payback of this project into a one- to two-year period.
Bakhresa flour mill: Milling grains	160kW motors controlled with VSDs. 2% below premium-efficiency motors.	• Investment in two new mill lines in the last 4 years. VSDs used for variable loads.
Tanzanian Breweries: Total operations (Dar es Salaam, Mbeya)	Benchmark for outputs 8 (Mbeya) – 11 (Dar es Salaam) kWh/hectare Litre VSD motors, heat recovery, housekeeping, air-compressors, refrigeration, energy balancing.	• International branding for world class new plant. • 1-year payback for retrofit.
Twiga cement: Grinding mills of standard efficiency for 2 500 and 2x550 tonnes cement per day = 80% of energy consumption.	Demand side management. Reduce peak load (10MW). Significant load shifting opportunities (5MW)	• Good engineering practice
Superdoll: Welding and bodyworks for trucks and trailers	Compressors and air leaks and efficient lighting	• Offered as an intervention by consultants to reduce compressed air loss through repairing leaks at

		payback of 0.5 to 1.5 years.
MMI Steel 3MW Arc furnace	Power reliability and quality before efficiency	• Reducing downtime. Later smart meter data to correct power factor, lighting
Iron and Steel Company 2MW Arc furnace plus rolling mill	Power reliability and quality before efficiency. Improvement on 20% electricity availability would reduce current downtime of 50%.	• Reducing downtime. Later could benefit from high-efficiency motors, lighting upgrades and power factor correction
Ruffia Bags	Compressors (55kW, 37kW and 18.5kW) and chillers for process water cooling	• Smart meter data for power factor correction. • Opportunities for improved efficiency in motors, heating and lighting

Industrial Energy Management

Most companies have neither energy management policies nor structured energy management processes in place. Therefore, they seem to implement energy efficiency initiatives on a sporadic basis only when an opportunity is targeted or when equipment needs replacement or renovation. One notable exception is Tanzania Breweries. As part of the SABMiller group, the Tanzanian plant has to follow corporate policy stipulating that a global plant consumption reduction of 50% is mandatory by 2020. SABMiller operates 63 plants in Africa, of which four are located in Tanzania. Corporate policy for energy reduction is translated into individual objectives for each company plant. SABMiller takes into consideration the age of each facility when establishing energy intensity targets. Each source of energy is allocated its own target. For instance, the Dar es Salaam plant was assigned a target of 11kWh per hectolitre (hl) while most recent plants ended up with a target of 8kWh per hl. The Mbaya plant (which was built recently in Tanzania to the highest energy-efficiency standards) is one of the plants in the world with the most stringent target, i.e. 8kWh per hl. SABMiller also operates corporate energy management software that distributes the plant target down to individual equipment (kettle, cellar, tank farm, and packaging). The SABMiller plants offer an affirming demonstration of best practice in Tanzania and future efficiency programmes could benefit from the learning potential their presence affords.

Barrick Gold, is another example of energy efficiency being addressed in Tanzanian industry. They have made significant progress in improving quality, reliability and data management aspects of its electrical energy system over the past few years. It has also succeeded in establishing good energy management practices. Barrick is developing and tracking energy efficiency key performance indicators and establishing formal energy management planning practices on site.

Ministry of Energy and Minerals

A demand side management study by Hatch conducted for TANESCO in Dar es Salaam in 2010; quoted MEM officials that recent multi-sectoral audits was around 2003-2004. The survey was conducted on industrial energy use in the country, and audits were conducted of the Dar es Salaam water utility and four government ministries. No programme is reported to incentivize implementation or measure or verify savings, so there is no information on the results of the audits and post audit actions. The audit of water pumping reportedly in the report identified potential savings in the range of 40%. The audits of the government ministries reported a high level of inefficient energy use. For example, the audit for the Ministry of Education and Culture found:

a) Use of undersized and deteriorated electrical distribution systems leading to overheating losses;
b) Use of outdated and over-rated electrical protection switchgears and fuses that are also a safety concern;
c) Poor electrical system power factor;
d) Low level of good housekeeping to office equipment, lighting systems and air conditioning systems;
e) Inefficient and deteriorated lighting systems consisting of incandescent bulbs and 5 ft 65 W fluorescent lights that also lead to poor illumination levels to offices;
f) Inefficient office equipment, computers and air conditioners;
g) Deteriorated building envelope, high heat gain through glass windows and walls. Excessive hot air infiltration in air conditioned rooms with louvered windows;
h) Absence of a person responsible for energy efficiency matters in the Ministry;
i) Lack of energy conservation/efficiency awareness to workers; and
j) Absence of energy Policy for the Ministry of Education and Culture.

TANESCO

The HATCH report also reported a proposed TANESCO rural electrification programme, encompassing a one-year model programme on EE in which CFLs were to be distributed free of charge to customers. Normally, TANESCO connects customer with its own crews. Under the model programme, of which the implementation status is not clear, in addition to connecting the new customers, the six contractors would provide each household with four CFLs for free. TANESCO had technical specifications for the CFLs to ensure they are high quality. At the moment, this programme, funded by SIDA is the only proposed TANESCO energy efficiency programme planned. Again it is not clear whether it was implemented and why CFLs are not popular among Tanzanians.

Industrial Audits

In the mid-1990's, about 40 energy audits were performed on some of the largest industrial energy users, focusing mainly on motors and lighting. The donor funded TANESCO-Consultancy Services on Energy Rationalization & Demand Response in Tanzania through the World Bank's Energy Sector Management Assistance Program (ESMAP), identified 12MW worth of savings. However, according to a presentation by TANESCO officials in early 2010, the programme achieved a 25MW reduction in electricity demand. The reality is that there has been no formal measurement or verification of energy savings from the programme. The officials at TANESCO and MEM that were interviewed during the HATCH study (2010) stated that they have not heard about the audit recommendations being significantly implemented except some low cost operational measures at a few sites. Apart from TANESCO and MEM supporting radio advertisements encouraging energy efficiency and handing out pamphlets at trade fairs, the utility and MEM has not yet established a major demand and energy management programme even as it recognizes that such programmes could be cost effective for its power systems.

The Opportunity

In the HATCH study report (2010), a survey of several TANESCO customer groups was conducted in Dar es Salaam. It was revealed that there exist important potential for improvement of energy usage in Tanzania. This potential lies with a number of the types of end-use technologies reviewed. For example, there is a large potential for improvement in household lighting as there are still large quantities of incandescent bulbs used by

customers' homes. The efficiency of AC units was average and there is a good potential for improvement. Premium efficiency motors were generally reported not used in the country and there are still a large number of motor systems with variable loads that have not been retrofitted to variable speed drives. In the residential sector, appliances like refrigerators were often of low efficiency due to large numbers of old, inefficient units imported from abroad. There is also the potential for significant energy savings in many large industrial facilities. In addition, there are generation and co-generation opportunities at some of these industrial sites that could be put online to reduce the network peak load in exchange for financially compensating the generator owners. Some of these industrial customers could be potentially interested in programmes under which they would be compensated for shifting some of their operations to off-peak periods.

One of the rationales for TANESCO to implement EE initiatives is the financial loss that is currently incurred by supplying electricity at a lower cost than TANESCO's cost of service. The situation on the remote diesel mini-grids is much worse, since the cost of generation with diesel fuel is high but the same tariff structure is in place as for customers on the main grid.

Governmental leadership in energy efficiency and demand response

One of the most important factors required to ensure success of EE initiatives is a strong governmental leadership related to energy efficiency. Government needs to put in place the institutional framework as well as the enabling policies and structure required to coordinate and provide the required impulse for energy efficiency activities. Specific support for energy efficiency and load reduction was expressed in the 2003 National Energy Policy. This document already provides sound directives on energy efficiency and can serve as a basis for the future directives and actions from the government, including the development of dedicated energy policy and instruments.

In several countries, government intervention was required to ensure that the development of sustainable energy efficiency programs and demand responses actions took place. Government usually determines who are the main institutions that will participate in the energy efficiency improvement efforts and which responsibilities will be devoted to each one. One of the most important types of support that needs to be put in place by the government is proper financing mechanism for utilities that develop and implement energy efficiency and demand responses initiatives.

The governmental support to energy efficiency can also include a wide range of policies and regulatory requirements, including a national energy efficiency law, energy use reporting, minimum energy performance standard regulations (MEPS), labelling regulation, investment fund for energy efficiency, the training for Energy Service Companies (ESCOs) and requirements for energy managers for large customers. This is only a limited sample of the initiatives that can be taken by government to support energy efficiency.

In the short term, subsidies could be the only feasible way to implement programmes rapidly and curb the demand and energy consumption growth. However, in the mid to long term, developing financial instruments to extend credit facilities for energy efficiency projects will be an essential component of the financing structure. In the long term, another interesting form of financing might be introduced through Energy Service Companies (ESCOs). The ESCO experience shows that, in several countries, it can contribute significantly to the development of an energy efficiency marketplace while creating job opportunities. A number of ESCOs are currently operating in developed countries and several others are already operating in transition countries. The

opportunities for Nationally Appropriate Mitigation Activities (NAMA) through the United Nations Framework Convention on Climate Change may be a suitable fund raising route for sectoral or economy wide initiatives as would the carbon markets that could return in the form of the CDM or a new market mechanism in the near future.

Demand and Energy Management

A financial mechanism is crucial since several energy efficiency and demand response initiatives make sense on a national level, but they incur losses for the utility that implements them due to the associated losses of sales as a result of energy and demand savings. The most commonly used mechanism is to allow for income related to the loss of earning to be allowed in the tariff. In some countries, the utility received a slightly higher amount as an incentive to realize the demand and energy management activities. In those cases, the utility makes additional profits by implementing demand and energy management programmes compared to the sales of electricity. Other mechanisms for funding could be provided directly from the government through the treasury or from some special taxation mechanism. In Tanzania where the cost of service is not fully recovered by TANESCO's tariffs, it is more challenging to try to increase rates/tariffs to finance energy efficiency activities unless there is provision from the regulation authority that stipulates that a portion of tariff increases must be devoted to the implementation of energy efficiency programmes.

2.1.6.3 Household energy use and potential for energy savings

In households, energy efficiency can be gained in all energy services. Perhaps the largest gains can be made in thermal energy services such as cooking, lighting and space cooling/heating. The efficiency gains that can be made are in using the right fuel for the service, using an efficient appliance, and in managing the energy service well. In the area of electricity, the management of demand for electricity is particularly important for the energy economy as the usage patterns affect the sizing of infrastructure, the required investments and the overall cost and price of electricity. Tanzania is at the beginning of examining the energy efficiency potential of its economy and this is crucial in its timing, as access to electricity is being extended as a national priority. The entire biomass energy value chain could do with policy and regulatory attention that could affect efficient charcoal production, biomass fuel distribution, biomass end-use and use as a contributor to modern energy access.

There have been programmes promoting efficient cook stoves and behaviour changes. Although government has supported these, they have largely been implemented by NGOs. In addition, the timescales and geographical scope of these projects remains limited and lacks continuity and technology performance standards.

Energy efficient cook stoves, efficient biomass ovens and efficient kilns, have been promoted by international bilateral and multilateral agencies while cook stoves have been promoted by a range of NGOs such as TATEDO, ETC, etc. TaTEDO estimates that between 2000 and 2006, the production and uptake of improved charcoal stoves was 1.2 million (TaTEDO, 2012). However, whether these are still in use, and what percentage are replacements for older stoves is unknown. In addition, there appears to be no independent monitoring and verification of their performance. Artisans and women's groups in the informal sector have been the main actors in the household energy efficient stoves sub-sector. There is now increasing interest

from the formal private sector to enter the stove market, and regulation would help in making such investments sustainable.

Air Conditioning

Air conditioning (AC) units are found in all markets including residential, commercial, institutional and industrial. The market is currently dominated by split systems that are gaining share over traditional window or through-the-wall units that were more popular historically. Over the last years, the gap between the average price of split systems and unitary air conditioners has been decreasing considerably thereby boosting the market share of split systems. The added advantage of flexibility in positioning external and internal units generally drives consumers to select split systems. The HATCH report on DSM (2010), reported that most units observed in the field and in shops in Dar es Salaam had an Energy Efficiency Ratio (EER) of 2.64, which is relatively low compared to high-efficiency systems found in other countries.

The HATCH report on DSM (2010), reports only two sites were found where central water chillers were used for a portion of the building. There is no information available about the total number of systems in the whole country, but AC equipment vendors estimate that there are less than 50 chilled water systems countrywide. Both systems were using screw compressors that were relatively efficient. In the residential sector, the penetration rate of AC equipment is very small. Only a few houses do have this type of equipment. The penetration rate of AC units in T1 tariff category consumer residential buildings is insignificant. On the other hand, HATCH report found no AC unit in any of the D1 consumer houses visited. Furthermore, the owners of the house indicated that the units were used only when they had guests at home. Consequently, the contribution of AC equipment to the residential sector peak load, and in particular the evening peak load, is probably very small.

In the commercial sector, the usage of AC is mixed. Small shops that have wall openings for display or frequent door opening usually have no or have very few AC units. Larger buildings such as hotels have split units for rooms and common space. The only exception was a single five-star hotel that had one central chilled-water system for the common space. The hotel rooms, however, were equipped with split AC systems.

Small and medium offices usually use split systems. Contribution of the commercial AC equipment to the evening peak is probably limited except for hotels where the occupancy profile and AC usage peak during the evening. Hotels could be an interesting starting point for the promotion of efficient AC units and perhaps solar water heaters as an ESCO activity.

In the institutional sector, the schools that were visited had only a few AC units for the administration office. Hospitals usually have a larger quantity of units. In the largest hospital in Tanzania, about 90% of the AC load is supplied by split systems while only one building was identified that uses a central AC system.

More Energy Efficient AC Options

The split systems constitute the majority of AC units in the country. In fact, there are several options to significantly increase the efficiency of those appliances. For most AC units on the market (window, split), efficiency is expressed as an EER. This is the ratio of cooling energy provided by the unit in BTU divided by the energy input in Watts. Better designed splits incorporating high-efficiency compressors as well as larger

and more efficient evaporators and condensers exist and can boost efficiency from a standard EER of 2.64 to an EER of 3.32.Furthermore, incorporation of the inverter technology boosts unit efficiency to an EER of 4.7 and even up to 5.6 when the best units are selected. If transformation efforts are introduced to bring units up to an EER of 3.5 in the market, a 30% efficiency improvement can be achieved. The additional cost of purchasing a high-efficiency unit is between about 25-40% in the current market due to a current low demand for such products.

Other options to increase AC unit efficiency may include using evaporator pre-cooling. These units have been on the market for several years but have had difficulty gaining significant share in the world market. This technology requires a reliable supply of clean and inexpensive water, a requirement which is not met in Tanzania with frequent shortages in water supply. As a result, this technology is not recommended in Tanzania. It is possible to increase the efficiency of medium-size chilled-water systems (in the range of 40 tons to 200 tons of refrigeration) by about 8%-10% by selecting units with more efficient compressors and oversized evaporators and condensers. Variable speed screw compressors are used very often in those units.

Decreasing the load required for ACs through the use of insulation, natural ventilation, shading, orientation and other passive thermal performance improvements is perhaps the most cost effective way of decreasing load requirements. This can be costly to retrofit, but more cost effective in new structures.

Barriers to energy efficiency improvements, as with other renewable and or high quality equipment are up-front cost increments to achieve life-cycle benefits, the small size of the market (i.e. economies of scale), awareness of benefits, technical know-how, availability of finance at the right time in project cycles, limited policy instruments (including rebates for verified efficiency gains), and lack of energy pricing signals that would affect efficient behavioural practices.

Refrigeration

The market of domestic and commercial appliances is dominated by low-cost used or new imported poor energy performance products. Many small shops sell used refrigerators that are shipped to Tanzania from countries that discard old and inefficient products. As for new refrigerators, a wide range of brands was found on the market with some of them being counterfeit. A number of better-quality models (e.g. efficiency class B, based on the European Union (EU) Standard) were also identified. However, they are more expensive than low-quality equivalent appliances whose efficiency level is unknown. There is no national database on the products sold in the market.

There exist in Tanzania abundance of imported household appliances, whose efficiency varies considerably. On the one hand, the highest efficiency models found locally are rated as A or B. These energy labels refer to an efficiency matrix used by the Minimum Energy Performance Standards (MEPS) and labelling regulations of the EU. Refrigeration appliances featuring an energy index of A or B are considered as efficient. On the other hand, many low-cost unbranded models are available on the market. Despite the lack of technical details found on those counterfeit appliances, it is assumed that the latter have a low energy performance when compared to standard-efficiency branded models. It is important to note that most refrigerators and freezers available in Tanzania originate from Asia (China, India, Japan, and South Korea), the Middle East (mainly from the United Arab Emirates), Europe (Germany, France, and Italy) and South Africa. It is estimated that more than 50% of the refrigeration appliance market is located in the city of Dar es Salaam.

Comparatively, it was found that most consumers of the D1 residential market sector are cost conscious when it comes to buying appliances. Based on the HATCH study report, there is high penetration of refrigerators and televisions in D1 tariff for residential households, which were typically old and second-hand. The penetration of energy efficiency products is low among consumers in this segment. The age of these refrigerators are often ten or more years. The HATCH report records a test using with an energy meter that indicated that the average refrigerator consumes about 235kWh per month, which is high compared to the estimated energy consumption of high efficiency models of similar capacity.

With regards to commercial appliances, it was noted that many soda machines are installed in Tanzania. Kwanza, the largest of the distributors, has 9000 of these machines in grocery stores and mini-markets in the country. According to Kwanza representatives, voltage fluctuations result in premature burn-out of the compressors.

Energy-efficiency models of refrigerators, washing machines, dryers and dishwashers are still insignificant in Tanzanian market.

Barriers to more efficient refrigerators

The small Tanzanian market for electrical appliances with limited control on quality makes it an interesting destination for the dumping of small consignments of substandard appliances from elsewhere. Hence a concern to achieve market transformation to more efficient appliances requires some management of the quality with respect to performance technologies that enter the country. The situation is one in which the market for larger electrical appliances is too small to warrant minimum performance standards and the achievement of compliance with these. Similarly market size is too small for local manufacture that could compete with grey or second-hand imports. However, this could change as universal access to electricity is achieved and with it increasing penetration of domestic appliances.

Moreover, voltage fluctuations may be an issue for a few appliances resulting in a reduced lifetime. A number of high-quality appliances have a built-in voltage stabilizer and are thus more resilient to voltage fluctuations. However, this additional feature makes the appliances more expensive and less attractive to customers. Therefore, consumers may be willing to pay more for a lower-efficiency appliance equipped with a voltage stabilizer rather than for a high-efficiency equivalent model that is less resistant to voltage drops. This situation should be taken into account when designing and implementing a DSM programme on refrigeration appliances.

Lighting

The HATCH report on Demand Side Management in Dar es Salaam (2010) observed that in the residential market, a large proportion of lighting is provided using incandescent lamps. However, the CFL penetration rate is becoming more significant as this class of lighting is used by approximately 30% (for D1 consumers) to 70% (for T1 residential consumers). Linear fluorescents of 18 W and 36 W are popular, accounting for approximately 35% of the lighting fixtures installed in residential buildings. It was noted through the household survey that many D1 consumers did use CFLs even though they were many times more expensive than incandescent. CFLs show significant penetration in all sectors and are available in a range of qualities. Low-quality units sell for a cheaper price and will generally fail before their quoted lifespan as they cannot sustain

voltage variations. Higher-quality units from recognized international manufacturers are also available, but their price makes penetration in the market low.

Linear fluorescent fixtures, the 18 W (2 feet) and 36 W (4 feet) fixtures are predominant in the market. Most fixtures use standard ballasts. Electronic ballasts are also becoming available with various levels of quality depending on their price. Several market actors mentioned that low-quality electronic ballasts are sold on the market.

All types of high-intensity discharge lamps are used for high-bay applications and exterior lighting applications. Fixtures with mercury vapour, metal halide and high-pressure sodium lamps are common.

Barriers to more efficient lighting

The natural substitute for incandescent lamps is the CFL or LED technology classes. A CFL unit can provide the same level of illumination as an incandescent bulb while consuming only one fourth of the energy. The CFL lamps found in local shops have a large range of qualities and prices. Some units from eastern countries sell for relatively low prices but several customers have reported that these units did not have a long service life, especially with the voltage fluctuation that is common in Tanzania. As far as linear fluorescent lighting is concerned, the replacement candidate for the current predominant 36 W (4 feet) lamp is the T5 lamp. Surprisingly, the 32 W lamp which has been commonplace in North America for more than 15 years is not available from local sources of supply. In North America, this technology has provided a cost-effective solution to bridge the gap between the 36 W lamp and the T5 unit. The 32 W lamp uses a better phosphor coating to provide the same level of illumination as a 40 W or a 36 W linear fluorescent while requiring less operating power.

The Light Emitting Diode (LED) technology increasingly available elsewhere in the world is still to make some significant market penetration in Tanzania outside of the PV solar lantern market where the low voltage LEDs usage is an increasing norm.

The main issue related to market transformation is the presence of low-quality and low-cost CFL units in the market. Bad customer experience with units that fail prematurely is spreading by word of mouth, which creates a barrier to further penetration of the technology. Education in the market is required so that consumers can recognize the value of higher-quality (although more expensive) products. The main barriers to linear fluorescent implementation are the absence of an intermediate technology (such as 32 W linear fluorescents with electronic ballasts) as well as the failure rate of T5 fixtures and electronic ballasts currently entering the market.

The T5 technology also poses different challenges when considered for a retrofit application. T5 lamps have a different length and socket than T8 lamps. As a result, they cannot be easily retrofitted in existing fixtures. Either the existing fixture has to be modified extensively, which implies important labour costs, or it can be replaced with a new fixture which makes the payback period in a retrofit application more difficult. No particular barrier was noted for high-intensity discharge fixtures. The metal halide and high-pressure sodium units that can replace the mercury vapour and quartz units are readily available in the market.

Other household appliances

The energy consumption generated by fans, entertainment appliances (radios, televisions, DVDs, etc.) and office equipment (computers, printers, fax machines, etc.) is not irrelevant. On the other hand, it does not justify a detailed assessment or the development of a DSM programme for those appliances. According to HATCH report of 2012, electricity consumption of these appliances varies between 5% and 25% of total electricity consumption in all audited segments. The report states that during day time, electricity demand in the D1 segment is mostly due to refrigerators, televisions and a few lights. Peak demand arises in the evening due to the combined use of lighting, televisions and radios. The night-time base load is very low and is mainly due to external lighting or refrigerators. Fans are seasonal and used mainly at night during the summer period (between October and February). In the T1 residential sector, the base load is mainly caused by cold appliance (air conditioners) consumption. The difference between peak load and base load in this segment is large as consumers use more lights during the evening. This creates an electricity peak demand early in the evening when refrigerators, lighting and entertainment system consumption add up.

The penetration of cooking appliances (such as ovens, microwaves, etc.) is relatively low in the T1 segment. Studies have shown low level of electrical cooking as supply variability and increasing prices have driven a back-switching to biomass based cooking. There is some LPG used for cooking but this remains a low and has decreased as prices linked global oil prices have increased. From 2001 to 2007, the proportion of households in Dar es Salaam using charcoal as their primary energy source has increased from 47% to 71%. Use of liquefied petroleum gas (LPG) has declined from 43% to 12%. In other urban areas, the share of households using charcoal for cooking remained at 53%, while the share of fuelwood use increased from 33% to 38%. The use of electricity for cooking is below 1%. (World Bank report and Policy Note (Environmental Crisis or Sustainable Development opportunity? 2009:) pp1, box 1.1). The penetration of electric water heaters and solar water heaters appears negligible.

Considering the lifestyle of T1 residential consumers, the average electricity consumption per inhabitant person is still much higher in that segment than in the D1 residential sector. Considering the diverse nature of T1 commercial consumer activities, it would be difficult to detail peak demand exactly. In general, the activities of most small and medium industries are primarily manual and do not require large quantities of electricity. As for restaurants and hotels under the T1 segment, electricity is mainly used for lighting, entertainment appliances and refrigeration. Typical T1 consumers record most of the daily electricity demand during day time when they are the most active. However, the electricity demand of hotels, restaurants and bars under the T1 market sector may be at its highest point in the evening when guests arrive.

Summary on key drivers for the energy efficiency

Efficiency improvements can be interesting for a range of reasons stated above. They include: reducing costs of energy services for users, reducing requirements for energy supply and distribution infrastructure, reducing energy payment arrears in metered or landlord owned structures, achieving least-cost energy planning requirements (if required by regulations), improving load factors, reducing emissions of pollutants and greenhouse gasses, etc. Below are a number of policy instruments that can be utilised for improving energy efficiency, but the key driver under traditional energy policy approaches is one of aligning the suppliers and distributors with achieving end-use efficiency improvements. This can be done through tariff setting measures that reward efficiency improvements or through sectoral, subsector or service related energy intensity targets with tight compliance monitoring, verification and reporting and serious penalties for not attaining these.

Awareness: It is clear from the above discussion that there are a wide variety of players that can contribute to barrier removal measures, who can also stimulate the drivers and thereby help the penetration of energy efficient technologies. A case in point is the strong competition between technology manufacturers that results in aggressive advertising campaigns. The advertising campaign in this example is the measure (stimulant), and the high level of awareness of energy efficient technologies, thus created, is the driver.

Decrease in technology price levels: A high level of awareness is usually not sufficient to attract private investment and guarantee market success. The general understanding of market mechanisms dictates that price of a technology is an important factor in its speedy penetration. Hence, one can assume that educational/promotional activities are important, even though, there should be other incentives, such as rebates of super efficient technologies, as well. Along with advertisement campaigns, the competition should lead to a decrease in the cost of the technology. Such reductions in prices can safely be assumed to lead to an increase in the sales of the technology.

Increase in energy prices: Cost savings in energy bills through reduced use of energy is one of the reasons for the decision to buy energy efficient equipment. A look at the electricity prices in developing countries over the past few years indicates that nominal electricity prices increased rapidly during the 1990s. In real terms, the price increase may be less, but it is still significant to affect purchasing and investment decisions. If there is a continuous and predictable increase in its price, consumers are more likely to be motivated to adopt energy efficient equipment to conserve electricity and heat.

Technology appeal: While analysing drivers, one factor that may be of worth considering is the 'smartness' of the technology. If the energy-efficient equipment gives an impression that it looks 'modern', 'appealing', and 'fashionable', there is a higher probability of consumers purchasing the technology. These non-economic motivations, in general, dominate the decisions primarily of high-income groups, for whom, technological appeal rather than practicality, is a major driving factor.

Non-energy benefits: Non-energy benefits are important drivers of energy efficiency. They accrue at the national level, e.g. via improved competitiveness, energy security, job creation and GHG reductions. From a consumer perspective, it is often the non-energy benefits that motivate decisions to adopt energy efficient measures. The benefits to the consumer through these measures include (i) improved indoor environment, comfort, health, safety, and productivity; (ii) reduced noise; (iii) labour and time savings; (iv) improved process control; (v) increased reliability, amenity or convenience; and (vi) direct and indirect economic benefits from downsizing or elimination of equipment.

Environmental Regulations: Environmental regulations, if well designed, can serve as a driver for investments in energy efficiency. In the absence of environmental regulations, the societal costs of electricity generation in the form of gaseous and particulate emissions, water use and other environmental impacts are not borne by the energy producer or by the consumer. Consequently, these actors do not see the true economic costs of their production and consumption decisions. Environmental regulations can force producers and consumers to internalize these environmental costs into the price of their energy goods and services in the form of increased environmental compliance costs. These increased environmental costs can send a price signal for increased investments in energy efficiency by making efficiency investments comparatively more

attractive financially. Not all environmental regulations are created equally, however. If an environmental regulation simply mandates that an industry install a particular pollution control device, then the industry's response will be to seek ways to minimize its cost of compliance with the pollution control requirement and the price signal for efficiency investments will be muted. Once the pollution control device is installed, there will be little incentive to improve the efficiency of the overall production process. If, on the other hand, the environmental regulation uses market mechanisms to reward industry for reducing emissions through, for example, tradable permits, certificates or carbon credits, then the industry would have the incentive to improve the efficiency of and continuously improve its manufacturing process and potentially turn the environmental regulations into a source of profitability. A more efficient manufacturing process would naturally follow.

The challenges include the following:
In biomass there is potential for efficiency gains in the preparation, distribution and use of fuels. However, biomass energy policy is not in place, and hence the sector is unregulated, not organised and therefore difficult to penetrate. There are significant gains to be made in the making of charcoal and in the use of efficient biomass in stoves, but no standards exist. There is, however, methodologies in the carbon markets that could stimulate uptake of efficient stoves and more efficient charcoal kilns, and even the growing of biomass fuel crops. In general, engagement in the biomass as a national asset that could contribute to the vision of a modern energy economy needs to be developed amongst policy makers, for policy instruments to effect efficiency gains specifically and biomass resource management generally.

In electricity the variability in quality and availability appears to be the main concern of productive sectors that depend on it before they consider efficiency practices. Pricing signals in tariffs that result in system load management will need to be developed into the future along with other demand side management measures that reward good management. Allowing generous reward to the utility in advancing efficiency by allowing for cost recovery and more through tariff negotiations with energy regulator would be a good step in securing supply and stabilising costs and prices and genuine efficiency ambition by the utility. Efficient appliances and passive measures need to be promoted by government, and measures need to be put in place to protect the economy against the dumping of low efficiency new and used appliances.

Specific work on boilers, motors, lamps, ACs and refrigerators as well as promotion of the least-cost fuel/appliance combinations for the energy services to the energy economy would be worthwhile – such as solar water heaters in place of electric water heaters. Rebates for efficient practice, sectoral benchmarking, Minimum Energy Performance Standards, improved thermal performance of structures, comparative labelling and ESCOs all have merit into the future. In summary some challenges existing in the energy efficiency subsector include:

- Technological challenges
- Economic challenges
- Risk/uncertainty challenges
- Social challenges
- Political challenges

2.2 RENEWABLE ENERGY vis-à-vis GOAL OF SE4ALL

2.2.1 Overview and Assessment

Tanzania is blessed with high quality renewable resources, largely untapped. They include hydro, geothermal, solar, wind and biomass. According to MEM, presently about 6.5% of total generation capacity in Tanzania is from renewable energy, including captive generation in sugar, tannin and sisal factories, solar, and small hydro plants, but excluding large hydro. The Government of Tanzania has a goal to increase the share of renewable energy (excluding large hydro), in the electricity mix to about 14% by 2015. When large hydropower is included, the total renewable energy generation capacity is about 40%. A summary of renewable energy potentials in Tanzania is provided as Annex 4.

Hydropower

The total unexploited hydropower potential in Tanzania is estimated at 4500MW. This includes cost-effective potential in Ruhudji (358MW), Rumakali (222MW) and Songwe River (more than 300MW) (TANESCO, 2012). A Hydropower Development Master Plan was develop to guide cost-effective selection of potential sites for hydropower. In addition, a number of feasibility and pre-feasibility studies have been conducted on various sites and there is public and private interest in developing some of these. Key challenges to hydropower potential for developers include access to finance, and permits required before site development. The private sector for example cited excessive delays – of up to one year in some cases – in decision making over water permits.

The Global Village Energy Partnership (GVEP), with support from the World Bank and the Russian Federation are supporting a programme to assist with capacity building on feasibility studies, impact assessments and business plans for potential developers. Over 6 mini-hydro sites are under consideration for further development.

The assessed potential of small hydropower resources (up to 10MW) is 480MW. The MEM is currently carrying out small hydro feasibility studies in eight regions of Morogoro, Iringa, Njombe, Mbeya, Ruvuma, Rukwa, Katavi, and Kagera. GVEP International, in partnership with REA is supporting the development of six mini hydro mini-grids with total capacity in the 7.4-8.8MW range. EU is financing the Yovi Hydro Power project and Sustainable Community-Based Hydro Power Supply; and UNIDO co-funding the development of six mini-grids based on mini/micro hydropower. REA have identified more than 60 small and mini-grid sites for which developers are sought.

Geothermal

Development Partners have shown interest in supporting the geothermal sub-sector. DFID and JICA have expressed interest in supporting the preparation of the Geothermal Development Roadmap. The German Government, through BGR is supporting capacity building and resource characterisation. Tanzania is a partner in the ARGeo project to support geothermal development in the Rift Valley countries. A company, Geothermal Power Tanzania Ltd. (GPTL), partly owned by the Tanzanian National Development Corporation has begun shallow well drilling in Mbaka. The Climate Investment Funds through the Scaling-up of Renewable Energy

Programmes (SREP) have provided grant finance for the development of geothermal energy and renewable energy mini-grids in Tanzania. The SREP resources are being utilised to leveraged private investors and other funds advance geothermal energy in Tanzania where a number of promising sites exist.

Wind

Several areas of Tanzania are known to have promising wind resources. In areas where assessments have been conducted to-date, only Kititimo (Singida) and Makambako (Iringa) areas were identified to have adequate wind speeds for the grid scale electricity generation. The wind speeds average 9.9 m/s at Kititimo and average 8.9 m/s at Makambako, both measured at a height of 30 metres. According to REA presentation at COSTECH in March 2013, REA in collaboration with TANESCO are conducting more specific wind resource assessments in Mkumbara (Tanga), Karatu (Manyara), Gomvu (Dar es Salaam), Litembe (Mtwara), Makambako (Iringa), Mgagao (Kilimanjaro) and Kititimo (Singida). REA is supporting wind measurements at Mafia Island (Coast region). MEM and TANESCO will be conducting wind resource assessments in Usevya (Mpanda). In addition, in Makambako area, the government, with NORAD's support are assessing the possibilities of a wind park with 100MW capacity (NORAD, 2009).

Existing total wind potential is not well understood and had not been exploited. Exploration of wind resources for grid and off-grid electricity has started, but is still in its infancy.

Apart from electricity production, there is also potential for harnessing wind for water pumping to support irrigation and drinking water supplies. Although the country has a long history of wind pumps with installations across the country, the majority of these are in disrepair.

Solar

Tanzania has high levels of solar energy, ranging between 2800 – 3500 hours of sunshine per year and a global radiation level of 4 to 7kWh/m^2/day. Solar resources are especially good in the central portions of the country. This makes Tanzania a suitable country for the application of solar energy as a viable alternative to conventional energy sources if efficiently harnessed and utilized. Both solar PV and solar thermal technologies are in development in the country.

To date, it is estimated that about 3MWp of solar electricity has been installed countrywide for various applications in schools, hospitals, health centre's, police posts, street lighting and households. More than 50% of the capacity is being utilized by households in peri-urban and rural areas. The Government is committed to implementing modern energy access by carrying out awareness and demonstration campaigns on the use of solar systems for domestic and industrial use, as well as supporting direct installation in public institutions.

Tanzania, like many other African countries gives priority to the dissemination of PV technology as one of the potential renewable energies for solving rural energy problems and reduction of heavy dependence on biomass-based and hydrocarbon fuels. In 2004, the Government of Tanzania in collaboration with UNDP/GEF implemented a solar PV project called "Transformation of the Rural Photovoltaic Market in Tanzania". The aim of the project was to remove barriers to wide spread utilization of PV to provide basic electricity services to rural Tanzania, thus improving the balance of payments by reducing the country's dependence on imported fuels (kerosene, diesel and petrol). Initially the project focused in Mwanza Region, but following the lessons learnt and experiences gained, has been replicated in other neighbouring regions (Shinyanga, Mara and

Kagera) since 2007. Further, in 2006 SIDA/MEM implemented a solar PV project focusing on increasing markets for solar PV equipment in 14 regions on the Tanzania mainland.

In recent years, demand and installations of solar products has increased and the market is estimated to grow at 20% per year. While the sub-sector is still dependent on donor and NGO projects, the private sector and demand from individual households are growing as important actors, thereby creating the potential for a sustainable market. Recent years have seen an increase of social entrepreneurs selling increasingly robust and durable solar lanterns able to charge phones and power radios.

Public service facilities such as rural health facilities, offices and schools are the main targets for solar products for lighting, ICT and water pumping. REA, through the Lighting Rural Tanzania programme has funded 9 projects related to solar lighting to the value of US$882,542 (REA, 2010). The projects include installations of solar PV, solar entrepreneur development, creation of revolving funds and credit facilities. Parallel to this, are efforts by TEDAP to install over 8000 PV systems in private and public spaces under the Sustainable Solar Market Packages Project.

Solar water heaters are another technology, which can provide much needed thermal energy while reducing energy bills in households, hotels, businesses and public services institutions such as education and health facilities. Solar water heaters can also reduce heating demand and hence reduce load on the electricity network. Given the current high costs of generation from thermal plants that use imported oil, the development of solar based electricity generation is increasingly an economically feasible option. Concentrated Solar Power, despite its high initial costs could in the long run have lower input costs.

Biomass energy

The contribution of biomass to Tanzania's primary energy is more than 85% and it provides for more than 90% of rural household energy needs. The main sources of biomass for Tanzania include charcoal, wood fuel and agricultural waste. In particular, wood fuel has been utilized extensively across the country and institutions like prisons, schools, clinics and hospitals in Tanzania are using wood fuel as their main fuel. The majority of small and medium enterprises such as hotels, food vendors and small-scale processing facilities also use biomass resources as the primary source of energy.

Biogas and waste-to-energy

Biogas activities in Tanzania go as far back as the 1970s, but for several reasons have never been sustained. SNV estimates that there is potential for domestic biogas for up to 165,000 households particularly in Kilimanjaro, Mbeya, Iringa and Ruvuma are the areas with the most potential (SNV, 2007). DGIS through SNV, Hivos and the African Biogas Partnership are the main partners in biogas dissemination. The Tanzania Domestic Biogas Programme (TDBP) aims to install 6,750 biogas units. The Centre for Agricultural Mechanisation and Rural Technology (CAMARTEC) is the national agent for the programme.

Initial investment for biogas units are however high, and can range from US$800 to US$1700 (SNV, undated, PACE, undated). Although a US$100 unit has been introduced in Tanzania, its performance is not yet known. In addition, where units are sensitive to waste water, they can impose extra water collection burdens, particularly for women.

Waste-to-energy initiatives also have possibilities for energy generation. UNIDO and UNDP have already supported the use of waste from sisal processing for energy. Under the initiative on rural energy for productive use, biogas from sisal waste used to generate 300kW of electricity (UNDP, 2012). This electricity used for sisal processing and excess is distributed to residential areas on the estate. Other potential areas of harnessing waste-to-energy potential include abattoirs, municipal waste, and waste from institutions such as schools. The Global Environment Facility has also supported various biogas projects between 2001 and 2004.

Cogeneration

Agro-processing and mining in Tanzania offer potential for cogeneration. Harnessing cogeneration potential would improve installed capacity but also contribute to improving the country's energy efficiency goals. The sugar industry has the most prominent possibilities, which include Kilombero Sugar Company, Mtibwa Sugar Estates Tanganyika Planting Company (TPC) and Kagera Sugar Company. In 2004, Gwang'ombe estimated potential for co-generation from the sugar industry only to be 99.4 GWh with future potential of 127.5GWh. Other co-generation potential exists in sisal processing, wattle processing and others.

2.2.2 On-Grid and Off-Grid Renewable Energy

Large Hydropower

Grid connected renewable energy systems are highlighted in table 1 under section 1.2.1.1 of this report. Other potentials not yet connected include those in section 2.3.1 above.

Small hydropower

The installed grid connected small hydro projects contribute only about 15MW. Most of the developed small hydropower projects are owned by private entities and are not connected to the national electricity grid. Five sites in the 300 to 8000kW range are owned by TANESCO and more than 16 are owned by faith-based groups and range in capacities of 15 to 800kW with an aggregate capacity of 2MW. More recently, under the SPP programme, the 4MW Mwenga hydro is supplying power to the nearby rural villages with excess being sold to TANESCO. The 300kW Mawengi hydropower plant is supplying electricity to an isolated community through its own mini-grid. An SPPA has been signed for the 7.5MW St. Agnes Chipole project in Songea. It will serve the nearby rural communities and sell excess power to TANESCO. TANESCO has also signed Letters of Intent for eight small hydro projects with a combined capacity of 40.9MW.

Solar photovoltaics:

To date there are no reliable data on solar PV systems connected to the grid. However there are reported initiatives to generate solar electricity in central parts of Tanzania for connecting to the grid.

Wind power

Tanzania is developing the Singida Wind project which aims to start with generating 50MW of power before increasing to 300MW. The total capital costs are estimated at US$123 million and it is expected to be operational by 2013. So far, four companies have shown interest in investing in wind energy, namely Geo-Wind Tanzania Ltd and Wind East Africa, both in Singida Region; Sino Tan Renewable Energy Limited and Wind Energy Tanzania Ltd at Makambako in Iringa Region. These companies are considering investments in wind farms in the 50 to 100MW range.

Off-grid Solar Photovoltaics (PV)

To date about 6MWp of solar PV electricity has been installed countrywide for various applications in schools, hospitals, health centres, police posts, street lighting, telecommunication small enterprises, and households. More than 50% of the capacity is being utilised by households in peri-urban and rural areas. The Government of Tanzania is carrying out awareness and demonstration campaigns on the use of solar systems for domestic and industrial use, as well as supporting direct installation in institutions. In order to make solar PV more attractive, the Government of Tanzania has removed VAT and import tax for main solar components (panels, batteries, inverters and regulators); this has allowed end-users to get PV systems at a more affordable price.

The Government of Tanzania, through REA, as well as various donors has supported a number of solar PV programmes targeting off grid areas where it is lower cost than using generators or kerosene for lighting. Among these are the following:

Wind systems

The Rural Energy Agency (REA) has installed a 10kW wind turbine at a girls' secondary school in 2010 (REA, 2010). A number of other small off grid wind turbines are also report in the country, but not coordinated for reliable citation. Other wind systems for non-electrical uses including water pumping are also reported in several central and Lake Zone regions of Tanzania including Mwanza, Mara, Singida, Shinyanga, Dodoma. Estimation by MEM on installed wind pumps in Tanzania in 2004 was about 200 units. Because of uncertain coordination no reliable data exist currently.

Hydropower

There is also uncoordinated use of insignificant number of hydro rams used for water pumping in Arusha, Njombe and Mbeya. The reported hydro rams in Njombe and Mbeya regions are providing water to communities with population 1300 and 1500 respectively with 17 to 12 water drawing points (AFREPEN Regional report on Non-Electric Renewable Energy, 2002). It is however, important to note that hydro rams technology is site specific. Such technologies could provide extra means for increased use of modern energy services in Tanzania if effectively promoted and disseminated.

2.2.3 Use of Renewable Energy Sources (RES) for Thermal Applications (Cooking and heating)

The large-scale utilization of biomass resources results in depletion of the major forest areas that are also the water catchment areas for the country. Inefficiently use of forest resources affect hydrological cycles (increased runoff, flash flooding, reduced infiltration, soil erosion, siltation in the dams), causing water shortages across the country. Modern use of biomass is being encouraged. This includes combined-heat and power generation from biomass residues or municipal wastes. Potential candidates are TPC-Moshi, TANWAT, Sao Hill, Mtibwa, Kilombero and Kagera sugar factories. Presently more than 35.5MW of electricity is being generated from biomass (bagasse and woody residues), and about 30% of this capacity is connected to the grid. It is expected that more power will be generated from other factories that expect to engage in biofuel.

Biomass resources are a major contributor to Tanzania's energy consumption profile. It is a critical energy source for households, agro-industries, the construction sector and small-scale industries such as road-side food retailers, fish smoking, distillation and beer brewing, bakeries and others. However, the current use of

biomass for energy is not sustainable due to inefficiencies of harvesting and production modes (e.g. charcoal and fire wood) and end-user technology and behaviour. Biomass energy is considered 96% non-renewable according to the UNFCCC. More information on biomass for cooking and heating in households is available in section 2.2.2 above.

The Government of Tanzania is attempting to address the use of biomass as a renewable resource through a number of initiatives. Key development partners in the sector include FINNIDA, DANIDA, GIZ, World Bank, NORAD, SIDA and the Swiss Development Cooperation (SDC). In 2010, MEM and EUEI partnered to develop a Biomass Energy Strategy (BEST) for Tanzania. SDC, through the World Bank, has also supported Tanzania with efforts to transform the charcoal sector into a more efficient and sustainable sector (World Bank, 2009). The World Bank is also supporting biomass briquetting as a sustainable alternative to charcoal. Further, the Rural Energy Fund is supporting the development of biomass gasification in Mafia Island (0.4MW) and biomass cogeneration in Iringa (2MW) and, through the Lighting Rural Tanzania Competition, a biomass gasification project in Nkurunga.

Bio-fuels

Bio-fuels potential in Tanzania include potential to produce ethanol from existing sugar factors as well as from new feedstock, use of Jatropha for biodiesel and other feed stock-based biofuels. Current entities engaged in biofuels development include:

- Diligent Tanzania Ltd – a Dutch company based in Arusha, contracting over 5,000 local farmers across Northern Tanzania to produce biofuels from Jatropha. An expected 10,000 ha of land will be used;
- FELISA – a Tanzanian-Belgian company targeting 10,000 ha of oil palm in Kigoma Region through smallholder out-growers and from a plantation palm;
- SEKAB Bioenergy Tanzania Ltd – a Swedish bioethanol producer targeting large-scale sugarcane production for bioethanol in Tanzania. It aims to acquire 22,000 ha in Bagamoyo District and several hundred thousand hectares of land in Rufiji District; and
- Sun Biofuels Tanzania Ltd – a UK-based company targeting 11,226 ha in Kisarawe District (WWF Scoping Report on Biofuel in Tanzania, 2008l).

The large amount of land being targeted for biofuels production is a concern although there appears to be no independent and definitive study of its potential effects either way. However, the case of Swedish Ethanol Chemistry AB (SEKAB) Bioenergy has attracted attention as it will affect over 10,000 villagers in 12 villages. Biofuel production which will largely be in rural, low-income area raises concerns over power disparities between large foreign companies (together with their local partners) and low-income villagers who might have little negotiating power or may be compromised by immediate survival needs, limited understanding of contractual obligations and promises of benefits that may never materialise. Further, findings of other biofuels projects show water and fertiliser requirements that are contrary to assertions that suggest that biofuels will grow in marginal lands and with little input from farmers. In addition, it is unclear whether the markets for these biofuels are local or international and the extent to which such configurations will contribute to local energy needs. Where there is an assumption that such biofuels will feed local markets, the supply and value chains, including availability and acceptability of appliances for biofuels remain unclear. However, a biofuels blending bill has been proposed. In addition, the government of Tanzania has developed biofuels development guidelines in an effort to ensure their sustainable production and use.

2.2.4 Use of Renewable Energy Sources for productive uses

Biomass and biomass residues are used in small industries as main or auxiliary fuel in textiles, cement, and other thermally intensive industries. It is also used for smoking of fish and curing of tobacco.

Solar passive drying is used for crop and fish preservation.

Solar mini grids for both consumptive productive uses are still limited but on the increase trend. It includes for oxygen generation required in fish eggs incubations, powering barber shops appliances and equipment, water pumping for communities, livestock, and irrigation, and telecommunication towers for communication purposes.

Wind mills are used in Tanzania for water pumping in several parts of the country including lake zone and central zone of Tanzania. They normally pump water for surrounding communities, livestock and irrigation purposes.

Hydro rams are also found in limited parts of the community, such as in Arusha and Njombe regions.

The challenge with productive uses of RE is coordination, follow-ups and documentations sharing of experiences and possible replication. Technical know-how is another valid challenge of most Tanzanians.

2.2.5 Consolidated summary: Problem statements with regard to energy access, energy efficiency and renewable energy.

The following problem statements summarise issues relating to energy access, energy effciency, and renewable energy extracted from section 2. Some cross-cutting issues exist and these are dealt with first.

1. General data availability and management is the starting point to develop well informed and targetted energy policy, strategies and instruments.

2. Policy makers need to become aware of the international finance available for low carbon energy solutions available to Tanzania and utilise it to support a technological leapfrog in low carbon energy access.

3. Institutional and policy reform is required to streamline policy implementation to achieve sustainable least-cost energy solutions in Tanzania.

Energy Access:

1. Access to electricity is being undertaken rapidly albeit at a slower rate than what is required to reach access targets. Acceleration of access will be required if targets are to be obtained.

2. Acceleration will require mobilisation of grid, mini-grid and stand alone electricity sytems through upscaling and making accessible finance, technical skills and institution capacity to deliver.

3. Delivery through TANESCO, REA/REF, NGOs, IPPs, agribusinesses businesss, co-operatives and social entrepreneurs will all need to be supported if targets are to be met.

4. Informed decision making by energy users to select energy technolofy and access solutions needs to be acceelarated to harness ownership, sustainability and efficient behaviour at the time of access.

5. Access will be achieved but affordability beyond the poverty tariff for households will be limited further stressing cost recovery.

6. Efficient biomass cookstoves and charcoal kilns require promotion once there is an agreed definition of what an effciient stove or kiln is and how this will be incentivised and regulated.

Energy Efficiency:

Prior to interest in improving electricity efficiency, reliable supply must be secured.

1. Energy effciiency in modern energy has not yet been attempted. An exception in industry is in Tanzanian Breweries which could provide a useful affirming demonstration of what is possible using benchmarking targets (xkWh/kilolitre of beer). Examples exist in portable and institutional biomass cookstoves which can also provide affirming demonstrations of such measures.

2. The 2003 Energy Policy has a number of references to energy efficiency which could serve as a basis for dedicated energy efficiency policy and/or energy efficiency policy development.

3. Energy Eficiency policy and/or startegies will need to explain the full range of policy instruments for achieving verified efficiency gains, procure efficient equipment, undertake efficient urban/industry/transport/dwelling structure designs, and build awareness, capacity, and standards. Instruments could include: energy pricing, rebates on efficient equipment, relaxation of rebates or taxes, rapid depreciations for tax purposes, relaxation of import duties for certain classes of energy efficient equipment (variable speed drives, efficient boilers, efficient HVAC systems, LED lighting, thermal insulation material, high efficiency motor vehiclesetc.), etc.

4. Efficient biomass cook stoves utilising carbon finance can be accelerated if CDM DNA promotes biomass saving initiatives.

5. There are requirements for energy performance standards and labelling programmes and promotions of these amongst users.

Renewables

1. Renewables are included in the 2003 energy but dedicated renewable energy policy does not yet exist.

2. Some renewables energy policy strategies and instruments exist for the inclusion of renewable energy in grid connected and standalone applications but these are not technology specific rather generalised offers to offset conventional grid and offgrid sources.

3. While TANESCO is illiquid, guarantees for investors wanting to feed into the grid, need to be in place.

4. Geothermal energy requires dedicated energy and mining policy and regulatory support in its formalisation.

5. Renewable biomass energy requires inclusion in the modern energy paradigm vision for it to be regulated. Modern biomass from fuel crops and agricultural residues will attrect investments if formalised.

6. Standards for renewable energy equipment, codes of practice for practitioners and compliance regimes are required if the renewable energy sector is to be established and grow in Tanzania.

7. Financial institutions need experience and technical capcity to appraise loans and extend access to dedicated concesionary finance for renewable energy technologies.

2.3 SE4All goals

The SE4ALL is UN Secretary General's initiative launched in September 2011.The initiative aims at ensuring universal access to modern energy services, doubling the rate of energy efficiency and doubling the share of renewable energy in the global energy mix by 2030.

This important initiative comes at a time when the Government of Tanzania is making efforts to implement a number of actions to reform the energy sector including upgrading and expansion of energy infrastructure. The core challenges that the country faces are related to energy management, in terms of conservation, efficiency in production, transmission and usage. Modern energy access timelines align with national development plans and strategies.

2.3.1 Energy Access

The energy access goals of the Tanzanian government are somehow in line with the UN's goals for Sustainable Energy for all; although not necessary completely aligned. The government has put in place a range of goals and targets for energy access. In the short term, the Government of Tanzania plans to achieve 30% access by 2015 and a goal of 75% access by 2033. Access goals as per SE4ALL for other middle years are not very popular in the sector. Tanzania's energy access target is within a realistic but transformational range required by the UN SE4All initiative, within the constraints of its socio-economic context. However the goal is below the universal access target, which could be amended if human, institutional and resource constraints were reduced. The Tanzanian definition of modern energy access and how this links to electrification subsidy will need elaboration, for example is it exclusively electricity and which of grid, mini-grid, and standalone, does it include?

The biggest gaps are in the energy efficiency and renewable energy goals where specific targets and strategies are still limited; more specific mid- term targets could also be popularised and more focused initiatives and actions to achieve them widely communicated.

Initiatives to achieve the targets for access gas indicated in the 2012/13 MEM budget include:

- Increasing generation of energy, utilization of capacity and coverage - specifically double power generation capacity in order to enhance power availability, and reliability by 2015;
- Developing new power plants (hydro, gas, and coal fired) in order to increase energy access where distribution costs are prohibitive, especially rural areas;
- Promote public-private partnerships especially in IPP schemes;
- Promote rural electrification by supporting the Rural Energy Agency;
- Explore the expansion of oil, natural gas and coal's contribution to GDP;

- Collaborate in regional energy initiatives including SADC energy initiatives, the Southern African Power Pool (SAPP) and the Regional Electricity Regulators Association (RERA) to implement the SAPP Pool plan; and

  Increase electricity access in rural areas from 2% to 25% by 2013 (from 2006 baseline) and to 30% by 2015.

2.3.2 Energy Efficiency

Energy efficiency policy is included in the Energy Policy (2003) but without targets or policy instruments. The MEM is in the process of initiating energy efficiency policies. Consequently there are no clear specific targets on several relevant EE parameters in the productive use, cogeneration, waste to energy, ICS, efficient lighting, ACs, Motors, refrigerators, gasification as per UN proposed framework for Gap analysis. The only targets available for energy efficiency are related to uptake of energy conservation measures in industry (5%) included in the mid-term energy strategy (2011 -2016) and transmission and distribution losses of TANESCO. The latter has embarked on a Loss Reduction Programme that aims to reduce losses from 21% in 2008 to 14.6% by 2014 (Ministry of Finance and Economic Affairs (MOFEA), 2011; Ridgway Capital Projects Limited, 2010). TANESCO has also partnered with Statnett of Norway in an effort to improve its performance through knowledge exchange. Clear target for achieving energy efficiency for various potential technologies and services would have assisted the Government of Tanzania to focus its strategies.

Initiatives planned to achieve energy efficiency in Joint Energy Sector Review (JESR) 2012, MEM midterm strategic plan and annual budget 2012/13 includes:

- Expand, strengthen, stabilize and reduce losses on the National Grid;
- Promote use of energy-efficient appliances and equipment, use of natural gas for industrial heating and domestic cooking;
- Promote energy saving technology, at household, industries, institutions, and community levels;
- Promote energy efficient and conservation as well as integrated environmental management;
- Put in place energy management system standards particularly for intensive energy users; and
- In order the Government of Tanzania to have more specific energy efficiency targets for 2015, 2020, 2025, 2030 which would allow for effective tracking of performance and results of strategies for same various sub-sectors, efforts are needed to categorize them well in advance.

2.3.3 Renewable Energy

There exists a clear blanket goal for renewable energy contribution in the energy mix. However, it is for midterm targets of achieving 30% contribution in the energy mix from 14.5% in 2011 to 30% in 2016. Other clear targets for the other years as per Gap analysis framework such as for years 2020 and 2030 are not popularised. Equally important contribution of individual RETs and services targets would help government focus more their strategies. Individual targets for wind, solar, hydro, and geothermal could strengthen and direct focusing of government and private sector in a sustainable manner. Initiatives planned to achieve renewable energy targets in JESR 2012, MEM annual budget 2012/13 and midterm strategic plan includes:

- Expand the exploitation of bio-fuel potential without compromising food security;
- Improve liquidity of TANESCO and formalize technology specific renewable targets and feed-in tariffs;
- Promoting projects which qualify for carbon credits through Clean Development Mechanism (CDM) or equivalent new-market or public sector window/s;
- Expanding renewable energies (solar, wind, mini-hydro and biogas) for off-grid areas;
- Increasing level of renewable energy in the energy mix;
- Strengthening REA rural energy portfolio;
- Formalizing and regulating the biomass energy sector and implementation of modern biomass energy programmes; and
- Introduction and implementation of geothermal activities.

Section 3: Challenges and opportunities for achieving SE4ALL goals

3.1 Institutional and policy framework

3.1.1 Energy and Development

3.1.1.1 Energy and Development Policy Framework

Tanzania's energy goals are broadly but not very specifically aligned to Poverty Reduction strategies. The main poverty reduction and development strategies in Tanzania are the National Development Vision 2025, MKUKUTA II (National Strategy for Growth and the reduction of poverty), Millennium Development Goals, and the Joint Aid Strategy of Tanzania (JAST). Within MKUKUTA II, energy is recognized as a key input to development including affordable and reliable energy services for (equitable) growth for Reduction of Income Poverty (cluster I), access to decent shelter and energy as contributing to the improvement of Quality of Life and Social Well-Being of the poorest and most vulnerable (Cluster II). Within Kilimo Kwanza – the government's flagship programme for the agricultural sector, energy is seen critical for enhancing efficiency in agriculture as well as enhancing food security through agro processing machines and irrigation pumps among others. Specifically MKUKUTA II broadly commits to cost-effective grid extension in "not-so-remote areas" and renewable energy and off-grid supply for remote areas. Within MKUKUTA II energy/electricity is listed as the first priority in improving manufacturing.

As early as 2003, in the National Energy Policy, Government of Tanzania reiterated its objective to reduce the dependence on fossil fuel for power supply and suggested development of renewable energy options. The Government of Tanzania was also keen to provide an impetus to both the geothermal and natural gas subsectors, in order to diversify its energy mix with clean energy sources. The Government of Tanzania has been instituting a range of energy sector reforms in order to create a legal and regulatory framework that is conducive to attracting investment in the energy sector. One key aim of these reforms was amongst others to attract private investment in order to boost modern energy supply and distribution and hence meet demand. The important policies and legislation governing the energy and renewable energy sectors in Tanzania include the following:

Energy and Water Utilities Authority Act 2001 and 2006: The Acts were promulgated to establish a regulatory authority – Energy and Water Utilities Regulatory Authority (EWURA). The Authority was empowered to amongst others: promote effective competition and economic efficiency; protect the interests of consumers; protect the financial viability of efficient suppliers; promote the availability of regulated services to all consumers including low income, rural and disadvantaged consumers; and enhance public knowledge, awareness and understanding of the regulated sectors.

National Energy Policy, 2003: The broad objective was to ensure availability of reliable and affordable energy supplies and use it in a rational and sustainable manner in order to support national development goals. This policy statement unequivocally stated the national commitment towards sustainable energy production and

use. Specific objectives includes: (i) enhance the development and utilisation of indigenous and renewable energy sources and technologies; (ii) adequately take into account environmental considerations for all energy activities, and (iii) increase energy efficiency and conservation in all sectors. The main elements of the policy are: The development of domestic energy sources, economic energy pricing, encouragement of private sector participation in the energy market, and enhancement of energy efficiency and energy reliability. Other key themes in the Policy include the development of a market economy for energy in the country, the institution of a clear regulatory regime for the energy sector to aid development, the rectification of unbalanced gender impact from inferior energy service, and the development of a clear financial regime for the sector, and balancing revenue generation and costs-of-service.

Rural Energy Act 2005 established the Rural Energy Board, Fund and Agency. It is responsible for promotion of improved access to modern energy services in the rural areas of Mainland Tanzania and through the Rural Energy Fund to provide grants to TANESCO for rural grid distribution investments, and to developers of rural energy projects and for related and consequential matters.

Electricity Act 2008: The Electricity Act established a general framework for the powers of the Ministry of Energy and Minerals and EWURA. It defined key parameters for EWURA's tariff setting criteria and procedures, EWURA's criteria for awarding provisional and permanent licenses, EWURA's monitoring and enforcement activities, a requirement for ministerial plans and strategies for rural electrification, dispute resolution procedures and a process for determining possible future reorganization of the electricity sector.

Public Private Partnership Act No. 18 of 2010: The Act sets out the responsibilities and obligations of the parties, penalties, remedies, financial management and control requirements, assistance available from public party, and dispute resolution. It established a PPP Coordination Unit within the Tanzania Investment Centre and a PPP Unit in the Ministry of Finance.

Policies and Legislation influencing biomass energy include the following: Guidelines for Sustainable Harvesting and Trade in Forest Produce 2007; New Royalty Rates for Forest Products 2007; Community-Based Forest Management Guidelines April 2007; Joint Forest Management Guidelines April 2007; Forest Act 2002; Subsidiary Legislation to the Forest Act 2002; National Forest Programme 2001; National Forest Policy March 1998; and Biofuels Guidelines 2010.

Environmental and land policy and legislation influencing renewable energy development include the following: Environmental Management Act, 2004; National Land Policy, Ministry of Lands and Human Settlements Development, 1997; National Environmental Policy1997.

Others policies and strategies include:

- Rural Electricity Master Plan 2006 (Study of Rural electrification of 2006);
- Power System Master Plan 2012;
- Electricity Rules for Standardised Small Power Purchase (SPP) Tariffs 2011 including SPP feed-in-tariffs; and
- Biofuel Guidelines 2011.

On the basis of the dynamism of the energy sector, several policies and strategies are under review and or formulation including the National Energy Policy of 2003 (under review), Renewable Energy (proposed), Gas Policy (under review), BEST (under development), just to mention a few.

There are several specific outcomes that have positive and profound impact on renewable energy and energy efficient developments resulting from these policies and legislation.

The first is the establishment of the Rural Energy Agency and the associated Rural Energy Fund. REA is the leading agency responsible for rural electrification as well as supporting the development of renewable energy to supply energy to rural communities. The Rural Energy Fund, with budget support from the Government of Tanzania, contributions from a surcharge on grid electricity sales as well as Development Partners co-finances rural and renewable energy electrification schemes implemented by TANESCO and the private sector. In addition, REA is the implementing agency for a number of donor-financed projects. REA is also preparing the Rural Electrification Master Plan and Investment Prospectus, which for the first time are taking a least-cost rural electrification planning approach that integrates grid and off-grid electrification options as well as renewable energy sources.

The second is the promulgation and application by EWURA of the Small Power Producers Programme, a system of regulations, standardized contracts and avoided cost-based non-negotiable tariffs pertaining to private small (under 10MW) renewable energy power projects to supply TANESCO grid as well as to enable these entities to supply electricity to isolated rural communities directly. EWURA issued Standardized Power Purchase Agreements (SPPA), Small Power Producer (SPP) tariff methodology and tariffs, interconnection guidelines and SPP implementation rules. These enable private entities to invest in renewable power projects for both grid-connected projects and isolated grids. Consequently, nine SPPAs have already been concluded with TANESCO, thus paving the way for further development of rural and small renewable energy generation projects. The SPP tariffs are updated annually, based on TANESCO's avoided cost.

Thirdly, the Medium Term Strategic Plan (MTSP) (2011-2016) and the Power Sector Master Plan reinforces the commitment towards collaboration with and encouraging the private sector to participate in development of energy sector using different renewable and fossil energy sources to ensure energy security in the country. Key interventions under the MTSP include "increasing power generation; developing alternative and renewable energy sources; and promoting energy efficiency and conservation".

3.1.1.2 Energy and Development Institutional Framework

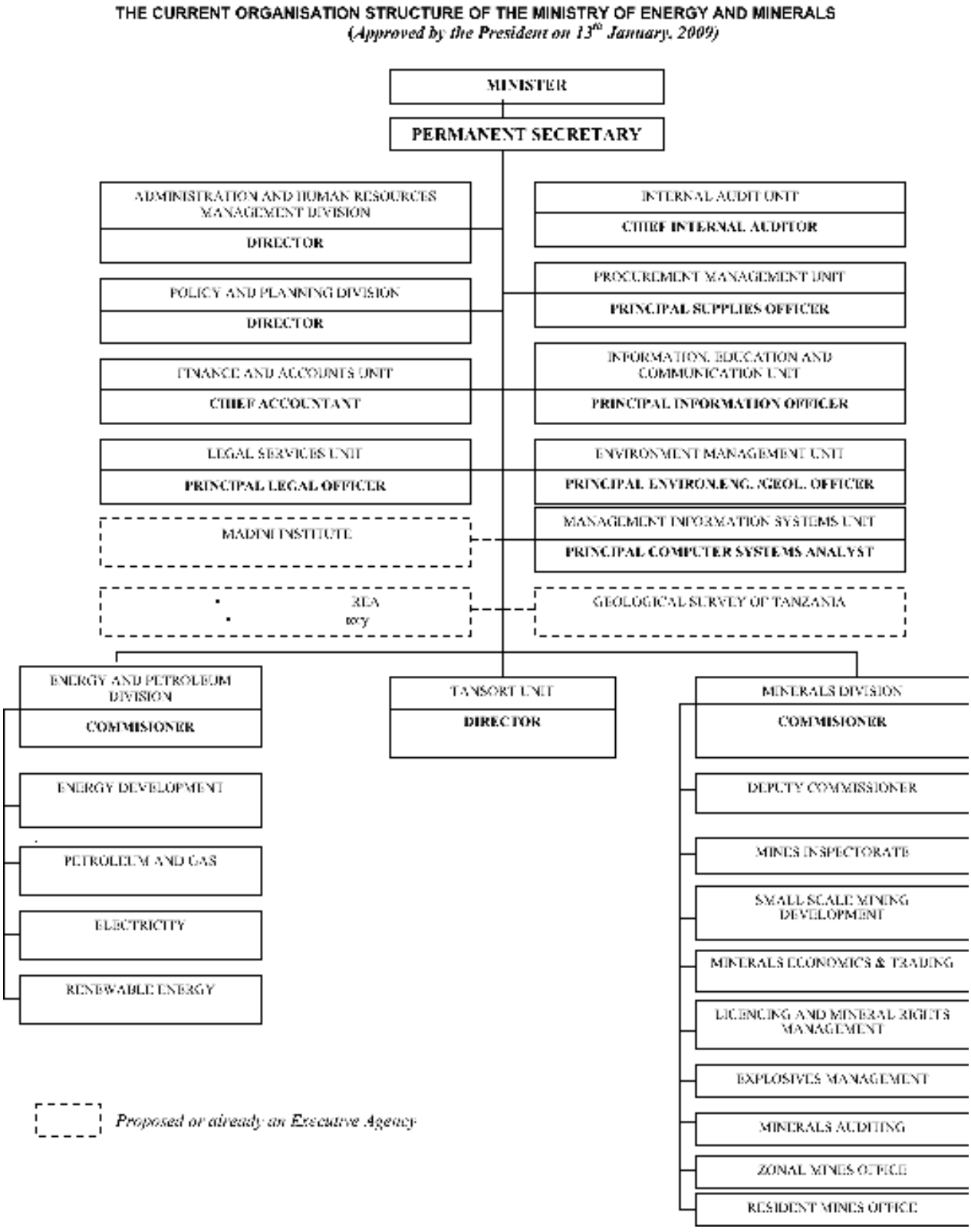
The energy sector in Tanzania comprises of various stakeholders, including national institutions, private sector operators, and non-governmental organizations. Figure 3 shows the institutional arrangements for Ministry of Energy and Minerals. Figure 4 shows the institutional framework for the electricity sector.

The Ministry of Energy and Minerals (MEM) is mandated to develop energy and mineral resources and manage the sector. It is responsible for formulation and articulation of policies to create an enabling environment for stakeholders. Promoting renewable energy is part of the MEM mandate. MEM plays an essential policy guidance role, complementing other players such as REA supporting rural grid electrification, leading off-grid rural electrification and development of renewable energy for the rural and off-grid sector; TANESCO as the principal electricity supplier and as the generator, transmitter, buyer of electricity from grid connected IPP and SPP projects, including renewable energy, and electricity distribution; EWURA as the

regulator; private companies and NGOs as developers, investors and operators of on-grid and off-grid renewable energy projects; and financiers as crucial providers of financing.

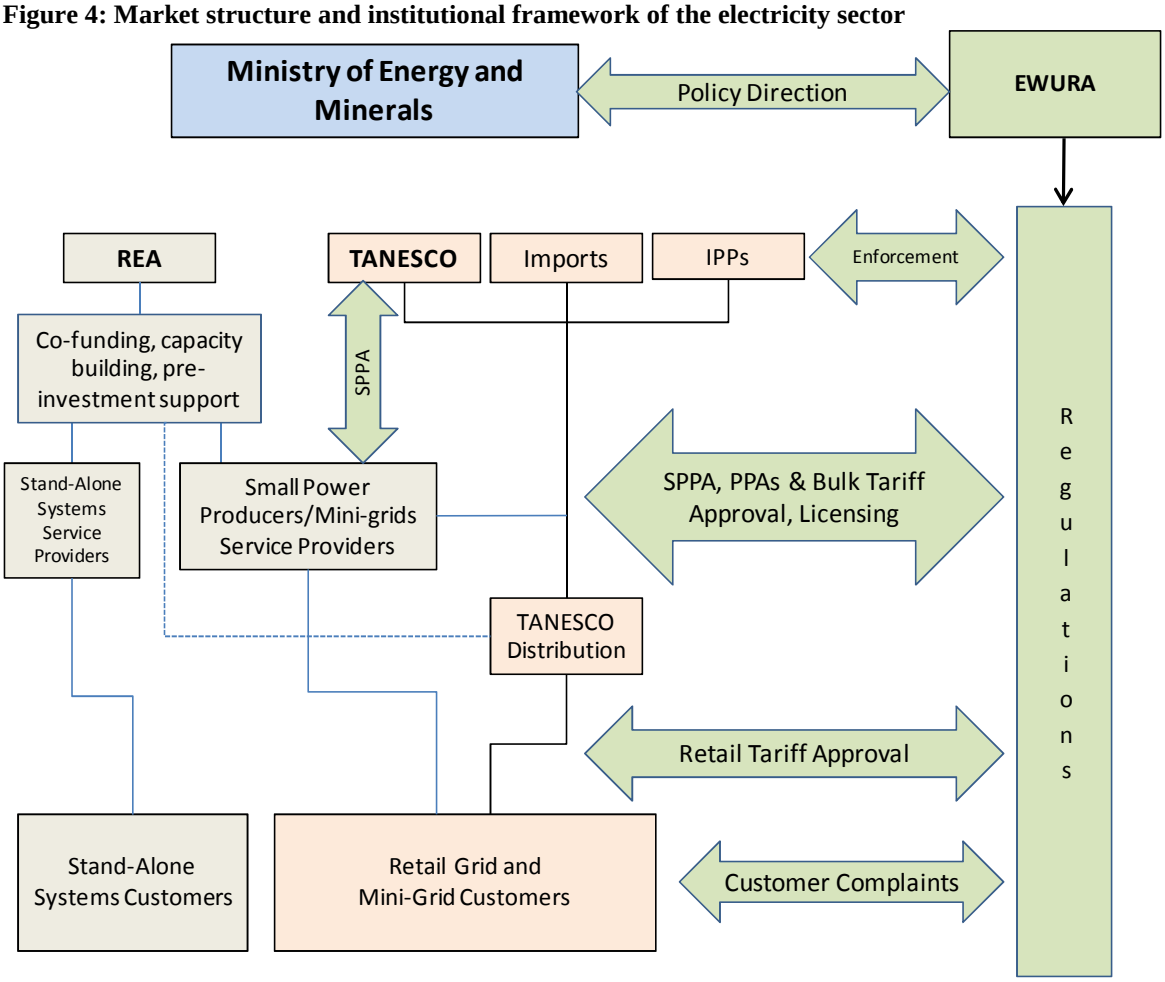
Tanzania is also a member of the SADC power pool and the East African Power Pool. It imports electricity from Zambia and Uganda. In the short term, it plans to import electricity from Rwanda and interconnect to Mozambique and Malawi and from Kenya in future to interconnect with Ethiopia.

Figure 3: Institutional structure of the Ministry of Energy and Minerals



Notes to Figure 3: Since 2009, REA has been formalized in the structure, as have TANESCO and Tanzanian Petroleum Development Corporation. Petroleum and gas section have been separated into two sections. EWURA is missing because is reporting through Ministry of Water. REA's role and functions are now formulated and TANSORT is a unit overseeing diamond trading. EWURA is not included as it reports through the water ministry.

Figure 4: Market structure and institutional framework of the electricity sector



The Rural Energy Agency (REA) is an autonomous body under the Ministry of Energy and Minerals; it promotes and facilitates improved access to modern energy services in rural areas of Mainland Tanzania. REA became operational in October 2007. The principal responsibilities are to: promote, stimulate, facilitate and improve modern energy access in rural areas, in order to support rural economic and social development; promote rational and efficient production and use of energy, and facilitate identification and development of improved energy projects and activities in rural areas; finance eligible rural energy projects through the Rural Energy Fund (REF); prepare and review application procedures, guidelines, selection criteria, standards and terms and conditions for the allocation of grants; build capacity and provide technical assistance to project developers and rural communities; and facilitate the preparation of bid documents for rural energy projects. REA's mandate excludes biomass energy for thermal services.

The Tanzania Electric Supply Company (TANESCO) is the principal electricity generator, transmitter and distributor and presently provides nearly 60% of the effective generating capacity of the national grid. TANESCO is a public company that is currently not recovering costs of its operations and the purchase of emergency electricity supplies. TANESCO, caught between the Government requirement of delivering on

affordable electricity and cost recovery, receives government subsidies to cover the shortfall between the costs of supplying electricity and income from sales and services.

The Energy and Water Utilities Regulatory Authority (EWURA) is an autonomous multi-sectoral regulatory authority established by the Energy and Water Utilities Regulatory Authority Act. It is responsible for technical and economic regulation of the electricity, petroleum, natural gas and water sectors in Tanzania. EWURA reports to Government through the Ministry of Water.

Universities, Research and Training Institutions: There are a number of universities and training institutions that build the human skills needed for the energy sector. These include, the University of Dar es Salaam, Dar es Salaam Institute of Technology, Mbeya Institute of Science and Technology, Arusha Technical College, and Vocational Education Training Authority (VETA). REA is working with VETA in training technicians. Sokoine University of Agriculture is working on biomass energy issues, including charcoal, through its Faculty of Forestry and Nature Conservation.

Private Sector

Supported by the Government's commitment to create and maintain an enabling business environment, Tanzania has a dynamic private sector that is also active in renewable energy development. The private sector has become a key contributor to economic growth particularly in the tourism, mining, energy, building and construction, transport and communication, agriculture, manufacturing, and financial sectors.

Independent Power Producers and Emergency Power Producers: currently six IPPs/EPPs (Symbion, Ubungo, IPTL, Symbion Arusha, Songas, Aggreko and Symbion Dodoma) are operating in the country contributing approximately 40% of the effective generating capacity to the national grid. There are several other private power companies in the process of developing large scale (hydro, solar, wind and geothermal projects).

Small Power Producers (SPPs): A number of private companies are engaged in small renewable power development under the SPPA to sell power to TANESCO and/or sell directly to retail customers. Many of these firms are already in rural areas in other enterprises such as tea, sugar, sisal, tannin, amongst others.

Non-Governmental Organizations: The Tanzanian Renewable Energy Association (TAREA) is an NGO that brings together stakeholders in the renewable energy sector to promote renewable energies in Tanzania. Tanzania Traditional Energy Development and Environment Organisation (TaTEDO) also a non-governmental organization, has been promoting access to sustainable energy since early 1990s. Others include Tanzania Engineering and Manufacturing Design Organization, WODSTA (efficient stoves promotion), Solar Innovations of Tanzania, AMKA Trust, and CARE-Tanzania. For a complete list see TAREA directory.[5]

Though, not specifically classified as a renewable energy organization, there are a number of faith-based organizations that utilize renewable energy to meet the rural energy needs of their communities.

Other Renewable Energy Providers: There are a large number of renewable energy equipment and service providers that engage in retail sales of products such as solar home systems, and offer design, installation and repair services. TAREA Directory is available for the list but also through their website www.tarea.or.tz. Social

[5] TAREA Directory, http://tarea-tz.org/index.php/membership/general-information

entrepreneurs with the backing of international foundations and charities are also selling portable solar lanterns and are looking into the possibility of doing the same with efficient cook stoves and water purifiers in the future.

Financiers

Tanzania's financial system includes a banking sector with more than 20 commercial banks that are, with support from development partners, increasingly looking at financing renewable energy and energy efficiency opportunities. With the advent of the Small Power Programme, the World Bank established a US$23 million line of credit under TEDAP, accessible through commercial banks, finance renewable energy. The credit facility is managed by the Tanzania Investment Bank and supported by REA. REA also uses part of REF resources to support rural grid network investments.

Public sector financing to TANESCO is from the Government of Tanzania, REA as well as multilateral and bilateral lenders and donors. TANESCO also borrows from commercial banks for working capital. IPP, EPPs and SPPs bring their own financing, both equity and debt, some of it sourced externally. SPPs have access to the TEDAP credit line.

Stakeholders Feedback on RE Development

Key stakeholders[6] consulted during the Gap analysis consultation stage offered a number of important suggestions regarding the priorities to be addressed, the types of activities to be undertaken and the policy and regulatory directions to be followed.

Among them were the providing clarity on the renewable energy strategy and the role of the private sector, streamlining processes for project development, renewable energy tariff setting, covering payment risks by TANESCO and other off-takers, and the need to improve credibility, comprehensiveness and access to renewable resource data.

Stakeholders also noted the importance of formalizing the biomass sector. They are not comfortable with the current situation where the overwhelming majority of energy consumed in Tanzania is left in the informal sector. Deliberate efforts are required to tap the otherwise lost government income in the biomass sector. The revenue services argue that they are not keen to tax very poor people, however, there are places in the value chain where tax could be applied. The current budget of biomass is less than 1% of the total MEM budget. Many argue that this should be increased. At least 10% should be allocated for biomass energy development. Equally important, efforts should be made to forge strong working relations between MEM and MNRT where the source for biomass belongs to effectively engage with the biomass energy sector in an effort to formalise its contribution to modern energy access.

Other inputs included developing a Geothermal Development Roadmap. A legal and regulatory framework for geothermal development is needed as the Mining Act, which governs the award of licenses for geothermal

[6]Private sector consultations were held in January 2013. Geothermal sector stakeholders' feedback was obtained during the Geothermal Legal and Regulatory Framework Workshop on hosted by MEM, AfDB and DFID in March 2013. SREP IP consultations were held with a broader group of stakeholders including private sector, NGOs, financiers and other government agencies during the SREP Joint Mission in March 2013. Regional Energy consultations were conducted in March 2013 in Dar es Salaam as part of the global initiative Post-2015 World We Want.

resource development, but this may not fully suited to geothermal energy. Increasing human skills and institutional capacity is needed for geothermal sector governance, and resource development, is urgently needed. The stakeholders recommended to MEM that it would be more effective if geothermal development policy was made the responsibility of the Energy Department in MEM, rather than the Minerals Department.

EWURA based on the Energy Water Utility Regulatory Authority Act [Cap 414 R: E 2002] stipulate its duties as:

> It shall be the duty of the Authority that in carrying out its functions it shall strive to enhance the welfare of Tanzania society by *(a) promoting effective competition and economic efficiency; (b) protecting the interests of consumers; (c) protecting the financial viability of efficient suppliers; (d) promoting the availability of regulated services to all consumers including low income, rural and disadvantaged consumers; (e) enhancing public knowledge, awareness and understanding of the regulated sectors including: (i) the rights and obligations of consumers and regulated suppliers; (ii) the ways in which complaints and disputes may be initiated and resolved; and (iii) the duties, functions and activities of the Authority; (f) taking into account the need to protect and preserve the environment.*

Therefore this is an avenue where by individuals and civil society organizations can use their constitutional right to claim consultation on energy the information on energy and also access to energy.

Section 23 of EWURA Act (Cap 414 R: E 2002) it clearly require consultation with consumers, industry and Government. Section 23 (1) of the Act stipulates that;

> *The Authority shall, before the start of each year, establish an annual programme for consultation with such persons and organizations as the Authority may consider necessary or desirable to consult for the purpose of effectively carrying out its functions.*

This right for consultation is extended to consumers, industry and the government however when you look into it as per section 23(4) the consultation right is limited depending on the wish of EWURA it stipulates that; *For the purposes of this section, it shall be the duty of the Authority to establish and identify the persons, organizations and institutions to be consulted*. How EWURA deems which individuals/institutions to consult is not known.

The consultation report shall be submitted yearly as stipulated by section 23(2) of the Act 2) Subject to provisions of subsection (1), the Authority shall, supply a copy of its consultation programme to the Minister and place a copy on the Public Register. Further to that section 23 (3) The Authority shall include in its annual report, a report on the implementation of its consultation programme during the year covered by the report.

This is an avenue by both the constitution of United Republic of Tanzania and other laws specifically EWURA Act [Cap 414 R: E 2002] and Mineral Policy of 1997, hence the government is obliged to offer consultation on energy and the individual or civil society organization can demand this access.

There is no clarity on monitoring and enforcement, other than through the legislative assembly.

3.1.2 Thermal energy for households

3.1.2.1 Targets, policies, strategies and plans

There appears to be no specific targets and policies on thermal energy for households. However, aspects of household thermal energy are reflected in various legislation, policy documents and initiatives including Guidelines for Sustainable Harvesting and Trade in Forest Produce 2007; New Royalty Rates for Forest Products 2007; Community-Based Forest Management Guidelines April 2007; Joint Forest Management Guidelines April 2007; Forest Act 2002; Subsidiary Legislation to the Forest Act 2002; National Forest Programme 2001; National Forest Policy March 1998; and Biofuels Guidelines 2010, Environmental Management Act, 2004; National Land Policy, Ministry of Lands and Human Settlements Development, 1997; National Environmental Policy1997.

Development of a Biomass Energy Strategy for Tanzania (BEST) is in progress. BEST consultation team members point to an agreed biomass energy baseline as the primary output on which a strategy for transforming biomass energy into an asset that can contribute to the envisaged modern energy economy.

3.1.2.2 National institutions

MEM and the MNRT are the Ministries responsible with the thermal energy for households. EWURA, and Tanzanian Bureau of Standards on the other hand, are responsible with regulation of the energy sector, and household technology standards respectively. While tariffs for petroleum products and electricity are proposed by EWURA, biomass sources of thermal energy for households are unregulated. As presented above, the dependence on biomass for thermal services in households and other sectors of the economy, has resulted in deforestation and proliferation of inefficient technologies for both production of charcoal, transportation and marketing of biomass and inefficient end-use. The Tanzanian Forestry Services manages forestry in the country under the Ministry of Natural Resources and Tourism. Biomass energy policy oversight falls into the joint jurisdiction of MEM and MNRT. REA since its inception in 2006 has not been effective in the household biomass energy activities and initiatives.

3.1.3 Power Sector

3.1.3.1 Targets, policies, strategies and plans

MKUKUTA II articulates the government of Tanzania's aim to double power generation capacity in order to enhance power availability, and reliability by 2015. Already, a regulation to allow IPPs is in place including feed-in-tariffs for small power producers. The country now has 5 IPPs that can contribute to meeting its power sector targets and there is room for more. Other electrification targets include electrification rate at 30% in 2015 from the current rate at 18.4%, and 75% in 2035.

As part of efforts to balance energy demand and supply cost-effectively, TANESCO has also committed to reducing distribution and transmission losses (Table 9). Any savings from these losses could contribute to reaching more Tanzanians with electricity. It would also assist in TANESCOs financial performance and hence alleviating the need for abrupt rate hikes in order to meet cost of service.

Table 9: Historical, current and target distribution and transmission losses for TANESCO

Energy Losses	2008	2009	2010	2011	2012	2013	2014
Distribution Losses (% Energy Fed into MV Netwo	18.0%	19.7%	19.7%	18.5%	17.2%	15.9%	14.6%
Transmission Losses (% of Generation)	5.1%	5.3%	5.3%	5.2%	5.1%	5.0%	4.4%

Source: EWURA, 2010

3.1.3.2 National institutions

The mandate for regulating the power sector is with EWURA, which sets tariffs and is responsible for licensing power producers. The approach for attractive IPPs that TANESCO has taken has been positively rated (Partner, 2011, World Bank, 2010).

3.1.4 Modern energy for Productive sectors

3.1.4.1 Targets, policies, strategies and plans

Electricity is recognised as the number one priority in improving manufacturing capacity in Tanzania according to MKUKUTA II. Missing in the government's targets is the recognition of thermal energy and biomass energy in productive sector. Given the high level of informal entrepreneurs who are likely to have no access to electricity now and in the near future, this represents a missed opportunity for addressing energy in the productive sector. Efforts are necessary for the government to deliberately plan and put clear targets and plans for increased use of modern biomass productive uses in agro-processing including efficient barns used for curing tobacco leaves. Other similar requirements include a dire need of modern energy for productive use in fruits processing, crop conservation and food preservation processes. Clear strategies and targets are also very instrumental for planning and ensuring sustainable development of supply and use of modern thermal systems and services for heating and cooking in social facilities such as schools, hospitals, colleges and prisons, where inefficient biomass technologies are still employed for food processing, thereby leading to severe deforestation and Indoor Air Pollution (IAP) hazards. With proper interventions and targeting, financial savings, environment conservation, IAP improvement and income opportunities are possible. As such, both government and the private sector should explore and encourage efforts in that direction. Agro processing sector targeting could generate several opportunities for increased productive uses of energy such as cashew shells and cashew apples, in fact any agro process with significant residues could be used for industrial boilers heating, biogas and electricity generation. Equally important, rice husks, maize cobs and forestry residues (saw dusts, etc.) have the potential for increased supply and in turn access to modern productive uses.

Another area is that of small and medium enterprises (SMEs) development. A number of traditional use of thermal and biomass energy are still rampant in the SMEs operations. In the livestock sector, for example, SMEs involved in milk processing, on a large extent are still using traditional pasteurization methods including firewood for heating. Tanzania could improve SMEs milk businesses by improving modern energy access for such a sector in rural settings. It is worth noting that with proper planning some processes and interventions could complement each other. As an example, in the livestock industry, the same cow producing milk could also provide cow dung for biogas production, which in turn could further be used to provide heat for milk pasteurization. Biogas could also be used to generate power and lighting in rural areas, thereby reducing the rate of deforestation and improving access to modern productive use of thermal energy services.

3.1.4.2 National institutions

Critical institutions with capacity to achieve goals relating to thermal energy in the productive sector include TaTEDO, CARMATEC, Small Industry Development Organisation (SIDO) and the Chamber of Commerce. Entrepreneurs such as installers of solar water heaters and heat pumps can also play a role. The capacities of

these players, particularly on the production and installation are of varied quality. Capacities of these institutions, their coverage, allocated budgets for increased adaptive researches and dissemination of planned activities is another challenge if we need to make a difference in the subsector. The level at which information about these institutions is known to target beneficiaries and candidates are another nightmare. At least one energy institute in every zone of the 7 zones in the country, would make a difference in the energy sector at the local level. The competence to manage energy initiatives for energy access in public and private institutions and households in collaboration with REA/REF/MEM at district level also needs to be vested in officials at district level.

A special topic on productive use of energy in education institutes would prepare the young generation for productive use of energy for economic gains and poverty reduction initiatives.

3.1.5 National Monitoring for SE4ALL

3.1.5.1 Proposed Indicators

On energy access, there is no clear explicit picture on access and use of modern thermal energy in households, SMEs and in the agricultural sector. Also with the 2033 target of 75% electricity access, there appears no provision for ensuring that poor households will be especially targeted. Capacity to implement power sector projects is also limited as exemplified by the Ministries' below budget spending despite a range of opportunities.

On energy efficiency Tanzania lacks a national wide legal and regulatory framework for enforcing energy efficiency measures, though this may be elaborated in proposed and dedicated energy efficiency policy under programmatic development at MEM with assistance from SIDA and UNDP. In addition, there is lack of a concerted effort, including financial incentives, to promote energy efficiency measures such as solar water heaters to reduce the thermal demand on the grid in urban areas, hotels and commercial structures.

For renewable energy there is also limited information on how RE and EE installations are functioning especially where these are isolated grids or off-grid installations. Also given that off-grid and isolated installations seem to lack support services, there are no data on whether in the long run, it is more cost-efficient to have larger grids that are managed centrally (not necessary at national level) rather than off-grid installations whose management is left to individual households and villages that have little experience of managing technologies. Consideration of Integrated Rural Utilities that include electricity and thermal energy technologies and finance, may assist in sustainability in this regard. EWURA would benefit from such knowledge in regulating least-cost solutions. REA has commissioned some work on the costs of electrification in rural areas to understand what standards to apply and what subsidies to call for. It is quite clear that it will take a while to achieve economies of scale in driving the costs down.

Cutting across all these, there is almost no gender and socio-economic desegregation in the data. The following indicators are therefore proposed to fill these data gaps:

- Percentage of households using biomass only.
- Percentage of households using biomass for cooking while electrified.
- Respiratory infections attributable to solid fuel use.
- Percentage of households, SMEs and agri-businesses with access to modern thermal energy.

All indicators above should be disaggregated by gender and income quintiles.

Sectoral and sub-sectoral energy intensities will be worth tracking to understanding and incentivising progress in achieving energy efficiency. Likewise contributions of renewable energy to the energy economy including the identification of renewable biomass and hydropower need special attention and longitudinal monitoring to understand the efficacy of energy systems and learn from what works and what doesn't.

Energy resources mapping and comprehensive baseline studies (with comprehensive indicators and regular time table) on modern energy access, EE and RE for the entire country is necessary in order to be able to track changes and impacts emanating from specific interventions at regular intervals. Such baseline data should indicate the level of every individual technology development, uptake level, key actors, challenges, threats, weaknesses, opportunities and strengths. When monitoring, it should be easier to quantify changes, which has happened after a certain period of interventions on the baseline individual parameters aforementioned.

It is further worth noting that there is no monitoring entities at the district and local level on energy in general, including on access, RE, and EE. Monitoring of energy parameters as such is always done in relation to a specific requirement of a project and is not necessarily addressing the requirement comprehensively. Efforts should be made to establish monitoring entities and or agencies for energy sector development in the entire country. Nomination of by communities of users of energy advisors in every village could provide updated information of energy sector development in each village, ward, district, and eventually updated figures at the national focal point, preferably MEM or REA or with industry bodies, such as TAREA. It is easier for village energy advisors to provide realistic updates of energy access in their villages, which, with district level coordinators on energy, could compile the same and at the end lead to national annual updates.

It is important noting that indicators for energy sector development might need a monitoring officer with a good knowledge and understanding on energy issues. This leads to another requirement of building capacity of planning officers and other monitoring personnel to be able to establish monitoring indicators that will display a comprehensive picture of the industry. As such, capacity in monitoring energy sector issues needs to be built and resources to undertake regular monitoring allocated. Village executives and/or District Executive Directors could also be capacitated to be energy advisors and oversee the updating of energy statistics in their respective villages/districts including how many people have access to amongst others: electricity, use fire wood in cooking, use biogas, use charcoal, and kerosene.

3.1.5.2 Data requirements, Gaps and Development needs

A number of gaps exist in the data for monitoring energy access, energy efficiency and renewable energy monitoring. Base line data and some relevant targets are non-existent. So are some of the important indicators such as for biomass productive uses, agro-processing uses and many others.

Strategies and institutional arrangement for enforcing policies and strategies are not yet well in place. As an example the Ministry of Energy and REA are only coordinated at National level. TBS and EWURA, which are also instrumental in efforts for access to efficient energy services have limited geographical coverage.

Effective representation of these organizations and others at the district and even lower levels of development plan and decision-making, are necessary for a successful attainment of SE4ALL targets. In the future, the need for enforcement of the energy performance of imported technologies will require the mobilisation and training of customs and Ports Authority officials.

Another gap in data for SE4ALL is the missing thermal performance of buildings, solar water heaters, and air-conditioners. All of these will require the mobilisation and training National and local government officials managing structures and building inspectors.

The Biomass Energy Strategy, which would significantly formalize the biomass energy sector, is still underway. Its finalization introduction as policy will determine the future biomass energy sector development in Tanzania and it may rely on the Tanzanian Forestry Services for upstream or supply side implementation. It is interesting to learn that the biomass strategy is being prepared in absence of a dedicated biomass policy. A legal, institutional and implementation framework for BEST is another important undertaking that is required to mobilise efficient thermal energy access into the future as one of the outputs of SE4ALL as alternative fuels are unlikely to replace biomass in the foreseeable future. The tracking of the attention given by policy makers to the inclusion of biomass in the modern energy access agenda, the policy instruments and resource allocations to institutions mandated with oversight, will be an essential ingredient of SE4ALL monitoring protocol in Tanzania.

3.2 Programmes and Financing

3.2.1 Thermal energy

The BEST should identify means of ensuring a more sustainable supply chain of biomass energy; raise the efficiency with which biomass energy sources and technologies and services are produced and utilised; promote access to alternative energy sources where appropriate and affordable; and ensure an enabling institutional environment for implementation and access to capital. In working towards these objectives, the BEST should aim to identify and introduce policy options and instruments and institutional ownership for change and reform, in recognition of the fact that previous efforts aimed at policy change in the field of biomass energy alone have had limited success. Expectations of BEST are not high as it is hoping as a minimum to focus the attention of policy makers on the status quo or baseline of the biomass energy situation. The strategy is expected to be complete by June 2013.

NORAD allocated US$120 million to REA in March 2013 and SIDA are planning further to REA for rural energy initiatives in which they have indicated and are expected to push increased and sustainable use of modern biomass technologies and services in the country, thermal energy services included.

3.2.1.1 Supply

NGOs, donors, technical assistance and private sector such as TAREA, TaTEDO, Appropriate Rural Technology Institute (ARTI), ENVOTEC Service Ltd, SNV Tanzania, FINNIDA, GIZ, and many others are on-going with implementation of initiatives in capacity building for local manufacturing and scaling-up of biomass technologies including improved cooking stoves, biogas and on related service in the sector. Their efforts could be greatly enhanced by a national strategy that provides some co-ordination and data management. SNV in collaboration with TAREA and other key players in the sector are working on a national programme on improved cook stoves.

Government initiatives including those of Commission on Science and Technology (COSTECH), Centre for Agricultural Mechanised and Rural Technology (CAMARTEC) and research institutions such as College of Engineering and Technology at UDSM (COET), Sokoine University of Agriculture are positively impacting on supply and financing supply capabilities in the biomass sector.

Development partners including UNDP, NORAD, USAID, SIDA, FINNIDA, DANIDA, WB and EU and others have been instrumental in supporting development of the biomass sector in Tanzania through funding promotional and development of supply/value chains.

3.2.1.2 Demand

Uncoordinated biomass sector operations in an unregulated/lawless environment and left to the informal sector are unlikely to attract formal investments. As such biomass will remain unsustainable employing low efficiency technologies and services and receiving less respect from the government and continue to be

treated as low grade or primitive energy. BEST will strive to formalize the biomass sector, thereby drawing the right reputation to the sector from the community through increased government revenues and recognition of this significant national asset. In doing so, more budget allocations and strategic investments should be made and improve the technologies and services employed in the sector. Furthermore, pertinent knowledge and capacity should be developed and disseminated. As a result of increasing demand and related financing for capital and investment are likely to increase thereby improving affordability of biomass based modern energy services.

Financial, policy and political support from the government translated into budget terms, stands to benefit the biomass technology industry. Opportunities are in place, but need to be properly and extensively promoted with the general public. REA, announced the planning of a national programme on biomass sector development at a renewable energy status workshop at COSTECH on March 26, 2013.

3.2.1.3 Sustainability

Coordinated efforts in lobbying and advocacy for formalization of the biomass sector, more budget allocations from the government reflecting its proportion in the national energy budget is necessary for sustainability and investment inflow in the sector. The facts will improve the quality of technologies used and size of investment thereby improving on the sustainability of the sector.

While intensifying electrification initiatives, the government needs to face the fact that biomass is likely to remain as a prominent contributor to the Tanzanian energy economy for the foreseeable future. It is worth noting that even the electrified customers in Tanzania increasingly use biomass for cooking in the cities. As such, electrification and electricity uptake efforts should go hand in hand with improvement of the biomass sector.

Strengthened coordination of support and redirecting it from piecemeal projects to a policy-enabled programme in the biomass sector, would contribute to sustainable development both environmentally and to poverty alleviation efforts in the country. Until such a time, the biomass energy sector is unlikely to become sustainable.

3.2.2 Power sector: programmes and financing to improve access, efficiency and use of RES for power supply

Scaling-up of Renewable Energy Program (SREP) is an Investment Plan (IP), which is a country-level and outcome-focused programmatic approach to scaling up renewable energy. The IP was prepared by the Government of Tanzania's SREP Task Force and is in line with national renewable energy development strategy as stipulated in: the Tanzania Vision 2025; National Strategy for Economic Growth and Reduction of Poverty (Kiswahili acronym MKUKUTA); MDGs by 2015; the National Energy Policy of 2003; Power System Master Plan (2009 and its 2012 Update); Rural Energy Agency Act 2005; EWURA Act 2006; Electricity Act 2008, among others. The IP brings together into a single cohesive document various power sector, renewable energy and climate change policies, and proposes strategic development programme leading to greater utilisation of renewable energy.

The Project involves lead MDBs, with SREP and other supports for the implementation of the specific investments in the energy sector of Tanzania.

The objective of SREP Tanzania is to support the large-scale deployment of renewable energy and thereby transform the energy sector, principally the electricity sector, from one that is becoming increasingly locked into fossil fuel dependence to one that is using more balanced, secure and diverse energy sources. Achieving this objective will help Tanzania move towards a low carbon emissions development pathway, increase energy security, generate new economic opportunities and widen access to energy services.

In accordance with SREP modalities, this objective will be achieved through an integrated approach that includes investments in renewable energies (particularly infrastructure needed for their production and distribution), capacity building of stakeholders, integration with dynamic public-private partnership, and provision of adequate technical assistance services. Furthermore, SREP Tanzania will support actions deemed appropriate in consolidating or upgrading policy, strategic and regulatory frameworks of the sector and will encourage the dissemination and use of renewable energies in the country. The initial focus of SREP in Tanzania is on geothermal energy and renewable energy mini-grids.

The SREP Tanzania approach is based on the assumption that any transformational change will only occur through the improvement of energy market conditions and financing of the energy sector, as well the creation of specific conditions for gaining investors' confidence (public and private, small-/medium-/large-scale enterprises, national or international investors). These conditions are indispensable for any replication and scaling-up of public and private investments in renewable energies.

The main results expected from the Programme are as follows:

- The access and reliability of energy and electricity services used by Tanzanians populations are improved.
- Increase in the supply of GWh from renewable energies.
- The proportion of rural and urban population with access to renewable energy is increased.
- Jobs related to the adoption of renewable energy are created in targeted areas (for men and women).
- The enabling environment is improved through the optimization of the legal and regulatory framework and the increased capacity of relevant government authorities in carrying negotiations with the Private Sector.
- Additional financial resources for renewable energy projects are mobilized.

3.2.2.1 Physical access (electrification)

The Sustainable Solar Market Package (SSMP) is a contracting mechanism that provides for the supply and installation of PV systems, along with a maintenance-and-repair contract (e.g., 5 years with an option to extend) in a defined rural area. PV systems to meeting electricity needs in schools, clinics, and other community facilities are bundled with requirements and incentives for commercial sale to households, businesses, and other non-governmental customers. Funding for the public and community services facilities, is provided by the government and/or donors, Grants are used to help household consumers defray the cost of SHS. They either obtain a loan from a partner microfinance institution, fee for service/use, pay-as-you-go technology to link usage to payment, or they pay cash for the balance of the SHS payment. By bundling applications in a defined area, the SSMP approach addresses key affordability and sustainability issues of past PV projects: standardization, reduced transaction costs, larger business volume, and reduced risk.

There is an electrification grant of US$500, which is likely to be increased to US$800 in the foreseeable future for grid and non-grid connections. REF plays a role in the consideration of these grants applications and allocation to project developers.

3.2.2.2 Availability (new capacity)

REA and TANESCO are implementing the World Bank and GEF-assisted Tanzania Energy Development and Access Project (TEDAP) to support rural electricity access. TEDAP has supported the creation of an enabling environment, including regulatory and tariff framework for power plants committing to supply up to 10MW to TANESCO, and capacity building. It has also facilitated the development of a pipeline of renewable energy electrification projects – with the potential for around 135MW. A TEDAP line of credit available through commercial banks offers financing. Several other donors are also supporting renewable energy-based mini-grids. REA received US$44.2 million of the International Development Association (IDA) credit and the GEF grant for the off-grid electrification component. The IDA funds include US$23 million credit line to offer long-term financing in Tanzanian Shillings to local commercial banks to on-lend to small renewable energy projects. The refinancing facility was in response to the severe difficulties the private sector faced in obtaining long term financing needed to support off-grid electrification projects. The objectives of the off-grid component were to increase electricity access in rural and peri-urban Tanzania; establish a functioning institutional framework for commercially oriented, sustainable service delivery for rural electrification that can be scaled up; and exploit Tanzania's renewable energy potential.

Renewable energy-based electrification outcomes to-date include TANESCO signing Small Power Purchase Agreements with nine developers to supply 35MW of power (currently three projects are supplying 14.5MW to TANESCO); TANESCO signing Letters of Intent (precedes SPPA) with another nine developers for 42MW of power. REA performance-based grant support to mini-grid and stand-alone electrification and the innovative "Lighting Rural Tanzania" project will benefit over hundred thousand households. Additional grant co-funding to prepare 60 mini-grid projects and stand-alone solar projects to benefit many more consumers have been awarded or are being processed.

REA is supporting renewable energy based mini-grids and stand-alone solar solutions that are operated by the private sector and NGOs; these are lower cost than, or can survive on the avoided costs of, diesel operations. The mini-grids, powered by mini-hydro and biomass power plants are either stand alone, or are connected to the TANESCO grid – but operated by private entities.

3.2.2.3 Reliability (grid maintenance/upgrade)

TEDAP is financed by the World Bank through a US$157.9 million IDA credit and a US$6.5 million grant from the GEF to improve the quality and efficiency of the electricity service provision in Tanzania and to establish a sustainable basis for energy access expansion. It includes $113.7 million for TANESCO for urgent investments in its transmission and distribution network.

AfDB under Electricity V financed construction of distribution lines in Mwanza and Shinyanga; and Rehabilitation of 4 substations in Dar es Salaam and Arusha; 3 studies (from grant): Distribution System Master Plan for 8 regions (4 in Dar, Coast, Kilimanjaro, Arusha and Mwanza) and Study Supervisory Control

and Data Acquisition (SCADA) re-evaluation of TANESCO assets; and project engineering, supervision and management.

3.2.2.4 Sustainability (investment in RE, on grid and off grid, and energy efficiency)

Tanzania has received significant support from its Development Partners for the energy sector, including renewable energy and electrification. Development Partners offer well-coordinated assistance to Tanzania that is aligned with the national priorities and strategies. The multi-year energy sector commitments of the Development Partners are about Tsh 1.5 trillion (US$1 billion), including renewable energy. The Development Partner funding commitment for renewable energy is approximately US$350 million. In addition to the technology-specific assistance described later, sector-wide support is also provided. UNDP is supporting the Low Carbon Sustainable Energy Access (LCSEA) project for energy access in 10 Tanzanian districts. NORAD (US$120 million) and SIDA are expected to provide significant funding to the Rural Energy Fund, and USAID is establishing a fund for financing rural and renewable energy. AFD is establishing a €20 million credit line that can be accessed through domestic commercial banks for renewable and rural energy. DFID has a £30 million regional soft loan facility that could finance renewable energy investments.

In an effort to increase access to electricity, the government is promoting Small Power Projects of up to 10MW, through the introduction of a simplified implementation framework. The MEM, EWURA and the REA have developed a framework for renewable energy projects. The framework includes a Standardised Power Purchase Agreement (SPPA), Standardised Power Tariff Methodology, and a Standardised Power Tariff (SPT). Feed-in tariffs are yet to be technologically differentiated; currently the tariff applies to all technologies and is based on an avoided cost of diesel-powered generation. The national energy regulator only has regulatory power over system additions of more than 1MW. The current feed-in tariffs limit ambitions along with the ability of TANESCO to pay the tariff, making additions to the grid a risky proposition and perversely focussing attention at off-grid possibilities.

In 2008, the Energy Development and Access Expansion Project, a US$111.5 million International Development Association credit and Global Environment Facility grant, was approved by the World Bank. This project is primarily focused on the improvement of TANESCO's transmission and distribution grid. The project also supports renewable energy options, namely, mini-hydropower generation, biomass co-generation, and solar energy. Mechanisms to encourage investment include a the connection grant for each new rural connection and a Sustainable Solar Market Packages programme, offering power solutions for a range of sectors.

Financing of energy programmes in Tanzania has not benefited substantially from private sector finance, whether foreign direct investments or local investments. Programmes are highly dependent on donor financing, which is typically for 3 to 5 years and in this time there is usually not enough buy-in from the general public to ensure market driven demand. In addition, donor finance is often limited in its scope and can be unpredictable. There is programmatic funding from some development partners including UNDP, UNIDO, NORAD and SIDA with concentration on financing demonstration or pilot projects and little on scaling-up.

One question that any SE4All strategy moving forward will have to answer is why power sector reforms to date have not attracted substantial private financing, and necessary adjustments will have to be made to create an environment that attracts and sustains private financing. In recent years, Tanzania has however been

innovative and considering raised financing locally from the social security fund. The current and short term financing for new capacity and reliability in loans and grants is as shown in Table 10 (there is much more detail in Annexures 1 and 2). Despite this innovative approach, public and donor financing alone are unlikely to help Tanzania attain the goals of SE4All.

Table 10: Grant support for main power sector project from 2009 to 2014

Grants	2009	2010	2011	2012	2013	2014
MCC Grant	-	43,950	87,900	87,900	-	-
World Bank Funds - TEDAP	175	25,575	20,460	4,277	2,860	-
IDA - Songsongo - Grant	6,181	13,515	10,812	6,032	384	-
ORET- 50% loan, 50% Grant	51,169	-	-	-	-	-
REA	7,853	29,450	55,275	-	-	-
Government Contribution	12,810	35,938	150,977	70,543	-	7,705
AfDB	-	-	858	1,144	858	-
JICA	8,750	8,481	2,488	1,000	1,000	-
SIDA	4,750	4,750	40,485	55,027	285	-
Total	**91,689**	**161,659**	**369,255**	**225,923**	**5,386**	**7,705**

Source: EWURA, 2010

3.2.3 Modern energy for productive use: programmes and financing to improve access, efficiency and use of renewable resources in productive sectors

Efforts for increased use and dissemination of modern energy for productive uses including programmes and financing opportunities have been promoted by a number of development partners in Tanzania. However, coordination and documentation for public use of this information has been limited. Availability of such information has been limited to project implementers and other funding requirements and retirements.

The EU supported TaTEDO on Up-Scaling Access to integrated modern energy services for poverty reduction, in which TaTEDO implemented a project for Multi-Functional Platforms (MFP) and solar powered containers aimed for increased access of modern productive services and use in rural areas. About Euro 2.3 million was provided as a grant. More detailed information on financing is available in Annex 2.

3.2.3.1 Supply: programmes and investment to develop domestic manufacturing capacities, including access to capital and know-how for productive applications

Domestic manufacturing of productive use equipment and appliances is still limited in Tanzania. However, REA has been supporting private sector in local development of small wind turbines and construction of biogas plants and micro hydro power plants. UNIDO under GEF support is supporting establishing a micro hydro centre of excellence at the University of Dar es Salaam where turbines will be locally fabricated and tested. Under the same support, installation of 6 pilot micro hydro power systems will be carried out. The EU through REA has supported production of portable biogas plants SIMGAS)(for heating and cooking purposes in households. Portable SIMGAS products for the same cooking and purposes will also be available in the near future. SNV with support from the Netherlands is supporting capacity building and commercialization of biogas construction industry in Tanzania. TaTEDO, SNV, ARTI Tanzania and many other NGOs and private sector with support from different donors and development partners are involved in capacity building for different types of biomass cooking technologies.

3.2.3.2 Demand: Financial support schemes to improve affordability of modern energy technologies for industrial and agricultural enterprises, as well as build their knowledge and capacity

REA through matching grants, competition awards, performance grants, WB grantee fund and many others are supporting financing various schemes and initiatives targeting improving affordability of modern energy technologies and agricultural enterprises, as well as building their capacity. The UNIDO supports the Centre of Excellence in micro hydro at the University of Dar es Salaam will build local capacity for manufacturing turbine and other components that is expected to reduce their price. SNV is training local technicians and subsidizing the cost of r installing household domestic biodigesters, which reduces the overall biogas plant cost to the end-user.

3.2.3.3 Sustainability: programmes aimed at improving environment sustainability of energy supply, such as demand side energy efficiency and use of renewable energy

As suggested above, there are few clear policy, strategies and programmes already in place for creating an enabling environment of energy supply such as EE, RE and biomass energy in the country. An example of a enabling policy instrument is the REA matching grant has the opportunity of supporting feasibility studies and Environmental and Social Impact Assessments that can be further utilized by potential investors, thereby creating supportive environment for the RE. SREP on the other hand, with support from AfDB and other co-funders, is a programme expected to support the growth of RE in Tanzania through investment both in supply opportunities in some RE technologies and in guarantee to IPPS for electricity sold to TANESCO. SIDA is also strengthening involvement of the private sector in energy initiatives, which is expected to trigger further sustainability. Already the World Bank has provided a guarantee fund through REA to Commercial Banks in Tanzania aimed at long-term loans for private sector in Tanzania investing in the energy sector.

3.3 Private Investment and Enabling Environment

The private sector plays a major role in addressing electricity shortages and their scope for supporting energy access and infrastructure development remains vast. Electricity shortages between and 2009 resulted in power outages, and created better opportunities for private producers. By the end 2008, Independent Power Producers (IPPs) provided 282MW (or 30%) of electricity to the national and isolated grids through emergency power supply agreements. These agreements however come at the expense of TANESCO, which pays high prices for the generated electricity. According to CDKN, while retail tariffs are around US$0.13/kWh, TANESCO purchases emergency power for as much as US$0.40/kWh (CDKN, 2012). Need to look at sustainability and at the cost of the electricity supply basket and then the pricing.

Other than the role of providing emergency power, the private sector with some notable exceptions has contributed little to improving energy access, energy efficiency and renewable energy availability generally in Tanzania, particularly in terms of long term and transformational investments. The following subsections discuss the barriers that various private sector actors face in providing energy for specific sub-sectors on the energy sector.

Generally, the absence of a long, loud, legal and consistent leadership in the area of low carbon development and the limited low carbon dedicated investment or market mechanisms (SREP is a notable exception) has not expressed the almost unrivalled opportunity to establish an example of modern energy transformation in access and supply that is the nascent Tanzania energy economy.

3.3.1 Thermal energy for households

3.3.1.1 Private sector in supply chain (energy supply companies, TP, financiers)

Actors involved in the supply chain of thermal energy for households are largely artisans (improved cook stoves) and small companies undertaking solar water heater installations. Women in particular have a role here, producing and supplying first generation cook stoves but their participation in other supply chains such as solar water heaters is limited. ESCO activities are not known of in Tanzania.

3.3.1.2 Barriers to private investment in modern energy supplies and technologies for cooking and other thermal applications

The barriers that actors face in supply chain for thermal energy for households and generally for energy service investments include:

- Limited awareness of financing institutions of the energy sector;
- High interest rates of capital with high collateral requirements;
- High upfront costs for technologies and capital such as solar water heaters;
- end-users' lack of awareness of the benefits of the technologies which in turn, leads to a small market scope;
- High comparative costs marketing of products such as improved cook stoves and solar water heaters;
- Small sizes of projects compared to financial packages available;
- Bridging finance for outcomes or results based financing limits uptake;

- Low perception of impacts of solid biomass use that limit the creation of an appropriate supportive framework; and
- Lack of confidence in performance of thermal technologies such as improved cook stoves for which there are no standards or certification.

More barriers are summarised available in Annex 3.

3.3.2 Power sector

3.3.2.1 Private sector actors in supply chain (power generation and distribution companies, IPPs, financiers, TP)

Power sector IPP's involvement in the supply chain and barriers they faced relative to regional standards. Tanzania has a high number of private players in the power sector, which has been a sharp learning experience and one from which other countries can learn, with four IPPs already operating and three more signed up. Transmission remains wholly owned by TANESCO. The main financiers in the sector include local banks, bilateral partners such as NORAD and the World Bank, while technology is almost entirely imported.

3.3.2.2 Barriers to private investment in new on grid and off grid power generation capacity (especially for RES, grid extension/maintenance, demand side management and EE)

The some barriers faced by power sector IPPs include;

- No district competency on energy policy implementation and abilities to access policy instruments;
- High capital costs and collateral requirements;
- TANESCO defaulting on payments to IPPs (e.g. as of August 2012, TANESCO owed Symbion about US$20 million);
- Regulatory uncertainty due to discontinuities in leadership of the MEM and the power utility (e.g. over the last 7 years, there have been four energy ministers);
- Low trust in the ministerial leadership (of the four ministers, 3 have resigned after being linked to corrupt dealings or for failure to take corrective measures);
- Hydrology uncertainties due to climate variability and change (specific for hydropower);
- Low customer base for rural off-grid concessions;
- Low affordability index (for rural off-grid customers);
- Few affirming demonstrations of the range of energy technologies so as to allow informed technology choices for users;
- Limited awareness of DSM and energy efficient benefits;
- Lack of a culture of investing based on pay-back period;
- Low levels of trust of service providers for correct billing (which is a disincentive for investing in energy efficiency);
- Misinformation in the market place (e.g. as regards life of CFLs);
- Poor market priming for efficiency (as a result of low quality energy efficient CFLs at the time of access);
- No attempt to harness the efficient energy management attributes of the poor gaining access to modern energy for the first time;
- No rebates for energy efficiency technologies or incentives for demand or energy savings for users or utility; and
- No ESCO capacity.

More barriers are summarised in Annex 3.

3.3.3 Modern energy for productive use

3.3.3.1 Private sector actors on the demand and supply side (SMEs/agricultural enterprises, technology providers, financiers)

The main actors in providing energy for productive services have so far been NGOs, private sector and development partners including NGOs, TaTEDO, REDCOT, CAMARTEC and several others.

3.3.3.2 Barrier to private investment in modern energy for productive and socio-economic uses with a focus on EE and RETs and solutions

The private sector has been slow to invest in these opportunities because of the following barriers;

- There is limited data on energy usage, intensities and trends in productive sectors and sub-sectors;
- Lack of awareness of different technologies and their second hand value;
- Lack of a culture of investing based on pay-back period;
- Few affirming demonstrations of best-practice (Tanzanian Breweries is an exception);
- Low cost of manual labour makes human energy cheaper than modern energy;
- Limited price-signalling for energy efficiency including but not limited to billing;
- Limited localised decision-making and accrual of benefits (i.e. investment decisions made by management away from business entity and savings made by workers' efforts do not accrue to them or their working conditions);
- Access to finance is generally difficult;
- Financiers do not see energy efficiency as gainful endeavour to lend to while the grid remains of variable quality;
- Capital and operating expenditure are separated and as a result not optimised to achieve low life cycle costs; and
- Limited profitability and stability of SMEs and agro-businesses make them and potential financiers investment and risk averse.

More barriers are summarised in Annex 3.

3.4 Gaps and Barriers

The main gaps and barriers faced by Tanzania's energy sector relate to broader themes of economic, human capacity and awareness, and governance as outlined below.

One of the most prominent gaps and barriers to informed policy making, that is not unique to Tanzania, is the lack of credible and longitudinal energy access, use and service data that is maintained in a database and accessible to the public. Sectoral, sub-sectoral and end-use/service energy intensities and intensity trends are essential in understanding where and how to intervene in the energy economy to achieve efficiencies.

This document provides a good template for tracking data and inventorizing progress and may be worth utilising as an annually updated sub-sector overview timed for publication with annual policy review or budgetary allocation events such as the Joint Energy Sector Review.

More barriers on RE are also summarized in Annex 3.

3.4.1 Thermal energy for households

3.4.1.1 Governance (institutions, policies, enforcement capacities)

- No clear biomass policy, strategies and effectively enforced regulations for a sector supplying primary energy for about 90% of Tanzanian population.
- Biomass energy receives less than 1% of the total annual energy budget allocation at MEM.
- Government is yet to recognize charcoal as the main source of fuel for cooking in both urban and rural areas, as such charcoal and biomass is left to the informal sector.
- Charcoal Producers have to obtain a Charcoal making licence which indicated tree species one is supposed to harvest depending to the locality, tree sizes, where the harvesting and charcoal production will be done, where charcoal will be sold (insitu or far from the production area). (Mr. Chamuya, MNRT, pers. comm. 28th May 2013). The extent to which there is compliance with this measure is unknown.
- Charcoal traders have to get a trading licence indicating where charcoal is sold, Amount that they are allowed to sell, the source of the charcoal they are supposed to have a copy of licence from the charcoal producers. (Mr. Chamuya, MNRT, pers. comm. 28th May 2013). The extent to which there is compliance with this measure is unknown.
- Left and managed in the informal sector as such biomass sector investments are generally unattractive to large capital.
- Large sections of the biomass energy sector operate outside the law.
- The scattered sector is hardly caught in facts, data and figures (baseline information), thereby resulting into limited market information both on the supply and demand side in all their variety for policy formulation.

- The illegal and scattered nature of the biomass energy sector inhibits the uptake of modern systems of production and consumption.
- There is a shortage of well-qualified personnel to support sector development (not the case with forestry services).
- Limited clear rules and responsibilities and reinforcement of the same.
- Limited capacity and will to organize the charcoal production sector.
- Charcoal is an underpriced energy resource. Trees are obtained free of charge from the forest.
- Poor, polluting, inefficient and unsustainable biomass utilizing technologies including current traditional charcoal production practices and technologies.
- Most charcoal is produced through traditional earth mound kilns from wood cleared mostly from natural forests. 7-10kg of wood is required to produce 1kg of low quality charcoal with calorific value of 26kJ/kg. However with more efficient kilns, 4.5kg of wood is required to yield 1kg of charcoal with a calorific value of more than 31kJ/kg.
- Logical alternatives are either unavailable (briquettes) or seen to be dangerous and too expensive (LPG, kerosene).
- No effective sustainable working relations between Forest Division of MNRT and Energy Department of MEM, and other stakeholders to enhance sustainable management of natural resources for charcoal and firewood production.
- Within the charcoal catchments areas of Dar es Salaam it has been observed that the forest mean annual increment is 2.35m^3/ha/year while annual cut for charcoal is 6.4m^3/ha/year.
- Ministry of Natural Resources and Tourism believes that current annual forest reduction is between 120,000 and 500,000 hectares, against only 25,000 hectares planted.
- The accelerated harvesting of trees impacts negatively upon soil, watersheds, biodiversity and climate change.
- According to various studies and calculations, each ton of charcoal produced and consumed in Tanzania generates nine tons of CO_2 emissions, one million tons of charcoal thus translating into nine million tons of CO_2.

3.4.1.2 Supply Chain (access to capital, technologies and know how)

- Currently the charcoal industry, despite its many shortcomings, delivers charcoal to urban users through an informal system based on unfair market forces. (Dar es Salaam is said to see delivery of 28000 50kg bags of charcoal per day entirely informally).
- Lack of biomass producer and supply associations for a stable and sustainable supply chain.
- No legal framework to attract and commit investments and capital in the biomass primary energy chain for Tanzania.
- Inefficient technologies and services are employed in the current unsustainable supply chain.

- Limited personnel with know-how on development and empowering key actors and stakeholders on sustainable supply chain management of biomass resources and markets in Tanzania.
- Limited awareness of the private sector and FI on the potential business in the biomass sector of Tanzania. Recent data put annual charcoal consumption is valued at approximately Tsh311 billion per year (roughly US$250 million).
- It is a key sector employing more than 150,000 people-using local energy resources and technology in an informal sector, mostly outside of the law.
- Some District Councils near main urban areas reports that, greater than 70% of their revenue is a result of licenses, penalties and duties imposed upon charcoal producers and traders.
- Transportation of charcoal is informal.

3.4.1.3 Households (capacities and access to capital/affordability)

- Charcoal production with high manual labor (time intensive) and minimal income compounds poverty for rural households involved in charcoal production in Tanzania.
- Costs of purchasing charcoal, and firewood collection remove time for other productive activities and contribute to the poverty Tanzanians.
- Households involved in current informal biomass sector cannot access/attract affordable efficient technologies and services in production and use.
- Capacities of households to access modern technologies necessary for efficient production, marketing and use of modern efficient biomass stoves are minimal.
- Formal human resource development in the sector is minimal.

3.4.2 Power sector

3.4.2.1 Governance (existence of enabling regulatory/framework for investment, enforcement capacities)

- EWURA exist as a regulator in the power sector with limited and somewhat blunt compliance instruments for energy law-breakers.
- EWURA lacks enforcement capacities in terms of skills to undertake and achieve least-cost planning outcomes, number of employees and geographical coverage.
- There is limited transparency in power sector contracting and regulations.
- There is a limited technological scope of coverage by EWURA FIT for different energy resources. Current EWURA FIT is based on hydro and avoided diesel costs for generation.
- There is inefficient production, transmission and distribution of power services.
- Poor governance (rampant corruption) in the power sector.
- The social aims of equity in access and affordability are in conflict with disciplined cost recovery.

- Subsidies for modern energy access are in place but below the financial costs of physical access.

3.4.2.2 Supply Chain (access to grid, capital, technologies, and know how)

- Tanzania has a large land area with about 75% of its population located in dispersed rural areas. Infrastructure for grid extension is therefore high and in most parts of the country absent.
- Most rural electrification actors and developers are based in urban areas with limited financial muscle and hence reluctant to develop energy supply chains in rural areas.
- Energy per capita for Tanzanians is the lowest in sub-Saharan region making it unattractive for grid extension investment and mini grid investments expecting cost recovery.
- Scattered households in rural communities of Tanzania require large investment for grid electrification making it prohibitively costly to extend grids.
- There is limited awareness of private sector and FIs of Tanzania on the available business opportunities in the energy sector.
- Poor liquidity of the only current buyer of IPP generated power (TANESCO) negatively impacts on the interest of private investors and FI in investing in electricity infrastructure.
- There is limited technical know-how of potential local developers and investors in modern energy businesses.
- There exists a business paradigm of investing in low-hanging business opportunities (fast moving business) compared to longer term investments in the energy sector.
- There are few incentives for private sector participation in power businesses.
- There is limited publication of available opportunities and incentives within REA and development partners for energy sector development (small and mini-hydro opportunities is an exception).

3.4.2.3 End-users (affordability and access to capital)

- Poor communities with many unattended priorities such as health, food, education and clothing render access to modern energy unachievable.
- There is limited capacity of end-users to link energy poverty with other life challenges such as economic opportunities, quality health and education, water supply and many livelihood enhancing opportunities.
- There is limited consumer financing opportunities in Tanzania other than through savings co-operatives, village banks and other micro-finance facilities.
- High initial cost of most renewable energy options and limited financing opportunities.
- Limited access of most end-users' to capital and credit facilities as a result of, first, being in rural areas where few if any FI are willing and interested to operate, and end-user poverty which provide no collateral acceptable to FIs for loan underwriting.

3.4.3 Modern energy for productive use

3.4.3.1 Governance (existence of enabling regulatoryhydropowerframework for investment, enforcement capacities)

- Limited clear regulatory framework and incentives for investing in modern energy for productive use technologies and services.
- Limited awareness of potential local investors at various levels of the community in available opportunities and incentives for investing in efficient modern productive use technologies and services.
- Limited financial institutions willing and interested to invest in modern productive energy use services.
- Limited access to the centralized services, incentives and support for rural modern energy productive uses facilities. REA/REF services could be decentralized to allow for increased access by potential developers in various parts of the country. Currently one has to travel to Dar es Salaam to access REA services, though REA is moving from a reactive facility to a more proactive one.
- EWURA is based in Dar es Salaam and hence has limited regular geographical accessibility to other parts of Tanzania where its regulations require application to modern energy services for productive uses.
- Limited capacities for enforcement of quality, standards and desired code of practice in modern productive energy services.
- Poor governance (corruption, etc.).

3.4.3.2 Supply Chain (access to capital, technologies and know how)

- Lack of sustainable supply chain for modern productive use technologies and services.
- Limited personnel with adequate technical know-how for management of sustainable modern productive use technologies and services.
- Limited access of potential actors to financial services to invest in modern productive use supply chain development.

3.4.3.3 End-users, agricultural and industrial enterprises, SME (capacities and access to capital)

- Poor targeting by project implementers e.g. targeting women as users without targeting men as those who make household purchasing decisions.
- High poverty levels of some end-users to benefit from the modern productive use services and technologies. Some end-users are so poor that they need other services prior to benefiting from modern energy access for productive services. Some end-users first need food, shelter, clothing and then you can engage them on energy for productive uses.
- Poor record keeping of some SMEs and enterprises, which are vital for access to capital and investments from FIs.

- Limited technical know-how of some SMEs, enterprises and end-users on the potential and management requirements for optimizing access to modern energy services for productive use.

3.4.4 Summary: Key gaps, barriers and additional requirements

3.4.4.1 Economic

- Dependence of the poor to earn income from biomass harvesting, processing and sales leaves governments with the dilemma of replacement options.
- Dependence on fiscal income from oil produces will need to be replaced with the increasing energy efficiencies and shift to renewable energy.
- Limited access to finance and limited financial instruments for both service providers and consumers.
- High cash poverty levels of most people, SMEs and communities in Tanzania.
- Existence of other low hanging business opportunities compared to longer term energy investments.
- High initial cost of most modern energy and energy efficiency technologies and services.
- Tariffs, duties and levies waiving needs to be evenly applied to renewable energy and energy efficiency technologies.
- Least-cost planning capacity needs skilled personnel and institutional capacity within EWURA.
- Mimimum Performance Standards at an agreed level need to be instituted to avoid dumping and the importation of substandard energy technologies.

3.4.4.2 Human capacity and awareness

- Low capacity to implement programmes and effectively utilise and account for the available public financing.
- Lack of awareness on the costs and benefits of RETs and EE technologies.
- Lack of awareness of international instruments that could contribute to low-carbon energy access and reductions in GHG emissions.
- Limited technical know-how on management and financing of RETs, EE and modern productive use technologies and services.
- Lack of knowledge of communities on close linkages between modern energy poverty and other poverty features such as limited economic activities, poor education and health services quality, limited water supply, and other livelihood and productive opportunities.
- General limited human skills and institutional capacity to address the energy opportunities and challenges in achieving a technological leapfrog to a low emissions energy economy avoiding large scale and fossil lock-ins.
- Need for early learning in new energy technologies through affirming demonstrations and informed energy decisions based on local needs, respecting indigenous knowledge and that is gender sensitive.

3.4.4.3 Governance

- Lack of a conducive legal and regulatory energy policy framework that is enabling, stable, reliable and enforceable.
- Lack of attention of policymakers' attention to the biomass energy resource abundance and its future align it with the desired modern energy sector vision.

- Low trust in governance system needs attention to achieve an adequate, affordable and sustainable energy sector for input to national economic development that is based on transparency and stakeholder consultations and informed decision making at all levels.
- Poor targeting of gender sensitivity by some project implementers e.g. targeting women as users without targeting men as those who make purchasing decisions.
- Supporting systems for development of Energy, RE, EE and modern energy services are centralised in Dar es Salaam. The fact limits access of majority of Tanzanians in remote districts of the country to services of REA, DP, EWURA, just to mention a few.
- Ineffective working relations between MNRT and MEM on biomass energy issues.

3.4.4.4 Sector based issues

- Tariffs: there is a need to have a cost reflective tariff structure for various RE sources. The current rate that is not technology specific is not financially viable for most technologies, but may provide opportunities for biomass residue power generation.
- Tariffs also are vulnerable to currency risks and here too some assistance. However, there has to be a strong justification why TANESCO should pay a higher tariff than the avoided cost, for example, factors such as diversity of generation is not considered in TANESCO planning and decision making but is valuable in the achievement of energy security.
- Capacity and risk issues with the off-taker: the under-recovery situation of TANESCO has created downstream issues for the project developers as the ability of the utility/off-taker to meet its FIT/PPA obligations. The government could explore setting up a risk guarantee to shore up the FIT/PPA commitments that guarantees such agreements as has been proposed for the SREP geothermal programme. Without such guarantees the appetite of private sector investors may evaporate.
- There is a need for a clear pathway for the private sector in the development of large RE in Tanzania. The current policy is not very detailed on this aspect; concerns are raised on the long-term impact of the new concessions being offered in geothermal. What is required is a long-term strategy that outlines the role of the private sector.
- The entire biomass value chain from fuel crops, through charcoal production, distribution and efficient stoves needs attention to achieve efficiencies inside or outside of policy.
- Measures are required to control the quality of energy using electrical technologies/appliances entering the Tanzanian market and once in the market the use of labels and/or rebates are required to advance the most efficient pumps, boilers, air-conditioners, lamps and refrigerators.
- Solar water heaters, efficient air-conditioners and insulation measures could be advanced with hotels, commercial and public buildings sectors (as part of an job creation ESCO initiative).
- The advancement of good urban planning for increased densification and associated convenient public transport systems are required to have energy efficiency spin offs.
- Rebates, subsidies, grants, tax breaks and feed-in tariffs information needs to be advanced amongst developers unaware of pre-investment support for generation and generation feasibility study and electricity connection grants available from REA/REF.

3.4.4.5 Commercial viability

- Feasibility studies: energy resource mapping exercises to determine/confirm the potential of the various RE sources and efficiency potentials is required, as has been done by REA for micro and

small scale hydro investment opportunities. Demand side studies (isolated and mini-grids) will help private sector to engage having a better understanding of energy uptake potentials.

- The commercial banks have highlighted a need for technology cost/performance information to inform their investment portfolios. [Note: training for bankers in small hydro and biomass power project due diligence has been provided by Triodos team with TEDAP/SIDA support. Updates and top-ups need to be provided on a regular basis.]
- Risk guarantees: both the project developers and commercial banks have requested for risk guarantee to enhance the attractiveness of projects/investments for Private sector investors.

3.4.4.6 Firm/project level

- Working capital is required specifically for new project developers working on results/outcomes based financing modalities.
- Capacity shortfalls in technical, financial modelling, planning, institutional, process, project structuring and packaging and feasibility assessments
- Lack of long-term/patient financing to enhance viability of the projects.
- High equity requirements of around 40% by banks (required by Bank of Tanzania rules) can be a barrier for firms.
- Several power suppliers (small and large) report significant payment delays for power supplied to TANESCO. Situation might be improving as recent tariff increase increases (still below cost) are approved). Unfortunately tariff increase coincided with low hydro electricity contributions and as a result TANESCO needs to use more costly emergency thermal plants.
- Uncertainties in policy implementation such as the MEMs plan to revoke the licenses that are already issued for Geothermal concessions awarded for six sites to Geothermal Development Tanzania Ltd., can reduce investor confidence in such inherently risky projects

Annex 1: Basic Donor Information

Institution Name	Grant	TA	Loan/Credit	Loan Condition			Budgeting Cycle
				Interest rate	Grace Period	Repayment Period	
AfDB	No	Yes	Yes	0.75% per annum	10 YEARS	50 YEARS	Annual budget (Jan-Dec)
EU	Yes	No	No				National Indicative Programme 2008-2013 (5 years)
Finland	Yes	Yes	No				Annual budget (Jan-Dec)
JICA	Yes	Yes	Yes	0.01% per annum	10 years	30 years	Annual budget (April-March)
Korea EDCF	No	No	Yes	0.01% per annum	15 years	40 years	Annual budget (Jan-Dec)
MCC	Yes	Yes	No	NA	NA	NA	Funding committed for 5 year grant (2008-2013)
Netherlands	Yes	Yes	No				N/A
Norway							
SIDA	Yes	Yes	Yes	Market	Market	Market	Annual budget (Jan-Dec)
UNDP							
WB (IDA)	Yes	Yes	Yes	0.75% per annum	10 years	30 years	Annual budget (July-June)

Annex 2: Current and Near-Term Donor Partner-supported Renewable Energy Projects

Projects	Implementing Agency	Objectives	Amount	Components and/or Results and Achievements Enhanced Up to August 2012	Linkages with SREP	Development Partner Supporting GoM	Date
Clusters PV Project	CAMCO	15,000 solar home systems financed through associations' members in Lake Victoria Region with microfinancing through local banks and with subsidy from REA (TEDAP).	Euro 950k	Approaching the end of year one, Project currently working with nine Cluster groups. Tenders for the SHS for the first three groups have been awarded and contract negotiations underway.		EU	2011- 2014
Up-Scaling Access to integrated modern energy services for poverty reduction	TaTEDO	Improve energy productivity	Euro 2.3 million	Installation and commissioning of 50 Multi-Functional Platforms, 50 Productive Use Containers and 25 combined MFP and PUC in 100 villages in northern Tanzania.		EU	2008 – 2013
Mwenga 3MW Hydro Power	Mufindi Tea Company Ltd.	Renewable energy-based rural electrification	Euro 7. 2 million	Construction and commissioning of a 3MW hydro power plant, transmission and distribution to surrounding rural communities	Model for SREP scale up	EU	2007 – 2012
Integrated Rural Electrification Planning in Tanzania	REA	Rural electrification planning methodology development	Euro 1 million	Formulation of a relevant Rural Electrification planning methodology through the use of modern and sustainable tools, capacity building for the target groups	Renewable energy projects identification for SREP support	EU	2011 – 2012
Yovi Hydro Power Project		Construction and commissioning of a 1MW hydro power plant on the Yovi River in Msolwa (Kilosa Disctrict), transmission and distribution to surrounding rural communities (min-grid)	Euro 4.2 million			EU	2011 – 2014
Sustainable Community-Based Hydro Power Supply in 6 villages of Ludewa District		Upgrading of the existing Mawengi micro hydro plant and mini-grid extension to surrounding communities	Euro 1.8 million		Model for SREP scale up	EU	2011 – 2014

Increasing access to modern energy services in Ikondo Ward		Upgrading of the existing Ikondo micro hydro plant and mini-grid extension to surrounding communities	Euro 1.8 million			EU	2011 – 2015
Introducing a new concept for affordable biogas system		Private sector development and market extension in order to reach at least 10,000 rural households for affordable and locally made new concept of plastic biodigester	Euro 1.5 million			EU	2011-2015
Best Ray Project	Oikos East Africa, Italian NGO (Matteo Leonardi, project manager)	Solar panels are to be installed in all primary and secondary schools in Oldonyo Sambu and Ngarenanyuki wards in Arumeru district to promote the use of renewable sources of energy	Euro 1.5 million	?	Review experience on approach, links to REA efforts as lessons for SREP	EC	~2010
Masigira hydropower	TANESCO	Feasability Study	NORK 7 million	Procurement		Norway	**?**
Operation and Maintenance	TANESCO	Operation and Maintenance at existing Hydropower generation	NORK 60 million	Not started		Norway	Approved
Kihansi minihydro	TANESCO	Construction of mini hydro	NORK 15 million	Not started		Norway	Proposed
Pinyiny small hydro	TANESCO	Construction of mini hydro		Not started		Norway	Proposed
Energy Small and Medium Enterprises	GVEP International in partnership with REA	Pre-investment support for six mini-hydro projects six projects with a combined capacity of ~ 7.5MW in regions of Mbeya, Iringa, Ruvuma, Arusha and Kigoma. Most are isolated mini-grids not connected to the main	US$XX million from Russian Federation via a World Bank Trust Fund	Six projects identified from long list of 2 and feasibility studies underway.	Approach could be replicable for project development. Financing for projects	Russian Federation (World Bank managed Trust Fund)	2010-?
Development services for solar companies in 16 regions	CAMCO	Technical and marketing training for solar retailers, technicians and vocational school instructors); marketing and awareness, networking among solar industry stakeholders; and policy and institutional support for the implementation of national quality control standards. Support for the strengthening of the Tanzanian Renewable Energy Association (TAREA)	USD 3.2 million	Builds on similar project conducted in Mwanza from 2004-2009, the Project was completed in 2011 (after six years). Over the period the national PV market grew from 100kWp to over 2MW. Over 150 new retailers established and an equal number of rural technicians trained. Tanzanian Renewable Energy Association (TAREA)	Builds capacity that could be used for off grid solar scale up with SREP support.	SIDA	2005-2011

				strengthened, and the Tanzanian Bureau of Standards (TBS) equipped and trained to control solar PV equipment quality.			
REF	REA	Rural Energy Fund support	SEK 203 million			SIDA	2010-2014
Capacity building	REA	Capacity Development to REA	SEK 28 million			SIDA	2010 – 2014
WB Trust Fund	REA	Support to REA and rural energy	SEK 30 million			SIDA	To 2013
Ruhudji & Kakono Hydro	TANESCO	Hydropower studies	SEK 30 million			SIDA	2011 – 2012
Hale Hydropower	TANESCO	Rehabilitation of 21MW Hale Hydro Power Plant in Tanga Region	SEK 160 million			SIDA	
Bio-fuel Project	MEM	Support in strengthening Policy, Legal, Regulatory and Institutional framework to the Development of a sustainable biofuels industry in Tanzania	SEK 13 million			SIDA	2009 – 2012
Mini-Grids Based on Mini/Micro-Hydropower Source to Augment Rural Electrification in Tanzania	UNIDO with REA	Develop nine mini hydropower projects with total capacity of 3.2MW to boost economic development activities in Ruvuma, Iringa, Mbeya and Rukwa regions. Establish centre of excellence for minihydro at the College of Engineering and Technology (CoET) of	US$13 million with US$XX form GEF through UNIDO	Could be scaled up by SREP to increase access		United Nations Industrial Development Organization (UNIDO)	2012-2016
Malagarasi Hydropower	TANESCO	Malagarasi Hydropower Feasibility Study	US$1.8 million	Implementation		US MCC	2010 – 2012
Kigoma Solar	REA with contractors CAMCO, Rex Investments	Kigoma Solar PV Programme. Installation at 45 secondary schools, 10 health centers, 120 dispensaries, municipal buildings and businesses across 25 village market centers.. Also encourage households to install SHS.	US$4.7 million	Contract awarded for supply and installation of PV systems for public/community facilities and programme management	Part of REA Sustainable Solar Market Packages. Could be scaled up under SREP.	US MCC	2012-2013
Lighting Rural Tanzania 2009	REA	Competitive grant programme to support private enterprises in developing and delivering a wide array of modern lighting products for rural households and businesses.	US $0.982 million. 10 grants up to US$100,000	In April 2010, a competition in Arusha, Tanzania, selected 10 recipients for implementation over 12 months. Awards made to private sector (including NGOs and community organizations).	Model for expanding modern renewable energy lighting solutions. SREP could	World Bank	2010-2012

				Subprojects demonstrated innovation and built local capacity in delivering energy services to rural areas in Tanzania, increasing the potential for replicability and scale up of these activities. . Based on the success of the activity, REA has raised funds and organize a second LRT. .	support successful business models scale up		
Lighting Rural Tanzania 2010	REA	Competitive grant programme to support private enterprises in developing and delivering a wide array of modern lighting products for rural households and businesses. · Increase access to modern lighting systems for households, schools and health centres. · Improve technology for production of low cost renewable energy products. · Bring to the market, products that are competitive in terms of price.	Maximum grant per winner Tsh 150 million Maximum 20 winners US$2 million	Continuation of the Lighting Rural Tanzania Competition (LRTC) programme. WB-IFC Lighting Africa team will continue to advice REA based on its experience in other countries.	Model for expanding modern renewable energy lighting solutions. SREP could support to successful business models scale up	World Bank	2012-2014
ARGEO	UNEP, World Bank	Promote the development of geothermal energy in the selected countries, including Tanzania. It is expected that this will add low-cost power generation capacity and increase the security of power supply. The global objective of the project is to facilitate reduction of green-house gas emissions in these countries.	Total project US$136.6 million (?) for Djibouti, Eritrea, Ethiopia, Kenya, Tanzania, and Uganda. GEF grant: US$18 million (or 36?). co-financing of about US$41.5 million from KfW, Iceland, Italy, USA; and recipient countries.	1. The creation of a Regional Network managing a geothermal information system and capacity building and awareness raising programmes. (UNEP) 2. A Risk Mitigation Fund will provide financial instruments to assist in mitigating the exploration and appraisal risks (World Bank). 3. Technical Assistance, a. Institutional and technical capacity building (UNEP) b. Risk Management Fund related activities (World Bank). c) No country including Tanzania (ARGEO member have already	If resource is confirmed, potential support from SREP for production wells and power generation	World Bank	2010-2015

			Remainder from private sources.	secured fund to assist in mitigating the exploration and appraisal risks			
Energy Small and Medium Enterprises (ESME) Trust Fund	REA	Provides green generation performance grants (in the value of future Carbon Emission Reductions) to support small renewable energy projects reach financial closure.	6.5 million from Russian Trust Fund executed by the World Bank	Grant approved this year. Several developers have expressed interest in this facility. The first transaction is expected to be for the 10MW Mapembasi project.	The facility could be supplemented by SREP funding taking into consideration the interest expressed by	World Bank	Dec 2010; to be extended to 2014
Singida Wind Power	Wind East Africa JV Telecoms, UK-based Aldwych International and Danish wind consultancy KenTec Denmark)	The proposed project consists of a 100MW wind farm to be built, owned, and operated by Wind EA. This privately financed project will supply power into the Tanzanian national grid under a long term PPA with TANESCO. The wind farm will be constructed along the Rift Valley on a site located east of the town of Singida. The Project will include the construction of any necessary transmission line to connect the plant to the grid.	Total project cost US$300 million. World Bank: US$100 million PRG to cover commercial lenders against debt service payment defaults.	Decision Meeting scheduled for September 2013.	SREP partner financing	World Bank	2013- ?
CDM Programme of Activity (PoA)	REA	To provide additional revenues to the small renewable energy projects (up to 10MW) to fill the equity gap and reach financial closure	US$10 million	REA submitted request to the World Bank to become a Seller Participant under CPF Several projects submitted letters of interest to REA to register under the PoA that is expected to reduce their carbon finance transaction cost	Supports the development of small renewable energy projects that could be co-funded by SREP	World Bank, Carbon Partnership Facility (CPF)	
Tanzania Energy Access and Development Project	REA and MEM	Off grid component to support an institutional set-up for the newly established Rural Energy Agency (REA) and to develop and test new off grid electrification approaches for future scale-up.	US$59.6 million. US$16 million IDA. US$6.5 million GEF	1. Standardized Power Purchase Agreement for renewable power to supply TANESCO main and mini-grids. a. Tariffs, and SPPA implementation and guidelines issued by EWURA. b. TANESCO set up Small Power Project Office to facilitate project development. c. REA: Matching grants to support pre-feasbility for new projects.	Good regulatory framework, institutional capacity and strong project pipeline that could be developed with SREP cofounding. SSMP and Clusters models could be scaled up for off-grid	World Bank, GEF	2007-2015

				d. REA: US$500/connection (max 80% of distribution cost) for mini-grid connections. e. Several projects operating or under construction (TPC, TanWatt, Mafia Island). f. Several mini-hydro and biomass power projects under development. g. Strong pipeline of projects 2. Sustainable Solar Market Packages (SSMP) provide off grid solar electricity for public facilities and households. a. Four SSMP in Rukwa Region under implementation. b. New SSMP packages being prepared for eight more regions. 3. Clusters Projects: Solar home systems for member of associations (coffee, tea, cashew,…) with financing through NMB/Stanbic 4. Other TA includes low cost electrification methods, renewables financing training for bankers, project developers and sector institutions, wind resource assessment at 4 sites.			
Tanzania Energy Access and Development Additional Financing Project	REA and TIB	Credit line for financing renewable energy projects	US$25 million IDA	Credit line overseen by REA and managed under trust arrangement by TIB. Commercial banks approved for on-lending funds: CRDB, NMB, Azania Bank Limited, Twiga Bancorp First loan for Mwenge mini-hydro and mini grids approved and disbursing. The second mini-hydro project, Mapembasi is near financial closure.	Credit line facility can be used to provide SREP and other co-financing for additional renewable energy investments	World Bank	2011- 2015

CDM Projects	Tanzania DNA	Carbon emissions reductions		1 Registered project: Landfill gas and Electricity generation at Mtoni dumpsite (202,271 CERs, 3.5MW annually) 3 PINs (PIN = Project Idea Note) – given Letter of No Objection: 1. Wind Energy project - Singida 2. Energy efficiency project- TaTEDO 3. Power generation from sisal biogas project - Katani Ltd.	Additional revenues to improve viability of SREP supported projects		

Source: Scoping Mission Aide Memoire, 2012, Scaling-up Renewable Energy Programme in Low Income Countries: SREP Tanzania

Annex 3: Constraints to Renewable Energy Development

Key Barrier	Main barriers and constraints hampering the development of RE in Tanzania	Strengths of the Sector and how far they got already	Additional "mitigation" measures to which SREP activities may contribute
Institutional, regulatory and legal constraints			
Planning uncertainties	Uncertainty on the future direction of power sector hampers stakeholders' investment planning. · Lack of information on grid extension plans reduce incentive to develop mini-grid projects, including supply of renewable electricity to TANESCO isolated grid (those developing projects feeding mini-grids get higher tariff. One isolated grid connected to main grid, gets only lower main grid tariff) · There is mismatch between renewable energy resource distribution relative to existing grid/load centres	· MEM in final review phase of Power Sector Development Master Plan (due end 2012) · REA launched National Rural Electrification Prospectus (due mid 2013) Both these should give greater clarity to energy development plans and opportunities for renewable energy.	· Publicly issue Master Plan and Prospectus without delay. · Recognizing the role for and incentivizing the ability of RE to contribute significant electricity quickly, to complement to the forthcoming national plan and prospectus. · Need greater transparency and early notification by TANESCO as to grid network expansion plans.
Pre-investment time is long	RE project approval process takes time and requires coordination and approvals from NEMC, TANESCO, REA (if project development and co-financing support is needed), as well as financing mobilization.	Regulatory frameworks, legal agreements and tariff, implementation guidelines issued by Regulator EWURA and effectively administered. TANESCO has set up private power cell to facilitate support for small (up to 10MW) renewable project approvals.	Further strengthening capacities of key institutions beyond that undertaken with TEDAP and related assistance
Quality is low	Solar market spoilage through poor quality and counterfeit products at very low prices flooding market. Consumers highly price sensitive. Market spoilage is happening.	Lighting Africa has engaged with Customs to inform them of quality requirements and to determine how to stop poor quality/mislabeled products entering markets. But border higher porous and near impossible to stop such products entering market.	· Engage further with border controllers, with wholesalers, distributors and retailers and have expanded awareness programmes launched in key target market areas · Development of standards by Tanzania Bureau of Standards and regulations by EWURA Enforcement
Technical capacities and human skills			

Low human skills and institutional capacity	Technical, institutional and financial capacities are still relatively low.	- REA has undertaken capacity building in the banking sector. · TANESCO supported in strengthening its private small power cell. · REA offering advisory services and cost shared (up to 80%) funding for pre-investment work. · SIDA and UNDP have supported solar training in several areas that have been very effective. · Incorporating solar technology in VETA'S curriculum.	Initiate further and expanded systematic programme aimed at building the capacities of all the stakeholders on issues related to RE to banking sector as well as product and service providers (information, project due diligence/appraisal, new financial instruments, awareness building, marketing, sales and repair)
Low human skills and institutional capacity	There is limited experience and expertise in country for undertaking feasibility studies, detailed designed, construction etc. Existing capacities of experts over stretched.	· REA offers cost shared support to developers to undertake feasibility and detailed engineering studies. · GVEP supporting the developing of 6 small hydro mini-grid projects. · GEF through UNIDO supporting the development of nine (9) small hydro mini – grid projects · Some developers setting up JV arrangements with foreign partners to fill expertise gap.	· Specialized training to building required experience in mini-hydro and biomass technologies. · Expand training through appropriate university and technical schools. · Support partnerships with international firms through South-South exchanges.
Low human skills and institutional capacity	Off grid solar for public service facilities difficult to service/maintain due to limited technical capability in area, theft of modules and batteries from public facilities, users do not have adequate capacity to use/operate and do routine maintenance due to staff turnover.	REA has piloted with the "Sustainable Solar Market Packages" (SSMP) approach that issues supply and installation contracts to a large group of public facilities in a contiguous area, with incentives to sell/service SHS to public customers. Some signs of success but problems remain. REA preparing packages in seven other regions. Also incorporating solar technology in VETA'S curriculum.	· Future SSMP packages must be designed to overcome contract- and contract-performance problems. · Greater attention to contractor capability and less to "lowest cost" in contractor selection. · More effective methods of making SHS affordable to private customers.
Renewable resource uncertainty	Renewable resource information of a quality and duration is lacking	Wind resource monitoring supported by REA in six areas. · Hydro resource data collection being	· Expand resource monitoring to cover biomass and verify solar resources (currently depending on data from NASA,

		undertaken by developers with cost-shared assistance from REA at specific project sites and assessment of Small hydro by MEM and TANESCO in 5 regions. Norway supporting more extensive hydro potential characterization (but may focus on larger scale RE) Geothermal Power Tanzania given concession in Lake Ngozi and Rufiji and investing $5 million in geotechnical, geological and drilling work. · Surface exploration done at Lake Ngozi · Area special for energy crops to be identified in the country	EU satellite-based sources). · More resources for hydro resource characterization for mini grids to feed mini-grids (TANESCO and private). · Expand geothermal resource assessment work. · To support Agro – ecological zoning
Renewable resource uncertainty	Climate change impacts increase variability of hydro flows (REA IP)	Afforestation efforts are underway.	
Economic and financial context			
High pre-investment and transaction costs	High cost of resource assessment and feasibility studies.	· REA offering cost-shared support for pre-investment studies. · EWURA has issued guidelines for renewable project development up to 100MW. · REA supporting wind resource assessment and mapping hydro resources. · REA offers cost shared funding for feasibility studies Exploration concession awarded to Geothermal Power Tanzania Ltd.	Continue REA support programmes. Support expanded and well-designed geothermal resource assessment - surface exploration and appraisal drilling Default note have been issued to all geothermal licensees to make geothermal resource develop in a better way.
High capital cost renewable energy technology and development	· Upfront investment costs of RE are high due to intrinsic capital intensity of technology. · High also due to limited number of projects, lack of competition, currency depreciation etc. · High transport costs due to long distances to sites. · Unduly long time for pre-investment, financial closure and construction include costs as well as increase IDC	· Designed incentive packages to promote private sector investments by zero rating import Duties and Taxes on equipment and accessories. · Annual budget allocation of approximately USD 625,000 to develop geothermal	· Increased implementation scale can help reduce costs. In the case of geothermal, comprehensive geo-scientific investigations that precede test and production well drilling reduces risks of expensive dry wells. · Little can be done to overcome some

	requirements · For grid connected projects including electricity distribution networks, customer connection costs are very high	· Partnering with Development Partners in funding geothermal development · REA supporting better project designs through cost-shared pre-investment support encourages international partnerships. · REA offers $500/connection (up to 80% of connection cost), to mini-grid developers. · Low cost rural electrification study underway, include pilot to demonstrate lower cost methods	constraints, but support to streamlining processes, especially pre-investment requirements, financial closure. · Support best practice through encouraging international partnerships. · If low cost electrification pilot successful, mainstream approaches emerging from low cost electrification study. For a limited time, support connection subsidies to those adopting low cost methods.
Financing unavailability	Domestic banks require high equity share (40%) for investments and makes mobilizing project financing difficult and expensive.	Those requiring additional equity are bringing in foreign equity partners (e.g. green funds or other investors). Others getting local investors	· Guarantee instruments to cover currency and other commercial risks that foreign equity partners may require. · Quasi equity facility
Financing unavailability	Domestic banks mobilize only short term funds and so hesitant to lend long term. Limited or no long term financing available.	· TEDAP has established a US$22 million credit line. It offers long term financing to banks at AWDR plus a margin to cover forex risk. · Introduction of the Green Energy Facility (REA)	· Increase funding to credit line. · Encourage and facilitate international green funds and socially-oriented investors to invest in Tanzania's renewable energy sector.
Investment risk high	International private investors consider the energy sector in Tanzania a risky sector. Those who do come seek higher risk premiums which make projects financially unviable.	TEDAP credit line and World Bank engagement has helped attract international investors, but significant risks remain.	Provide greater guarantees and security to private investors and define conditions to improve public-private partnerships for utility scale projects, such as grid connected RE investments
Revenues inadequate	Off-grid solar electrification, though a thriving business in some areas is limited by affordability to higher income consumers.	· REA and World Bank have funded pilot efforts to engage SACCOS to lend to solar, undertaken "Cluster" projects to aggregate SHS loans to association members (group lending), with some positive results, but too early to declare success. · GOVERNMENT OF TANZANIA has removed all taxes and duties from SHS REA offers grants ($2.5/Wp)	· Further engagement with banks and MFIs as well as large agricultural or mining operations, with appropriate incentives and training to engage in such credit schemes. · Mobilization of additional funding (grants) from development partners (to subsidize initial investment costs)

Revenues inadequate	Renewable energy tariff, based on avoided cost is distorted by gas price subsidies, preventing otherwise economically viable renewables not being developed.	EWURA has established, and transparently and effectively manages the RE tariff setting process. But pricing is based on financial prices and not economic pricing.	Policy dialogue with GOVERNMENT OF TANZANIA and EWURA on a pricing formula to recognize true economic avoided costs. Consider pool of funds to cover payments for difference between economic and financial avoided cost as TANESCO should not bear that cost. · Consider technology-specific Feed in Tariffs (FiT) to support energy supply diversity.
Revenues inadequate	CDM project prospects exist but progress slow to non-existent due to complexities of CDM process, lack of country capacity, small scale of projects and bureaucracy in Tanzania.	· Several CDM training sessions held in Tanzania. · One project registered and 3 PINS prepared. · REA submitted request to the World Bank to become a Seller Participant under CPF. Several projects submitted letters of interest to REA to register under the PoA.	· Greater pro-activity and effectivity of DNA required. · REA to be approved as Seller participant in PoA.

Source: Scoping Mission Aide Memoire, 2012, Scaling-up Renewable Energy Programme in Low Income Countries: SREP Tanzania

Annex 4: Summary of Renewable Energy Resources in Tanzania

Renewable Energy Sources	**What type of Mapping is available?**	**Key Mapping Data** (Zones and potential in terms of MW)	**If not available, is there any mapping planned to be done shortly?**	**Sources where information is available**
Geothermal	Identified through surface manifestations except at Lake Ngozi – Songwe Mbeya region where detailed geological, geophysical, and geochemical studies done) (June 2006-July 2007 and July 2010).	According to Government of Tanzania sources, potential is more than 650MW. More than 50 potential geothermal sites are identified along the Rift Valley, Lake ngozi (Songwe), Lake Natron (Manyara), Luhoi (coast region) and Kisaki ranked as first four. Geothermal potential areas in Tanzania are divided into four zones; this is due to two arms of rift formation (eastern and western rift) The Lake Ngozi – Songwe potential ~100MWe.	Geothermal Power Tanzania Ltd. granted prospecting licenses for geothermal exploration in the Mbeya area and Rufiji. Announced plans in May 2012 to invest $5 million in geotechnical, geological and drilling work. Contracting a dedicated geothermal drilling rig with capacity to drill to 2.5 km. Expects drilling to commence at end 2012. Main target: geothermal reservoir at the Ngozi volcano ~100MWe.	MEM, Geological Survey of Tanzania, Federal Institute for Geosciences and Natural Resources (BGR) of Germany and TANESCO. SWECO – Swedish company based in Sweden
Solar	Meteorology and solar radiation for NASA SSE from the NASA satellite and re-analysis research programmes. Parameters based upon the solar and/or meteorology data were derived and validated based on recommendations from partners in the energy industry. PV system sizing based on solar radiation maps available from EC JRC (less useful than NASA for planning and system design)	Tanzania is situated in the solar belt with high levels of solar energy with global radiation of 4 - 7kWh/m2day (REA).  **Figure 1 Solar Radiation – 2250-2750kWh/m2/year (EC-JRC PVGIS)**		NASA Surface meteorology and Solar Energy http://data.nasa.gov/surface-meteorology-and-solar-energy/ European Commission, Joint Research Centre, Photovoltaic Geographical Information System-Interactive Maps http://re.jrc.ec.europa.eu/pvgis/apps4/pvest.php?map=africa
Hydro -Large		Large hydro potential about 4700MW, only 12 % exploited. Increased rainfall variability has led to unpredictability in output. Saiguran Loisulie reports "There is a general decrease of the amount of annual rainfall. The frequency of below average rainfall is generally going up. It is also evident that the severity of extreme weather events like dry and wet spells is intensifying. The predictability of seasonal weather patterns is becoming more challenging."	Norway-supported the survey.	TANESCO Saiguran Loisulie, Vulnerability of the Tanzanian Hydropower Production to Extreme Weather Events, Sokoine University of Agriculture, Faculty of Science Department of Physical Sciences, Morogoro. saiguran@suanet.ac.tz, +255 757 876603

Hydro - Small	TANESCO desk studies and fieldwork. New sites identified via topographical map reading of the standard 1:50,000 sheets. Reconnaissance studies of new potentials and confirmation of existing information are completed for Rukwa, Kagera and Ruvuma regions (2007). Also field studies were done 2007 in Iringa, Mbeya andMorogoro The next will be Kigoma regions.	The assessed potential for small, mini and micro-hydro system (with capacities of less than 10MW each) is 480MW. A survey by TANESCO identified 85 specific sites is187MW (TANESCO)	Norway supporting large hydro development survey and planning (check status!). REA supported by WB and GVEP funding feasibility studies for SHP based rural electrification and grid supply projects MEM and TANESCO is assessing small hydro potential in 7 regions and 5 regions already completed	TANESCO surveys. Kato T. Kabaka and Florence Gwang'ombe, Challenges in Small Hydropower Development in Tanzania: Rural Electrification Perspective, International Conference on Small Hydropower - Hydro Sri Lanka, 22-24 October 2007. GTZ, Tanzania`s Small-Hydro Energy Market, 2009. Table 6 gives location of 56 SHP sites with estimated capacities, head, flow etc. REA SHP database gives more specific data on SHP sites.
Biomass	Forest 35 million hactares are available	Biomass consumption estimated at 40 million m3 of wood equivalent leading to clearing nearly 400,000 ha of forest annually.		MEM
Biomass – Point sources Industrial/Power, MSW	Factory data, survey reports MSW in major cities	Biomass production estimated at more than 2 billion m3 of solid wood/annum (2000). Largely from sugar, timber, paper, tannin, and sisal processing. TPC-Moshi, TANWAT, Sao Hill, Mtibwa, Kilombero and Kagera sugar factories, Mufindi Paper, etc. Sugar Industry: Production in 2011 ~320,000 MT. 4-5 MT of bagasse/MT sugar. Bagasse production 1.5 million MT. AfDB funded 2004 study: Sugar (see update, above) Sisal Industry: 200,000 tons sisal waste Coffee Curing: Present production is 45,000 MT, to increase to 65,000 MT by 2010. About 20% of the gross weight is coffee husks, which are not utilized so far. There are plans to convert the husks into charcoal. Rice Milling: Annual rice production (2004) ~800,000 tons. Forest/wood industry: slight surplus of wood biomass available (2004) for energy use will shift		M. A. Kishimba, The Potential of Energy From Sugar Cane Wastes in Tanzania, AFREPREN, October, 2000. DECON – SWECO – Inter-Consult, Tanzania Rural Electrification Study, for MEM and TANESCO, 2004, funded by AfDB M.A. Kishimba, Energy Recovery from Municipal Waste, Chemistry Department, University of Dar es Salaam Daily News Online Edition, http://dailynews.co.tz/index.php/biz/1459-sugar-production-potential-yet-to-be-fully-exploited

		into a deficit by 2020. Major potential at TANWATT, Saohill. MSW: Kishimba estimates only about 10% of Dar es Salaam MSW ends up in landfills. Forecasts 4.7 million MT of urban MSW by 2015 with energy potential of 1200 GWh/year		
Biomass – Distributed	Research/survey data, REA	Agricultural, municipal, and industrial wastes and residues, and animals waste ~ 15 million MT/annum. 17.5 million cattle, 12.5 million goats, 3.5 million sheep (1998 Census) 1.1 million tons forest residues. Available nationwide as fuelwood, charcoal from forest resources for urban consumers (contributes to deforestation) and agricultural waste. Biomass contributes 80% of Tanzania's final energy demand. Provides for more than 90 % of rural household energy needs.		
Wind	Anemometer measurements. Also estimates based on satellite data available from NASASurface meteorology and Solar Energy	Assessments in Kititimo (Singida) and Makambako (Iringa) areas. Average wind speed estimated 9.9 m/s at Kititimo and 8.9 m/s at Makambako (50m?).	REA supporting wind mapping in six areas: Makambako in Iringa region, Karatu in Arusha region, Mkumbara in Tanga region, Mafia in Coast region (off-grid), Sumbawanga in Rukwa region (off-grid) and Singida. MEM with TANESCO conducting a Wind Assessments in Mkumbara (Tanga), Karatu (Manyara), Gomvu (Dar es Salaam),Litembe (Mtwara), Makambako (Iringa), Mgagao (Kilimanjaro), and Kititimo (Singida). Plans for assessment in Usevya area (Mpanda).	MEM, TANESCO, REA, DANIDA

Source: Scoping Mission Aide Memoire, 2012, Scaling-up Renewable Energy Programme in Low Income Countries: SREP Tanzania

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SUSTAINABLE
ENERGY FOR ALL

Sustainable Energy for All

Rapid Assessment and Gap Analysis

TANZANIA

May 2013

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EXECUTIVE SUMMARY

The purpose of this Rapid Assessment and Gap Analysis is to identify the gaps to meeting the sustainable energy for all goals in the Republic of Tanzania, within the context of its economic and social development and poverty eradication. It assesses where the country stands with respect to the three SE4ALL goals of the UN Secretary General's initiative. The review provides an overview of the main challenges and opportunities relating to energy access, energy efficiency and renewable energy, with specifications of where the major investments, policies and enabling environments will be required. This analysis is to form the basis and background for an Action Plan that may follow as part of the SE4ALL activities in the country.

Within in its policy framework, Tanzania is aligned to the SE4All goals, particularly for energy access where it targets 75% electricity access by 2033. No other explicit targets for non-electricity modern energy services such as for heating are included in Tanzanian energy strategies, although efficiency and conservation of energy uptake by industry is mentioned in the MEM Strategic Plan for the period 2011 to 2016. However, the weakness of this target is that there is minimum focus on other forms of energy access such as cleaner cooking energy and other thermal applications, in favour of electricity despite the fact that users are unlikely to afford to use it for thermal applications. While commitment for cleaner cooking has been made at a regional level, it is not emphasised and focused upon in translating it to national strategies and goals and charting a course to embracing biomass energy as a contributor to the envisaged modern energy economy. In the policy arena, there is a clear need for renewable energy, energy efficiency and modern biomass policies, policy implementation strategies and accessible policy instruments.

In order to meet the SE4All goals, Tanzania will have to address a range of issues including attracting private financing. This will in part be achieved through the creation of a conducive legal and regulatory framework that allows for cost recovery and reasonable financial incentives in the energy sector. However, there is also the reality of high levels of poverty, which despite a conducive environment, will deter private investors as they are primarily interested in profits. In this sense, tariff design and diversification of solutions will assist in balancing economic viability and achievement of equity goals.

There is a need to establish, manage and allow public access to a database that tracks the impacts of energy policy, tracking trends against agreed baselines including energy intensities, renewable energy contributions, access to energy services and the social, gender, environmental and economic co-benefits. EWURA and MEM would benefit from additional technical capacity and systems to evaluate and promote policy advancing least-cost energy options. However, in the short term, a priority is the stabilisation of the electricity utility to ensure cost-recovery and a reliable supply, only then can electricity energy efficiency improvements be addressed with any firm resolution.

1 Section I: Introduction

1.1 COUNTRY OVERVIEW

1.1.1 Basic socio-economic data

Tanzania has an estimated population of 44 million persons, with a per capita GDP of US$512. The proportion of those living under the basic needs poverty-line is 33% on Mainland Tanzania and 49% on Zanzibar Island (MOFEA, 2010), Up to 51% of the Tanzanian population is female. An estimated 25% of households are headed by females and 33% of females headed-households live under the basic needs[1] poverty line (HBS, 2007). According to a World Bank report published in 2012, the urban population (as percentage of total population) in Tanzania was last reported in 2010, and was estimated at 25.5% with a growth rate at 4.6. Urban population refers to people living in urban areas as defined by national statistical offices. It is calculated using World Bank population estimates and urban ratios from the United Nations World Urbanization Prospects.

The country's economy mainstay is agriculture. According to 2013 CIA world Fact book and Tanzania national website and other sources, 27.1% of GDP is from agricultural products, the bulk of which is subsistent agriculture. Important exports include tea, coffee, cashew nuts, cotton and tobacco. However, minerals such as gold, as well as tourism are increasingly contributing a substantial proportion of the country's economy. Industry makes a relatively small contribution of 24.1% to GDP. The country has in recent years discovered higher gas reserves than previously assumed. Gas is therefore likely to be an important future source of revenue, and likely to play a key role in meeting energy needs into the future. National planning priorities are framed by the shared 2025 national development vision and strategies MKUKUTA II.

1.2 **ENERGY SITUATION**

1.2.1 Energy Supply

1.2.1.1 Primary energy sources

The Tanzania energy supply is highly dependent on biomass. Biomass represents about 90% of the total primary energy consumption (MEM, 2010). Electricity represents 1.2% while petroleum products provide 8% of the total energy consumed in Tanzania. Solar, coal, wind and other energy sources represent about 0.5% of total energy consumption. According to the IEA (2011), Tanzania consumed a total of 19.6 MTOE, of which net imports were 1.7 MTOE in 2009.The government of Tanzania estimates this to have increased to 22 MTOE in 2010. Energy imports represent 23% of total imports, and about US$1.5 billion in national expenditure and almost all of this is fossil fuels. Total energy consumption is 0.45 TOE per capita in 2010. More specific data and information on primary energy sources potential include the following:

(i) Biomass Resources

Tanzania has about 33.5 million ha of forests and woodlands (FAO, 2010). Of this total area, almost two thirds consists of woodlands on public lands, which lack proper management. According to Mwampamba (2007), Tanzania's forests consist of 13 million ha of forest reserves. Zahabu (2008) mentions 16 million ha of

[11]Basic needs are x$/capita/day

reserved forests (according to the Forest Act (URT 2002) "Forest reserve" means a forest area, either for production of timber and other forest produce or for the protection of forests and important water catchments, controlled under the Forests Ordinance and declared by the Minister. In addition, declared forests under village managements are also recognized as forest reserves. Over 80,000 ha of the gazetted area are under plantation forestry and about 1.6 million ha are under water catchment management. The forests offer habitat for wildlife, beekeeping unique natural ecosystems and genetic resources. Biomass energy is the main sources of fuel for rural and urban populations alike. However, it is estimated that the sector's contribution to the Gross Domestic Product is between 2.3%, and 10% of the country's registered exports. This contribution is underestimated because of unrecorded consumption of wood fuels.

According to REA records, there is about 15 million tons per year of agricultural, livestock and forestry residues. Some of which that may be available for use in power generation. These include sugar bagasse (1.5 million tons per year (mtpy)), sisal (0.2 mtpy), coffee husk (0.1 mtpy), rice husk (0.2 mtpy), MSW (4.7 mtpy), forest residue (1.1 mtpy)) with the balance from other crop wastes and livestock. Further supplies can be obtained through sustainably harvested fuel wood from fast-growing trees plantations. For example, a 50MW biomass power plant could obtain all its fuel wood needs from a 10, 000 hectare plantation.

There is also considerable unrealized scope for crop wastes supplying a larger portion of the nation's energy supply using commercially proven anaerobic digestion technology. Crop wastes make an ideal feedstock for biogas – either for electricity or for domestic use in lighting and cooking. At an industrial scale, crop wastes can be used both for anaerobic digestion for gas or electricity, and the residues from that process make excellent charcoal briquettes.

(ii) Geothermal

The potential for geothermal energy is significant, but has not yet been fully quantified. Estimations of geothermal potential of Tanzania are put at more than 650MW, with most of the prospects located within the East African Rift System (Government of Tanzania/SREP, 2013). Most of the geothermal prospects were identified by on-surface manifestation, mainly hot springs. Surface geothermal assessments started in 1976 and to-date more than 50 sites have been identified. These are grouped into three main prospect zones: the North-eastern Zone (Kilimanjaro, Arusha and Mara regions), the South-western Zone (Rukwa and Mbeya regions), and the Eastern coastal belt, which is associated with rifting and magmatic intrusions (Rufiji Basin).

Geothermal electricity, like most renewables, involve high capital costs and relatively low operating costs. Therefore the cost of capital is the crucial determinant of the economics of most geothermal developments. Fully exploring the geothermal resources in order to convert them to proven reserves is an expensive and uncertain task. If the risk is to be borne fully by commercial power companies the consequence will be that the costs and the cost of capital will increase. Thus either they will seek higher tariffs than can be afforded, or else the exploration will happen slowly or not at all. Scaling up Renewable Energy Programme (SREP) funding is planned through AfDB to catalyze the development of about 100 or more MW of geothermal power, principally by the private sector and establish enabling environment for large-scale geothermal development. It will do so by (1) creating the enabling environment and capacities; (2) reducing development risks by co-financing the riskiest stage of development – exploration through to test drilling at several promising locations. It is normally harder and more costly for the private sector to raise such funds where there are no geothermal power projects to set a precedence; and (3) providing risk mitigation or other forms of financing for the geothermal power development phase. While SREP funding alone will not suffice, it must catalyse significantly greater

resources from both public and private sectors. The Government of Tanzania plans to use SREP funding to reduce development risks at both the resource confirmation stage and the power development stage. This lower investor risk, should lower the cost of capital, and will therefore make more geothermal resources available at any given tariff level. The SREP funding will also be used to improve the legal and regulatory frameworks, improve power planning capabilities, and strengthen institutional and human capacities.

(iii) Hydropower

Large hydroelectric power has been the mainstay of the national electricity system. The assessed potential of large hydropower resources is about 4.7GW (MEM/Government of Tanzania 2003). An exploited resource is mainly from a small number of large dams and a few smaller plants. Total installed capacity so far is 562MW (MEM/SREP, 2013). However, intermittent river flows as a result of droughts have made this a much less reliable source of power in recent years.

Small hydropower assessed potential resources (up to 10MW) is 480MW (MEM/SREP, 2013). The installed grid connected small hydro projects contribute only about 15MW. Most of the developed small hydropower projects are owned by private entities and are not connected to the national electricity grid. Already in REA's pipeline/portfolio there are more than 60 projects seeking investors, which signal the existing larger potential for micro and small hydro in Tanzania.

(iv) Wind

Several areas of Tanzania are known to have promising wind resources. In areas where assessments have been conducted to-date, only Kititimo (Singida) and Makambako (Iringa) areas were identified to have adequate wind speeds for the grid scale electricity generation. The wind speeds average 9.9 m/s at Kititimo and average 8.9 m/s at Makambako, both measured at a height of 30 metres (REA, 2010). The MEM in collaboration with TANESCO is conducting further wind resource assessments in Mkumbara (Tanga), Karatu (Manyara), Gomvu (Dar es Salaam), Litembe (Mtwara), Makambako (Iringa), Mgagao (Kilimanjaro), Kititimo (Singida), and Usevya (Mpanda) for further more specific data (REA, 2010). REA is supporting wind measurements at Mafia Island (Coast region).

(v) Solar

Tanzania has high levels of solar energy, ranging between 2800 – 3500 hours of sunshine per year and a global radiation of between 4 to 7kWh/m2/day (MEM, 2013). Solar resources are especially good in the central portions of the country. This makes it naturally a suitable country for the application of solar energy as a viable alternative to conventional energy sources if efficiently harnessed and utilized. Both solar PV and solar thermal technologies are under development in the country.

(vi) Natural Gas

Available data with EWURA and TPDC indicate that the proven and probable reserves in the Songo Songo gas field are estimated at 810 billion standard cubic feet (BCF), while the proven, probable and possible reserves stand at 1.10 trillion standard cubic feet (TCF). The proven, probable and possible gas reserves in Mnazi Bay vicinities are estimated at 2.2 TCF. Proved reserves are those quantities of natural gas, which, by analysis of geological and engineering data, can be estimated with a high degree of confidence to be commercially recoverable from a given date forward, from known reservoirs and under current economic conditions. As soon as BG Group finalises its assessment for the commerciality of the deep-sea discoveries,

the proven reserves will change (EWURA, 2010). According to CIA world fact book dating 2011, proven natural gas reserves in Tanzania stand at 6.513 Trillion cubic meters for years 2008 through to 2011. Much of the variability in quotes is because of the probability ratios typically from 50 to 90% certainty being common in quoting gas, oil and other mineral proven reserves.

(vii) Uranium

Uranium deposits investigation is on-going in southern and central Tanzania regions. Already a number of pertinent companies are busy in the areas exploring and extracting samples for further investigation and possible mining of the same in Tanzania. Uranium is another potential resource for energy generation.

(viii) Coal

According to the National Energy Policy (2003), Tanzania has proven coal reserves estimated at 304 million tonnes and inferred reserves is estimated at about 1200 million tonnes.

1.2.1.2 Power sector – generation, imports and exports

The country's available electricity generation capacity as presented by MEM on March 2013 in a SREP workshop conducted in Dar es Salaam was 1,564MW. It is based principally on thermal (62% – 33% from natural gas and 29% from oil), large hydropower (35) and with the balance from small renewable energy power and imports (Table 1). The hydro-plants operated by TANESCO are interconnected with the national grid. The 20 townships in other regions served by TANESCO are dependent on isolated diesel (18) and natural gas (2) generators, and imports. Independent Power Producers (IPP) supplied 26% of the capacity. Emergency Power Producers (EPP) supplied 13%. In addition, there is an estimated 300MW of private diesel generation not connected to TANESCO grid, whose fuel cost alone is expected to exceed US cents 35/kWh.

Table 1: Power generation capacities in Tanzania, March 2013

Generation Capacities (MW) in March 2013						
Source	**TANESCO**	**IPP**	**EPP**	**SPP**	**Total**	**Percent**
Hydropower	553	-	-	-	553	35%
Small Hydro (<10 MW)	9	-	-	4	13	0.8%
Oil (Jet-A1 and diesel)	88	163	205	-	456	29%
Gas	252	249	-	-	501	32%
Biomass	-	-	-	27	27	1.7%
Imports	14	-	-	-	14	0.9%
Total	916	412	205	31	1,564	100%
Percent	59%	26%	13%	2.0%	100%	
IPP: Independent Power Producers, EPP: Emergency Power Producers, SPP: Small Power Producers, Imports from Uganda (10 MW), Kenya (1MW) and Zambia (3MW).						
Source: TANESCO, March 7, 2013 (provided to SREP)						

Diversification of generation sources is essential to avoid the risks of supply interruptions and price increases. A particular challenge facing Tanzania is the increasing unpredictability of hydroelectric power in face of changing weather patterns. This problem is exacerbated by having most of the hydropower on two river systems that are now prone to drought. This necessitated the country having to extensively shed load and run expensive thermal power plants as base load. The Government of Tanzania expects the addition of significant thermal capacity up to 2016, much of it natural gas, to overcome power shortages.

Among the previously scheduled generation projects due to come on-stream during 2012-2017 are 1,428MW gas, 160MW oil, 50 to 100MW wind, 60MW solar, 11MW small hydroelectric power, and 200MW coal. Of this, nearly 1,100MW of gas, solar, wind and coal projects are expected be IPP/SPP projects. A favorable investment climate is an essential requirement for significant private capital to be attracted to these investments.

Table 2: Below provides an overview of Power plants ownership, installed and planned capacities in Tanzania

Install	Plant	Retire	Fuel	Capacity (MW)	Remarks
1968	Nyumba ya Mungu	-	Hydro	8	
1975	Kidatu	-	Hydro	204	
1988	Mtera	-	Hydro	80	
1995	New Pangani	-	Hydro	68	
2000	Kihansi	-	Hydro	180	
	Dodoma	2015	IDO	7.44	
2002	Tegeta IPTL	2022	HFO	90	
2004	Songas 1	2024	Natural Gas	38.3	
2005	Songas 2	2025	Natural gas	110	
2006	Songas 3	2026	Natural Gas	37	
2007	Ubungo G-1	2027	Ubungo Gas	102	
2009	Tegeta G	2029	Natural gas	43.99	
2010	TANWAT	-	Biomass	2.75	SPP sales 1MW to the grid
	TPC		Biomass	20	SPP sales 2.5MW to the grid
2011	Aggreko-U	2012	GO	50	The two plants plants Ubungo 50MW and Tegeta 50MW are available and will be retired after expiration of the one year contract in October 2012
	Aggreko-T	2912	GO	50	
	Symbion I	2013	JET-A1	60	The 112MW plant is available and will be retired after expiration of the contract 2012
	Symbion II	2013	GO	52.5	
	Symbion205-DOM	2013	GO	55	Both 50MW plant at Dodoma and 50MW plant at Arusha are available (operating)
	Symbion205-ARS	014	GO	50	

	MwanzaIDO		IDO	60	All 10 units of generating sets have been manufactured, assembled and shipped; expected date of arrival at site is end of September 2012.
	Mtwara (18)		Natural Gas	18	
2013	Symbion205-DAR	2014	GO	100	
	Ubungo_G-2	2031	Natural Gas	105	Plant is fully in commercial operation, however Fichtner Consultant expert in turbine gen sets arrived on 22nd August 2012 to participate in the investigation of GTG3 breakdown
2014	Symbion205-DAR	2015	Natural Gas	100	
	Sao Hill		Biomass	10	SPP to sale 10MW to the Grid; delays due to review of capacity of forestry resources to support plant
	Kilwa Energy		Natural Gas	210	
	Jacobsen		Natural Gas	150	Project negotiation is ongoing between Government and lenders
	Kinyerezi 240-I	2033	Natural Gas	120	Contract has been signed and all project documents have been sent to the Ministry of Finance for Financial Closure Arrangement
2015	Kinyerezi 240-II	2033	Natural Gas	120	
	Ngaka I		Coal	120	Intra Energy has submitted Draft PPA to TANESCO for review and comments
	Wind I		Wind	50	Evaluation of the technical proposal for procurement of transaction advisor completed and revised evaluation report submitted to the secretary of the Tender Board for deliberations
	Mchuchuma-I		Coal	50	Own Use; Government of Tanzania and Chinese Company have signed MoU, and the project is now in the initial development stages
2016 (and beyond)	Mgololo COGEN		Biomass	30	
	Kinyerezi III		Natural Gas	300	TANESCO advised CMEC (Chinese EPC Contractor) to implement the project in two phases, first phase being 300MW dual fuel simple cycle power plant and 220 kV transmission line from Kinyerezi to Ubungo/Kimara. Phase two is to construct 400 kV transmission line from Kinyerezi – Chalinze – Morogoro – Dodoma. EPC contract has already been signed, and negotiations with lenders are at an advanced stage.
	Hale		Hydro	21	
	TANESCO Coal		Coal	500	
	Kiwira		Coal	200	MEM has tasked State Mining Corporation (STAMICO) to develop the project.

Source: TANESCO/MEM 2013

1.2.2 Energy demand (overview of main consuming sectors, industry, residential, agriculture, transport)

The Ministry of Natural Resources and Tourism believes that current annual forest reduction is between 120,000 and 500,000 hectares, against only 25,000 hectares planted. Charcoal production alone, causes loss of forest cover at a rate of more than 100,000 hectares a year, and this is on the increase. The accelerated harvesting of trees negatively impacts on soil, watersheds, biodiversity and climate change. According to the 2009 World Bank report on biomass, total annual charcoal consumption in Tanzania is estimated at 1 million tons. The annual supply of wood needed for this is estimated at 30 million cubic meters. To produce charcoal it is estimated that as many as 160,000 earth kilns are used each year, or 438 per day. An average annual loss of forest area of about 100,000–125,000 hectares can be attributed to the charcoal sector. From 2001 to 2007, the proportion of households in Dar es Salaam using charcoal as their primary energy source has increased from 47% to 71%. Use of liquefied petroleum gas (LPG) has declined from 43% to 12%. In other urban areas, the share of households using charcoal for cooking remained at 53%, while the share of fuel wood use increased from 33% to 38%. The use of electricity for cooking is below 1% (World Bank 2009).

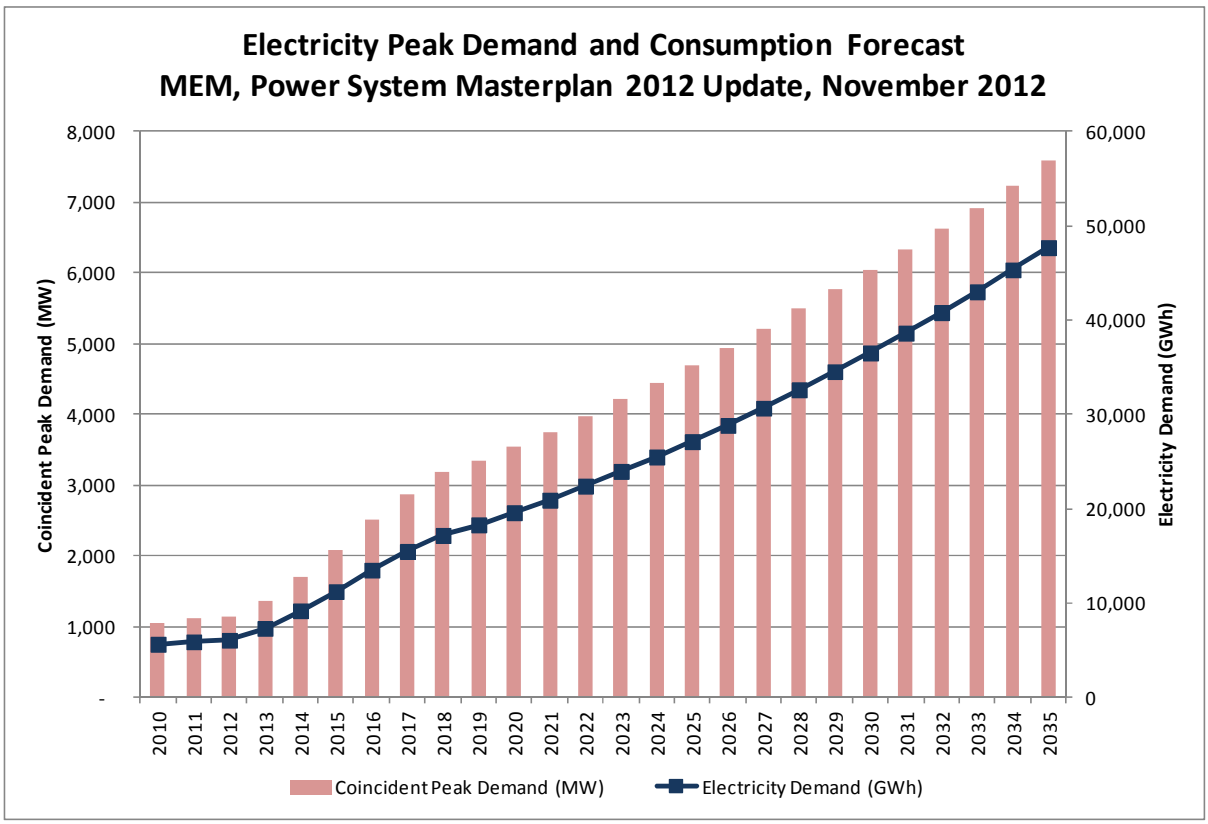
Electricity demand as per MEM strategic plan (2012-2016) increases at a rate of 12-15%, while generation increases at a rate of 6% annually. As such, increased supply and generation initiatives are necessary to cope with the existing demand.

Tanzania has very low levels of electricity consumption per capita – about 85kWh per person per year (IEA, 2010). This can be compared to the world average per capita consumption of 2,000kWh per annum and average consumption in developing countries in sub-Saharan African of 552kWh per annum. According to MEM presentation in the Dar es Salaam SREP workshop in March 2013, only about 18.4% of the country population has access to grid electricity. Some obtain access through stand-alone solar photovoltaic (PV) and several mini-hydro mini-grids operated by local NGOs and faith based groups.

Electricity demand in the country is increasing rapidly mainly due to accelerated productive investments, increasing population, and increasing access. There is also significant suppressed demand, partly met by private diesel generators. The Power System Master Plan (2010 – 2035) anticipates that Tanzania will increase electrification status from 18.4% of 2010 to at least 75% by 2035 while demand from connected customers will increase significantly as Tanzania becomes a middle income country as stipulated in Tanzania Vision 2025. A medium term goal of 30% access is stipulated in the MEM strategic plan for the period 2011-2016.

TANESCO anticipates major demand increases from several mining operations, LNG plant, factories and water supply schemes. Peak demand is projected to increase rapidly from about 1,000MW today to about 4,700MW by 2025 and 7,400MW by 2035.

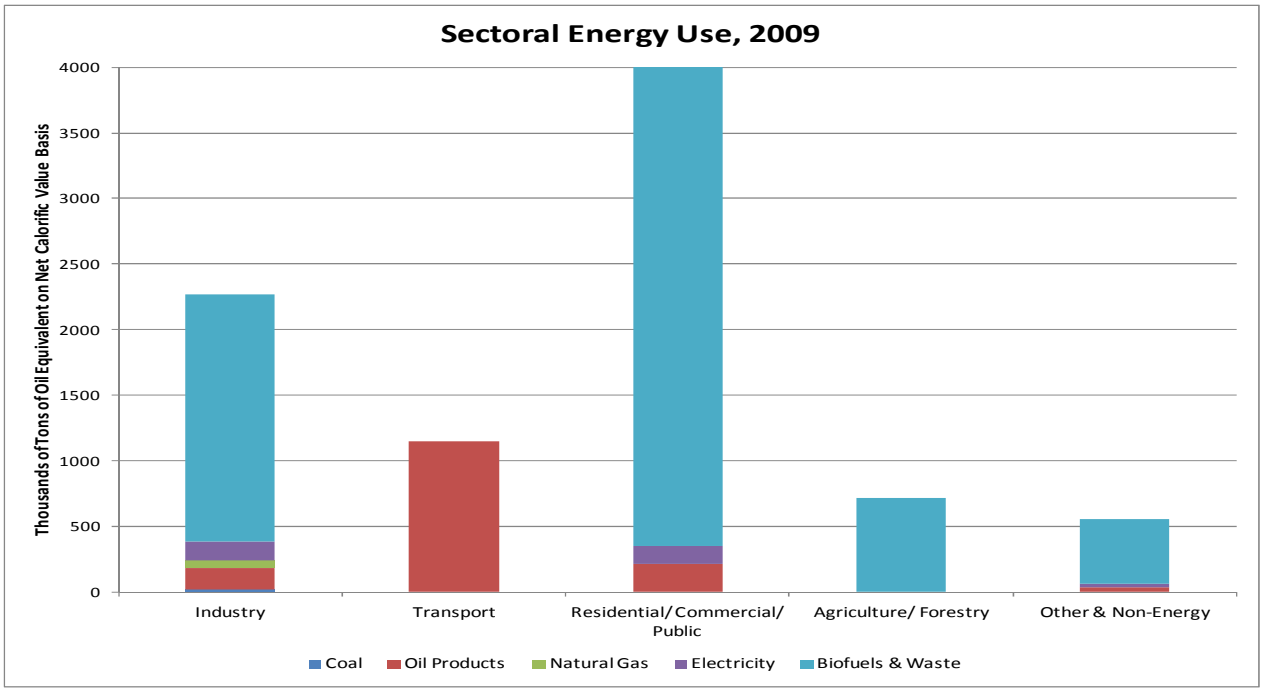
Figure 1: Electricity demand outlook 2010-2035



Source: MEM 2012

The main energy consuming sectors in Tanzania are industry, residential, agriculture, mining and transport. Residential consumes about 90% of the total primary energy consumption mainly in the form of biomass (firewood and charcoal). According to the National Energy Policy (2003), of the petroleum energy sources consumed in Tanzania, 56% was for transportation, 26% for industry and 10% for residential mainly kerosene for lighting and cooking. In terms of electricity, the industrial sector contributes the largest demand followed by the residential sector as shown in Figure 2 below.

Figure 2: Sectoral Energy Use



Source: Government of Tanzania/SREP, 2013

The IEA estimates per capita use of electricity in Tanzania to be 85kWh (2009 Energy Balance for Tanzania). To enhance affordability to domestic users, electricity is subsidized with a block tariff design. Tariffs are lowest for users of up to 50kWh per month. However, the entire tariff system can be considered subsidized since TANESCO does not charge the full cost of the electricity service. Electricity Act (2008) specifies cost recovery in each of the tariff brackets, which by definition prohibits cross-subsidy to domestic electricity users.

Use of liquefied petroleum gas (LPG) in residences is low and only about 0.2% of the population uses it. The low use of electricity and LPG at household level correlates with an overdependence of firewood, which has detrimental effects on socio-economic wellbeing of households, particularly women and children who are primary collectors and users (women) of traditional biomass. Use of biomass energy source has significant negative gender consequences; is responsible for about 18,900 deaths (mainly women and children due to IAP; its collection exhausts women and leave them little time to engage in other important endeavours of education, production and politics).

1.2.3 Energy and economic development

As per IEA, 2011, the total primary energy per GDP for Tanzania is 1.21TOE/1000 USD. Proportion of energy in Tanzanian GDP is not reliably accessible through main official references. However, the World Bank in its 2010 report estimates charcoal business in Tanzania at $650m/annum. The percentage of the national energy budget in the financial year 2010/2011 decreased to 2.9% from 3% in the previous year (MOF, 2011). Of the total energy budget, 60.1% represents capital expenditures that include infrastructure construction, rehabilitation and studies supporting the energy sector. Despite a small share of energy allocations in the national budget, the energy sector was also singled out in the mid-term fiscal report as having low execution performance at 22.3% in 2010 (MOF, 2011). This low execution rate and under-spending is a persistent feature of the Tanzanian energy sector and was also reported in previous fiscal years.

Although energy access at household level is low, the national expenditure on energy access does represent a significant proportion of national expenditure. Actual costs of imports of energy in US$ and a proportion of total imports effect on balance of payments and forex reserves (EWURA 2011 fuel imports). In terms of economic development, this implies that substantial national resources only benefit a small number of Tanzanians, thereby contributing to broader inequalities. In addition to this imbalance, the electricity sector drastically affects economic development due to its low reliability. According to World Bank 2010, economic costs of electricity outages during the recent drought were equivalent to an estimated 4% of the GDP. Equally important, low reliability, poor quality and high prices of power in Tanzania impact adversely on economic development by negatively impacting on different sectors including industry, commerce, agriculture, transport, and mining.

Except for the improved cook stoves energy technologies and services, there exists limited energy equipment production and dissemination in the country. Most of the energy equipment is imported, adding pressure on the scarce forex of the country. Local manufacturing and dissemination would improve availability and sustainability of the energy contribution to the GDP.

1.2.4 Energy strategy and relevant targets (access, generation, capacity and energy security)

The Government of Tanzania has various policies/strategies, targets and implementation plans in place, aimed at meeting growing demand for electricity and modern energy in general. In the medium term, the 2010 Joint Energy Sector Review (JESR) sets the target for national electrification at 75% by 2033 (JESR, 2010). This would set the country at par with global levels of electrification in 2010. TANESCO has committed to connecting 250,000 customers per year to contribute to this goal. In terms of generation capacity, Tanzania plans to more than double capacity (from 2011 baseline of about 1100MW) by investing in an additional 1680MW by 2015. This would improve the country's ability to meet growing demand and improve energy security, but also meet some of its access goals.

Assuming an ideal situation in which Tanzania meets its 2033 objective, this target assumes that about 25% will have no access to electricity by 2033. Unless these people are specifically targeted with other forms of modern energy, Tanzania is unlikely to meet the goals of the SE4All.

The MEM Strategic Plan from 2012-2016 accommodates the following strategic initiatives to achieve the planned targets:

1.2.4.1 Increase Power Generation

According to MEM power generation in 2011 stood at 1,270MW. In order to meet demand growth expressed in section 1.2.2 above, the Ministry is under implementation of plans to increase power generation capacity by 1,788MW (2015). The plan is to increase generation by 160MW in 2012/13; 970MW in 2013/14; 300MW in 2014/15; and 358MW in 2015/16.

1.2.4.2 Natural Gas Development

By 2011, five gas fields had been discovered which are Songo Songo, Mnazi Bay, Mkuranga, Kiliwani and Off-Shore Deep Sea. Production of gas is currently taking place at Songo Songo and Mnazi Bay fields where gas

is used for electricity generation and in some industries. The plan is to expand the processing plant at these fields to increase distribution level of gas to the market. Gas discoveries at Mkuranga, Kiliwana, and Deep Sea will be developed through the constructing new processing plants and pipelines. In addition, construction of a new pipeline from Mtwara, Songo Songo to Dar es Salaam is underway which will increase gas supply for electricity generation and other industrial uses. The Ministry will also finalise the Gas Utilization Master Plan that will identify the most appropriate use for natural gas, when it comes on line over the next decade.

1.2.4.3 Develop New and Renewable Sources of Energy

With respect to the new and renewable energy resources, their share to the energy mix in 2011 was reported to be 14.5% (excluding biomass energy which is overwhelming non-renewable) though it is unclear what is included in this figure. The government has an ambitious programme to increase the new and renewable energy share of the energy mix (biofuel, solar, wind etc.) to 30% country-wide by 2016. This will reduce the dependence on hydropower generation.

1.2.4.4 Construction and Upgrading of Power Transmission and Distribution System

According to the Joint Energy Sector Review (JESR, 2012), the Government will construct and upgrade the following power transmission and distribution lines projects:

i) Makambako – Songea 132 kV Transmission Line

The project will include; design, supply, construction and installation of the transmission sub-project, a 250km 132 kV transmission line from Makambako to Songea, three 132/33 kV substations, and the distribution sub-project, 900km 33kV distribution lines with transformers, low voltage distribution networks and connections to about 8,500 customers and 650 street lights.

ii) North-West Grid extension 220 kV Line

This project involves extension of existing 220 kV line from Geita to Kigoma via Nyakanazi and extending it to Mpanda, Sumbawanga up to Mbeya in order to provide reliable power to the North Western parts of the country.

iii) Iringa – Shinyanga 400 kV Transmission Line

The objective of the project is to upgrade the transmission line between Iringa and Shinyanga and to improve power supply reliability to the North West Grid. This is a project financed by the World Bank, European Investment Bank, African Development Bank, JICA and the Government of Korea. Implementation of Resettlement Plan involving compensation to people affected by the project is the responsibility of the Government of Tanzania.

And, the JESR went further to suggest:

iv) Promote Energy Efficiency and Conservation

This aims at promoting energy efficiency and conservation in various sectors such as industrial, commercial, transport and household. About 40% of energy could be saved through energy efficiency in Government buildings according to energy audit conducted in 2006. Based on this audit, the plan is to develop guideline/standards that will be used to implement energy efficiency and conservation activities in various

sectors. The Ministry with collaboration with other institutions dealing with energy issues and will also continue to create awareness to the public on the procedures of conserving energy.

v) Restructure the Power sub-Sector

The restructuring of the power sub–sector will be undertaken by the Government in order to achieve the following: to put in place conducive environment for attraction of capital for development of the power sub–sector through private sector participation; vertical and horizontal unbundling of TANESCO for improving operational and financial performance of the utility; to promote regional electricity trading by interconnecting the national grid with the grids in the region. Generally, the strategy to restructure the power sub-sector will be undertaken in the spirit of modernising the sector to sustainably support the growth of the national economy.

1.2.5 Promote and expedite access to modern energy in rural areas

Access to modern energy in rural areas is key for improving growth, economic development and enhancing living standards. Therefore, access to modern energy services in rural areas will be scaled-up and expedited to cover district headquarters, townships, villages and commercial centres, thereby increasing the percentage of population with access to electricity from 6.5% (2011) to 15% (2016). The key interventions include:

1.2.5.1 Strengthening Rural Energy Agency and Rural Energy Fund (REA/REF)

This includes efforts to continuously increasing funds for REA/REF from the annual Government budgetary allocations, efficient collection of statutory levies to REF and mobilizing financial resources from other sources including donors and multi-lateral development banks.

1.2.5.2 Promoting and Expediting Rural Electrification

This include facilitating finalization of all projects in progress; electrification of district headquarters, townships, district councils and commercial centres; identifying, promoting and facilitating development of potential sources of new and renewable energy such as mini-hydro, geothermal, solar, wind and biogas. The low cost design electrification programme will be scaled-up with a view to ensuring electricity connection is costs reflective and affordable to majority low-income rural population.

1.2.5.3 Development of Rural Energy Master Plan

Detailed Rural Energy Master Plan (REMP) nearing completion is being prepared to serve as a blueprint for identification, promotion, facilitation and development of modern energy services in rural areas in a specific period. The REMP will enlighten priority energy projects; set a systematic implementation plan with specific targets, implementation methods, time schedule and budgetary requirements. It will also provide various approaches of involvement and collaboration with private sector. To begin with, REA with the support from NORAD, are working on a rural energy prospectus, which will have input to the REMP.

1.2.6 Improve revenue collection from energy and mineral sectors

Revenue collection from the energy sector is targeted at Tshs.84.41 billion in 2015/16. Main strategies that will be used to achieve this target include:

(i) Promoting up-stream activities to increase production and sales of natural gas; and

(ii) Promoting industrial and domestic use of natural gas to combat environmental degradation and to increase revenue.

It is worth noting that in 2010 the connection rate to the national grid was about 50,000 against the target of 100,000 customers (TANESCO, 2010). Other targets with actual installations in brackets are 2011, target 100 000 (68,000) and current target is put at 250,000 connections per year. This underperformance may be attributed to a number of reasons including suppressed demand, inadequate connecting equipment and appliances (LV and HV insulators, poles, transformers, etc.), poor governance (corruption, theft, inefficiencies etc.) and high connection fees faced by poor potential customers (TANESCO annual reports). The current target by MEM as per mid-term strategic plan is 30% electrification rate by 2015. The strategy for achieving the target from the current 18.4% includes grid extension, stand-alone systems, solar lanterns, isolated, mini grids and reducing connection fees since the beginning of 2013.

A number of related Energy Policies and Acts exist; some are under review to accommodate the current challenges and dynamism of the sector. Such policies, acts and strategies include:

- Energy and Water Utilities Authority Act 2001 and 2006 were promulgated to establish a regulatory authority – Energy and Water Utilities Regulatory Authority (EWURA).
- National Energy Policy of 2003 with a broad objective of ensuring availability of reliable and affordable energy supplies, their sustainable and rational use, to support national development goals.
- Rural Energy Act 2005 which established the Rural Energy Board, Fund and Agency
- Electricity Act 2008, which established a general framework for the powers of the Ministry of Energy and Minerals and EWURA.
- Public Private Partnership Act No. 18 of 2010 which sets out the responsibilities and obligations of the parties, penalties, remedies, financial management and control requirements.
- Other Policies and Legislation influencing biomass energy include the following: Guidelines for Sustainable Harvesting and Trade in Forest Produce 2007; New Royalty Rates for Forest Products 2007; Community-Based Forest Management Guidelines April 2007; Joint Forest Management Guidelines April 2007; Forest Act 2002; Subsidiary Legislation to the Forest Act 2002; National Forest Programme 2001; National Forest Policy March 1998; and Biofuels Guidelines 2010.
- Environmental and Land Policy and legislation influencing renewable energy development include the following: Environmental Management Act, 2004; National Land Policy, Ministry of Lands and Human Settlements Development, 1997; National Environmental Policy, 1997.
- Policies and strategies under review and preparations include national Energy Policy, Biomass energy strategy Tanzania (BEST), Biofuel guidelines, gas, uranium and renewable energy policies

1.2.7 Indicators and Monitoring for Energy at MEM

The implementation of energy policy is reduced to mid-term and annual plans. The current relevant plan is the Medium Term Strategic Plan, which contains the following targets for the energy sector:

(i) Total electricity increased from 1100MW in 2011 to 2780MW by 2016;
(ii) 1342MW generation added, 1591 Kilometres of transmission and distribution of power added by June 2016;
(iii) Energy Efficiency and utilization of diversified energy sources enhanced through reduction of transmission and distribution losses from 23% to 15% by June 2015;
(v) Reduction in petroleum consumption by 15% in industries, households and transport by 2015;
(v) Reduction in electricity consumption by 20% in manufacturing industries and households by 2015;
(vi) Contribution of non-hydro renewable sources of energy to power generation increased from 4% (2011) to 10% by June 2016;

(vii) Natural gas management and infra-structure completed and commissioned by June 2014; and
(viii) Access to electricity increased from 14.5% (2011) to 30% by June 2015.

1.2.8 MEM Outcome indicators for 2011-2016

The following are the mid-term energy outcome indicators:

- electricity in MW added to the grid;
- number of industries and households using natural gas;
- number of MW produced by natural gas;
- number of MW from solar;
- wind and small hydro;
- % reduction in wood-fuel and traditional fuels per capita;
- % power losses and rate of outages;
- number of production sharing agreements signed;
- % of industries adhering to energy conservation practices;
- number of public facilities connected to electricity;
- number of district headquarters electrified; and
- % of population with access to electricity in rural areas and nationally.

It is worth noting that the necessary infrastructure and supply capacity required for power to accommodate envisaged targets, will have to be rapidly increased. Efforts are required to put in place a policy, detailed implementation plans and investment environment to enable the planned development and targets in the power sector. Such improvements include amongst others:

(i) Standardized Power Purchase Agreements (SPPA), Feed-In-Tariffs (FITs), need improvement (disaggregated for technologies/energy resources) for IPPs. The current Grid FITs is based on hydro and that of off-grid based on avoided diesel costs. Efforts by EWURA and TANESCO are underway to develop tariffs, which are technology specific to attract diversity of potential private investors. It is being unrealistic to assume same level of investment and expected rate-of-return for solar PV project developer and micro-hydro developer. Clear targets for each energy sub-sector contribution should be put in place and communicated extensively to potential developers accompanied by possible incentives for participation.

(ii) Ensure availability of effective communication strategy of opportunities available with REA/REF and other development partners at all levels of the community in a language understandable by potential entrepreneurs/investors in rural areas. This would substantially impact on the level and rate of rural electrification interventions. Availability of REA/REF district offices could add to the efficiency of the Agency and Fund in achieving its targets and that of the nation in relation to universal modern energy access for all.

(iii) The current installed capacity coupled with aging transmission and distribution infrastructure does not provide adequate guarantee for increasingly reliable access. Large-scale extension and strengthening of the existing transmission and distribution infrastructure are vital for improved access. This may require institutional reforms for generation, transformation and distribution to improve efficiency and performance. Sound governance in the energy sector is also strategic in ensuring commitment of personnel to their functional obligations.

(iv) Efficiency targets/policy/strategies could be more specific (e.g. cogeneration). Efficiency standards and policy requirements are vital for improving the energy access situation in the country. For example, it could relax the burden on the national grid by allowing for self-generation of some industries. Sugar industries, cashew nuts and rice agro processing could make use of bagasse and husks respectively, for powering principal factory energy requirements and export to the grid. More specific targets and strategies on such abovementioned resources contribution in the MEM strategic plan for the period from 2011 – 2016 could direct and focus significantly most efforts and initiatives from the government.

(v) Scaling-up engagements of the private sector with the government through PPP Act of 2010. Public Private Partnership Act of 2010 stands could provide a framework for private sector engagement in modern energy generation and distribution. However, implementation tools including capacity building, relevant awareness creation and creation of conducive environment and incentives for partnership, is necessary in the first place. Private sector, for example, is not in favour of unnecessary bureaucracy both in decision-making that the public sector requires and is more interested in timely reaction to business opportunities. However, there are no targets and indicators for PPP in the energy sector. Equally important, there are no targets for the number of SPPAs that are planned within a certain time frame.

2 Section 2: Current situation with regard to SE4ALL goals

2.1 ENERGY ACCESS vis-à-vis GOAL OF SE4ALL

2.1.1 Overview and assessment

What do we mean by access?

Energy access refers to the need to increase the number of people with access to higher-quality energy and to improve the quality of the energy for those who already have it. While much international discussion remains focused on energy access, decades of experience and scholarship indicate that maximum flexibility is retained if policies focus not only on increasing the quantity of energy delivered, but also the services that energy provides and providing these at least-cost to the economy. Therefore, energy efficiency is a fundamental element of expanding energy access.

Are households, industry, food processing addressed explicitly?

There exist no clear/specific targets and strategies for addressing energy for industry, households and food processing in Tanzania. Such issues are important and would improve focus and tracking of changes resulting from set interventions, strategies and approaches for attaining set targets on universal energy access.

What is the government doing?

The government is keen to address the energy access issue. It has put a number of initiatives in place that aims at improving electricity access in Tanzania. Some examples include reduction of customers' connection fees to the national utility grid network by 60% (from about Tsh 500,000 to Tsh 199,000). The Government through its REA is motivating and supporting the private sector to participate in small-scale isolated mini-hybrid rural electrification initiatives. It has embarked on supporting the finance industry of Tanzania with a guarantee scheme for a long-term private sector loans for up to 15 years intended for energy projects. It is currently working on a RE policy, biofuel guidelines, petroleum and gas policy, biomass energy strategy, the SREP initiative and many others. However there is no dedicated energy efficiency policy in place yet.

2.1.2 Modern energy for thermal applications (cooking, heating)

Of all modern energy sources (e.g. modern biomass-biogas, gasification, etc., LPG, CNG, PNG, electricity), electricity is the most common modern energy source in households. Up to 73% and 22.7% of the population on Mainland Tanzania use firewood and charcoal respectively for cooking (HBS, 2007). Another 0.2% use coal while 0.1% uses farm residuals and waste. LPG gas and biogas, is used by about 0.1% (HBS, 2007).

Are there policies/strategies for biomass and other thermal energy access?

Regardless of the fact that 90% of the primary energy consumed in Tanzania is biomass related, there is neither biomass energy policy, nor explicit biomass energy strategy, and the sector is left informal with a budget allocation from MEM at less than 1%. Total MEM budget allocation for year 2007/2008 was US$354 million, of which US$194.9 million was allocated for the energy sector; and of that amount only US$300,000 was allocated for RE and EE, of which, biomass energy is a small part. MEM's total budget for 2012/2013 was Tsh 6.41 billion with the percentages/proportions of RE and biomass in the energy sector budget reflective of 2007/2008 aforementioned trend. In order to make sizable changes in modern energy access, efforts should

be made to increase allocations to this subsector. Equally important, there are no explicit strategies for other thermal energy access. The challenge that is increasingly pressing is to include biomass energy in the modern energy access agenda and to formalise the biomass and charcoal energy subsectors.

GIZ with support from EU are currently supporting development of a Biomass Energy Strategy (BEST), but the pace of its development and its possible implementation after completion, is another challenge. The team is still collecting stakeholders' views to complete the draft strategy document. Elevating the biomass sector to a status it deserves among policy/decision makers and the population at large, both economically and socially, is equally another challenge. The World Bank report on biomass (2009), estimates total annual revenue generated by the charcoal sector for Dar es Salaam alone is US$350 million and it generates employment and cash income for several hundred thousand people. The total annual charcoal revenues for Dar es Salaam alone is substantially higher than annual income from coffee and tea estimated to contribute only US$60 million and US$45 million to the national economy, respectively.

Unregulated and unregistered activities in charcoal production and utilization lead to an estimated revenue loss of about US$100 million per year to the national economy. The Forestry and Beekeeping Division (FBD) of the Ministry of Natural Resources and Tourism (MNRT) has a financing gap between expenditures and revenues of about US$2 million and these could easily be covered through income from taxing formal sustainable charcoal activities. However, initially an increase in the MEM budget share going to biomass is required. Budget additions in MEM allocations will allow for both technological advancement and efficiency improvement of existing biomass technologies and services.

The existing mid-term strategies have indicators of reduced biomass usage per capita, yet no viable alternatives are available.

What about PNG, LPG and water heaters?

Alternative thermal services to biomass need extra attention if non-renewable biomass consumption is to be reduced. Efforts could range from establishing supportive policies/strategies and regulatory frameworks, which are currently non-existent, to the development of promotional programmes and provision of more incentives for private sector to participate and develop dealer networks with capacity to disseminate technologies and services such as LPG, CNG, solar water heaters, efficient cookers and many others. Such technologies and services could relax some of the intensive biomass uses in SMEs, schools, health sector, local brewing, and agro-processing heating services. While CNG and LPG are unlikely to replace biomass to significant level due to their price linkages to oil making them unaffordable to the majority of Tanzanians. Well-planned CNG and LPG initiatives could result in reduced biomass usage from the middle-income populations in urban areas.

2.1.2.1 Physical access to modern energy services

Availability of reliable information on physical access of farms, SMEs, commercial undertakings, agro processing industries, schools, clinics, mines, transport etc. to modern efficient heating services and technologies is difficult to obtain and unreliable. However, such access information packaging and dissemination is important for planning, growth of the economy, sustainability and well-being of Tanzanians. Equally important, there is limited readily available information and standards, publicly known among majority of key players and stakeholders regarding modern cooking/heating appliances, technologies and services.

There are no reliable data on solar water heaters and cookers, and their contribution is minimal in thermal applications of modern energy services.

2.1.2.2 Availability/quality of supply: status of domestic supply chain

Biomass, widely used in households is highly unsustainable. The UNFCCC CDM allows for 96% to be used as the proportion of non-renewable biomass used for energy. The unsustainable use of biomass is not only as a result of inefficient household use, but more importantly (but less focussed on), is the unsustainable use of biomass in agriculture (e.g. for curing crops) and small industries (e.g. brick making, local brewing and fish smoking etc.).

Biomass is used in the form of firewood and/or charcoal. Technologies employed include inefficient charcoal and firewood stoves with efficiencies as low as 3%. Most families use three stone fires, which are very inefficient. On the other hand, metal charcoal stoves without clay liners inside are also inefficient, with efficiency ranging between 10-15% (TaTEDO, 2010). The improved cook stoves for both firewood and charcoal have efficiencies between 20-35%. Access to efficient heating and cooking systems such as LPG and biogas, currently is limited to better-off families and communities that can afford them.

Upstream in the charcoal supply chain it is important to note that it takes between 7 and 10kgs of wood biomass to produce a kilogramme of charcoal using traditional earth kilns. Efforts are needed to increase the use of improved kiln technologies such as IBEK, half orange, etc. though this is unlikely in such an informal sector. The main source of all firewood and charcoal used for heating and cooking are from public and restricted government forests. The biomass used for charcoal results in harvesting that is unsustainable. Forest management techniques and fuel wood crops are vital to achieving forest and biomass energy sustainability.

According to GVEP's 2012 report on biomass (GVEP, 2012), a lot of charcoal stove production is done in the informal artisan sector and quality is often of variable quality. SECCO is reported to be amongst the largest formal producers of quality household stoves in Dar es Salaam.

The following selection of stoves available in the Tanzanian market is from the above-mentioned 2012 GVEP's report on biomass in Tanzania.

Table 3: Biomass stoves available in Tanzania

(A) Improved Charcoal Stove	Type 1	Type 2	Type 3
Manufacturer	SECCO/TaTEDO, Dar es Salaam	CAMARTEC, Arusha	
Cost Range	$6.25-$7.5(subsidized)	~$40 medium	
Efficiency	35%	25%	
Key Features	Ceramic liner with metal cladding. SECCO make complete stove. Subsidized by about $3, will generate Carbon revenue	Ceramic liner made from bricks with outer metal cladding and metal charcoal grate. Metallic parts sourced elsewhere.	

	through Voluntary Carbon Market.		
Production Capacity	Currently around 700 stoves a month. Sold over 6000 stoves so far.	Sold over 500 so far but capacity to make more	
Distribution Channels	Sell through network of 48 agents around Dar es Salaam	Sell through agricultural fairs and contacts	
(B) **Envirofit Imported Stove**		**Rocket wood stoves**	**Fixed Maasai Wood Stove**
Manufacturer	Envirofit (Distributor L's Solution)	M&R Appropriate Technology Engineering	ICSEE (manufactured locally)
Cost Range	$12 (subsidized)	$20	$45 (subsidized)
Efficiency	33%	30-35%	24%
Key Features	Highly engineered wood stove manufactured in China.	Liner made from clay and sawdust, with metal cladding and insulation material	Stove brings hot gases around the pot before escaping through chimney.
Production Capacity	Demand Driven. 16,000 sold to date through L's Solution	500 – 800 annually. Currently seeking investment for expansion	300 installed so far. Factory capacity currently 150hydropowermonth
Distribution Channels	Through road shows and network of distributors	Mainly direct sales and exhibitions	Sold within Maasai community, installed through local women

The GVEP report on Institutional Stoves (GVEP, 2012), indicates most institutions in Tanzania using firewood as their primary cooking fuel. Improved institutional stoves have targeted schools, food vendors and restaurants, but uptake has been low mainly due to lack of awareness and financial mechanism to make them more affordable.

- Improved Institutional stoves have efficiencies over 40% and can save up to two thirds on fuel consumption.
- Improved institutional stoves can cost between US$1200 – 1900 depending on cooking capacity.
- They vary in size from 20 litres up to 250 litres.

Challenges

- Lack of end-user financing makes the stoves unaffordable to many institutions.
- Lack of government policy to encourage the transition to energy efficient cooking practices in institutions.
- There is a lack of awareness around the technologies.
- End-user training is needed so that cooks get maximum performance from the stoves.

Value Chain

GVEP report on cook stoves in Tanzania (GVEP, 2012) identifies several value chain options existence for the dissemination of cook stoves in Tanzania. The majority of producers sell through retailers within the local areas and countrywide distribution is rare. Producers may outsource the manufacture of ceramic and metal components separately and assemble the stove whilst others make the complete stove themselves. Quality

raw materials such as clay may be transported over large distances to reach producers. Donor programmes promoting objectives such as nutrition, water boiling and conservation occasionally procure stoves in large volumes. As such, the chain includes suppliers of raw materials, producer of components, cook stoves assemblers of various components, manufacturers of complete cook stoves, intermediary brokers, stockist, vendors and retail, and organizations promoting stoves, and end-users. On the other end of the supply chain, international manufacturers involve importers, distributors, retailers to end-users. Distribution costs can be high and smaller producers struggle to actively seek the market unless supported by external programmes**.**

Stakeholders

A variety of stakeholders exist in the cook stoves sector although experience and commitment in promoting improved cook stoves may vary. Government Departments include Ministry of Energy and Mineral, Ministry of Natural Resources - Division of Forestry and Beekeeping, Ministry of Community Development, Gender and Children, Ministry of Industry and Trade, Vice President's Office – Division of Environment, and Prime Minister's Office – Regional Administration and Local Government. Parastatal Organisations include Rural Energy Agency (REA), Small Industries Development Organisation (SIDO), Centre for Agricultural Mechanization and Rural Technology (CAMARTEC), Tanzanian Commission for Science and Technology (COSTECH), Tanzanian Industrial Development and Research Organisation (TIRDO), Tanzanian Bureau of Standards (TBS), and Tanzania Engineering and Manufacturing Design Organisation (TEMDO).

A variety of international and regional NGO's are involved in the cook stove sector through training cook stove artisans on technical and business skills, disseminating improved cook stoves or providing education on related issues. They include GIZ, CARE International, GVEP International, SNV, UNCHR, Millennium Village Projects, World Vision, UNDP, World Food Programme (WFP), Partners for Development, ICSEE, ARTI Tanzania, Canadian Physicians for Aid and Relief (CPAR) and E+Co.

Donors include European Union (EU), DGIS, World Bank, DFID, Southern African Development Community (SADC), HIVOS, German Government, Global Environment Facility (GEF), NORAD, USEPA, Shell Foundation, and UNDP/SGP,

There are several private sector individuals and businesses involved in the cook stove sector. Carbon developers are also entering the Tanzanian Improved Cook stove Sector. Private Sector members include Envirofit, Ecozoom, L's Solution, Zara Solar, Alternative Energy Tanzania Ltd, Kiwia & Lausten, SECCO, Envotech, Green Star, Morogore metal clusters, and M&R Appropriate Technology Engineering. Carbon mitigation project developers include CO2 Balance, Uganda Carbon Bureau, and E+Carbon. Envotech, M&R and Sunseed Tanzania. National NGOs include, The Family Alliance for Development and Cooperation, Karatu Development Association, Sunseed Tanzania Trust, Women Development for Science and Technology (WODSTA). Others include Tanzania Renewable Energy Association (TAREA), Camco and Round Table Africa.

Research organizations include University of Dar es Salaam, Sokoine University of Agriculture, and Berkeley Air Monitoring Group.

2.1.2.3 Affordability: fuel prices, cost of efficient cooking stoves and fuel supplies

In consideration of the poverty levels of most rural Tanzanians, most technologies associated with significant prices, are not affordable especially when compared to other priority issues such as food, health and

education competing for the same scarce resource. ICS in Tanzania have prices ranging from US$5 – US$40. This is already too much for most households, which can afford only a single meal per day. However, this is only about 36% of the population. The remaining 64% at least can afford some type of improved cooking technology. Equally important, biomass resource pricing does not reflect the full cost. At current pricing biomass is perceived as the cheapest heating and cooking option.

Over the past 10 years the LPG prices per a cylinder of 15kg have evolved from the price Tsh 23,000 to the current Tsh 54,000. This increment is of more than 100%. Although the number of dealers has increased, the gas and cylinders are imported with its price dependant on the oil price, US$/Tsh stability, and most of the dealers are located in urban areas only. Increased access and use depends much on innovative Government strategies to increase its availability at all levels of target potential communities through support on dealer network development and cost/price stabilization.

According to GVEP Assessment report (GVEP, 2012) on cook stoves in Tanzania, the following specific prices and costs for different stoves were collected and presented. The total existing market for improved stove ownership is around 400,000 households. According to the Tanzania Household Budget Survey 2007, 2.8% own a stove – the vast majority are traditional stoves. SNV in a report prepared in 2011 collated figures from a range of NGOs and SMEs and they estimated 3 million stoves had been 'disseminated' over the years 2000-10 period. This might suggest that as many as 400,000 households use an improved stove. Another study by Palmula and Baudiin in 2007 found 20% of all households in Dar es Salaam who use charcoal owned an improved stove (about 50,000 households) and 80% of charcoal users had traditional metal stoves. Assuming slightly lower levels of ownership in other urban areas approximately 300,000 households might be estimated to own an improved stove nationally. In the Shell Foundation research, no firewood users had bought an improved stove, 17% of peri-urban charcoal users had a stove, around 48% of urban charcoal users (earning US$1-3) and 67% (earning above US$3) had a stove. This equates to approximately 400,000 improved stoves in the country.

These figures may overstate true market size as some stoves were not purchased. The quality of many of the stoves in use is likely to be poor. The potential market will be larger than the number of households currently owning stoves, though it is difficult to quantify given currently available data. Increasing urbanisation and rising charcoal prices is likely to push up demand for efficient stoves in areas where people pay for fuel. In rural areas, penetration of stoves is almost non-existent and the Shell Foundation survey above suggests limited to no demand. Stove producers/retailers report significant challenges trying to sell quality stoves (SECCO, L's Solutions.)

Traditional cooking methods such as the three stone fire and traditional metal charcoal stoves are prevalent. Improved cook stoves have been promoted in the country since the early 80's but uptake is still low. Improved cook stoves are more readily available around urban centres particularly Dar es Salaam, Morogoro, Arusha, Mwanza and Dodoma, Kilimanjaro, Arusha and Tanga. Many of the stoves on the market are cheap and of low quality and many consumers are not willing to pay a higher price for quality, improved stoves. Wood stoves have been promoted by several NGO's but have failed to achieve commercial success. Innovation has occurred in the improved cook stove sector introducing new stoves types such as the KUUTE, Sazawa stove, however commercialization has been slow. Imported stoves such as the Envirofit wood stove have also been introduced to the market but the number of distributors is low since its distribution is a resource intensive

activity. Other imported stoves from Stovetech and Phillips have also been tested in the market with not much success.

Cooking with biogas is being promoted under the Tanzania Domestic Biogas Programme with the aim to install 12,000 biogas digesters in 5 years. According to SNV, by the end of 2012, already more than 5000 domestic biogas digesters had been installed with 50 biogas enterprises registered as companies. Uptake of LPG is low due to high up front cost of stove and gas cylinder and their limited availability outside urban centres.

Stoves and fuel wood costs

According to a GVEP International study report on cook stoves in Tanzania presented in March 2012, individual prices of cook stoves were as follows. The three stone fire attracted US$0, Traditional Metal Charcoal Stove about US$4, Jiko Bora (charcoal) about US$7, Basic Mud Wood Stove about US$5, Portable domestic rocket stove (wood) about $20, Envirofit (wood) stove about $12, LPG stove (one burner) about $20.

Whilst cost is a significant factor, availability and purchasing quantity are also important along with social and cultural factors. Wood is used primarily in rural areas whereas in urban areas people use mostly charcoal and firewood use is limited. Significant increases in the price of fuel have been experienced in the past five years. Many households in rural areas can collect firewood for free although it is becoming increasingly scarce. The price of fuel is higher in urban centres and increases during the rainy season. LPG use has increased in urban areas over the past 5 years but uptake is still low. It is often perceived as a dangerous fuel and availability outside urban centres is low. Kerosene is used by a small percentage of the population for tasks requiring rapid heating. Alternative fuel such as biomass pellets and briquettes are being introduced into the market but uptake is still low. Average price (in brackets) of charcoal in Dar es Salaam over past decade for a 40 kg sack is averaged as follows, years 2003 (US$2,5), 2007 (US$13.75) and 2012 (US$25).

Other cooking fuel costs as per GVEP International presentation in March 2012 are indicated in the following table below:

Table 4: Costs of cooking in Tanzania

Fuel	Purchase Unit	Usage	Cost	Cost per week (US$)
Firewood	3 pieces	1 day	500 Tsh/US$0.31	2.19
Charcoal	40kg sack	25 days	30,000 Tsh/US$19	5.25
LPG	13kg cylinder	30 days	56000 Tsh/US$35	8.12
Kerosene	1 litre	2 days	2500 Tsh/US$1.6	5.46

Source: GVEP International, 2012 Global Alliance for Clean Cook stoves: Tanzania Market Assessment (usage vary depending on family size, location and stove)

2.1.2.4 Sustainability

The price of modern heating and cooking technologies and fuels seems to be beyond affordability of most Tanzanians. This raises concern on its sustainability potential within poor communities in Tanzania. Deliberate efforts are necessary to increase affordability and hence influence sustainability on acceptance and uptake. Technical know-how on construction and manufacturing of these modern energy technologies and fuels such as pellets, biogas and briquettes is limited. Distribution networks are also not well established.

With the already mentioned figures by the MNRT on non-renewable forest reduction in section 1.2.2 and inefficient harvesting technologies, inefficient end-use technologies, limited coordination since it is left in the informal sector, the sustainability of heating and cooking technologies in Tanzania is at stake. Sustainability considerations in the heating and cooking industry need to be considered in the form of policy and regulation for the entire biomass fuel chain. Sustainability is at stake due to high rate of deforestation being experienced. Demand for biomass fuels is more than supply. Charcoal and cook stove technologies are persistently inefficient and damaging to health. In its report of 2007, the World Health Organization (WHO) estimated about 1.2 million deaths annually in Tanzania, attributed to indoor air pollution (IAP). Sustainability of such a technology is questionable and it cannot be left to go on like that. An intervention is necessary.

Involvement of the medium to large private sector players in the biomass-cooking sector is still limited, attributable to association with the primitive nature of biomass cooking and being outside the formal sector. The target in MKUKUTA II is on reducing the use of biomass and not on improving, making it sustainable and/or formalizing it so as to attract more investment.

Commercialization is adversely affected with limited financial capacities of most potential users, which further negatively impact on corresponding distribution channels rendering more challenges to the sector growth. It is also worth noting that there limited budget allocations for biomass sector (less than 1% of MEM budget), making it even harder for adequate capacity development, coordination, regulation and modernisation possibilities.

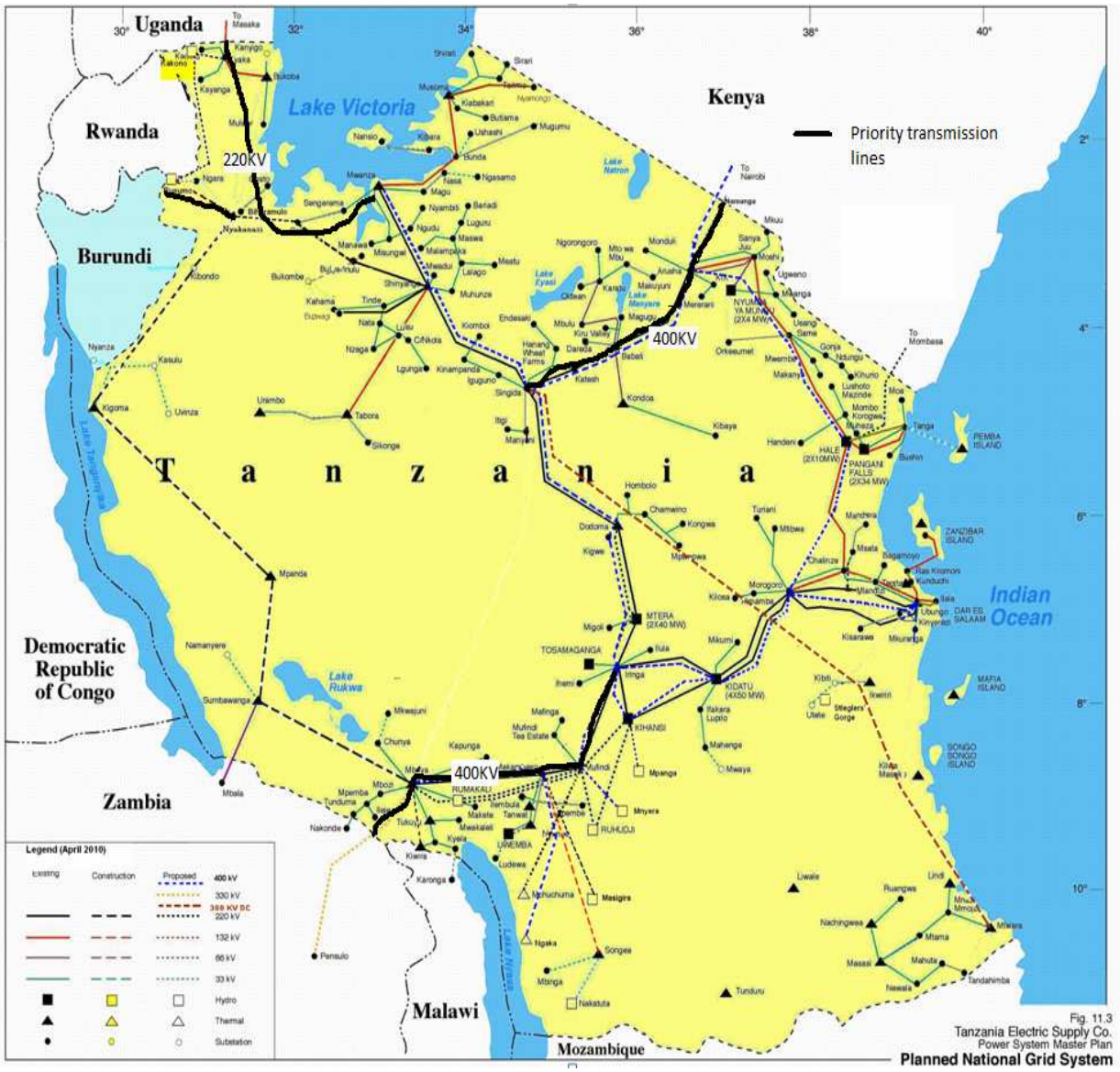
2.1.3 Access to electricity

2.1.3.1 Physical access (including: grid, mini-grid, off-grid and solar lanterns)

The current access to electricity in Tanzania is 18.4% of the population with rural areas access about 6.4% (MEM midterm strategy, 2012). Dar es Salaam is most advantaged with over 60% (TANESCO, 2010) electricity access (HBS, 2007) while the average for urban electrification is about 12%. Although electrification has improved since 2007, the ratios of electricity access among rural to urban is likely reflective of 2007 levels.

There is also variation in electricity access by geographical regions and as the transmission map (Figure 3) shows, grid infrastructure in Tanzania is concentrated in on two corridors; one that is from Mbeya in the South West and across to Dar es Salaam to the east through Morogoro, and another that cuts across to the north in Mwanza. Other areas are largely without adequate electricity infrastructure.

Figure 3: Electricity transmission map of Tanzania



Ref: Grid infrastructure in Tanzania (TANESCO, 2010)

2.1.3.2 Availability and reliability

Tanzania has a low quality of electricity supply. In between 2003 and 2012, the country experienced severe power rationing with electricity users experiencing daily black-outs, peaking in 2005/2006 and again in 2011. Electricity outages lasted 12 to 14 hours and were a daily occurrence (CDKN, 2012). Another study, based on experiences of the manufacturing sector, estimated that firms experience 63 electricity outages per year while an earlier study had estimated up to 75 electricity outages per year (World Bank, 2010). Low electricity reliability is a result of both load shedding and unplanned outages. Quality of electricity in Tanzania is further affected by voltage fluctuations, unbalanced phases and phase failures. Thus reliability is brought about by a range of factors including low water levels in hydro power reservoirs, and ageing infrastructure. The unreliability of electricity has been quoted as businesses one largest constraint to doing business in Tanzania. Most businesses that can afford it have stand-by generators for times when grid power is not available,

increasing the input costs to businesses, which in turn would be passed on to purchasers of goods and services.

The Government, through its development strategy and the Ministry of Energy and Minerals via its policies, strategies, short and medium term energy plans, have pledged to increase access to electricity and increase generation capacity through support to the national utility, and by creating an environment that is conducive for independent power producers to invest in. It further commits to exploring all viable renewable energy sources, which would in turn diversify supply and reduce its vulnerability to one single energy source. Available renewable energy sources with their potentials in brackets include large hydro (4700MW), small hydro (480MW), forest (33.5 million hectares), solar radiation (between 2800 – 3500 hours of sunshine/year and global radiation between 4-7kWh/m^2/day), agricultural/livestock/forestry residues (15 million tons/year) natural gas (about 6.513 trillion cubic metres), geothermal 650MW) and wind (up to 9.9m/s both measured at a height of 30m). In the electricity sector, TANESCO has set itself a range of key performance indicators, which if attained would improve the overall reliability of Tanzania's electricity sector. The performance of TANESCO is currently guided by the Capacity Investment Plan, which includes a Loss Reduction Programme. The Government of Tanzania/MEM in its midterm strategic plan has committed to reducing distribution and transmission losses from 23% in 2012 to 15% by 2015.

The following government initiatives are aimed at improving modern energy access to in Tanzania:

- First, the authorities aim at shifting the energy mix away from the expensive emergency oil-based power supply to more efficient and lower cost generation with a view to reducing the cost of electricity supply and to mitigate the risks of major shocks to the power system, such as droughts or oil price increases. The focus is presently on gas, coal and renewable energy in the near term, with coal and large hydro in the longer term.
- The second set of measures emphasizes the need to restructure sector institutions and strengthen investment planning, procurement and contracts management. This would include leveraging private investment through IPPs, procured through solicited and competitive bidding processes, and increasing market competition in power generation.
- Third, the Government of Tanzania will address TANESCO's financial gap through financing arrangements and through revenue-enhancing measures (Government of Tanzania/SREP, 2013).

2.1.3.3 Affordability (for users and public institutions for new access)

The low use of electricity for thermal applications as opposed to lighting suggests that most households find electricity unaffordable. As such, the use of charcoal and firewood which users perceive to be more affordable is high. While the price of electricity includes a subsidy for low energy users as shown in Table 5, there has been a decrease in the range of electricity users who are eligible to the subsidy since the low energy use tariff band was decreased from 0 to 100kWh, to 0 to 50kWh. However, in real terms the trend is unclear since new, mostly low-income households, are being electrified each year. These new consumers are likely to be low electricity users that would fall within the category eligible for a subsidy. Thus the reduction in the range of users entitled to the 50kWh subsidy does not necessarily mean a decrease in total subsidy.

Table 5: Domestic Electricity Tariff Level and Growth Rates in Tanzania 2007-2012 (Tsh)

	Tariff	Component	2007 approved Tariff	2011/2012 Approved Tariff	Growth rate per annum
D1	Domestic Low Usage	Energy Charge	40	60	8.4%
	Penalty – high usage	Energy Charge	128	273	16.4%
T1	General Use	Basic Charge	1,892	3,841	15.2%
		Energy Charge	106	221	15.8%
T2	Low Voltage	Supply Basic	7,012	14,233	15.2%
		Energy	70	132	13.5%
		Demand (kVA)	7,680	16,944	17.1%
T3	High Voltage	Supply Basic	7,012	14,233	15.2%
		Energy	65	118	12.7%
		Demand (kVA)	7,123	14,520	15.3%

Sources: TANESCO and EWURA application and order documents, OPM calculations (JESR, 2012)
NOTE: All the charges above exclude VAT and EWURA levy

While reducing the amount of subsidy is seen by some as being good for the economic performance of TANESCO, it is likely to have led to an increase in the number of households that cannot use electricity for cooking and other applications. Such a change must therefore be supported by measures to improve access and affordability of other forms of modern energy.

In addition to subsidization, TANESCO's tariffs are not based on cost of service, suggesting a blanket and hidden subsidy. A cost-reflective tariff has therefore been proposed as one of the reforms that TANESCO needs to implement to improve financial viability. While charging cost-reflective tariffs is advantageous to TANESCO, it is likely to increase the cost of electricity use among consumers. Part of the rapid increase in electricity costs has been due to the engagement of emergency electricity supplies to fill the hydro gap. These emergency supplies have become an ongoing part of the energy landscape as hydro power contributions have not been close to capacity. Already in January 2012, electricity tariffs increased by an average of 40% (except for users under 50kWh), and future increases are expected. Information on clear demarcation of tariff build-up: what part is capital, fuels, salaries, vat and levies could not be easily established.

Renewable Energy and Feed-in-Tariffs (REFIT)

TANESCO's power is largely hydropower comprising about 51% of installed capacity while only about 15% of its own generation is thermal. Of the total generation capacity, about 53% is from renewable energy sources comprising hydro- and biomass-based energy. The utility has also signed a range of power purchase agreement with other renewable energy producers, which will increase the share of renewable energy in the generation mix (Table 4). Further, off-grid renewables are being considered and include solar installations, mini-hydro and others. Few early movers are expected until TANESCO's financial situation brightens.

Table 6: Renewable energy contracts for sale to TANESCO

SPP Name	Technology	Export Capacity (MW)	Grid Connection	SPPA/LOI Date	Commission Date
SPPA Signed					
TANWATT	Biomass	1.5	Main	17-Sep-09	15-Jun-10
TPC, Moshi	Biomass	9.0	Main	6-Oct-09	13-Sep-10
Mwenga, Mufindi	Hydro	4.0	Main	19-Jan-10	21-Sep-12
Ngombeni, Mafia Is.	Biomass	1.5	Isolated	19-Jan-10	Mar-13
Sao Hill, Mufindi	Biomass	6.0	Main	26-Feb-10	Jun-14
Symbion-KMRI, Tunduru	Biomass	0.3	Isolated	17-Jul-12	Jul-14
Symbion-Kigoma	Biomass	3.3	Isolated	31-Dec-12	Mar-14
St. Agnes Chipole, Songea	Hydro	7.5	Isolated	11-Jan-13	Jul-14
NextGen Solawazi, Kigoma	Solar	2.0	Isolated	16-Jan-13	Apr-13
Total SPPA		**35.1**			
Letter of Intent Signed					
Mapembasi, Njombe	Hydro	10.0	Main	25-Jun-10	-
AHEPO, Mbinga	Hydro	1.0	Isolated	22-Sep-10	-
EA-Power, Tukuyu	Hydro	10.0	Main	7-Feb-11	-
Kikuletwa II, Kilimanjaro	Hydro	7.0	Main	28-Oct-11	-
Darakuta, Manyara	Hydro	0.9	Main	10-Jan-12	-
Mofajus, Mpanda	Hydro	1.2	Isolated	27-Apr-12	-
Tangulf, Nakatuta	Hydro	10.0	Main	16-Nov-12	-
Windpower, Mpanda	Solar	1.0	Isolated	21-Nov-12	-
Go On Tosa, Iringa	Hydro	0.8	Main	Lease from TANESCO	-
Total LOI		**41.9**			

Source, TANESCO, March 2013

2.1.3.2 Sustainability (Grid (TANESCO), Mini-Grid (IPPs), and off-grid)

Economic sustainability – Dependence on thermal power during low-water flow periods has led to high costs of power to the utility. In order to address the power crisis, TANESCO entered into power purchase agreements with independent power producers but ended up buying power at very high rates and selling at lower rates in many cases. Although this situation can change with the replacement of some heavy fuel thermal capacity with gas, the need for emergency short-lease power poses a threat to economic sustainability of TANESCO and eventually the Government itself, which periodically takes on financial burdens of public services providers. A change in the electricity act could alter the cost recovery from each tariff band and allow for cross-subsidy. IPPs could contribute to sustainability if their contracts were to be honoured by TANESCO[2].

The economic sustainability of energy supply is further affected by the earlier-mentioned tariffs that are not reflective of costs of service. An example of this financial threat is that TANESCO has delayed paying suppliers such as the Independent Power Producers, for goods and services rendered. This could in turn affect financial viability of IPPs and hence their ability to supply power. At a national level, power outages during the drought period are said to have reduced projected economic growth by about 4% of the GDP (World Bank, 2010). In January 2012, the energy and water utility regulator, EWURA, approved a 40.29% increase in electricity tariffs for all categories except those consuming less than 50kWh. This, however, is less than the 155% requested by TANESCO. The increase was achieved through government rescheduling some loans as grants, etc. More on this with respect to current and future tariff negotiations in pursuit of cost

[2] It is worth noting that, from time to time TANESCO has received delayed/deterred payment of electricity bills from some government institutions.

recovery are presented in JESR 2011/12 derived from calculation made from EWURA Orders. TANESCO has been urged to consider cost reflective tariff and a cost of service study was commissioned in 2012 to assess the appropriate level of tariff required. However, it is difficult in a situation of high cost emergency power purchases.

Environmental sustainability - Tanzania depends on hydro and thermal power and hydropower make up to 60% of generation capacity. However, its hydropower capacity has since 2005 been affected by low flows due to persistent and cyclic droughts. Thus, although hydropower is a renewable energy resource, it is a source that is susceptible to climate change and variability, and in this sense is not necessarily sustainable. Small hydropower, although more environmentally benign compared to large hydro, is also susceptible to climate change and variability, a situation that is unlikely to improve in the short term (based on climate change scenarios for Tanzania).

In terms of thermal use, Tanzania currently uses gas for the bulk of its fossil-based electricity generation. The use level is however currently too low to have any marked impact on the environment, when compared with the social and economic benefits.

The use of biomass for energy purposes have resulted in severe deforestation even in water catchment areas impacting adversely on the hydrological performance of rivers and other water sources in such areas. These rivers and catchment forests are habitats for various biodiversity and hence its destruction results into eco system destabilization. Forests are also used as carbon sinks. Deforestation activities impact negatively on sequestration capacity of forestry carbon sinks.

It is also worth noting that during power outages, petrol and diesel generators are switched on to power businesses in cities and urban areas. They result in significant noise and the generation volatile carbon, sulphur dioxide and other particulates at street level.

Social sustainability – Social sustainability of energy supply encapsulates goals related to job creation and improvements in gender, welfare and empowerment. While these are included in policies, their inclusion is very broad and lacks specific targets and monitoring frameworks. As an example of lack of monitoring frameworks, there is no data on electricity access differences between female and male-headed households. Low social sustainability is also displayed in the differences in electricity access among the very poor, the poor and the non-poor, which stands at 3%, 4% and 16% respectively. This shows that the non-poor are over 5 times likely to have electricity access than the very poor, and 4 times likely than then poor.

2.1.4 Modern energy for productive uses

2.1.4.1 Energy needs and access

Demand for modern energy and especially electricity is high in the productive sector both formal and informal, although good data on this demand is not available, electricity, gas, liquid fuels are being used by formal productive uses in agriculture, industry, and commerce. Informal sector demand is difficult to ascertain because it is intertwined with domestic demand, and sometimes with that of the formal sector. Demand for modern energy services in Tanzania is driven by a growing economy and population. Access to modern

energy in SMEs and agriculture is also unclear although it likely reflects patterns of household energy access, with urban and high-revenue SMEs and agribusinesses having a higher level of access.

According to UNIDO publication on carbon footprints reduction opportunities of 2011, energy intensities of main agricultural industries employing biomass energy sources include brick baking, fish smoking, baking, charcoal making, food preservation, agriculture and agricultural processing, milling and tobacco curing. Tobacco processing is the most energy intensive using about 160,000 MJ of energy per ton of tobacco produced. Charcoal production is the 2nd most energy intensive industry using about 100,000 MJ/ton of charcoal produced. Other industries include tea processing (over 40,000 MJ/ton), coffee processing (over 20,000 MJ/ton) and cashew processing at about 10,000 MJ/ton). The preservation of food can result in considerable spoilage, in some instances as high as 30% where dried food is stored in villages in small storage barns (F. Dowell, USDA).

2.1.4.2 Quality of local supply chain and availability of required technology and energy for productive applications (separate formal and informal energy value chains)

Formal sector

Supply of electricity for productive applications faces similar challenges as those faced by the broader society reliant on grid electricity. Poor supply reliability and voltage fluctuations are among some of the main issues that productive services face. Blackouts are frequent and of long duration in part resulting in an estimated 50 factories closing down and laying-off their employees. Low quality of supply also translates into high costs for small enterprises which have to find alternatives to electricity, lost production time during power outages and sometimes have to replace equipment damaged by to voltage fluctuations.

Petroleum products are widely available in urban areas and main rural centres. However, access in rural villages they are more costly as many households and business owners have to travel some distances to main trading centres to get them. In other cases, they depend on local shops for supply. This supply is susceptible to contamination and adulteration that is rarely accounted for in national assessments.

Adulteration is also common in the formal supply chain although this has improved significantly in the last 5 years. Of 432 outlets inspected in 2010, 48.6% of all the sampled retail outlets had products that were below the specifications of the Tanzania Bureau of Standards (TBS)(EWURA, 2010). Up to 36% of retail outlets, 29% of depots and 55% of tankers had products that were below the TBS standards. However, there has been an improvement in that percentage of outlets with adulterated petroleum products has decreased from an average of 78% in 2007 to about 40% in 2010 (EWURA, 2010). The high levels of adulteration of fuels in the supply chain (tankers) means a much higher level of sub-standard products are supplied to informal productive users.

Biomass Energy Strategy Tanzania (BEST) has been established to address biomass value chain in need of formalisation. BEST is expected to build awareness among policy makers of biomass as Tanzania's main source of primary energy and its relevance to poverty alleviation. BEST envisages supporting the government to develop and implement national biomass energy strategies that set out rational and implementable approaches to manage the biomass energy sector. Measures would include improving sustainability of supply chain, more efficient charcoal production and distribution, improving end-user efficiency of biomass use,

promotion of alternative sources of energy where appropriate and addressing negative perceptions of biomass energy aligned as a positive contributor to a modern energy economy.

Food drying value chain

Current food drying in Tanzania is done in open sun and using biomass. No reliable data of sustainably dried food value chain is available; however, traditional drying techniques are mostly used. Few initiatives from NGOs, research centres and universities are recorded, including TaTEDO, Sokoine University of Agriculture (SUA), AMKA, SIDO and others. Biomass is the main fuel used in drying processes.

Although the availability of renewable energy technologies such as solar dryers and Solar Water Heaters has not significantly improved over the years, their quality as well as the quality of after-sales service varies. Similarly there is generally low but varied availability of efficient stoves for small-scale industries. Programmes such as the World Bank's Lighting Africa programme, are leading in improving quality and availability of portable off-grid lighting solutions. There are a number of social entrepreneurs offering small lighting and phone charging solutions with various interesting marketing and financing strategies. Similar programmes could also focus on improving efficiency, quality and standards in the biomass sector.

2.1.4.3 Affordability and access to capital for productive use technologies

Tanzania has received significant support from its Development Partners for the energy sector, including renewable energy and electrification. Development Partners offer increasingly well-coordinated assistance to Tanzania that is aligned with the national priorities and strategies. The multi-year energy sector commitments of the Development Partners are about Tsh 1.5 trillion (US$1 billion), including renewable energy. The Development Partner funding commitment for renewable energy is approximately US$350 million. In addition to the technology-specific assistance described later, sector-wide support is also provided. UNDP is supporting Tanzania to mobilize actions in support of the three interlinked objectives of the "Sustainable Energy for All" initiative of providing, by 2030, universal access to modern energy services; doubling the global rate of improvement in energy efficiency; and doubling the share of renewable energy in the global energy mix. NORAD and SIDA are expected to provide significant funding to the Rural Energy Fund. There has recently been a grant of US$120 million to the Rural Energy Fund (JESWG EDPG, 2013), and many other contributions to grid transmission extensions. USAID is establishing a fund for financing rural and renewable energy. AfDB is establishing a €20 million credit line that can be accessed through domestic commercial banks for renewable and rural energy. DFID has a £30 million regional soft loan facility that could finance renewable energy investments.

The Government of Tanzania, through the Tanzania Energy Development Access Programme (TEDAP) provides subsidies and matching grants that aim to make it more affordable for the private sector to provide energy products and services. This subsidy is available from the Rural Energy Agency (REA) and commercial banks for small energy businesses to access. Various companies and services providers have also set up project clusters that can access financing from commercial banks such as Stanbic Bank.

The analysis of energy affordability and access to capital for energy for productive uses, however, shows some limitation. Some of the financing sources are limited to selected technologies and services stipulated by donors or financiers and some on specific geographical boundaries. Micro-financing institutions (MFIs) and

banks can provide a service in such an area but are limited by experience and technical know-how in the sector. Only solar products have been tried and in many cases, not succeed. Support of development agencies in financing and in reducing risk for banks and their energy portfolios is crucial in assisting them to lend for energy-specific products and services. However, providing finance only is inadequate and must include long-term support for the technical and financial products themselves as banks lack expertise in this area. A large network of Village Banks, Micro-Finance Institutions, saving schemes and co-operatives all make loans for small-scale energy investments and are being seen as possible local lenders for energy access projects such as the Low Carbon Sustainable Energy Access project of the UNDP, MEM and REA.

Other financing initiatives, which could benefit productive uses if well disseminated include:

Off-grid Solar Photovoltaics (PV) projects

To date about 6MWp of solar PV electricity has been installed countrywide for various applications in schools, hospitals, health centres, police posts, street lighting, telecommunication small enterprises, and households. More than 50% of the capacity is being utilised by households in peri-urban and rural areas. The Government of Tanzania is carrying out awareness building and demonstration campaigns on the use of solar systems for domestic and productive uses, as well as supporting direct installation in institutions. In order to make solar PV more attractive, the Government of Tanzania has removed VAT and import tax for main solar components (panels, batteries, inverters and regulators); this has allowed end-users to get PV systems at a more affordable price.

The Government of Tanzania, through REA, as well as donors have supported solar PV programmes targeting off-grid areas where it is lower cost than using generators or kerosene for lighting. Projects include the following:

- REA: Sustainable Solar Market Packages (SSMP) provide off-grid solar electricity for public facilities and households: SSMP in Rukwa Region under implementation to benefit 80 villages; new SSMP packages are being prepared for five more regions; financing and bulk procurement assistance were provided for solar home systems for members of associations (coffee, tea, cashew) with financing through NMB/Stanbic banks.
- REA: Establishment of a number of Vocational Education Training Centres (VETA) to provide technical support and training for systems design, installation, maintenance and repair.
- REA: The Lighting Rural Tanzania competitive grant programme supports private enterprises in developing and delivering a wide array of modern solar lighting products for rural households, businesses, schools and clinics.
- Oikos East Africa (NGO): Solar PV systems are being installed in all primary and secondary schools in OldonyoSambu and Ngarenanyuki wards in Arumeru district to promote the use of renewable sources of energy.
- Millennium Challenge Corporation: Solar PV systems are being installed in 45 secondary schools, 10 health centres, 120 dispensaries, municipal buildings and businesses across 25 village market centres currently without access to the electricity grid in the Kigoma Region.
- SIDA and UNDP: Business development services are provided to solar companies in 16 regions. These include technical and marketing training for solar retailers, technicians and vocational school instructors); marketing and awareness, networking among solar industry stakeholders; and policy and institutional support for the implementation of national quality control standards.

- European Union: 15,000 solar home systems are being financed through association members in Lake Victoria Region with micro-financing through Stanbic with subsidy from REA.

Renewable energy financing opportunities on different levels have been made available for productive uses in the past through financing by different summarised in the Table 7:

Table 7: Past experiences with financing of renewable energy technologies

Finance provider	Target products	Target group	Programme duration	Issues faced
FINCA Tanzania	Solar	-	2 years	Collateral Management problems as product was new Short lived
Promotion of Renewable Energy in Tanzania (PRET) With financial support from BMZ and technical support from GTZ (now GIZ)	Solar	-	n/a	Capacity of supply network including installers and maintenance services Lack of enforcement of guarantees Short lived
CRDB Bank with UNDP support	Solar	Salaried employees Well managed SACCOs Small businesses	n/a	Lack of collateral Poor business plans Very few subscribers (only one in first year, and a total of 5)
Tujijenge Micro Finance with support of Micro Energy International	Solar	Salaries employees Qualifying groups and individuals Also provides technical support for installation and sizing	Testing on-going in one branch	Lack of technical expertise on product
KAKUTE LTD	Solar	Rural households and institutions	Up to 3 years-Ongoing	Over subscribing
SCULTZ	Solar	Members of teachers association	Ongoing	Reliable finance from membership fees
E&CO	Solar, Improved cook stoves	Private companies and MFI	Ongoing	Successful in lending many renewable energy forms in Tanzania, repayment in USD
ARTI	Solar, Improved cook stoves	Small consumer financing	Ongoing	Small consumer loans
USAWA NETWORK	Solar, Biogas	Saccos network members	Ongoing	Large network
VICOBA	Solar	Vicoba members		Small consumer loans
CRDB Bank/REA	Micro hydro	Renewable energy project developers	Up to 15 years-ongoing	Long term Support for the private RE sector in Tanzania
TUNAKOPESHA	Solar	Salaried employees/consumer financing	Ongoing	Solar System Leasing
SIMGAS	Biogas	Regular income customers/consumer finance	Ongoing	Consumer loans for simgas plants through MFI
Umeme Nuru	Solar	Church members and related Sacco's members	Ongoing	Consumer loans for solar lanterns and SHS

Sources: GVEP, 2010, SEI, 2010; UNDP, 2009,

As Table 7 shows, loans are often limited to civil servants because they have monthly incomes and stable jobs. In addition, although cooking technologies have a critical role in energy access efforts, the majority of consumer lending efforts to date, as shown in the table, have focused on lighting. Other Issues limiting the financing productive use services include:

- Lack of collateral among target group;
- Lack of technical support which makes the products appear to be a risky investments;
- Reluctance of formal banks to provide small loans;

- Low-income households perceive formal banks and loan procedures as complicated and lengthy;
- Lack of credit history by potential borrowers;
- SMEs are seen as high risk customers;
- Limited competition and good performance of bank (within the context of Tanzania), which makes them risk averse;
- Dependence on informal lending facilities who are unlikely to understand the energy market[3]; and
- Lending gap that offers loans that are either too big for households SMEs or too small for medium sized enterprises.

Other challenges facing the modern productive uses include lack of awareness of the financial institutions in Tanzania on the potential businesses in the productive use sector, technologies and services. Equally important is the limited awareness and technical know-how of entrepreneurs on various productive use energy technologies. A clear focus and target would assist the government in specific strategizing.

[3] A study by FSDT shows that access to financing varies depending on location of population. Although the population without access to loans is comparable in rural and urban areas (33% vs 34%), rural populations are more dependent on informal financing compared to urban populations (36% vs 32%) and only 5% of the rural population can access formal loans compared to 18% of urban population. The low access to formal financing means that Tanzanians are subjected to high interest rates of informal and unregulated finance providers (World Bank 2010).

2.1.5 Overview and Assessment

The importance of energy efficiency lies in that it ensures provision of same quality and quantity of energy service using less fuel. Energy efficiency can also be achieved through fuel switching for specific energy services. Owing to the increasing demand and limited availability of fossil fuels, the importance of efficient use of energy has been realized all over the World. The measures of energy efficiency are useful in multiple ways reducing costs to households, productive activities and the national economy. Reduced use of fossil fuels is essential in lowering the emission of anthropogenic greenhouse gases contributing to global warming but also draws-down scarce foreign exchange for imported fuels contributing to improvements in balance of payments. The policies and policy instruments targeting improvements in energy efficiency aim to minimize the use of fossil and other fuels, thereby improving competiveness and affordability of energy services and reducing local and global pollutants. Energy efficiency reduces fuel consumption, saves capital costs in energy system sizing and operational costs in the use of fuels. Energy efficiency has both technical (hardware dimensions) and behavioural dimensions (software dimensions). Policies must address both of these through promotion and increasing awareness of increasingly energy efficient equipment and providing energy pricing signals and by finding the necessary instruments to get fuel suppliers to achieve demand side energy efficiency.

The concepts of renewable energy and energy efficiency go hand in hand. These two concepts are considered to be the “twin pillars” of the policies regarding sustainable energy. To make the most of the sustainable energy policies, there needs to be simultaneous application of strategies regarding renewable energy and efficient use of energy in the achievement of least cost energy services.

The two terms, energy efficiency and energy conservation, appear to be similar, though in actual terms they are different. Energy efficiency essentially implies making use of latest technology that assures production of same level of output or service using significantly less energy, this relates to energy intensity or the amount of energy per unit of service. An ideal example of an energy-efficient appliance is compact fluorescent lamp (CFL) or light emitting diode (LED). Energy requirements of these technologies are many times lower compared to that of incandescent lamp. However, light output quantity and quality is comparable. The concept of energy conservation on the other hand, implies reducing the total amount of energy in a system.

In Tanzania, energy efficiency is included in a number of the policies, acts, strategies and targets that frame the energy economy, however, there is no dedicated energy efficiency policy, nor explicit policy instruments. As a result the energy economy has much room for increasing energy efficiency in each of the fuel or energy service value chains. No assessments of the potential savings in the energy economy, subsectors nor energy services exist in literature reviewed in the preparation of this document. This constitutes a gap that can be filled as energy policy is developed and implemented.

TANESCO estimates for total losses from transmission and distribution amount to 21-24% of the electricity generated. Distribution losses in 2008 were at an estimated 18% and 19.7% in 2009. Transmission losses in 2009 were estimated at 6% compared to 5% in 2008. One reason for this is low investment in maintenance (Ridgway Capital Projects Limited, 2010). TANESCO allocates an average of 2.8% of revenues annually

(2005-2008) compared to recommended best practice of 12% of revenues annually. TANESCO is already involved in improving efficiency of its upstream electricity activities. It has embarked on a Loss Reduction Programme that aims to reduce losses to 14.6% by 2014 (MOFEA, 2011; Ridgway Capital Projects Limited, 2010). TANESCO has also partnered with Statnett of Norway in an effort to improve its performance through knowledge exchange.

The potential for energy efficiency in Tanzania is not known. Nor is there information of what is the extent of energy efficiencies within the economy and how this can be achieved. Such information is the starting point for the development of an energy efficiency strategy that is targeted at economic sub-sectors and rural and urban populations and productive activities.

Downstream energy efficiency

Downstream of the energy sector activities to improve efficiency are carried out by a range of actors including MEM, TANESCO, Tanzanian Bureau of Standards and NGOs. Development partners such as the World Bank are also critical partners in these efforts. Energy efficiency activities in Tanzania include:

a) **Energy Audits and investments in Public Buildings** – Energy audits have been carried out in a number of public building including University of Dar es Salaam and the Post Office Headquarters. However, energy auditing is not common or routine practice.

b) **Consumer engagement and awareness creation –** There are programmes promoting efficient cook stoves and behaviour changes. Although government has supported these, they have largely been implemented by NGOs. In addition, the timescales and geographical scope of these projects remains limited.

c) **Promotion of energy efficient appliances -** These include energy efficient lighting products such as CFLs, energy efficient cook stoves, efficient biomass ovens and kilns. CFLs have been promoted by international bilateral and multilateral agencies, while cook stoves are promoted by NGOs such as TATEDO. TATEDO estimates that between 2000 and 2006, the production and uptake of improved charcoal stoves was 1.2 million (TATEDO, 2012). However, whether these are still in use, and what percentage are replacements for older stoves, is unknown. In addition, there appears to be no independent monitoring and verification of their performance.

   Artisans and women's groups in the informal sector have been the main actors in the household energy efficient stoves sub-sector. There is increasing interest from the formal private sector to enter the stove market, particularly introducing second and third-generation improved cook stoves. Partly because there is no regulation in this market, the growth of retailers of improved cook stoves has been high. At the same time, the performance of these stoves cannot always be guaranteed as it can vary substantially depending on stove quality and supporting approaches (e.g. behaviour change interventions, cooking pot sizes etc.), a situation that has affected the stove sub-sector since its inception.

   Tanzania still lacks a dedicated energy efficiency agency. It also lacks sustained energy efficiency and its mainstreaming in government activities across sectors. There is a significant role for the TBS to play in the processes for the appraisal and/or measurement of performance in collaboration with stakeholders (amongst others, appliance manufacturers, importers, retailers, government import, manufacturing, energy agencies and ministries, EWURA, NGOs and other representatives of consumers). The

development or adoption of performance standards and labelling that is recognisable by Tanzanian users. The energy performance standards and labelling protocols will then need to vested in the Ports and Customs authorities so as to achieve compliance and avoid dumping.

d) **Energy conservation targets –** the Mid Term Energy Strategy (2011-2016) includes an outcome of the % of industries adhering to energy conservation practices. However, there is little if anything said about the policy instruments that enable this.

e) **Boilers and insulation -** There appears to be little work that has been done on boiler efficiency and thermal performance improvements of structures. Both are technologies where considerable savings can be made.

f) **Transportation energy –** There is nothing in energy policy supporting improvements in energy efficiency in transportation through city densification plans or increased public transport. Rapid Bus Transport systems are being introduced in Dar es Salaam is not driven by energy policy, but will have energy efficiency impacts. .

2.1.6 Energy Intensity of National Economy

The energy intensity of Tanzania averaged 1.21TOE/1000 GDP (2000 US$) in 2009. This is above both the world and African average energy intensity of 0.31TOE/1000 and 0.75TOE/1000 GDP respectively on a per capita basis it is well below the average. While the National Energy Policy (2003) acknowledges the need for energy efficiency as a cross cutting measure, it does not specify the need for decoupling energy and GDP. Neither does the national growth strategy paper – MKUKUTA. This is likely because at a Total Primary Energy Supply (TPES) of 20MTOE, Tanzania is a comparably low energy consumer. However, with increasing mining activities and economic growth, decoupling efficiency from GDP will increase in its importance. In addition, with recurrent energy shortages and the relatively high financial burden of the energy sector on the economy, energy efficiency presents a critical mitigation measure that can free energy capacity as well as finances. MEM is currently developing a range of energy efficiency measures but a comprehensive energy efficiency strategy is yet to be formulated. Particular attention in the development of an energy efficiency strategy is in harnessing the behavioural attributes of poor Tanzanians as they gain access to modern energy for the first time as well as in the utilisation of the recently located natural gas.

2.1.6.1 Industry energy use and potential for energy savings

Common to industries throughout the world are pumping, thermal and lighting energy services, so motors and boilers have received much attention internationally. A recent study considered energy efficiency possibilities in Industry, analysing costs and benefits of efficiency measures from a utility (TANESCO) and users' perspectives rather than a National Economic perspective. However, the Hatch study quoted here, evaluates a number of efficiency measures that could also benefit the national economy.

2.1.6.2 Industrial Electrical Equipment in Tanzania and its Usage - Motors and VSD

As per available literature and field visits conducted, most electric motors and Variable Speed Drives (VSDs) in Tanzania are to be found in the industrial sector and mainly in large companies. Some motors are also installed in large commercial buildings and hotels, mainly on ventilation and air conditioning (AC) systems. In

January 2008, a survey on operating motors, VSDs, AC units and lighting fixtures in Tanzanian facilities was conducted by Dr. Eng. Saanane Bonaventure of the Dar es Salaam Institute of Technology. To date, it is the most comprehensive study found to assess the penetration and existing market of electric motors in the industrial and commercial sectors. A total of 4,234 motors were audited as part of this survey in various regions, including Dar es Salaam, Morogoro, Tanga, Moshi, Arusha, Mbeya, Shinyanga and Mwanza. The sample of visited buildings was quite representative of the main Tanzanian market sectors such as cement, sugar, textile and metal facilities, breweries, hospitals and offices.

The motor survey showed that the majority of motors in Tanzania were manufactured between the 1970s and the early 1990s, making them less efficient than models available nowadays on the market. Similarly, most of the electric motors audited during HATCH study (2010) site visits were old and had been rewound several times. This was confirmed by local vendors of motors who mentioned that sales of new equipment are low because of the preference of industries to rewind old equipment up to ten times. New electric motors with improved efficiency are purchased particularly by large energy consumers, such as cement, water or tobacco industries. Smaller industries are used to rewinding existing motors several times instead of purchasing new equipment due to the low cost of rewinding. In the commercial and tourism sector of Dar es Salaam, very few central AC and ventilation systems are installed. This explains why only a small amount of electric motors, rather than those included in AC units, are in use in these two sectors.

The HATCH report (2010) estimates the following statistics to represent the new motor market, based on equipment efficiency:

- For small motors, 90% of motors sold are “standard-efficiency” (IE1). The remaining motors in this category are “high-efficiency” (IE2).
- For larger motors (whose nominal power is equal to or larger than 40kW), the percentage of high-efficiency (IE2) motors sold may be as high as 90% while standard-efficiency motors might account for only 10%.
- For both small and large motor market segments, the penetration of premium-efficiency (IE3) motors is almost nil in Tanzania.

It is estimated that, the incremental purchase cost of high-efficiency motors instead of standard-efficiency motors is approximately 5%. Premium-efficiency motors (IE3) were not available in the Tanzanian market. However, a number of international manufacturers, which are already distributing premium-efficiency motors in other countries, mentioned that they could import premium efficiency motors in Tanzania if the local demand for such equipment increases.

Another key finding from the HATCH study report is that most managers are not aware of the benefits of VSDs. Similar observations were made by experts following site visits to industries. Nevertheless, the VSD manufacturers interviewed confirmed that the VSD market is growing fast, mainly due to the high energy saving potential related to the installation of such systems. Finally, very little information was accessible on the actual market for power factor correction units. Despite its large potential for cost savings, it seems to be a small market both for electricity consumers and TANESCO.

More Energy Efficient Options

When compared to capital costs, operating costs (including energy) of typical electric motors are very relevant. Calculations show that the operating costs of heavy loaded motors over a one-year period could be as high as ten times the initial cost of the equipment. In addition, the capital cost represents only 1% to 2% of the total life-cycle costs of such equipment. Considering these insights, the choice between models of different efficiencies becomes very important.

Electric motor consumption in industries worldwide is estimated at 50% to 65% of total electricity consumption in the industry sector. In Tanzania, this percentage may be even higher with the presence of less auxiliary equipment (electrical heating, cooling, and others) than in other countries. In fact, Dr. Eng. Saanane's motor survey shows that the electricity consumption of motors in the Tanzanian industrial sector could be as high as 90%.

The main barrier to the penetration of high-efficiency motors is the current motor rewinding practice without considering the long-term energy usage of the motor. The HATCH report (2010) observes old rewound electric motors, especially in small- to medium-scale industries and commercial buildings. Rewinding failed motors seems to be a common practice in Tanzania mainly due to its related low cost when compared to the purchase and installation costs of new electric motors. When it comes to choosing between replacing and rewinding a failed motor, maintenance managers will elect to rewind the equipment regardless of the potential loss of efficiency.

Another barrier to market transformation is the typical payback period related to retrofitting an existing motor with a more efficient model only for the sake of saving energy. Unless the electricity price is very high or the conditions of existing equipment make it very inefficient, retrofitting electricity motors may be hardly cost-effective. Nevertheless, the incremental cost is paid back in three to five years in most situations in a replacement scenario (i.e., when the existing motor needs to be replaced and managers can choose between a standard, high-efficiency or premium-efficiency motor). A payback period of 3 to 5 years also applies to the purchase of new equipment. The first cost versus operating cost (of life-cycle costs) is a problem not unique to Tanzania, but common to business and public sector institutions where the budgets and oversight for procurement and operation are separated.

Other than knowledge of benefits, no major technical barrier to VSD implementation was found in both commercial and industrial facilities. Several VSDs are currently used in industrial areas. However, the awareness and knowledge of facility managers on VSDs is limited, especially in small industries and commercial buildings. Overcoming this barrier would require educating industry about the opportunity to replace a motor and benefit from long-term savings when a motor fails. Payback requirements are very short in retrofit situations, this constraint is relaxed in new-build of industrial facilities where a longer payback is acceptable.

Selected Energy intensive Industrial Sites

Industrial customers include the vast majority of T3 and a significant portion of T2 electricity consumers[4]. Small industries may also be supplied under the T1 rate with a three-phase connection. These industrial customers include largest mines of the country. The HATCH study report (2010) noted that a significant number of large T3 customers had recently made significant investments in new production lines. This money

[4] The T1, T2 and T3 refer to electricity consumer tariffs.

was also intended for the renovation of existing production lines with associated increases in productivity, product quality and energy efficiency. The newly added equipment has distinct characteristics as well as a lower potential for improvement than other production lines installed several years ago and which have never been renovated to improve efficiency.

The management of a number of these larger companies take investment directives from headquarters located abroad. These foreign-owned companies generally have access to corporate engineering support that gives them more opportunities to identify and install the most up-to-date technologies. Additionally, several locally or regionally owned companies invested significantly in new or upgraded plants and/or production lines. Most specifications for the lines added or renovated were provided by the engineering department of the home office abroad or by international consulting firms specialized in industrial engineering. Several of the new production lines visited were world-class.

The HATCH study included findings from a selection of companies, which are illustrative of progress made and practical barriers to efficiency improvements. A short summary of some of the interventions are included in the table 8 below:

Table 8: Summary of energy efficiency interventions in selected industries in Tanzania (Hatch 2010)

Site description	Measure	Status/Reason
Barrick Gold (Bulyanhulu, Buzwagi, and North Mara) Ore is processed through three large grinding mills (1,500 hp, 1,750 hp, 2,500 hp) and there are many motors on site ranging from 1 hp to 500 hp.	Most of the motors on site are "high-efficiency," purchased in Europe or North America. Approximately 85% of them have variable frequency drives.	• Already procured and installed
Barick Gold and other Industry players	Ventilation, compressed air systems, lighting, power factor correction, AC and monitoring	• Under examination for potential savings
Alaf: Zinc Aluminium	Integrated efficiency measures installed Efficient motors	• The marginal gain from switching to higher-efficiency motors could not be justified economically at the time of HATCH study (2010)
Alaf: Galvanization line	electrically-heated annealing cells switch to natural gas	• Retrofitting process transformation might be expensive and need significant technical expertise and financial support to bring the payback of this project into a one- to two-year period.
Bakhresa flour mill: Milling grains	160kW motors controlled with VSDs. 2% below premium-efficiency motors.	• Investment in two new mill lines in the last 4 years. VSDs used for variable loads.
Tanzanian Breweries: Total operations (Dar es Salaam, Mbeya)	Benchmark for outputs 8 (Mbeya) – 11 (Dar es Salaam) kWh/hectare Litre VSD motors, heat recovery, housekeeping, air-compressors, refrigeration, energy balancing.	• International branding for world class new plant. • 1-year payback for retrofit.
Twiga cement: Grinding mills of standard efficiency for 2 500 and 2x550 tonnes cement per day = 80% of energy consumption.	Demand side management. Reduce peak load (10MW). Significant load shifting opportunities (5MW)	• Good engineering practice
Superdoll: Welding and bodyworks for trucks and trailers	Compressors and air leaks and efficient lighting	• Offered as an intervention by consultants to reduce compressed air loss through repairing leaks at

		payback of 0.5 to 1.5 years.
MMI Steel 3MW Arc furnace	Power reliability and quality before efficiency	• Reducing downtime. Later smart meter data to correct power factor, lighting
Iron and Steel Company 2MW Arc furnace plus rolling mill	Power reliability and quality before efficiency. Improvement on 20% electricity availability would reduce current downtime of 50%.	• Reducing downtime. Later could benefit from high-efficiency motors, lighting upgrades and power factor correction
Ruffia Bags	Compressors (55kW, 37kW and 18.5kW) and chillers for process water cooling	• Smart meter data for power factor correction. • Opportunities for improved efficiency in motors, heating and lighting

Industrial Energy Management

Most companies have neither energy management policies nor structured energy management processes in place. Therefore, they seem to implement energy efficiency initiatives on a sporadic basis only when an opportunity is targeted or when equipment needs replacement or renovation. One notable exception is Tanzania Breweries. As part of the SABMiller group, the Tanzanian plant has to follow corporate policy stipulating that a global plant consumption reduction of 50% is mandatory by 2020. SABMiller operates 63 plants in Africa, of which four are located in Tanzania. Corporate policy for energy reduction is translated into individual objectives for each company plant. SABMiller takes into consideration the age of each facility when establishing energy intensity targets. Each source of energy is allocated its own target. For instance, the Dar es Salaam plant was assigned a target of 11kWh per hectolitre (hl) while most recent plants ended up with a target of 8kWh per hl. The Mbaya plant (which was built recently in Tanzania to the highest energy-efficiency standards) is one of the plants in the world with the most stringent target, i.e. 8kWh per hl. SABMiller also operates corporate energy management software that distributes the plant target down to individual equipment (kettle, cellar, tank farm, and packaging). The SABMiller plants offer an affirming demonstration of best practice in Tanzania and future efficiency programmes could benefit from the learning potential their presence affords.

Barrick Gold, is another example of energy efficiency being addressed in Tanzanian industry. They have made significant progress in improving quality, reliability and data management aspects of its electrical energy system over the past few years. It has also succeeded in establishing good energy management practices. Barrick is developing and tracking energy efficiency key performance indicators and establishing formal energy management planning practices on site.

Ministry of Energy and Minerals

A demand side management study by Hatch conducted for TANESCO in Dar es Salaam in 2010; quoted MEM officials that recent multi-sectoral audits was around 2003-2004. The survey was conducted on industrial energy use in the country, and audits were conducted of the Dar es Salaam water utility and four government ministries. No programme is reported to incentivize implementation or measure or verify savings, so there is no information on the results of the audits and post audit actions. The audit of water pumping reportedly in the report identified potential savings in the range of 40%. The audits of the government ministries reported a high level of inefficient energy use. For example, the audit for the Ministry of Education and Culture found:

a) Use of undersized and deteriorated electrical distribution systems leading to overheating losses;
b) Use of outdated and over-rated electrical protection switchgears and fuses that are also a safety concern;
c) Poor electrical system power factor;
d) Low level of good housekeeping to office equipment, lighting systems and air conditioning systems;
e) Inefficient and deteriorated lighting systems consisting of incandescent bulbs and 5 ft 65 W fluorescent lights that also lead to poor illumination levels to offices;
f) Inefficient office equipment, computers and air conditioners;
g) Deteriorated building envelope, high heat gain through glass windows and walls. Excessive hot air infiltration in air conditioned rooms with louvered windows;
h) Absence of a person responsible for energy efficiency matters in the Ministry;
i) Lack of energy conservation/efficiency awareness to workers; and
j) Absence of energy Policy for the Ministry of Education and Culture.

TANESCO

The HATCH report also reported a proposed TANESCO rural electrification programme, encompassing a one-year model programme on EE in which CFLs were to be distributed free of charge to customers. Normally, TANESCO connects customer with its own crews. Under the model programme, of which the implementation status is not clear, in addition to connecting the new customers, the six contractors would provide each household with four CFLs for free. TANESCO had technical specifications for the CFLs to ensure they are high quality. At the moment, this programme, funded by SIDA is the only proposed TANESCO energy efficiency programme planned. Again it is not clear whether it was implemented and why CFLs are not popular among Tanzanians.

Industrial Audits

In the mid-1990's, about 40 energy audits were performed on some of the largest industrial energy users, focusing mainly on motors and lighting. The donor funded TANESCO-Consultancy Services on Energy Rationalization & Demand Response in Tanzania through the World Bank's Energy Sector Management Assistance Program (ESMAP), identified 12MW worth of savings. However, according to a presentation by TANESCO officials in early 2010, the programme achieved a 25MW reduction in electricity demand. The reality is that there has been no formal measurement or verification of energy savings from the programme. The officials at TANESCO and MEM that were interviewed during the HATCH study (2010) stated that they have not heard about the audit recommendations being significantly implemented except some low cost operational measures at a few sites. Apart from TANESCO and MEM supporting radio advertisements encouraging energy efficiency and handing out pamphlets at trade fairs, the utility and MEM has not yet established a major demand and energy management programme even as it recognizes that such programmes could be cost effective for its power systems.

The Opportunity

In the HATCH study report (2010), a survey of several TANESCO customer groups was conducted in Dar es Salaam. It was revealed that there exist important potential for improvement of energy usage in Tanzania. This potential lies with a number of the types of end-use technologies reviewed. For example, there is a large potential for improvement in household lighting as there are still large quantities of incandescent bulbs used by

customers' homes. The efficiency of AC units was average and there is a good potential for improvement. Premium efficiency motors were generally reported not used in the country and there are still a large number of motor systems with variable loads that have not been retrofitted to variable speed drives. In the residential sector, appliances like refrigerators were often of low efficiency due to large numbers of old, inefficient units imported from abroad. There is also the potential for significant energy savings in many large industrial facilities. In addition, there are generation and co-generation opportunities at some of these industrial sites that could be put online to reduce the network peak load in exchange for financially compensating the generator owners. Some of these industrial customers could be potentially interested in programmes under which they would be compensated for shifting some of their operations to off-peak periods.

One of the rationales for TANESCO to implement EE initiatives is the financial loss that is currently incurred by supplying electricity at a lower cost than TANESCO's cost of service. The situation on the remote diesel mini-grids is much worse, since the cost of generation with diesel fuel is high but the same tariff structure is in place as for customers on the main grid.

Governmental leadership in energy efficiency and demand response

One of the most important factors required to ensure success of EE initiatives is a strong governmental leadership related to energy efficiency. Government needs to put in place the institutional framework as well as the enabling policies and structure required to coordinate and provide the required impulse for energy efficiency activities. Specific support for energy efficiency and load reduction was expressed in the 2003 National Energy Policy. This document already provides sound directives on energy efficiency and can serve as a basis for the future directives and actions from the government, including the development of dedicated energy policy and instruments.

In several countries, government intervention was required to ensure that the development of sustainable energy efficiency programs and demand responses actions took place. Government usually determines who are the main institutions that will participate in the energy efficiency improvement efforts and which responsibilities will be devoted to each one. One of the most important types of support that needs to be put in place by the government is proper financing mechanism for utilities that develop and implement energy efficiency and demand responses initiatives.

The governmental support to energy efficiency can also include a wide range of policies and regulatory requirements, including a national energy efficiency law, energy use reporting, minimum energy performance standard regulations (MEPS), labelling regulation, investment fund for energy efficiency, the training for Energy Service Companies (ESCOs) and requirements for energy managers for large customers. This is only a limited sample of the initiatives that can be taken by government to support energy efficiency.

In the short term, subsidies could be the only feasible way to implement programmes rapidly and curb the demand and energy consumption growth. However, in the mid to long term, developing financial instruments to extend credit facilities for energy efficiency projects will be an essential component of the financing structure. In the long term, another interesting form of financing might be introduced through Energy Service Companies (ESCOs). The ESCO experience shows that, in several countries, it can contribute significantly to the development of an energy efficiency marketplace while creating job opportunities. A number of ESCOs are currently operating in developed countries and several others are already operating in transition countries. The

opportunities for Nationally Appropriate Mitigation Activities (NAMA) through the United Nations Framework Convention on Climate Change may be a suitable fund raising route for sectoral or economy wide initiatives as would the carbon markets that could return in the form of the CDM or a new market mechanism in the near future.

Demand and Energy Management

A financial mechanism is crucial since several energy efficiency and demand response initiatives make sense on a national level, but they incur losses for the utility that implements them due to the associated losses of sales as a result of energy and demand savings. The most commonly used mechanism is to allow for income related to the loss of earning to be allowed in the tariff. In some countries, the utility received a slightly higher amount as an incentive to realize the demand and energy management activities. In those cases, the utility makes additional profits by implementing demand and energy management programmes compared to the sales of electricity. Other mechanisms for funding could be provided directly from the government through the treasury or from some special taxation mechanism. In Tanzania where the cost of service is not fully recovered by TANESCO's tariffs, it is more challenging to try to increase rates/tariffs to finance energy efficiency activities unless there is provision from the regulation authority that stipulates that a portion of tariff increases must be devoted to the implementation of energy efficiency programmes.

2.1.6.3 Household energy use and potential for energy savings

In households, energy efficiency can be gained in all energy services. Perhaps the largest gains can be made in thermal energy services such as cooking, lighting and space cooling/heating. The efficiency gains that can be made are in using the right fuel for the service, using an efficient appliance, and in managing the energy service well. In the area of electricity, the management of demand for electricity is particularly important for the energy economy as the usage patterns affect the sizing of infrastructure, the required investments and the overall cost and price of electricity. Tanzania is at the beginning of examining the energy efficiency potential of its economy and this is crucial in its timing, as access to electricity is being extended as a national priority. The entire biomass energy value chain could do with policy and regulatory attention that could affect efficient charcoal production, biomass fuel distribution, biomass end-use and use as a contributor to modern energy access.

There have been programmes promoting efficient cook stoves and behaviour changes. Although government has supported these, they have largely been implemented by NGOs. In addition, the timescales and geographical scope of these projects remains limited and lacks continuity and technology performance standards.

Energy efficient cook stoves, efficient biomass ovens and efficient kilns, have been promoted by international bilateral and multilateral agencies while cook stoves have been promoted by a range of NGOs such as TATEDO, ETC, etc. TaTEDO estimates that between 2000 and 2006, the production and uptake of improved charcoal stoves was 1.2 million (TaTEDO, 2012). However, whether these are still in use, and what percentage are replacements for older stoves is unknown. In addition, there appears to be no independent monitoring and verification of their performance. Artisans and women's groups in the informal sector have been the main actors in the household energy efficient stoves sub-sector. There is now increasing interest

from the formal private sector to enter the stove market, and regulation would help in making such investments sustainable.

Air Conditioning

Air conditioning (AC) units are found in all markets including residential, commercial, institutional and industrial. The market is currently dominated by split systems that are gaining share over traditional window or through-the-wall units that were more popular historically. Over the last years, the gap between the average price of split systems and unitary air conditioners has been decreasing considerably thereby boosting the market share of split systems. The added advantage of flexibility in positioning external and internal units generally drives consumers to select split systems. The HATCH report on DSM (2010), reported that most units observed in the field and in shops in Dar es Salaam had an Energy Efficiency Ratio (EER) of 2.64, which is relatively low compared to high-efficiency systems found in other countries.

The HATCH report on DSM (2010), reports only two sites were found where central water chillers were used for a portion of the building. There is no information available about the total number of systems in the whole country, but AC equipment vendors estimate that there are less than 50 chilled water systems countrywide. Both systems were using screw compressors that were relatively efficient. In the residential sector, the penetration rate of AC equipment is very small. Only a few houses do have this type of equipment. The penetration rate of AC units in T1 tariff category consumer residential buildings is insignificant. On the other hand, HATCH report found no AC unit in any of the D1 consumer houses visited. Furthermore, the owners of the house indicated that the units were used only when they had guests at home. Consequently, the contribution of AC equipment to the residential sector peak load, and in particular the evening peak load, is probably very small.

In the commercial sector, the usage of AC is mixed. Small shops that have wall openings for display or frequent door opening usually have no or have very few AC units. Larger buildings such as hotels have split units for rooms and common space. The only exception was a single five-star hotel that had one central chilled-water system for the common space. The hotel rooms, however, were equipped with split AC systems.

Small and medium offices usually use split systems. Contribution of the commercial AC equipment to the evening peak is probably limited except for hotels where the occupancy profile and AC usage peak during the evening. Hotels could be an interesting starting point for the promotion of efficient AC units and perhaps solar water heaters as an ESCO activity.

In the institutional sector, the schools that were visited had only a few AC units for the administration office. Hospitals usually have a larger quantity of units. In the largest hospital in Tanzania, about 90% of the AC load is supplied by split systems while only one building was identified that uses a central AC system.

More Energy Efficient AC Options

The split systems constitute the majority of AC units in the country. In fact, there are several options to significantly increase the efficiency of those appliances. For most AC units on the market (window, split), efficiency is expressed as an EER. This is the ratio of cooling energy provided by the unit in BTU divided by the energy input in Watts. Better designed splits incorporating high-efficiency compressors as well as larger

and more efficient evaporators and condensers exist and can boost efficiency from a standard EER of 2.64 to an EER of 3.32.Furthermore, incorporation of the inverter technology boosts unit efficiency to an EER of 4.7 and even up to 5.6 when the best units are selected. If transformation efforts are introduced to bring units up to an EER of 3.5 in the market, a 30% efficiency improvement can be achieved. The additional cost of purchasing a high-efficiency unit is between about 25-40% in the current market due to a current low demand for such products.

Other options to increase AC unit efficiency may include using evaporator pre-cooling. These units have been on the market for several years but have had difficulty gaining significant share in the world market. This technology requires a reliable supply of clean and inexpensive water, a requirement which is not met in Tanzania with frequent shortages in water supply. As a result, this technology is not recommended in Tanzania. It is possible to increase the efficiency of medium-size chilled-water systems (in the range of 40 tons to 200 tons of refrigeration) by about 8%-10% by selecting units with more efficient compressors and oversized evaporators and condensers. Variable speed screw compressors are used very often in those units.

Decreasing the load required for ACs through the use of insulation, natural ventilation, shading, orientation and other passive thermal performance improvements is perhaps the most cost effective way of decreasing load requirements. This can be costly to retrofit, but more cost effective in new structures.

Barriers to energy efficiency improvements, as with other renewable and or high quality equipment are up-front cost increments to achieve life-cycle benefits, the small size of the market (i.e. economies of scale), awareness of benefits, technical know-how, availability of finance at the right time in project cycles, limited policy instruments (including rebates for verified efficiency gains), and lack of energy pricing signals that would affect efficient behavioural practices.

Refrigeration

The market of domestic and commercial appliances is dominated by low-cost used or new imported poor energy performance products. Many small shops sell used refrigerators that are shipped to Tanzania from countries that discard old and inefficient products. As for new refrigerators, a wide range of brands was found on the market with some of them being counterfeit. A number of better-quality models (e.g. efficiency class B, based on the European Union (EU) Standard) were also identified. However, they are more expensive than low-quality equivalent appliances whose efficiency level is unknown. There is no national database on the products sold in the market.

There exist in Tanzania abundance of imported household appliances, whose efficiency varies considerably. On the one hand, the highest efficiency models found locally are rated as A or B. These energy labels refer to an efficiency matrix used by the Minimum Energy Performance Standards (MEPS) and labelling regulations of the EU. Refrigeration appliances featuring an energy index of A or B are considered as efficient. On the other hand, many low-cost unbranded models are available on the market. Despite the lack of technical details found on those counterfeit appliances, it is assumed that the latter have a low energy performance when compared to standard-efficiency branded models. It is important to note that most refrigerators and freezers available in Tanzania originate from Asia (China, India, Japan, and South Korea), the Middle East (mainly from the United Arab Emirates), Europe (Germany, France, and Italy) and South Africa. It is estimated that more than 50% of the refrigeration appliance market is located in the city of Dar es Salaam.

Comparatively, it was found that most consumers of the D1 residential market sector are cost conscious when it comes to buying appliances. Based on the HATCH study report, there is high penetration of refrigerators and televisions in D1 tariff for residential households, which were typically old and second-hand. The penetration of energy efficiency products is low among consumers in this segment. The age of these refrigerators are often ten or more years. The HATCH report records a test using with an energy meter that indicated that the average refrigerator consumes about 235kWh per month, which is high compared to the estimated energy consumption of high efficiency models of similar capacity.

With regards to commercial appliances, it was noted that many soda machines are installed in Tanzania. Kwanza, the largest of the distributors, has 9000 of these machines in grocery stores and mini-markets in the country. According to Kwanza representatives, voltage fluctuations result in premature burn-out of the compressors.

Energy-efficiency models of refrigerators, washing machines, dryers and dishwashers are still insignificant in Tanzanian market.

Barriers to more efficient refrigerators

The small Tanzanian market for electrical appliances with limited control on quality makes it an interesting destination for the dumping of small consignments of substandard appliances from elsewhere. Hence a concern to achieve market transformation to more efficient appliances requires some management of the quality with respect to performance technologies that enter the country. The situation is one in which the market for larger electrical appliances is too small to warrant minimum performance standards and the achievement of compliance with these. Similarly market size is too small for local manufacture that could compete with grey or second-hand imports. However, this could change as universal access to electricity is achieved and with it increasing penetration of domestic appliances.

Moreover, voltage fluctuations may be an issue for a few appliances resulting in a reduced lifetime. A number of high-quality appliances have a built-in voltage stabilizer and are thus more resilient to voltage fluctuations. However, this additional feature makes the appliances more expensive and less attractive to customers. Therefore, consumers may be willing to pay more for a lower-efficiency appliance equipped with a voltage stabilizer rather than for a high-efficiency equivalent model that is less resistant to voltage drops. This situation should be taken into account when designing and implementing a DSM programme on refrigeration appliances.

Lighting

The HATCH report on Demand Side Management in Dar es Salaam (2010) observed that in the residential market, a large proportion of lighting is provided using incandescent lamps. However, the CFL penetration rate is becoming more significant as this class of lighting is used by approximately 30% (for D1 consumers) to 70% (for T1 residential consumers). Linear fluorescents of 18 W and 36 W are popular, accounting for approximately 35% of the lighting fixtures installed in residential buildings. It was noted through the household survey that many D1 consumers did use CFLs even though they were many times more expensive than incandescent. CFLs show significant penetration in all sectors and are available in a range of qualities. Low-quality units sell for a cheaper price and will generally fail before their quoted lifespan as they cannot sustain

voltage variations. Higher-quality units from recognized international manufacturers are also available, but their price makes penetration in the market low.

Linear fluorescent fixtures, the 18 W (2 feet) and 36 W (4 feet) fixtures are predominant in the market. Most fixtures use standard ballasts. Electronic ballasts are also becoming available with various levels of quality depending on their price. Several market actors mentioned that low-quality electronic ballasts are sold on the market.

All types of high-intensity discharge lamps are used for high-bay applications and exterior lighting applications. Fixtures with mercury vapour, metal halide and high-pressure sodium lamps are common.

Barriers to more efficient lighting

The natural substitute for incandescent lamps is the CFL or LED technology classes. A CFL unit can provide the same level of illumination as an incandescent bulb while consuming only one fourth of the energy. The CFL lamps found in local shops have a large range of qualities and prices. Some units from eastern countries sell for relatively low prices but several customers have reported that these units did not have a long service life, especially with the voltage fluctuation that is common in Tanzania. As far as linear fluorescent lighting is concerned, the replacement candidate for the current predominant 36 W (4 feet) lamp is the T5 lamp. Surprisingly, the 32 W lamp which has been commonplace in North America for more than 15 years is not available from local sources of supply. In North America, this technology has provided a cost-effective solution to bridge the gap between the 36 W lamp and the T5 unit. The 32 W lamp uses a better phosphor coating to provide the same level of illumination as a 40 W or a 36 W linear fluorescent while requiring less operating power.

The Light Emitting Diode (LED) technology increasingly available elsewhere in the world is still to make some significant market penetration in Tanzania outside of the PV solar lantern market where the low voltage LEDs usage is an increasing norm.

The main issue related to market transformation is the presence of low-quality and low-cost CFL units in the market. Bad customer experience with units that fail prematurely is spreading by word of mouth, which creates a barrier to further penetration of the technology. Education in the market is required so that consumers can recognize the value of higher-quality (although more expensive) products. The main barriers to linear fluorescent implementation are the absence of an intermediate technology (such as 32 W linear fluorescents with electronic ballasts) as well as the failure rate of T5 fixtures and electronic ballasts currently entering the market.

The T5 technology also poses different challenges when considered for a retrofit application. T5 lamps have a different length and socket than T8 lamps. As a result, they cannot be easily retrofitted in existing fixtures. Either the existing fixture has to be modified extensively, which implies important labour costs, or it can be replaced with a new fixture which makes the payback period in a retrofit application more difficult. No particular barrier was noted for high-intensity discharge fixtures. The metal halide and high-pressure sodium units that can replace the mercury vapour and quartz units are readily available in the market.

Other household appliances

The energy consumption generated by fans, entertainment appliances (radios, televisions, DVDs, etc.) and office equipment (computers, printers, fax machines, etc.) is not irrelevant. On the other hand, it does not justify a detailed assessment or the development of a DSM programme for those appliances. According to HATCH report of 2012, electricity consumption of these appliances varies between 5% and 25% of total electricity consumption in all audited segments. The report states that during day time, electricity demand in the D1 segment is mostly due to refrigerators, televisions and a few lights. Peak demand arises in the evening due to the combined use of lighting, televisions and radios. The night-time base load is very low and is mainly due to external lighting or refrigerators. Fans are seasonal and used mainly at night during the summer period (between October and February). In the T1 residential sector, the base load is mainly caused by cold appliance (air conditioners) consumption. The difference between peak load and base load in this segment is large as consumers use more lights during the evening. This creates an electricity peak demand early in the evening when refrigerators, lighting and entertainment system consumption add up.

The penetration of cooking appliances (such as ovens, microwaves, etc.) is relatively low in the T1 segment. Studies have shown low level of electrical cooking as supply variability and increasing prices have driven a back-switching to biomass based cooking. There is some LPG used for cooking but this remains a low and has decreased as prices linked global oil prices have increased. From 2001 to 2007, the proportion of households in Dar es Salaam using charcoal as their primary energy source has increased from 47% to 71%. Use of liquefied petroleum gas (LPG) has declined from 43% to 12%. In other urban areas, the share of households using charcoal for cooking remained at 53%, while the share of fuelwood use increased from 33% to 38%. The use of electricity for cooking is below 1%. (World Bank report and Policy Note (Environmental Crisis or Sustainable Development opportunity? 2009:) pp1, box 1.1). The penetration of electric water heaters and solar water heaters appears negligible.

Considering the lifestyle of T1 residential consumers, the average electricity consumption per inhabitant person is still much higher in that segment than in the D1 residential sector. Considering the diverse nature of T1 commercial consumer activities, it would be difficult to detail peak demand exactly. In general, the activities of most small and medium industries are primarily manual and do not require large quantities of electricity. As for restaurants and hotels under the T1 segment, electricity is mainly used for lighting, entertainment appliances and refrigeration. Typical T1 consumers record most of the daily electricity demand during day time when they are the most active. However, the electricity demand of hotels, restaurants and bars under the T1 market sector may be at its highest point in the evening when guests arrive.

Summary on key drivers for the energy efficiency

Efficiency improvements can be interesting for a range of reasons stated above. They include: reducing costs of energy services for users, reducing requirements for energy supply and distribution infrastructure, reducing energy payment arrears in metered or landlord owned structures, achieving least-cost energy planning requirements (if required by regulations), improving load factors, reducing emissions of pollutants and greenhouse gasses, etc. Below are a number of policy instruments that can be utilised for improving energy efficiency, but the key driver under traditional energy policy approaches is one of aligning the suppliers and distributors with achieving end-use efficiency improvements. This can be done through tariff setting measures that reward efficiency improvements or through sectoral, subsector or service related energy intensity targets with tight compliance monitoring, verification and reporting and serious penalties for not attaining these.

Awareness: It is clear from the above discussion that there are a wide variety of players that can contribute to barrier removal measures, who can also stimulate the drivers and thereby help the penetration of energy efficient technologies. A case in point is the strong competition between technology manufacturers that results in aggressive advertising campaigns. The advertising campaign in this example is the measure (stimulant), and the high level of awareness of energy efficient technologies, thus created, is the driver.

Decrease in technology price levels: A high level of awareness is usually not sufficient to attract private investment and guarantee market success. The general understanding of market mechanisms dictates that price of a technology is an important factor in its speedy penetration. Hence, one can assume that educational/promotional activities are important, even though, there should be other incentives, such as rebates of super efficient technologies, as well. Along with advertisement campaigns, the competition should lead to a decrease in the cost of the technology. Such reductions in prices can safely be assumed to lead to an increase in the sales of the technology.

Increase in energy prices: Cost savings in energy bills through reduced use of energy is one of the reasons for the decision to buy energy efficient equipment. A look at the electricity prices in developing countries over the past few years indicates that nominal electricity prices increased rapidly during the 1990s. In real terms, the price increase may be less, but it is still significant to affect purchasing and investment decisions. If there is a continuous and predictable increase in its price, consumers are more likely to be motivated to adopt energy efficient equipment to conserve electricity and heat.

Technology appeal: While analysing drivers, one factor that may be of worth considering is the 'smartness' of the technology. If the energy-efficient equipment gives an impression that it looks 'modern', 'appealing', and 'fashionable', there is a higher probability of consumers purchasing the technology. These non-economic motivations, in general, dominate the decisions primarily of high-income groups, for whom, technological appeal rather than practicality, is a major driving factor.

Non-energy benefits: Non-energy benefits are important drivers of energy efficiency. They accrue at the national level, e.g. via improved competitiveness, energy security, job creation and GHG reductions. From a consumer perspective, it is often the non-energy benefits that motivate decisions to adopt energy efficient measures. The benefits to the consumer through these measures include (i) improved indoor environment, comfort, health, safety, and productivity; (ii) reduced noise; (iii) labour and time savings; (iv) improved process control; (v) increased reliability, amenity or convenience; and (vi) direct and indirect economic benefits from downsizing or elimination of equipment.

Environmental Regulations: Environmental regulations, if well designed, can serve as a driver for investments in energy efficiency. In the absence of environmental regulations, the societal costs of electricity generation in the form of gaseous and particulate emissions, water use and other environmental impacts are not borne by the energy producer or by the consumer. Consequently, these actors do not see the true economic costs of their production and consumption decisions. Environmental regulations can force producers and consumers to internalize these environmental costs into the price of their energy goods and services in the form of increased environmental compliance costs. These increased environmental costs can send a price signal for increased investments in energy efficiency by making efficiency investments comparatively more

attractive financially. Not all environmental regulations are created equally, however. If an environmental regulation simply mandates that an industry install a particular pollution control device, then the industry's response will be to seek ways to minimize its cost of compliance with the pollution control requirement and the price signal for efficiency investments will be muted. Once the pollution control device is installed, there will be little incentive to improve the efficiency of the overall production process. If, on the other hand, the environmental regulation uses market mechanisms to reward industry for reducing emissions through, for example, tradable permits, certificates or carbon credits, then the industry would have the incentive to improve the efficiency of and continuously improve its manufacturing process and potentially turn the environmental regulations into a source of profitability. A more efficient manufacturing process would naturally follow.

The challenges include the following:
In biomass there is potential for efficiency gains in the preparation, distribution and use of fuels. However, biomass energy policy is not in place, and hence the sector is unregulated, not organised and therefore difficult to penetrate. There are significant gains to be made in the making of charcoal and in the use of efficient biomass in stoves, but no standards exist. There is, however, methodologies in the carbon markets that could stimulate uptake of efficient stoves and more efficient charcoal kilns, and even the growing of biomass fuel crops. In general, engagement in the biomass as a national asset that could contribute to the vision of a modern energy economy needs to be developed amongst policy makers, for policy instruments to effect efficiency gains specifically and biomass resource management generally.

In electricity the variability in quality and availability appears to be the main concern of productive sectors that depend on it before they consider efficiency practices. Pricing signals in tariffs that result in system load management will need to be developed into the future along with other demand side management measures that reward good management. Allowing generous reward to the utility in advancing efficiency by allowing for cost recovery and more through tariff negotiations with energy regulator would be a good step in securing supply and stabilising costs and prices and genuine efficiency ambition by the utility. Efficient appliances and passive measures need to be promoted by government, and measures need to be put in place to protect the economy against the dumping of low efficiency new and used appliances.

Specific work on boilers, motors, lamps, ACs and refrigerators as well as promotion of the least-cost fuel/appliance combinations for the energy services to the energy economy would be worthwhile – such as solar water heaters in place of electric water heaters. Rebates for efficient practice, sectoral benchmarking, Minimum Energy Performance Standards, improved thermal performance of structures, comparative labelling and ESCOs all have merit into the future. In summary some challenges existing in the energy efficiency subsector include:

- Technological challenges
- Economic challenges
- Risk/uncertainty challenges
- Social challenges
- Political challenges

2.2 RENEWABLE ENERGY vis-à-vis GOAL OF SE4ALL

2.2.1 Overview and Assessment

Tanzania is blessed with high quality renewable resources, largely untapped. They include hydro, geothermal, solar, wind and biomass. According to MEM, presently about 6.5% of total generation capacity in Tanzania is from renewable energy, including captive generation in sugar, tannin and sisal factories, solar, and small hydro plants, but excluding large hydro. The Government of Tanzania has a goal to increase the share of renewable energy (excluding large hydro), in the electricity mix to about 14% by 2015. When large hydropower is included, the total renewable energy generation capacity is about 40%. A summary of renewable energy potentials in Tanzania is provided as Annex 4.

Hydropower

The total unexploited hydropower potential in Tanzania is estimated at 4500MW. This includes cost-effective potential in Ruhudji (358MW), Rumakali (222MW) and Songwe River (more than 300MW) (TANESCO, 2012). A Hydropower Development Master Plan was develop to guide cost-effective selection of potential sites for hydropower. In addition, a number of feasibility and pre-feasibility studies have been conducted on various sites and there is public and private interest in developing some of these. Key challenges to hydropower potential for developers include access to finance, and permits required before site development. The private sector for example cited excessive delays – of up to one year in some cases – in decision making over water permits.

The Global Village Energy Partnership (GVEP), with support from the World Bank and the Russian Federation are supporting a programme to assist with capacity building on feasibility studies, impact assessments and business plans for potential developers. Over 6 mini-hydro sites are under consideration for further development.

The assessed potential of small hydropower resources (up to 10MW) is 480MW. The MEM is currently carrying out small hydro feasibility studies in eight regions of Morogoro, Iringa, Njombe, Mbeya, Ruvuma, Rukwa, Katavi, and Kagera. GVEP International, in partnership with REA is supporting the development of six mini hydro mini-grids with total capacity in the 7.4-8.8MW range. EU is financing the Yovi Hydro Power project and Sustainable Community-Based Hydro Power Supply; and UNIDO co-funding the development of six mini-grids based on mini/micro hydropower. REA have identified more than 60 small and mini-grid sites for which developers are sought.

Geothermal

Development Partners have shown interest in supporting the geothermal sub-sector. DFID and JICA have expressed interest in supporting the preparation of the Geothermal Development Roadmap. The German Government, through BGR is supporting capacity building and resource characterisation. Tanzania is a partner in the ARGeo project to support geothermal development in the Rift Valley countries. A company, Geothermal Power Tanzania Ltd. (GPTL), partly owned by the Tanzanian National Development Corporation has begun shallow well drilling in Mbaka. The Climate Investment Funds through the Scaling-up of Renewable Energy

Programmes (SREP) have provided grant finance for the development of geothermal energy and renewable energy mini-grids in Tanzania. The SREP resources are being utilised to leveraged private investors and other funds advance geothermal energy in Tanzania where a number of promising sites exist.

Wind

Several areas of Tanzania are known to have promising wind resources. In areas where assessments have been conducted to-date, only Kititimo (Singida) and Makambako (Iringa) areas were identified to have adequate wind speeds for the grid scale electricity generation. The wind speeds average 9.9 m/s at Kititimo and average 8.9 m/s at Makambako, both measured at a height of 30 metres. According to REA presentation at COSTECH in March 2013, REA in collaboration with TANESCO are conducting more specific wind resource assessments in Mkumbara (Tanga), Karatu (Manyara), Gomvu (Dar es Salaam), Litembe (Mtwara), Makambako (Iringa), Mgagao (Kilimanjaro) and Kititimo (Singida). REA is supporting wind measurements at Mafia Island (Coast region). MEM and TANESCO will be conducting wind resource assessments in Usevya (Mpanda). In addition, in Makambako area, the government, with NORAD's support are assessing the possibilities of a wind park with 100MW capacity (NORAD, 2009).

Existing total wind potential is not well understood and had not been exploited. Exploration of wind resources for grid and off-grid electricity has started, but is still in its infancy.

Apart from electricity production, there is also potential for harnessing wind for water pumping to support irrigation and drinking water supplies. Although the country has a long history of wind pumps with installations across the country, the majority of these are in disrepair.

Solar

Tanzania has high levels of solar energy, ranging between 2800 – 3500 hours of sunshine per year and a global radiation level of 4 to 7kWh/m^2/day. Solar resources are especially good in the central portions of the country. This makes Tanzania a suitable country for the application of solar energy as a viable alternative to conventional energy sources if efficiently harnessed and utilized. Both solar PV and solar thermal technologies are in development in the country.

To date, it is estimated that about 3MWp of solar electricity has been installed countrywide for various applications in schools, hospitals, health centre's, police posts, street lighting and households. More than 50% of the capacity is being utilized by households in peri-urban and rural areas. The Government is committed to implementing modern energy access by carrying out awareness and demonstration campaigns on the use of solar systems for domestic and industrial use, as well as supporting direct installation in public institutions.

Tanzania, like many other African countries gives priority to the dissemination of PV technology as one of the potential renewable energies for solving rural energy problems and reduction of heavy dependence on biomass-based and hydrocarbon fuels. In 2004, the Government of Tanzania in collaboration with UNDP/GEF implemented a solar PV project called "Transformation of the Rural Photovoltaic Market in Tanzania". The aim of the project was to remove barriers to wide spread utilization of PV to provide basic electricity services to rural Tanzania, thus improving the balance of payments by reducing the country's dependence on imported fuels (kerosene, diesel and petrol). Initially the project focused in Mwanza Region, but following the lessons learnt and experiences gained, has been replicated in other neighbouring regions (Shinyanga, Mara and

Kagera) since 2007. Further, in 2006 SIDA/MEM implemented a solar PV project focusing on increasing markets for solar PV equipment in 14 regions on the Tanzania mainland.

In recent years, demand and installations of solar products has increased and the market is estimated to grow at 20% per year. While the sub-sector is still dependent on donor and NGO projects, the private sector and demand from individual households are growing as important actors, thereby creating the potential for a sustainable market. Recent years have seen an increase of social entrepreneurs selling increasingly robust and durable solar lanterns able to charge phones and power radios.

Public service facilities such as rural health facilities, offices and schools are the main targets for solar products for lighting, ICT and water pumping. REA, through the Lighting Rural Tanzania programme has funded 9 projects related to solar lighting to the value of US$882,542 (REA, 2010). The projects include installations of solar PV, solar entrepreneur development, creation of revolving funds and credit facilities. Parallel to this, are efforts by TEDAP to install over 8000 PV systems in private and public spaces under the Sustainable Solar Market Packages Project.

Solar water heaters are another technology, which can provide much needed thermal energy while reducing energy bills in households, hotels, businesses and public services institutions such as education and health facilities. Solar water heaters can also reduce heating demand and hence reduce load on the electricity network. Given the current high costs of generation from thermal plants that use imported oil, the development of solar based electricity generation is increasingly an economically feasible option. Concentrated Solar Power, despite its high initial costs could in the long run have lower input costs.

Biomass energy

The contribution of biomass to Tanzania's primary energy is more than 85% and it provides for more than 90% of rural household energy needs. The main sources of biomass for Tanzania include charcoal, wood fuel and agricultural waste. In particular, wood fuel has been utilized extensively across the country and institutions like prisons, schools, clinics and hospitals in Tanzania are using wood fuel as their main fuel. The majority of small and medium enterprises such as hotels, food vendors and small-scale processing facilities also use biomass resources as the primary source of energy.

Biogas and waste-to-energy

Biogas activities in Tanzania go as far back as the 1970s, but for several reasons have never been sustained. SNV estimates that there is potential for domestic biogas for up to 165,000 households particularly in Kilimanjaro, Mbeya, Iringa and Ruvuma are the areas with the most potential (SNV, 2007). DGIS through SNV, Hivos and the African Biogas Partnership are the main partners in biogas dissemination. The Tanzania Domestic Biogas Programme (TDBP) aims to install 6,750 biogas units. The Centre for Agricultural Mechanisation and Rural Technology (CAMARTEC) is the national agent for the programme.

Initial investment for biogas units are however high, and can range from US$800 to US$1700 (SNV, undated, PACE, undated). Although a US$100 unit has been introduced in Tanzania, its performance is not yet known. In addition, where units are sensitive to waste water, they can impose extra water collection burdens, particularly for women.

Waste-to-energy initiatives also have possibilities for energy generation. UNIDO and UNDP have already supported the use of waste from sisal processing for energy. Under the initiative on rural energy for productive use, biogas from sisal waste used to generate 300kW of electricity (UNDP, 2012). This electricity used for sisal processing and excess is distributed to residential areas on the estate. Other potential areas of harnessing waste-to-energy potential include abattoirs, municipal waste, and waste from institutions such as schools. The Global Environment Facility has also supported various biogas projects between 2001 and 2004.

Cogeneration

Agro-processing and mining in Tanzania offer potential for cogeneration. Harnessing cogeneration potential would improve installed capacity but also contribute to improving the country's energy efficiency goals. The sugar industry has the most prominent possibilities, which include Kilombero Sugar Company, Mtibwa Sugar Estates Tanganyika Planting Company (TPC) and Kagera Sugar Company. In 2004, Gwang'ombe estimated potential for co-generation from the sugar industry only to be 99.4 GWh with future potential of 127.5GWh. Other co-generation potential exists in sisal processing, wattle processing and others.

2.2.2 On-Grid and Off-Grid Renewable Energy

Large Hydropower

Grid connected renewable energy systems are highlighted in table 1 under section 1.2.1.1 of this report. Other potentials not yet connected include those in section 2.3.1 above.

Small hydropower

The installed grid connected small hydro projects contribute only about 15MW. Most of the developed small hydropower projects are owned by private entities and are not connected to the national electricity grid. Five sites in the 300 to 8000kW range are owned by TANESCO and more than 16 are owned by faith-based groups and range in capacities of 15 to 800kW with an aggregate capacity of 2MW. More recently, under the SPP programme, the 4MW Mwenga hydro is supplying power to the nearby rural villages with excess being sold to TANESCO. The 300kW Mawengi hydropower plant is supplying electricity to an isolated community through its own mini-grid. An SPPA has been signed for the 7.5MW St. Agnes Chipole project in Songea. It will serve the nearby rural communities and sell excess power to TANESCO. TANESCO has also signed Letters of Intent for eight small hydro projects with a combined capacity of 40.9MW.

Solar photovoltaics:

To date there are no reliable data on solar PV systems connected to the grid. However there are reported initiatives to generate solar electricity in central parts of Tanzania for connecting to the grid.

Wind power

Tanzania is developing the Singida Wind project which aims to start with generating 50MW of power before increasing to 300MW. The total capital costs are estimated at US$123 million and it is expected to be operational by 2013. So far, four companies have shown interest in investing in wind energy, namely Geo-Wind Tanzania Ltd and Wind East Africa, both in Singida Region; Sino Tan Renewable Energy Limited and Wind Energy Tanzania Ltd at Makambako in Iringa Region. These companies are considering investments in wind farms in the 50 to 100MW range.

Off-grid Solar Photovoltaics (PV)

To date about 6MWp of solar PV electricity has been installed countrywide for various applications in schools, hospitals, health centres, police posts, street lighting, telecommunication small enterprises, and households. More than 50% of the capacity is being utilised by households in peri-urban and rural areas. The Government of Tanzania is carrying out awareness and demonstration campaigns on the use of solar systems for domestic and industrial use, as well as supporting direct installation in institutions. In order to make solar PV more attractive, the Government of Tanzania has removed VAT and import tax for main solar components (panels, batteries, inverters and regulators); this has allowed end-users to get PV systems at a more affordable price.

The Government of Tanzania, through REA, as well as various donors has supported a number of solar PV programmes targeting off grid areas where it is lower cost than using generators or kerosene for lighting. Among these are the following:

Wind systems

The Rural Energy Agency (REA) has installed a 10kW wind turbine at a girls' secondary school in 2010 (REA, 2010). A number of other small off grid wind turbines are also report in the country, but not coordinated for reliable citation. Other wind systems for non-electrical uses including water pumping are also reported in several central and Lake Zone regions of Tanzania including Mwanza, Mara, Singida, Shinyanga, Dodoma. Estimation by MEM on installed wind pumps in Tanzania in 2004 was about 200 units. Because of uncertain coordination no reliable data exist currently.

Hydropower

There is also uncoordinated use of insignificant number of hydro rams used for water pumping in Arusha, Njombe and Mbeya. The reported hydro rams in Njombe and Mbeya regions are providing water to communities with population 1300 and 1500 respectively with 17 to 12 water drawing points (AFREPEN Regional report on Non-Electric Renewable Energy, 2002). It is however, important to note that hydro rams technology is site specific. Such technologies could provide extra means for increased use of modern energy services in Tanzania if effectively promoted and disseminated.

2.2.3 Use of Renewable Energy Sources (RES) for Thermal Applications (Cooking and heating)

The large-scale utilization of biomass resources results in depletion of the major forest areas that are also the water catchment areas for the country. Inefficiently use of forest resources affect hydrological cycles (increased runoff, flash flooding, reduced infiltration, soil erosion, siltation in the dams), causing water shortages across the country. Modern use of biomass is being encouraged. This includes combined-heat and power generation from biomass residues or municipal wastes. Potential candidates are TPC-Moshi, TANWAT, Sao Hill, Mtibwa, Kilombero and Kagera sugar factories. Presently more than 35.5MW of electricity is being generated from biomass (bagasse and woody residues), and about 30% of this capacity is connected to the grid. It is expected that more power will be generated from other factories that expect to engage in biofuel.

Biomass resources are a major contributor to Tanzania's energy consumption profile. It is a critical energy source for households, agro-industries, the construction sector and small-scale industries such as road-side food retailers, fish smoking, distillation and beer brewing, bakeries and others. However, the current use of

biomass for energy is not sustainable due to inefficiencies of harvesting and production modes (e.g. charcoal and fire wood) and end-user technology and behaviour. Biomass energy is considered 96% non-renewable according to the UNFCCC. More information on biomass for cooking and heating in households is available in section 2.2.2 above.

The Government of Tanzania is attempting to address the use of biomass as a renewable resource through a number of initiatives. Key development partners in the sector include FINNIDA, DANIDA, GIZ, World Bank, NORAD, SIDA and the Swiss Development Cooperation (SDC). In 2010, MEM and EUEI partnered to develop a Biomass Energy Strategy (BEST) for Tanzania. SDC, through the World Bank, has also supported Tanzania with efforts to transform the charcoal sector into a more efficient and sustainable sector (World Bank, 2009). The World Bank is also supporting biomass briquetting as a sustainable alternative to charcoal. Further, the Rural Energy Fund is supporting the development of biomass gasification in Mafia Island (0.4MW) and biomass cogeneration in Iringa (2MW) and, through the Lighting Rural Tanzania Competition, a biomass gasification project in Nkurunga.

Bio-fuels

Bio-fuels potential in Tanzania include potential to produce ethanol from existing sugar factors as well as from new feedstock, use of Jatropha for biodiesel and other feed stock-based biofuels. Current entities engaged in biofuels development include:

- Diligent Tanzania Ltd – a Dutch company based in Arusha, contracting over 5,000 local farmers across Northern Tanzania to produce biofuels from Jatropha. An expected 10,000 ha of land will be used;
- FELISA – a Tanzanian-Belgian company targeting 10,000 ha of oil palm in Kigoma Region through smallholder out-growers and from a plantation palm;
- SEKAB Bioenergy Tanzania Ltd – a Swedish bioethanol producer targeting large-scale sugarcane production for bioethanol in Tanzania. It aims to acquire 22,000 ha in Bagamoyo District and several hundred thousand hectares of land in Rufiji District; and
- Sun Biofuels Tanzania Ltd – a UK-based company targeting 11,226 ha in Kisarawe District (WWF Scoping Report on Biofuel in Tanzania, 2008l).

The large amount of land being targeted for biofuels production is a concern although there appears to be no independent and definitive study of its potential effects either way. However, the case of Swedish Ethanol Chemistry AB (SEKAB) Bioenergy has attracted attention as it will affect over 10,000 villagers in 12 villages. Biofuel production which will largely be in rural, low-income area raises concerns over power disparities between large foreign companies (together with their local partners) and low-income villagers who might have little negotiating power or may be compromised by immediate survival needs, limited understanding of contractual obligations and promises of benefits that may never materialise. Further, findings of other biofuels projects show water and fertiliser requirements that are contrary to assertions that suggest that biofuels will grow in marginal lands and with little input from farmers. In addition, it is unclear whether the markets for these biofuels are local or international and the extent to which such configurations will contribute to local energy needs. Where there is an assumption that such biofuels will feed local markets, the supply and value chains, including availability and acceptability of appliances for biofuels remain unclear. However, a biofuels blending bill has been proposed. In addition, the government of Tanzania has developed biofuels development guidelines in an effort to ensure their sustainable production and use.

2.2.4 Use of Renewable Energy Sources for productive uses

Biomass and biomass residues are used in small industries as main or auxiliary fuel in textiles, cement, and other thermally intensive industries. It is also used for smoking of fish and curing of tobacco.

Solar passive drying is used for crop and fish preservation.

Solar mini grids for both consumptive productive uses are still limited but on the increase trend. It includes for oxygen generation required in fish eggs incubations, powering barber shops appliances and equipment, water pumping for communities, livestock, and irrigation, and telecommunication towers for communication purposes.

Wind mills are used in Tanzania for water pumping in several parts of the country including lake zone and central zone of Tanzania. They normally pump water for surrounding communities, livestock and irrigation purposes.

Hydro rams are also found in limited parts of the community, such as in Arusha and Njombe regions.

The challenge with productive uses of RE is coordination, follow-ups and documentations sharing of experiences and possible replication. Technical know-how is another valid challenge of most Tanzanians.

2.2.5 Consolidated summary: Problem statements with regard to energy access, energy efficiency and renewable energy.

The following problem statements summarise issues relating to energy access, energy effciency, and renewable energy extracted from section 2. Some cross-cutting issues exist and these are dealt with first.

1. General data availability and management is the starting point to develop well informed and targetted energy policy, strategies and instruments.

2. Policy makers need to become aware of the international finance available for low carbon energy solutions available to Tanzania and utilise it to support a technological leapfrog in low carbon energy access.

3. Institutional and policy reform is required to streamline policy implementation to achieve sustainable least-cost energy solutions in Tanzania.

Energy Access:

1. Access to electricity is being undertaken rapidly albeit at a slower rate than what is required to reach access targets. Acceleration of access will be required if targets are to be obtained.

2. Acceleration will require mobilisation of grid, mini-grid and stand alone electricity sytems through upscaling and making accessible finance, technical skills and institution capacity to deliver.

3. Delivery through TANESCO, REA/REF, NGOs, IPPs, agribusinesses businesss, co-operatives and social entrepreneurs will all need to be supported if targets are to be met.

4. Informed decision making by energy users to select energy technolofy and access solutions needs to be acceelarated to harness ownership, sustainability and efficient behaviour at the time of access.

5. Access will be achieved but affordability beyond the poverty tariff for households will be limited further stressing cost recovery.

6. Efficient biomass cookstoves and charcoal kilns require promotion once there is an agreed definition of what an effciient stove or kiln is and how this will be incentivised and regulated.

Energy Efficiency:

Prior to interest in improving electricity efficiency, reliable supply must be secured.

1. Energy effciiency in modern energy has not yet been attempted. An exception in industry is in Tanzanian Breweries which could provide a useful affirming demonstration of what is possible using benchmarking targets (xkWh/kilolitre of beer). Examples exist in portable and institutional biomass cookstoves which can also provide affirming demonstrations of such measures.

2. The 2003 Energy Policy has a number of references to energy efficiency which could serve as a basis for dedicated energy efficiency policy and/or energy efficiency policy development.

3. Energy Eficiency policy and/or startegies will need to explain the full range of policy instruments for achieving verified efficiency gains, procure efficient equipment, undertake efficient urban/industry/transport/dwelling structure designs, and build awareness, capacity, and standards. Instruments could include: energy pricing, rebates on efficient equipment, relaxation of rebates or taxes, rapid depreciations for tax purposes, relaxation of import duties for certain classes of energy efficient equipment (variable speed drives, efficient boilers, efficient HVAC systems, LED lighting, thermal insulation material, high efficiency motor vehiclesetc.), etc.

4. Efficient biomass cook stoves utilising carbon finance can be accelerated if CDM DNA promotes biomass saving initiatives.

5. There are requirements for energy performance standards and labelling programmes and promotions of these amongst users.

Renewables

1. Renewables are included in the 2003 energy but dedicated renewable energy policy does not yet exist.

2. Some renewables energy policy strategies and instruments exist for the inclusion of renewable energy in grid connected and standalone applications but these are not technology specific rather generalised offers to offset conventional grid and offgrid sources.

3. While TANESCO is illiquid, guarantees for investors wanting to feed into the grid, need to be in place.

4. Geothermal energy requires dedicated energy and mining policy and regulatory support in its formalisation.

5. Renewable biomass energy requires inclusion in the modern energy paradigm vision for it to be regulated. Modern biomass from fuel crops and agricultural residues will attrect investments if formalised.

6. Standards for renewable energy equipment, codes of practice for practitioners and compliance regimes are required if the renewable energy sector is to be established and grow in Tanzania.

7. Financial institutions need experience and technical capcity to appraise loans and extend access to dedicated concesionary finance for renewable energy technologies.

2.3 SE4All goals

The SE4ALL is UN Secretary General's initiative launched in September 2011.The initiative aims at ensuring universal access to modern energy services, doubling the rate of energy efficiency and doubling the share of renewable energy in the global energy mix by 2030.

This important initiative comes at a time when the Government of Tanzania is making efforts to implement a number of actions to reform the energy sector including upgrading and expansion of energy infrastructure. The core challenges that the country faces are related to energy management, in terms of conservation, efficiency in production, transmission and usage. Modern energy access timelines align with national development plans and strategies.

2.3.1 Energy Access

The energy access goals of the Tanzanian government are somehow in line with the UN's goals for Sustainable Energy for all; although not necessary completely aligned. The government has put in place a range of goals and targets for energy access. In the short term, the Government of Tanzania plans to achieve 30% access by 2015 and a goal of 75% access by 2033. Access goals as per SE4ALL for other middle years are not very popular in the sector. Tanzania's energy access target is within a realistic but transformational range required by the UN SE4All initiative, within the constraints of its socio-economic context. However the goal is below the universal access target, which could be amended if human, institutional and resource constraints were reduced. The Tanzanian definition of modern energy access and how this links to electrification subsidy will need elaboration, for example is it exclusively electricity and which of grid, mini-grid, and standalone, does it include?

The biggest gaps are in the energy efficiency and renewable energy goals where specific targets and strategies are still limited; more specific mid- term targets could also be popularised and more focused initiatives and actions to achieve them widely communicated.

Initiatives to achieve the targets for access gas indicated in the 2012/13 MEM budget include:

- Increasing generation of energy, utilization of capacity and coverage - specifically double power generation capacity in order to enhance power availability, and reliability by 2015;
- Developing new power plants (hydro, gas, and coal fired) in order to increase energy access where distribution costs are prohibitive, especially rural areas;
- Promote public-private partnerships especially in IPP schemes;
- Promote rural electrification by supporting the Rural Energy Agency;
- Explore the expansion of oil, natural gas and coal's contribution to GDP;

- Collaborate in regional energy initiatives including SADC energy initiatives, the Southern African Power Pool (SAPP) and the Regional Electricity Regulators Association (RERA) to implement the SAPP Pool plan; and

  Increase electricity access in rural areas from 2% to 25% by 2013 (from 2006 baseline) and to 30% by 2015.

2.3.2 Energy Efficiency

Energy efficiency policy is included in the Energy Policy (2003) but without targets or policy instruments. The MEM is in the process of initiating energy efficiency policies. Consequently there are no clear specific targets on several relevant EE parameters in the productive use, cogeneration, waste to energy, ICS, efficient lighting, ACs, Motors, refrigerators, gasification as per UN proposed framework for Gap analysis. The only targets available for energy efficiency are related to uptake of energy conservation measures in industry (5%) included in the mid-term energy strategy (2011 -2016) and transmission and distribution losses of TANESCO. The latter has embarked on a Loss Reduction Programme that aims to reduce losses from 21% in 2008 to 14.6% by 2014 (Ministry of Finance and Economic Affairs (MOFEA), 2011; Ridgway Capital Projects Limited, 2010). TANESCO has also partnered with Statnett of Norway in an effort to improve its performance through knowledge exchange. Clear target for achieving energy efficiency for various potential technologies and services would have assisted the Government of Tanzania to focus its strategies.

Initiatives planned to achieve energy efficiency in Joint Energy Sector Review (JESR) 2012, MEM midterm strategic plan and annual budget 2012/13 includes:

- Expand, strengthen, stabilize and reduce losses on the National Grid;
- Promote use of energy-efficient appliances and equipment, use of natural gas for industrial heating and domestic cooking;
- Promote energy saving technology, at household, industries, institutions, and community levels;
- Promote energy efficient and conservation as well as integrated environmental management;
- Put in place energy management system standards particularly for intensive energy users; and
- In order the Government of Tanzania to have more specific energy efficiency targets for 2015, 2020, 2025, 2030 which would allow for effective tracking of performance and results of strategies for same various sub-sectors, efforts are needed to categorize them well in advance.

2.3.3 Renewable Energy

There exists a clear blanket goal for renewable energy contribution in the energy mix. However, it is for midterm targets of achieving 30% contribution in the energy mix from 14.5% in 2011 to 30% in 2016. Other clear targets for the other years as per Gap analysis framework such as for years 2020 and 2030 are not popularised. Equally important contribution of individual RETs and services targets would help government focus more their strategies. Individual targets for wind, solar, hydro, and geothermal could strengthen and direct focusing of government and private sector in a sustainable manner. Initiatives planned to achieve renewable energy targets in JESR 2012, MEM annual budget 2012/13 and midterm strategic plan includes:

- Expand the exploitation of bio-fuel potential without compromising food security;
- Improve liquidity of TANESCO and formalize technology specific renewable targets and feed-in tariffs;
- Promoting projects which qualify for carbon credits through Clean Development Mechanism (CDM) or equivalent new-market or public sector window/s;
- Expanding renewable energies (solar, wind, mini-hydro and biogas) for off-grid areas;
- Increasing level of renewable energy in the energy mix;
- Strengthening REA rural energy portfolio;
- Formalizing and regulating the biomass energy sector and implementation of modern biomass energy programmes; and
- Introduction and implementation of geothermal activities.

Section 3: Challenges and opportunities for achieving SE4ALL goals

3.1 Institutional and policy framework

3.1.1 Energy and Development

3.1.1.1 Energy and Development Policy Framework

Tanzania's energy goals are broadly but not very specifically aligned to Poverty Reduction strategies. The main poverty reduction and development strategies in Tanzania are the National Development Vision 2025, MKUKUTA II (National Strategy for Growth and the reduction of poverty), Millennium Development Goals, and the Joint Aid Strategy of Tanzania (JAST). Within MKUKUTA II, energy is recognized as a key input to development including affordable and reliable energy services for (equitable) growth for Reduction of Income Poverty (cluster I), access to decent shelter and energy as contributing to the improvement of Quality of Life and Social Well-Being of the poorest and most vulnerable (Cluster II). Within Kilimo Kwanza – the government's flagship programme for the agricultural sector, energy is seen critical for enhancing efficiency in agriculture as well as enhancing food security through agro processing machines and irrigation pumps among others. Specifically MKUKUTA II broadly commits to cost-effective grid extension in "not-so-remote areas" and renewable energy and off-grid supply for remote areas. Within MKUKUTA II energy/electricity is listed as the first priority in improving manufacturing.

As early as 2003, in the National Energy Policy, Government of Tanzania reiterated its objective to reduce the dependence on fossil fuel for power supply and suggested development of renewable energy options. The Government of Tanzania was also keen to provide an impetus to both the geothermal and natural gas subsectors, in order to diversify its energy mix with clean energy sources. The Government of Tanzania has been instituting a range of energy sector reforms in order to create a legal and regulatory framework that is conducive to attracting investment in the energy sector. One key aim of these reforms was amongst others to attract private investment in order to boost modern energy supply and distribution and hence meet demand. The important policies and legislation governing the energy and renewable energy sectors in Tanzania include the following:

Energy and Water Utilities Authority Act 2001 and 2006: The Acts were promulgated to establish a regulatory authority – Energy and Water Utilities Regulatory Authority (EWURA). The Authority was empowered to amongst others: promote effective competition and economic efficiency; protect the interests of consumers; protect the financial viability of efficient suppliers; promote the availability of regulated services to all consumers including low income, rural and disadvantaged consumers; and enhance public knowledge, awareness and understanding of the regulated sectors.

National Energy Policy, 2003: The broad objective was to ensure availability of reliable and affordable energy supplies and use it in a rational and sustainable manner in order to support national development goals. This policy statement unequivocally stated the national commitment towards sustainable energy production and

use. Specific objectives includes: (i) enhance the development and utilisation of indigenous and renewable energy sources and technologies; (ii) adequately take into account environmental considerations for all energy activities, and (iii) increase energy efficiency and conservation in all sectors. The main elements of the policy are: The development of domestic energy sources, economic energy pricing, encouragement of private sector participation in the energy market, and enhancement of energy efficiency and energy reliability. Other key themes in the Policy include the development of a market economy for energy in the country, the institution of a clear regulatory regime for the energy sector to aid development, the rectification of unbalanced gender impact from inferior energy service, and the development of a clear financial regime for the sector, and balancing revenue generation and costs-of-service.

Rural Energy Act 2005 established the Rural Energy Board, Fund and Agency. It is responsible for promotion of improved access to modern energy services in the rural areas of Mainland Tanzania and through the Rural Energy Fund to provide grants to TANESCO for rural grid distribution investments, and to developers of rural energy projects and for related and consequential matters.

Electricity Act 2008: The Electricity Act established a general framework for the powers of the Ministry of Energy and Minerals and EWURA. It defined key parameters for EWURA's tariff setting criteria and procedures, EWURA's criteria for awarding provisional and permanent licenses, EWURA's monitoring and enforcement activities, a requirement for ministerial plans and strategies for rural electrification, dispute resolution procedures and a process for determining possible future reorganization of the electricity sector.

Public Private Partnership Act No. 18 of 2010: The Act sets out the responsibilities and obligations of the parties, penalties, remedies, financial management and control requirements, assistance available from public party, and dispute resolution. It established a PPP Coordination Unit within the Tanzania Investment Centre and a PPP Unit in the Ministry of Finance.

Policies and Legislation influencing biomass energy include the following: Guidelines for Sustainable Harvesting and Trade in Forest Produce 2007; New Royalty Rates for Forest Products 2007; Community-Based Forest Management Guidelines April 2007; Joint Forest Management Guidelines April 2007; Forest Act 2002; Subsidiary Legislation to the Forest Act 2002; National Forest Programme 2001; National Forest Policy March 1998; and Biofuels Guidelines 2010.

Environmental and land policy and legislation influencing renewable energy development include the following: Environmental Management Act, 2004; National Land Policy, Ministry of Lands and Human Settlements Development, 1997; National Environmental Policy1997.

Others policies and strategies include:

- Rural Electricity Master Plan 2006 (Study of Rural electrification of 2006);
- Power System Master Plan 2012;
- Electricity Rules for Standardised Small Power Purchase (SPP) Tariffs 2011 including SPP feed-in-tariffs; and
- Biofuel Guidelines 2011.

On the basis of the dynamism of the energy sector, several policies and strategies are under review and or formulation including the National Energy Policy of 2003 (under review), Renewable Energy (proposed), Gas Policy (under review), BEST (under development), just to mention a few.

There are several specific outcomes that have positive and profound impact on renewable energy and energy efficient developments resulting from these policies and legislation.

The first is the establishment of the Rural Energy Agency and the associated Rural Energy Fund. REA is the leading agency responsible for rural electrification as well as supporting the development of renewable energy to supply energy to rural communities. The Rural Energy Fund, with budget support from the Government of Tanzania, contributions from a surcharge on grid electricity sales as well as Development Partners co-finances rural and renewable energy electrification schemes implemented by TANESCO and the private sector. In addition, REA is the implementing agency for a number of donor-financed projects. REA is also preparing the Rural Electrification Master Plan and Investment Prospectus, which for the first time are taking a least-cost rural electrification planning approach that integrates grid and off-grid electrification options as well as renewable energy sources.

The second is the promulgation and application by EWURA of the Small Power Producers Programme, a system of regulations, standardized contracts and avoided cost-based non-negotiable tariffs pertaining to private small (under 10MW) renewable energy power projects to supply TANESCO grid as well as to enable these entities to supply electricity to isolated rural communities directly. EWURA issued Standardized Power Purchase Agreements (SPPA), Small Power Producer (SPP) tariff methodology and tariffs, interconnection guidelines and SPP implementation rules. These enable private entities to invest in renewable power projects for both grid-connected projects and isolated grids. Consequently, nine SPPAs have already been concluded with TANESCO, thus paving the way for further development of rural and small renewable energy generation projects. The SPP tariffs are updated annually, based on TANESCO's avoided cost.

Thirdly, the Medium Term Strategic Plan (MTSP) (2011-2016) and the Power Sector Master Plan reinforces the commitment towards collaboration with and encouraging the private sector to participate in development of energy sector using different renewable and fossil energy sources to ensure energy security in the country. Key interventions under the MTSP include "increasing power generation; developing alternative and renewable energy sources; and promoting energy efficiency and conservation".

3.1.1.2 Energy and Development Institutional Framework

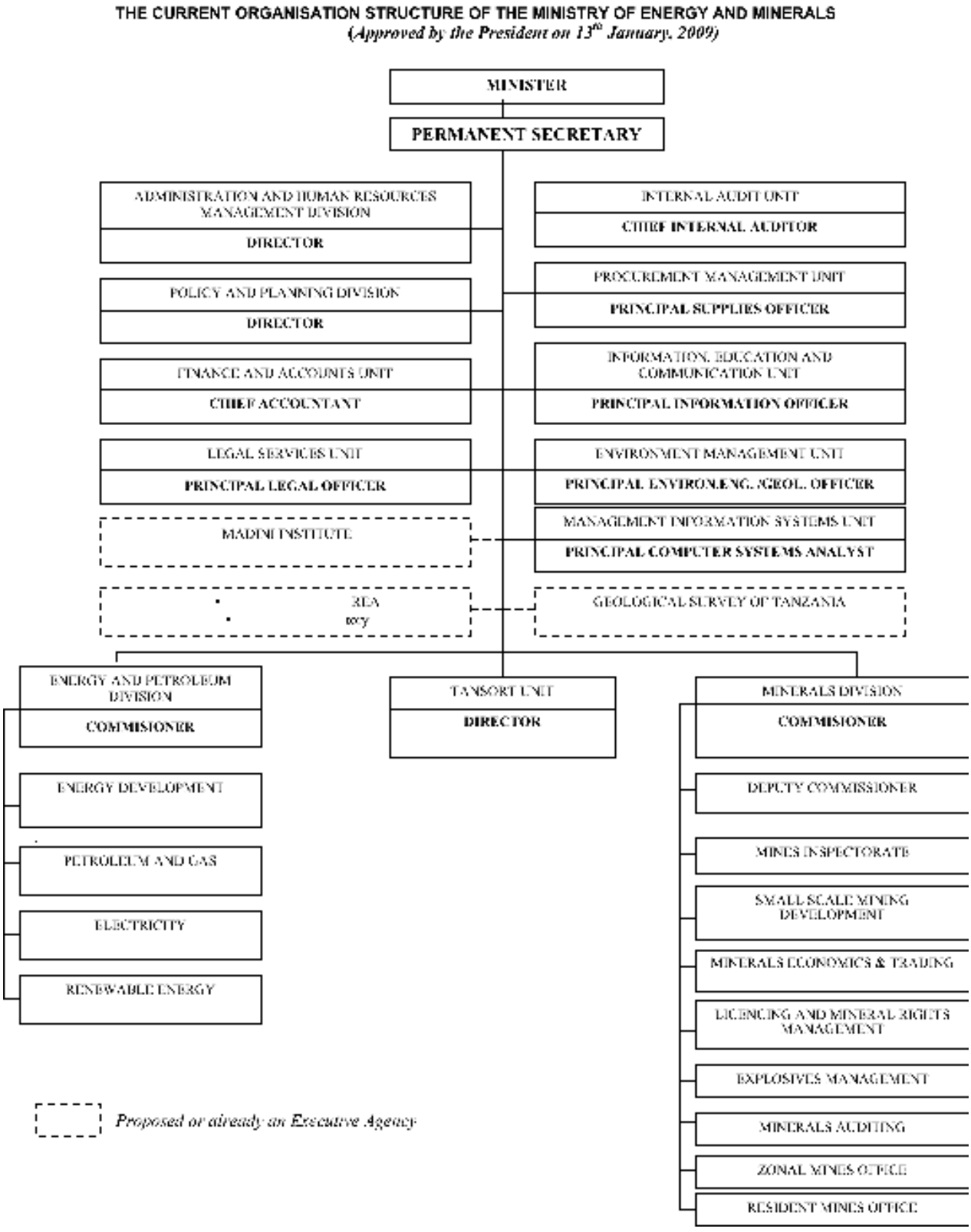
The energy sector in Tanzania comprises of various stakeholders, including national institutions, private sector operators, and non-governmental organizations. Figure 3 shows the institutional arrangements for Ministry of Energy and Minerals. Figure 4 shows the institutional framework for the electricity sector.

The Ministry of Energy and Minerals (MEM) is mandated to develop energy and mineral resources and manage the sector. It is responsible for formulation and articulation of policies to create an enabling environment for stakeholders. Promoting renewable energy is part of the MEM mandate. MEM plays an essential policy guidance role, complementing other players such as REA supporting rural grid electrification, leading off-grid rural electrification and development of renewable energy for the rural and off-grid sector; TANESCO as the principal electricity supplier and as the generator, transmitter, buyer of electricity from grid connected IPP and SPP projects, including renewable energy, and electricity distribution; EWURA as the

regulator; private companies and NGOs as developers, investors and operators of on-grid and off-grid renewable energy projects; and financiers as crucial providers of financing.

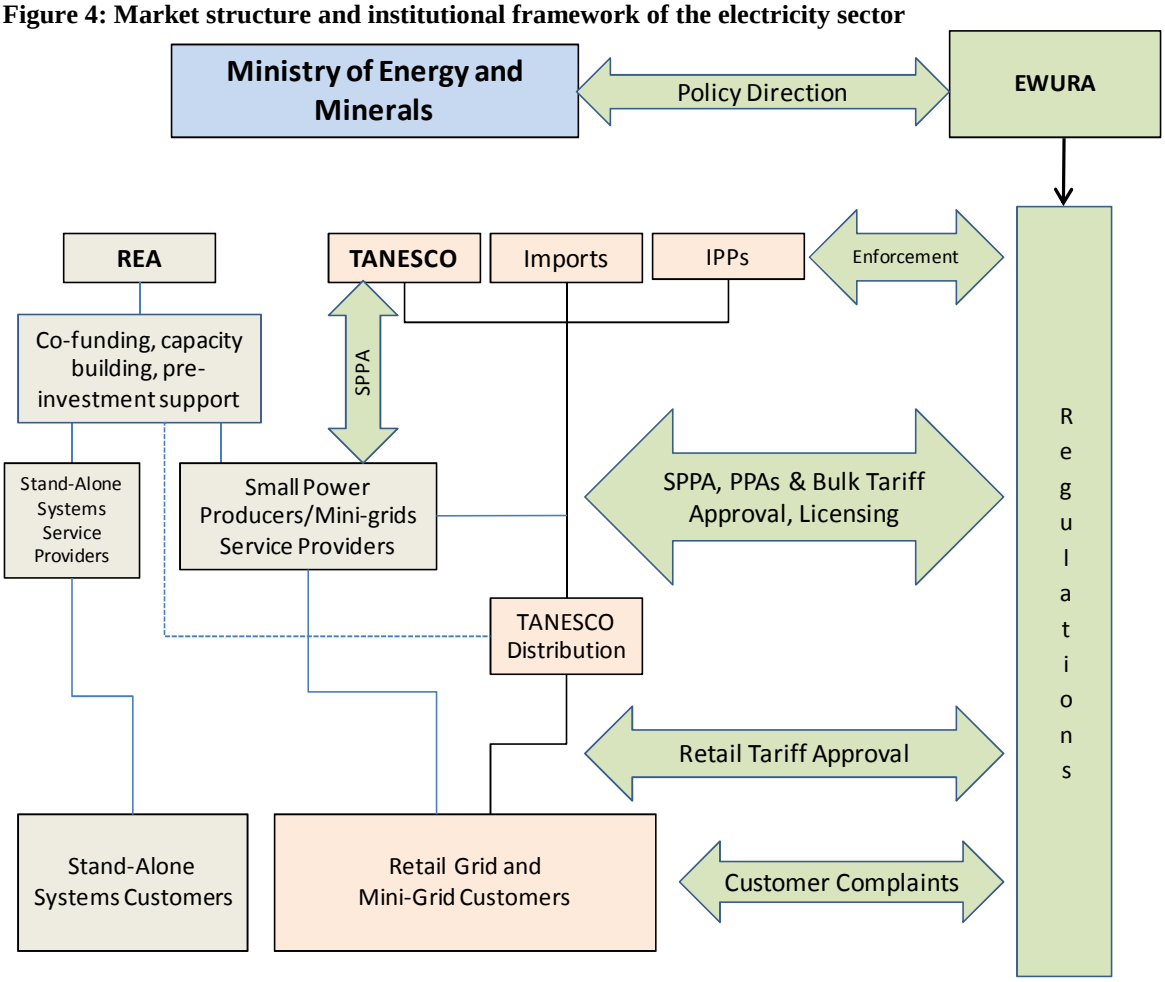
Tanzania is also a member of the SADC power pool and the East African Power Pool. It imports electricity from Zambia and Uganda. In the short term, it plans to import electricity from Rwanda and interconnect to Mozambique and Malawi and from Kenya in future to interconnect with Ethiopia.

Figure 3: Institutional structure of the Ministry of Energy and Minerals



Notes to Figure 3: Since 2009, REA has been formalized in the structure, as have TANESCO and Tanzanian Petroleum Development Corporation. Petroleum and gas section have been separated into two sections. EWURA is missing because is reporting through Ministry of Water. REA's role and functions are now formulated and TANSORT is a unit overseeing diamond trading. EWURA is not included as it reports through the water ministry.

Figure 4: Market structure and institutional framework of the electricity sector



The Rural Energy Agency (REA) is an autonomous body under the Ministry of Energy and Minerals; it promotes and facilitates improved access to modern energy services in rural areas of Mainland Tanzania. REA became operational in October 2007. The principal responsibilities are to: promote, stimulate, facilitate and improve modern energy access in rural areas, in order to support rural economic and social development; promote rational and efficient production and use of energy, and facilitate identification and development of improved energy projects and activities in rural areas; finance eligible rural energy projects through the Rural Energy Fund (REF); prepare and review application procedures, guidelines, selection criteria, standards and terms and conditions for the allocation of grants; build capacity and provide technical assistance to project developers and rural communities; and facilitate the preparation of bid documents for rural energy projects. REA's mandate excludes biomass energy for thermal services.

The Tanzania Electric Supply Company (TANESCO) is the principal electricity generator, transmitter and distributor and presently provides nearly 60% of the effective generating capacity of the national grid. TANESCO is a public company that is currently not recovering costs of its operations and the purchase of emergency electricity supplies. TANESCO, caught between the Government requirement of delivering on

affordable electricity and cost recovery, receives government subsidies to cover the shortfall between the costs of supplying electricity and income from sales and services.

The Energy and Water Utilities Regulatory Authority (EWURA) is an autonomous multi-sectoral regulatory authority established by the Energy and Water Utilities Regulatory Authority Act. It is responsible for technical and economic regulation of the electricity, petroleum, natural gas and water sectors in Tanzania. EWURA reports to Government through the Ministry of Water.

Universities, Research and Training Institutions: There are a number of universities and training institutions that build the human skills needed for the energy sector. These include, the University of Dar es Salaam, Dar es Salaam Institute of Technology, Mbeya Institute of Science and Technology, Arusha Technical College, and Vocational Education Training Authority (VETA). REA is working with VETA in training technicians. Sokoine University of Agriculture is working on biomass energy issues, including charcoal, through its Faculty of Forestry and Nature Conservation.

Private Sector

Supported by the Government's commitment to create and maintain an enabling business environment, Tanzania has a dynamic private sector that is also active in renewable energy development. The private sector has become a key contributor to economic growth particularly in the tourism, mining, energy, building and construction, transport and communication, agriculture, manufacturing, and financial sectors.

Independent Power Producers and Emergency Power Producers: currently six IPPs/EPPs (Symbion, Ubungo, IPTL, Symbion Arusha, Songas, Aggreko and Symbion Dodoma) are operating in the country contributing approximately 40% of the effective generating capacity to the national grid. There are several other private power companies in the process of developing large scale (hydro, solar, wind and geothermal projects).

Small Power Producers (SPPs): A number of private companies are engaged in small renewable power development under the SPPA to sell power to TANESCO and/or sell directly to retail customers. Many of these firms are already in rural areas in other enterprises such as tea, sugar, sisal, tannin, amongst others.

Non-Governmental Organizations: The Tanzanian Renewable Energy Association (TAREA) is an NGO that brings together stakeholders in the renewable energy sector to promote renewable energies in Tanzania. Tanzania Traditional Energy Development and Environment Organisation (TaTEDO) also a non-governmental organization, has been promoting access to sustainable energy since early 1990s. Others include Tanzania Engineering and Manufacturing Design Organization, WODSTA (efficient stoves promotion), Solar Innovations of Tanzania, AMKA Trust, and CARE-Tanzania. For a complete list see TAREA directory.[5]

Though, not specifically classified as a renewable energy organization, there are a number of faith-based organizations that utilize renewable energy to meet the rural energy needs of their communities.

Other Renewable Energy Providers: There are a large number of renewable energy equipment and service providers that engage in retail sales of products such as solar home systems, and offer design, installation and repair services. TAREA Directory is available for the list but also through their website www.tarea.or.tz. Social

[5] TAREA Directory, http://tarea-tz.org/index.php/membership/general-information

entrepreneurs with the backing of international foundations and charities are also selling portable solar lanterns and are looking into the possibility of doing the same with efficient cook stoves and water purifiers in the future.

Financiers

Tanzania's financial system includes a banking sector with more than 20 commercial banks that are, with support from development partners, increasingly looking at financing renewable energy and energy efficiency opportunities. With the advent of the Small Power Programme, the World Bank established a US$23 million line of credit under TEDAP, accessible through commercial banks, finance renewable energy. The credit facility is managed by the Tanzania Investment Bank and supported by REA. REA also uses part of REF resources to support rural grid network investments.

Public sector financing to TANESCO is from the Government of Tanzania, REA as well as multilateral and bilateral lenders and donors. TANESCO also borrows from commercial banks for working capital. IPP, EPPs and SPPs bring their own financing, both equity and debt, some of it sourced externally. SPPs have access to the TEDAP credit line.

Stakeholders Feedback on RE Development

Key stakeholders[6] consulted during the Gap analysis consultation stage offered a number of important suggestions regarding the priorities to be addressed, the types of activities to be undertaken and the policy and regulatory directions to be followed.

Among them were the providing clarity on the renewable energy strategy and the role of the private sector, streamlining processes for project development, renewable energy tariff setting, covering payment risks by TANESCO and other off-takers, and the need to improve credibility, comprehensiveness and access to renewable resource data.

Stakeholders also noted the importance of formalizing the biomass sector. They are not comfortable with the current situation where the overwhelming majority of energy consumed in Tanzania is left in the informal sector. Deliberate efforts are required to tap the otherwise lost government income in the biomass sector. The revenue services argue that they are not keen to tax very poor people, however, there are places in the value chain where tax could be applied. The current budget of biomass is less than 1% of the total MEM budget. Many argue that this should be increased. At least 10% should be allocated for biomass energy development. Equally important, efforts should be made to forge strong working relations between MEM and MNRT where the source for biomass belongs to effectively engage with the biomass energy sector in an effort to formalise its contribution to modern energy access.

Other inputs included developing a Geothermal Development Roadmap. A legal and regulatory framework for geothermal development is needed as the Mining Act, which governs the award of licenses for geothermal

[6]Private sector consultations were held in January 2013. Geothermal sector stakeholders' feedback was obtained during the Geothermal Legal and Regulatory Framework Workshop on hosted by MEM, AfDB and DFID in March 2013. SREP IP consultations were held with a broader group of stakeholders including private sector, NGOs, financiers and other government agencies during the SREP Joint Mission in March 2013. Regional Energy consultations were conducted in March 2013 in Dar es Salaam as part of the global initiative Post-2015 World We Want.

resource development, but this may not fully suited to geothermal energy. Increasing human skills and institutional capacity is needed for geothermal sector governance, and resource development, is urgently needed. The stakeholders recommended to MEM that it would be more effective if geothermal development policy was made the responsibility of the Energy Department in MEM, rather than the Minerals Department.

EWURA based on the Energy Water Utility Regulatory Authority Act [Cap 414 R: E 2002] stipulate its duties as:

> It shall be the duty of the Authority that in carrying out its functions it shall strive to enhance the welfare of Tanzania society by *(a) promoting effective competition and economic efficiency; (b) protecting the interests of consumers; (c) protecting the financial viability of efficient suppliers; (d) promoting the availability of regulated services to all consumers including low income, rural and disadvantaged consumers; (e) enhancing public knowledge, awareness and understanding of the regulated sectors including: (i) the rights and obligations of consumers and regulated suppliers; (ii) the ways in which complaints and disputes may be initiated and resolved; and (iii) the duties, functions and activities of the Authority; (f) taking into account the need to protect and preserve the environment.*

Therefore this is an avenue where by individuals and civil society organizations can use their constitutional right to claim consultation on energy the information on energy and also access to energy.

Section 23 of EWURA Act (Cap 414 R: E 2002) it clearly require consultation with consumers, industry and Government. Section 23 (1) of the Act stipulates that;

> *The Authority shall, before the start of each year, establish an annual programme for consultation with such persons and organizations as the Authority may consider necessary or desirable to consult for the purpose of effectively carrying out its functions.*

This right for consultation is extended to consumers, industry and the government however when you look into it as per section 23(4) the consultation right is limited depending on the wish of EWURA it stipulates that; *For the purposes of this section, it shall be the duty of the Authority to establish and identify the persons, organizations and institutions to be consulted*. How EWURA deems which individuals/institutions to consult is not known.

The consultation report shall be submitted yearly as stipulated by section 23(2) of the Act 2) Subject to provisions of subsection (1), the Authority shall, supply a copy of its consultation programme to the Minister and place a copy on the Public Register. Further to that section 23 (3) The Authority shall include in its annual report, a report on the implementation of its consultation programme during the year covered by the report.

This is an avenue by both the constitution of United Republic of Tanzania and other laws specifically EWURA Act [Cap 414 R: E 2002] and Mineral Policy of 1997, hence the government is obliged to offer consultation on energy and the individual or civil society organization can demand this access.

There is no clarity on monitoring and enforcement, other than through the legislative assembly.

3.1.2 Thermal energy for households

3.1.2.1 Targets, policies, strategies and plans

There appears to be no specific targets and policies on thermal energy for households. However, aspects of household thermal energy are reflected in various legislation, policy documents and initiatives including Guidelines for Sustainable Harvesting and Trade in Forest Produce 2007; New Royalty Rates for Forest Products 2007; Community-Based Forest Management Guidelines April 2007; Joint Forest Management Guidelines April 2007; Forest Act 2002; Subsidiary Legislation to the Forest Act 2002; National Forest Programme 2001; National Forest Policy March 1998; and Biofuels Guidelines 2010, Environmental Management Act, 2004; National Land Policy, Ministry of Lands and Human Settlements Development, 1997; National Environmental Policy1997.

Development of a Biomass Energy Strategy for Tanzania (BEST) is in progress. BEST consultation team members point to an agreed biomass energy baseline as the primary output on which a strategy for transforming biomass energy into an asset that can contribute to the envisaged modern energy economy.

3.1.2.2 National institutions

MEM and the MNRT are the Ministries responsible with the thermal energy for households. EWURA, and Tanzanian Bureau of Standards on the other hand, are responsible with regulation of the energy sector, and household technology standards respectively. While tariffs for petroleum products and electricity are proposed by EWURA, biomass sources of thermal energy for households are unregulated. As presented above, the dependence on biomass for thermal services in households and other sectors of the economy, has resulted in deforestation and proliferation of inefficient technologies for both production of charcoal, transportation and marketing of biomass and inefficient end-use. The Tanzanian Forestry Services manages forestry in the country under the Ministry of Natural Resources and Tourism. Biomass energy policy oversight falls into the joint jurisdiction of MEM and MNRT. REA since its inception in 2006 has not been effective in the household biomass energy activities and initiatives.

3.1.3 Power Sector

3.1.3.1 Targets, policies, strategies and plans

MKUKUTA II articulates the government of Tanzania's aim to double power generation capacity in order to enhance power availability, and reliability by 2015. Already, a regulation to allow IPPs is in place including feed-in-tariffs for small power producers. The country now has 5 IPPs that can contribute to meeting its power sector targets and there is room for more. Other electrification targets include electrification rate at 30% in 2015 from the current rate at 18.4%, and 75% in 2035.

As part of efforts to balance energy demand and supply cost-effectively, TANESCO has also committed to reducing distribution and transmission losses (Table 9). Any savings from these losses could contribute to reaching more Tanzanians with electricity. It would also assist in TANESCOs financial performance and hence alleviating the need for abrupt rate hikes in order to meet cost of service.

Table 9: Historical, current and target distribution and transmission losses for TANESCO

Energy Losses	2008	2009	2010	2011	2012	2013	2014
Distribution Losses (% Energy Fed into MV Netwo	18.0%	19.7%	19.7%	18.5%	17.2%	15.9%	14.6%
Transmission Losses (% of Generation)	5.1%	5.3%	5.3%	5.2%	5.1%	5.0%	4.4%

Source: EWURA, 2010

3.1.3.2 National institutions

The mandate for regulating the power sector is with EWURA, which sets tariffs and is responsible for licensing power producers. The approach for attractive IPPs that TANESCO has taken has been positively rated (Partner, 2011, World Bank, 2010).

3.1.4 Modern energy for Productive sectors

3.1.4.1 Targets, policies, strategies and plans

Electricity is recognised as the number one priority in improving manufacturing capacity in Tanzania according to MKUKUTA II. Missing in the government's targets is the recognition of thermal energy and biomass energy in productive sector. Given the high level of informal entrepreneurs who are likely to have no access to electricity now and in the near future, this represents a missed opportunity for addressing energy in the productive sector. Efforts are necessary for the government to deliberately plan and put clear targets and plans for increased use of modern biomass productive uses in agro-processing including efficient barns used for curing tobacco leaves. Other similar requirements include a dire need of modern energy for productive use in fruits processing, crop conservation and food preservation processes. Clear strategies and targets are also very instrumental for planning and ensuring sustainable development of supply and use of modern thermal systems and services for heating and cooking in social facilities such as schools, hospitals, colleges and prisons, where inefficient biomass technologies are still employed for food processing, thereby leading to severe deforestation and Indoor Air Pollution (IAP) hazards. With proper interventions and targeting, financial savings, environment conservation, IAP improvement and income opportunities are possible. As such, both government and the private sector should explore and encourage efforts in that direction. Agro processing sector targeting could generate several opportunities for increased productive uses of energy such as cashew shells and cashew apples, in fact any agro process with significant residues could be used for industrial boilers heating, biogas and electricity generation. Equally important, rice husks, maize cobs and forestry residues (saw dusts, etc.) have the potential for increased supply and in turn access to modern productive uses.

Another area is that of small and medium enterprises (SMEs) development. A number of traditional use of thermal and biomass energy are still rampant in the SMEs operations. In the livestock sector, for example, SMEs involved in milk processing, on a large extent are still using traditional pasteurization methods including firewood for heating. Tanzania could improve SMEs milk businesses by improving modern energy access for such a sector in rural settings. It is worth noting that with proper planning some processes and interventions could complement each other. As an example, in the livestock industry, the same cow producing milk could also provide cow dung for biogas production, which in turn could further be used to provide heat for milk pasteurization. Biogas could also be used to generate power and lighting in rural areas, thereby reducing the rate of deforestation and improving access to modern productive use of thermal energy services.

3.1.4.2 National institutions

Critical institutions with capacity to achieve goals relating to thermal energy in the productive sector include TaTEDO, CARMATEC, Small Industry Development Organisation (SIDO) and the Chamber of Commerce. Entrepreneurs such as installers of solar water heaters and heat pumps can also play a role. The capacities of

these players, particularly on the production and installation are of varied quality. Capacities of these institutions, their coverage, allocated budgets for increased adaptive researches and dissemination of planned activities is another challenge if we need to make a difference in the subsector. The level at which information about these institutions is known to target beneficiaries and candidates are another nightmare. At least one energy institute in every zone of the 7 zones in the country, would make a difference in the energy sector at the local level. The competence to manage energy initiatives for energy access in public and private institutions and households in collaboration with REA/REF/MEM at district level also needs to be vested in officials at district level.

A special topic on productive use of energy in education institutes would prepare the young generation for productive use of energy for economic gains and poverty reduction initiatives.

3.1.5 National Monitoring for SE4ALL

3.1.5.1 Proposed Indicators

On energy access, there is no clear explicit picture on access and use of modern thermal energy in households, SMEs and in the agricultural sector. Also with the 2033 target of 75% electricity access, there appears no provision for ensuring that poor households will be especially targeted. Capacity to implement power sector projects is also limited as exemplified by the Ministries' below budget spending despite a range of opportunities.

On energy efficiency Tanzania lacks a national wide legal and regulatory framework for enforcing energy efficiency measures, though this may be elaborated in proposed and dedicated energy efficiency policy under programmatic development at MEM with assistance from SIDA and UNDP. In addition, there is lack of a concerted effort, including financial incentives, to promote energy efficiency measures such as solar water heaters to reduce the thermal demand on the grid in urban areas, hotels and commercial structures.

For renewable energy there is also limited information on how RE and EE installations are functioning especially where these are isolated grids or off-grid installations. Also given that off-grid and isolated installations seem to lack support services, there are no data on whether in the long run, it is more cost-efficient to have larger grids that are managed centrally (not necessary at national level) rather than off-grid installations whose management is left to individual households and villages that have little experience of managing technologies. Consideration of Integrated Rural Utilities that include electricity and thermal energy technologies and finance, may assist in sustainability in this regard. EWURA would benefit from such knowledge in regulating least-cost solutions. REA has commissioned some work on the costs of electrification in rural areas to understand what standards to apply and what subsidies to call for. It is quite clear that it will take a while to achieve economies of scale in driving the costs down.

Cutting across all these, there is almost no gender and socio-economic desegregation in the data. The following indicators are therefore proposed to fill these data gaps:

- Percentage of households using biomass only.
- Percentage of households using biomass for cooking while electrified.
- Respiratory infections attributable to solid fuel use.
- Percentage of households, SMEs and agri-businesses with access to modern thermal energy.

All indicators above should be disaggregated by gender and income quintiles.

Sectoral and sub-sectoral energy intensities will be worth tracking to understanding and incentivising progress in achieving energy efficiency. Likewise contributions of renewable energy to the energy economy including the identification of renewable biomass and hydropower need special attention and longitudinal monitoring to understand the efficacy of energy systems and learn from what works and what doesn't.

Energy resources mapping and comprehensive baseline studies (with comprehensive indicators and regular time table) on modern energy access, EE and RE for the entire country is necessary in order to be able to track changes and impacts emanating from specific interventions at regular intervals. Such baseline data should indicate the level of every individual technology development, uptake level, key actors, challenges, threats, weaknesses, opportunities and strengths. When monitoring, it should be easier to quantify changes, which has happened after a certain period of interventions on the baseline individual parameters aforementioned.

It is further worth noting that there is no monitoring entities at the district and local level on energy in general, including on access, RE, and EE. Monitoring of energy parameters as such is always done in relation to a specific requirement of a project and is not necessarily addressing the requirement comprehensively. Efforts should be made to establish monitoring entities and or agencies for energy sector development in the entire country. Nomination of by communities of users of energy advisors in every village could provide updated information of energy sector development in each village, ward, district, and eventually updated figures at the national focal point, preferably MEM or REA or with industry bodies, such as TAREA. It is easier for village energy advisors to provide realistic updates of energy access in their villages, which, with district level coordinators on energy, could compile the same and at the end lead to national annual updates.

It is important noting that indicators for energy sector development might need a monitoring officer with a good knowledge and understanding on energy issues. This leads to another requirement of building capacity of planning officers and other monitoring personnel to be able to establish monitoring indicators that will display a comprehensive picture of the industry. As such, capacity in monitoring energy sector issues needs to be built and resources to undertake regular monitoring allocated. Village executives and/or District Executive Directors could also be capacitated to be energy advisors and oversee the updating of energy statistics in their respective villages/districts including how many people have access to amongst others: electricity, use fire wood in cooking, use biogas, use charcoal, and kerosene.

3.1.5.2 Data requirements, Gaps and Development needs

A number of gaps exist in the data for monitoring energy access, energy efficiency and renewable energy monitoring. Base line data and some relevant targets are non-existent. So are some of the important indicators such as for biomass productive uses, agro-processing uses and many others.

Strategies and institutional arrangement for enforcing policies and strategies are not yet well in place. As an example the Ministry of Energy and REA are only coordinated at National level. TBS and EWURA, which are also instrumental in efforts for access to efficient energy services have limited geographical coverage.

Effective representation of these organizations and others at the district and even lower levels of development plan and decision-making, are necessary for a successful attainment of SE4ALL targets. In the future, the need for enforcement of the energy performance of imported technologies will require the mobilisation and training of customs and Ports Authority officials.

Another gap in data for SE4ALL is the missing thermal performance of buildings, solar water heaters, and air-conditioners. All of these will require the mobilisation and training National and local government officials managing structures and building inspectors.

The Biomass Energy Strategy, which would significantly formalize the biomass energy sector, is still underway. Its finalization introduction as policy will determine the future biomass energy sector development in Tanzania and it may rely on the Tanzanian Forestry Services for upstream or supply side implementation. It is interesting to learn that the biomass strategy is being prepared in absence of a dedicated biomass policy. A legal, institutional and implementation framework for BEST is another important undertaking that is required to mobilise efficient thermal energy access into the future as one of the outputs of SE4ALL as alternative fuels are unlikely to replace biomass in the foreseeable future. The tracking of the attention given by policy makers to the inclusion of biomass in the modern energy access agenda, the policy instruments and resource allocations to institutions mandated with oversight, will be an essential ingredient of SE4ALL monitoring protocol in Tanzania.

3.2 Programmes and Financing

3.2.1 Thermal energy

The BEST should identify means of ensuring a more sustainable supply chain of biomass energy; raise the efficiency with which biomass energy sources and technologies and services are produced and utilised; promote access to alternative energy sources where appropriate and affordable; and ensure an enabling institutional environment for implementation and access to capital. In working towards these objectives, the BEST should aim to identify and introduce policy options and instruments and institutional ownership for change and reform, in recognition of the fact that previous efforts aimed at policy change in the field of biomass energy alone have had limited success. Expectations of BEST are not high as it is hoping as a minimum to focus the attention of policy makers on the status quo or baseline of the biomass energy situation. The strategy is expected to be complete by June 2013.

NORAD allocated US$120 million to REA in March 2013 and SIDA are planning further to REA for rural energy initiatives in which they have indicated and are expected to push increased and sustainable use of modern biomass technologies and services in the country, thermal energy services included.

3.2.1.1 Supply

NGOs, donors, technical assistance and private sector such as TAREA, TaTEDO, Appropriate Rural Technology Institute (ARTI), ENVOTEC Service Ltd, SNV Tanzania, FINNIDA, GIZ, and many others are on-going with implementation of initiatives in capacity building for local manufacturing and scaling-up of biomass technologies including improved cooking stoves, biogas and on related service in the sector. Their efforts could be greatly enhanced by a national strategy that provides some co-ordination and data management. SNV in collaboration with TAREA and other key players in the sector are working on a national programme on improved cook stoves.

Government initiatives including those of Commission on Science and Technology (COSTECH), Centre for Agricultural Mechanised and Rural Technology (CAMARTEC) and research institutions such as College of Engineering and Technology at UDSM (COET), Sokoine University of Agriculture are positively impacting on supply and financing supply capabilities in the biomass sector.

Development partners including UNDP, NORAD, USAID, SIDA, FINNIDA, DANIDA, WB and EU and others have been instrumental in supporting development of the biomass sector in Tanzania through funding promotional and development of supply/value chains.

3.2.1.2 Demand

Uncoordinated biomass sector operations in an unregulated/lawless environment and left to the informal sector are unlikely to attract formal investments. As such biomass will remain unsustainable employing low efficiency technologies and services and receiving less respect from the government and continue to be

treated as low grade or primitive energy. BEST will strive to formalize the biomass sector, thereby drawing the right reputation to the sector from the community through increased government revenues and recognition of this significant national asset. In doing so, more budget allocations and strategic investments should be made and improve the technologies and services employed in the sector. Furthermore, pertinent knowledge and capacity should be developed and disseminated. As a result of increasing demand and related financing for capital and investment are likely to increase thereby improving affordability of biomass based modern energy services.

Financial, policy and political support from the government translated into budget terms, stands to benefit the biomass technology industry. Opportunities are in place, but need to be properly and extensively promoted with the general public. REA, announced the planning of a national programme on biomass sector development at a renewable energy status workshop at COSTECH on March 26, 2013.

3.2.1.3 Sustainability

Coordinated efforts in lobbying and advocacy for formalization of the biomass sector, more budget allocations from the government reflecting its proportion in the national energy budget is necessary for sustainability and investment inflow in the sector. The facts will improve the quality of technologies used and size of investment thereby improving on the sustainability of the sector.

While intensifying electrification initiatives, the government needs to face the fact that biomass is likely to remain as a prominent contributor to the Tanzanian energy economy for the foreseeable future. It is worth noting that even the electrified customers in Tanzania increasingly use biomass for cooking in the cities. As such, electrification and electricity uptake efforts should go hand in hand with improvement of the biomass sector.

Strengthened coordination of support and redirecting it from piecemeal projects to a policy-enabled programme in the biomass sector, would contribute to sustainable development both environmentally and to poverty alleviation efforts in the country. Until such a time, the biomass energy sector is unlikely to become sustainable.

3.2.2 Power sector: programmes and financing to improve access, efficiency and use of RES for power supply

Scaling-up of Renewable Energy Program (SREP) is an Investment Plan (IP), which is a country-level and outcome-focused programmatic approach to scaling up renewable energy. The IP was prepared by the Government of Tanzania's SREP Task Force and is in line with national renewable energy development strategy as stipulated in: the Tanzania Vision 2025; National Strategy for Economic Growth and Reduction of Poverty (Kiswahili acronym MKUKUTA); MDGs by 2015; the National Energy Policy of 2003; Power System Master Plan (2009 and its 2012 Update); Rural Energy Agency Act 2005; EWURA Act 2006; Electricity Act 2008, among others. The IP brings together into a single cohesive document various power sector, renewable energy and climate change policies, and proposes strategic development programme leading to greater utilisation of renewable energy.

The Project involves lead MDBs, with SREP and other supports for the implementation of the specific investments in the energy sector of Tanzania.

The objective of SREP Tanzania is to support the large-scale deployment of renewable energy and thereby transform the energy sector, principally the electricity sector, from one that is becoming increasingly locked into fossil fuel dependence to one that is using more balanced, secure and diverse energy sources. Achieving this objective will help Tanzania move towards a low carbon emissions development pathway, increase energy security, generate new economic opportunities and widen access to energy services.

In accordance with SREP modalities, this objective will be achieved through an integrated approach that includes investments in renewable energies (particularly infrastructure needed for their production and distribution), capacity building of stakeholders, integration with dynamic public-private partnership, and provision of adequate technical assistance services. Furthermore, SREP Tanzania will support actions deemed appropriate in consolidating or upgrading policy, strategic and regulatory frameworks of the sector and will encourage the dissemination and use of renewable energies in the country. The initial focus of SREP in Tanzania is on geothermal energy and renewable energy mini-grids.

The SREP Tanzania approach is based on the assumption that any transformational change will only occur through the improvement of energy market conditions and financing of the energy sector, as well the creation of specific conditions for gaining investors' confidence (public and private, small-/medium-/large-scale enterprises, national or international investors). These conditions are indispensable for any replication and scaling-up of public and private investments in renewable energies.

The main results expected from the Programme are as follows:

- The access and reliability of energy and electricity services used by Tanzanians populations are improved.
- Increase in the supply of GWh from renewable energies.
- The proportion of rural and urban population with access to renewable energy is increased.
- Jobs related to the adoption of renewable energy are created in targeted areas (for men and women).
- The enabling environment is improved through the optimization of the legal and regulatory framework and the increased capacity of relevant government authorities in carrying negotiations with the Private Sector.
- Additional financial resources for renewable energy projects are mobilized.

3.2.2.1 Physical access (electrification)

The Sustainable Solar Market Package (SSMP) is a contracting mechanism that provides for the supply and installation of PV systems, along with a maintenance-and-repair contract (e.g., 5 years with an option to extend) in a defined rural area. PV systems to meeting electricity needs in schools, clinics, and other community facilities are bundled with requirements and incentives for commercial sale to households, businesses, and other non-governmental customers. Funding for the public and community services facilities, is provided by the government and/or donors, Grants are used to help household consumers defray the cost of SHS. They either obtain a loan from a partner microfinance institution, fee for service/use, pay-as-you-go technology to link usage to payment, or they pay cash for the balance of the SHS payment. By bundling applications in a defined area, the SSMP approach addresses key affordability and sustainability issues of past PV projects: standardization, reduced transaction costs, larger business volume, and reduced risk.

There is an electrification grant of US$500, which is likely to be increased to US$800 in the foreseeable future for grid and non-grid connections. REF plays a role in the consideration of these grants applications and allocation to project developers.

3.2.2.2 Availability (new capacity)

REA and TANESCO are implementing the World Bank and GEF-assisted Tanzania Energy Development and Access Project (TEDAP) to support rural electricity access. TEDAP has supported the creation of an enabling environment, including regulatory and tariff framework for power plants committing to supply up to 10MW to TANESCO, and capacity building. It has also facilitated the development of a pipeline of renewable energy electrification projects – with the potential for around 135MW. A TEDAP line of credit available through commercial banks offers financing. Several other donors are also supporting renewable energy-based mini-grids. REA received US$44.2 million of the International Development Association (IDA) credit and the GEF grant for the off-grid electrification component. The IDA funds include US$23 million credit line to offer long-term financing in Tanzanian Shillings to local commercial banks to on-lend to small renewable energy projects. The refinancing facility was in response to the severe difficulties the private sector faced in obtaining long term financing needed to support off-grid electrification projects. The objectives of the off-grid component were to increase electricity access in rural and peri-urban Tanzania; establish a functioning institutional framework for commercially oriented, sustainable service delivery for rural electrification that can be scaled up; and exploit Tanzania's renewable energy potential.

Renewable energy-based electrification outcomes to-date include TANESCO signing Small Power Purchase Agreements with nine developers to supply 35MW of power (currently three projects are supplying 14.5MW to TANESCO); TANESCO signing Letters of Intent (precedes SPPA) with another nine developers for 42MW of power. REA performance-based grant support to mini-grid and stand-alone electrification and the innovative "Lighting Rural Tanzania" project will benefit over hundred thousand households. Additional grant co-funding to prepare 60 mini-grid projects and stand-alone solar projects to benefit many more consumers have been awarded or are being processed.

REA is supporting renewable energy based mini-grids and stand-alone solar solutions that are operated by the private sector and NGOs; these are lower cost than, or can survive on the avoided costs of, diesel operations. The mini-grids, powered by mini-hydro and biomass power plants are either stand alone, or are connected to the TANESCO grid – but operated by private entities.

3.2.2.3 Reliability (grid maintenance/upgrade)

TEDAP is financed by the World Bank through a US$157.9 million IDA credit and a US$6.5 million grant from the GEF to improve the quality and efficiency of the electricity service provision in Tanzania and to establish a sustainable basis for energy access expansion. It includes $113.7 million for TANESCO for urgent investments in its transmission and distribution network.

AfDB under Electricity V financed construction of distribution lines in Mwanza and Shinyanga; and Rehabilitation of 4 substations in Dar es Salaam and Arusha; 3 studies (from grant): Distribution System Master Plan for 8 regions (4 in Dar, Coast, Kilimanjaro, Arusha and Mwanza) and Study Supervisory Control

and Data Acquisition (SCADA) re-evaluation of TANESCO assets; and project engineering, supervision and management.

3.2.2.4 Sustainability (investment in RE, on grid and off grid, and energy efficiency)

Tanzania has received significant support from its Development Partners for the energy sector, including renewable energy and electrification. Development Partners offer well-coordinated assistance to Tanzania that is aligned with the national priorities and strategies. The multi-year energy sector commitments of the Development Partners are about Tsh 1.5 trillion (US$1 billion), including renewable energy. The Development Partner funding commitment for renewable energy is approximately US$350 million. In addition to the technology-specific assistance described later, sector-wide support is also provided. UNDP is supporting the Low Carbon Sustainable Energy Access (LCSEA) project for energy access in 10 Tanzanian districts. NORAD (US$120 million) and SIDA are expected to provide significant funding to the Rural Energy Fund, and USAID is establishing a fund for financing rural and renewable energy. AFD is establishing a €20 million credit line that can be accessed through domestic commercial banks for renewable and rural energy. DFID has a £30 million regional soft loan facility that could finance renewable energy investments.

In an effort to increase access to electricity, the government is promoting Small Power Projects of up to 10MW, through the introduction of a simplified implementation framework. The MEM, EWURA and the REA have developed a framework for renewable energy projects. The framework includes a Standardised Power Purchase Agreement (SPPA), Standardised Power Tariff Methodology, and a Standardised Power Tariff (SPT). Feed-in tariffs are yet to be technologically differentiated; currently the tariff applies to all technologies and is based on an avoided cost of diesel-powered generation. The national energy regulator only has regulatory power over system additions of more than 1MW. The current feed-in tariffs limit ambitions along with the ability of TANESCO to pay the tariff, making additions to the grid a risky proposition and perversely focussing attention at off-grid possibilities.

In 2008, the Energy Development and Access Expansion Project, a US$111.5 million International Development Association credit and Global Environment Facility grant, was approved by the World Bank. This project is primarily focused on the improvement of TANESCO's transmission and distribution grid. The project also supports renewable energy options, namely, mini-hydropower generation, biomass co-generation, and solar energy. Mechanisms to encourage investment include a the connection grant for each new rural connection and a Sustainable Solar Market Packages programme, offering power solutions for a range of sectors.

Financing of energy programmes in Tanzania has not benefited substantially from private sector finance, whether foreign direct investments or local investments. Programmes are highly dependent on donor financing, which is typically for 3 to 5 years and in this time there is usually not enough buy-in from the general public to ensure market driven demand. In addition, donor finance is often limited in its scope and can be unpredictable. There is programmatic funding from some development partners including UNDP, UNIDO, NORAD and SIDA with concentration on financing demonstration or pilot projects and little on scaling-up.

One question that any SE4All strategy moving forward will have to answer is why power sector reforms to date have not attracted substantial private financing, and necessary adjustments will have to be made to create an environment that attracts and sustains private financing. In recent years, Tanzania has however been

innovative and considering raised financing locally from the social security fund. The current and short term financing for new capacity and reliability in loans and grants is as shown in Table 10 (there is much more detail in Annexures 1 and 2). Despite this innovative approach, public and donor financing alone are unlikely to help Tanzania attain the goals of SE4All.

Table 10: Grant support for main power sector project from 2009 to 2014

Grants	2009	2010	2011	2012	2013	2014
MCC Grant	-	43,950	87,900	87,900	-	-
World Bank Funds - TEDAP	175	25,575	20,460	4,277	2,860	-
IDA - Songsongo - Grant	6,181	13,515	10,812	6,032	384	-
ORET- 50% loan, 50% Grant	51,169	-	-	-	-	-
REA	7,853	29,450	55,275	-	-	-
Government Contribution	12,810	35,938	150,977	70,543	-	7,705
AfDB	-	-	858	1,144	858	-
JICA	8,750	8,481	2,488	1,000	1,000	-
SIDA	4,750	4,750	40,485	55,027	285	-
Total	**91,689**	**161,659**	**369,255**	**225,923**	**5,386**	**7,705**

Source: EWURA, 2010

3.2.3 Modern energy for productive use: programmes and financing to improve access, efficiency and use of renewable resources in productive sectors

Efforts for increased use and dissemination of modern energy for productive uses including programmes and financing opportunities have been promoted by a number of development partners in Tanzania. However, coordination and documentation for public use of this information has been limited. Availability of such information has been limited to project implementers and other funding requirements and retirements.

The EU supported TaTEDO on Up-Scaling Access to integrated modern energy services for poverty reduction, in which TaTEDO implemented a project for Multi-Functional Platforms (MFP) and solar powered containers aimed for increased access of modern productive services and use in rural areas. About Euro 2.3 million was provided as a grant. More detailed information on financing is available in Annex 2.

3.2.3.1 Supply: programmes and investment to develop domestic manufacturing capacities, including access to capital and know-how for productive applications

Domestic manufacturing of productive use equipment and appliances is still limited in Tanzania. However, REA has been supporting private sector in local development of small wind turbines and construction of biogas plants and micro hydro power plants. UNIDO under GEF support is supporting establishing a micro hydro centre of excellence at the University of Dar es Salaam where turbines will be locally fabricated and tested. Under the same support, installation of 6 pilot micro hydro power systems will be carried out. The EU through REA has supported production of portable biogas plants SIMGAS)(for heating and cooking purposes in households. Portable SIMGAS products for the same cooking and purposes will also be available in the near future. SNV with support from the Netherlands is supporting capacity building and commercialization of biogas construction industry in Tanzania. TaTEDO, SNV, ARTI Tanzania and many other NGOs and private sector with support from different donors and development partners are involved in capacity building for different types of biomass cooking technologies.

3.2.3.2 Demand: Financial support schemes to improve affordability of modern energy technologies for industrial and agricultural enterprises, as well as build their knowledge and capacity

REA through matching grants, competition awards, performance grants, WB grantee fund and many others are supporting financing various schemes and initiatives targeting improving affordability of modern energy technologies and agricultural enterprises, as well as building their capacity. The UNIDO supports the Centre of Excellence in micro hydro at the University of Dar es Salaam will build local capacity for manufacturing turbine and other components that is expected to reduce their price. SNV is training local technicians and subsidizing the cost of r installing household domestic biodigesters, which reduces the overall biogas plant cost to the end-user.

3.2.3.3 Sustainability: programmes aimed at improving environment sustainability of energy supply, such as demand side energy efficiency and use of renewable energy

As suggested above, there are few clear policy, strategies and programmes already in place for creating an enabling environment of energy supply such as EE, RE and biomass energy in the country. An example of a enabling policy instrument is the REA matching grant has the opportunity of supporting feasibility studies and Environmental and Social Impact Assessments that can be further utilized by potential investors, thereby creating supportive environment for the RE. SREP on the other hand, with support from AfDB and other co-funders, is a programme expected to support the growth of RE in Tanzania through investment both in supply opportunities in some RE technologies and in guarantee to IPPS for electricity sold to TANESCO. SIDA is also strengthening involvement of the private sector in energy initiatives, which is expected to trigger further sustainability. Already the World Bank has provided a guarantee fund through REA to Commercial Banks in Tanzania aimed at long-term loans for private sector in Tanzania investing in the energy sector.

3.3 Private Investment and Enabling Environment

The private sector plays a major role in addressing electricity shortages and their scope for supporting energy access and infrastructure development remains vast. Electricity shortages between and 2009 resulted in power outages, and created better opportunities for private producers. By the end 2008, Independent Power Producers (IPPs) provided 282MW (or 30%) of electricity to the national and isolated grids through emergency power supply agreements. These agreements however come at the expense of TANESCO, which pays high prices for the generated electricity. According to CDKN, while retail tariffs are around US$0.13/kWh, TANESCO purchases emergency power for as much as US$0.40/kWh (CDKN, 2012). Need to look at sustainability and at the cost of the electricity supply basket and then the pricing.

Other than the role of providing emergency power, the private sector with some notable exceptions has contributed little to improving energy access, energy efficiency and renewable energy availability generally in Tanzania, particularly in terms of long term and transformational investments. The following subsections discuss the barriers that various private sector actors face in providing energy for specific sub-sectors on the energy sector.

Generally, the absence of a long, loud, legal and consistent leadership in the area of low carbon development and the limited low carbon dedicated investment or market mechanisms (SREP is a notable exception) has not expressed the almost unrivalled opportunity to establish an example of modern energy transformation in access and supply that is the nascent Tanzania energy economy.

3.3.1 Thermal energy for households

3.3.1.1 Private sector in supply chain (energy supply companies, TP, financiers)

Actors involved in the supply chain of thermal energy for households are largely artisans (improved cook stoves) and small companies undertaking solar water heater installations. Women in particular have a role here, producing and supplying first generation cook stoves but their participation in other supply chains such as solar water heaters is limited. ESCO activities are not known of in Tanzania.

3.3.1.2 Barriers to private investment in modern energy supplies and technologies for cooking and other thermal applications

The barriers that actors face in supply chain for thermal energy for households and generally for energy service investments include:

- Limited awareness of financing institutions of the energy sector;
- High interest rates of capital with high collateral requirements;
- High upfront costs for technologies and capital such as solar water heaters;
- end-users' lack of awareness of the benefits of the technologies which in turn, leads to a small market scope;
- High comparative costs marketing of products such as improved cook stoves and solar water heaters;
- Small sizes of projects compared to financial packages available;
- Bridging finance for outcomes or results based financing limits uptake;

- Low perception of impacts of solid biomass use that limit the creation of an appropriate supportive framework; and
- Lack of confidence in performance of thermal technologies such as improved cook stoves for which there are no standards or certification.

More barriers are summarised available in Annex 3.

3.3.2 Power sector

3.3.2.1 Private sector actors in supply chain (power generation and distribution companies, IPPs, financiers, TP)

Power sector IPP's involvement in the supply chain and barriers they faced relative to regional standards. Tanzania has a high number of private players in the power sector, which has been a sharp learning experience and one from which other countries can learn, with four IPPs already operating and three more signed up. Transmission remains wholly owned by TANESCO. The main financiers in the sector include local banks, bilateral partners such as NORAD and the World Bank, while technology is almost entirely imported.

3.3.2.2 Barriers to private investment in new on grid and off grid power generation capacity (especially for RES, grid extension/maintenance, demand side management and EE)

The some barriers faced by power sector IPPs include;

- No district competency on energy policy implementation and abilities to access policy instruments;
- High capital costs and collateral requirements;
- TANESCO defaulting on payments to IPPs (e.g. as of August 2012, TANESCO owed Symbion about US$20 million);
- Regulatory uncertainty due to discontinuities in leadership of the MEM and the power utility (e.g. over the last 7 years, there have been four energy ministers);
- Low trust in the ministerial leadership (of the four ministers, 3 have resigned after being linked to corrupt dealings or for failure to take corrective measures);
- Hydrology uncertainties due to climate variability and change (specific for hydropower);
- Low customer base for rural off-grid concessions;
- Low affordability index (for rural off-grid customers);
- Few affirming demonstrations of the range of energy technologies so as to allow informed technology choices for users;
- Limited awareness of DSM and energy efficient benefits;
- Lack of a culture of investing based on pay-back period;
- Low levels of trust of service providers for correct billing (which is a disincentive for investing in energy efficiency);
- Misinformation in the market place (e.g. as regards life of CFLs);
- Poor market priming for efficiency (as a result of low quality energy efficient CFLs at the time of access);
- No attempt to harness the efficient energy management attributes of the poor gaining access to modern energy for the first time;
- No rebates for energy efficiency technologies or incentives for demand or energy savings for users or utility; and
- No ESCO capacity.

More barriers are summarised in Annex 3.

3.3.3 Modern energy for productive use

3.3.3.1 Private sector actors on the demand and supply side (SMEs/agricultural enterprises, technology providers, financiers)

The main actors in providing energy for productive services have so far been NGOs, private sector and development partners including NGOs, TaTEDO, REDCOT, CAMARTEC and several others.

3.3.3.2 Barrier to private investment in modern energy for productive and socio-economic uses with a focus on EE and RETs and solutions

The private sector has been slow to invest in these opportunities because of the following barriers;

- There is limited data on energy usage, intensities and trends in productive sectors and sub-sectors;
- Lack of awareness of different technologies and their second hand value;
- Lack of a culture of investing based on pay-back period;
- Few affirming demonstrations of best-practice (Tanzanian Breweries is an exception);
- Low cost of manual labour makes human energy cheaper than modern energy;
- Limited price-signalling for energy efficiency including but not limited to billing;
- Limited localised decision-making and accrual of benefits (i.e. investment decisions made by management away from business entity and savings made by workers' efforts do not accrue to them or their working conditions);
- Access to finance is generally difficult;
- Financiers do not see energy efficiency as gainful endeavour to lend to while the grid remains of variable quality;
- Capital and operating expenditure are separated and as a result not optimised to achieve low life cycle costs; and
- Limited profitability and stability of SMEs and agro-businesses make them and potential financiers investment and risk averse.

More barriers are summarised in Annex 3.

3.4 Gaps and Barriers

The main gaps and barriers faced by Tanzania's energy sector relate to broader themes of economic, human capacity and awareness, and governance as outlined below.

One of the most prominent gaps and barriers to informed policy making, that is not unique to Tanzania, is the lack of credible and longitudinal energy access, use and service data that is maintained in a database and accessible to the public. Sectoral, sub-sectoral and end-use/service energy intensities and intensity trends are essential in understanding where and how to intervene in the energy economy to achieve efficiencies.

This document provides a good template for tracking data and inventorizing progress and may be worth utilising as an annually updated sub-sector overview timed for publication with annual policy review or budgetary allocation events such as the Joint Energy Sector Review.

More barriers on RE are also summarized in Annex 3.

3.4.1 Thermal energy for households

3.4.1.1 Governance (institutions, policies, enforcement capacities)

- No clear biomass policy, strategies and effectively enforced regulations for a sector supplying primary energy for about 90% of Tanzanian population.
- Biomass energy receives less than 1% of the total annual energy budget allocation at MEM.
- Government is yet to recognize charcoal as the main source of fuel for cooking in both urban and rural areas, as such charcoal and biomass is left to the informal sector.
- Charcoal Producers have to obtain a Charcoal making licence which indicated tree species one is supposed to harvest depending to the locality, tree sizes, where the harvesting and charcoal production will be done, where charcoal will be sold (insitu or far from the production area). (Mr. Chamuya, MNRT, pers. comm. 28th May 2013). The extent to which there is compliance with this measure is unknown.
- Charcoal traders have to get a trading licence indicating where charcoal is sold, Amount that they are allowed to sell, the source of the charcoal they are supposed to have a copy of licence from the charcoal producers. (Mr. Chamuya, MNRT, pers. comm. 28th May 2013). The extent to which there is compliance with this measure is unknown.
- Left and managed in the informal sector as such biomass sector investments are generally unattractive to large capital.
- Large sections of the biomass energy sector operate outside the law.
- The scattered sector is hardly caught in facts, data and figures (baseline information), thereby resulting into limited market information both on the supply and demand side in all their variety for policy formulation.

- The illegal and scattered nature of the biomass energy sector inhibits the uptake of modern systems of production and consumption.
- There is a shortage of well-qualified personnel to support sector development (not the case with forestry services).
- Limited clear rules and responsibilities and reinforcement of the same.
- Limited capacity and will to organize the charcoal production sector.
- Charcoal is an underpriced energy resource. Trees are obtained free of charge from the forest.
- Poor, polluting, inefficient and unsustainable biomass utilizing technologies including current traditional charcoal production practices and technologies.
- Most charcoal is produced through traditional earth mound kilns from wood cleared mostly from natural forests. 7-10kg of wood is required to produce 1kg of low quality charcoal with calorific value of 26kJ/kg. However with more efficient kilns, 4.5kg of wood is required to yield 1kg of charcoal with a calorific value of more than 31kJ/kg.
- Logical alternatives are either unavailable (briquettes) or seen to be dangerous and too expensive (LPG, kerosene).
- No effective sustainable working relations between Forest Division of MNRT and Energy Department of MEM, and other stakeholders to enhance sustainable management of natural resources for charcoal and firewood production.
- Within the charcoal catchments areas of Dar es Salaam it has been observed that the forest mean annual increment is 2.35m^3/ha/year while annual cut for charcoal is 6.4m^3/ha/year.
- Ministry of Natural Resources and Tourism believes that current annual forest reduction is between 120,000 and 500,000 hectares, against only 25,000 hectares planted.
- The accelerated harvesting of trees impacts negatively upon soil, watersheds, biodiversity and climate change.
- According to various studies and calculations, each ton of charcoal produced and consumed in Tanzania generates nine tons of CO_2 emissions, one million tons of charcoal thus translating into nine million tons of CO_2.

3.4.1.2 Supply Chain (access to capital, technologies and know how)

- Currently the charcoal industry, despite its many shortcomings, delivers charcoal to urban users through an informal system based on unfair market forces. (Dar es Salaam is said to see delivery of 28000 50kg bags of charcoal per day entirely informally).
- Lack of biomass producer and supply associations for a stable and sustainable supply chain.
- No legal framework to attract and commit investments and capital in the biomass primary energy chain for Tanzania.
- Inefficient technologies and services are employed in the current unsustainable supply chain.

- Limited personnel with know-how on development and empowering key actors and stakeholders on sustainable supply chain management of biomass resources and markets in Tanzania.
- Limited awareness of the private sector and FI on the potential business in the biomass sector of Tanzania. Recent data put annual charcoal consumption is valued at approximately Tsh311 billion per year (roughly US$250 million).
- It is a key sector employing more than 150,000 people-using local energy resources and technology in an informal sector, mostly outside of the law.
- Some District Councils near main urban areas reports that, greater than 70% of their revenue is a result of licenses, penalties and duties imposed upon charcoal producers and traders.
- Transportation of charcoal is informal.

3.4.1.3 Households (capacities and access to capital/affordability)

- Charcoal production with high manual labor (time intensive) and minimal income compounds poverty for rural households involved in charcoal production in Tanzania.
- Costs of purchasing charcoal, and firewood collection remove time for other productive activities and contribute to the poverty Tanzanians.
- Households involved in current informal biomass sector cannot access/attract affordable efficient technologies and services in production and use.
- Capacities of households to access modern technologies necessary for efficient production, marketing and use of modern efficient biomass stoves are minimal.
- Formal human resource development in the sector is minimal.

3.4.2 Power sector

3.4.2.1 Governance (existence of enabling regulatory/framework for investment, enforcement capacities)

- EWURA exist as a regulator in the power sector with limited and somewhat blunt compliance instruments for energy law-breakers.
- EWURA lacks enforcement capacities in terms of skills to undertake and achieve least-cost planning outcomes, number of employees and geographical coverage.
- There is limited transparency in power sector contracting and regulations.
- There is a limited technological scope of coverage by EWURA FIT for different energy resources. Current EWURA FIT is based on hydro and avoided diesel costs for generation.
- There is inefficient production, transmission and distribution of power services.
- Poor governance (rampant corruption) in the power sector.
- The social aims of equity in access and affordability are in conflict with disciplined cost recovery.

- Subsidies for modern energy access are in place but below the financial costs of physical access.

3.4.2.2 Supply Chain (access to grid, capital, technologies, and know how)

- Tanzania has a large land area with about 75% of its population located in dispersed rural areas. Infrastructure for grid extension is therefore high and in most parts of the country absent.
- Most rural electrification actors and developers are based in urban areas with limited financial muscle and hence reluctant to develop energy supply chains in rural areas.
- Energy per capita for Tanzanians is the lowest in sub-Saharan region making it unattractive for grid extension investment and mini grid investments expecting cost recovery.
- Scattered households in rural communities of Tanzania require large investment for grid electrification making it prohibitively costly to extend grids.
- There is limited awareness of private sector and FIs of Tanzania on the available business opportunities in the energy sector.
- Poor liquidity of the only current buyer of IPP generated power (TANESCO) negatively impacts on the interest of private investors and FI in investing in electricity infrastructure.
- There is limited technical know-how of potential local developers and investors in modern energy businesses.
- There exists a business paradigm of investing in low-hanging business opportunities (fast moving business) compared to longer term investments in the energy sector.
- There are few incentives for private sector participation in power businesses.
- There is limited publication of available opportunities and incentives within REA and development partners for energy sector development (small and mini-hydro opportunities is an exception).

3.4.2.3 End-users (affordability and access to capital)

- Poor communities with many unattended priorities such as health, food, education and clothing render access to modern energy unachievable.
- There is limited capacity of end-users to link energy poverty with other life challenges such as economic opportunities, quality health and education, water supply and many livelihood enhancing opportunities.
- There is limited consumer financing opportunities in Tanzania other than through savings co-operatives, village banks and other micro-finance facilities.
- High initial cost of most renewable energy options and limited financing opportunities.
- Limited access of most end-users' to capital and credit facilities as a result of, first, being in rural areas where few if any FI are willing and interested to operate, and end-user poverty which provide no collateral acceptable to FIs for loan underwriting.

3.4.3 Modern energy for productive use

3.4.3.1 Governance (existence of enabling regulatoryhydropowerframework for investment, enforcement capacities)

- Limited clear regulatory framework and incentives for investing in modern energy for productive use technologies and services.
- Limited awareness of potential local investors at various levels of the community in available opportunities and incentives for investing in efficient modern productive use technologies and services.
- Limited financial institutions willing and interested to invest in modern productive energy use services.
- Limited access to the centralized services, incentives and support for rural modern energy productive uses facilities. REA/REF services could be decentralized to allow for increased access by potential developers in various parts of the country. Currently one has to travel to Dar es Salaam to access REA services, though REA is moving from a reactive facility to a more proactive one.
- EWURA is based in Dar es Salaam and hence has limited regular geographical accessibility to other parts of Tanzania where its regulations require application to modern energy services for productive uses.
- Limited capacities for enforcement of quality, standards and desired code of practice in modern productive energy services.
- Poor governance (corruption, etc.).

3.4.3.2 Supply Chain (access to capital, technologies and know how)

- Lack of sustainable supply chain for modern productive use technologies and services.
- Limited personnel with adequate technical know-how for management of sustainable modern productive use technologies and services.
- Limited access of potential actors to financial services to invest in modern productive use supply chain development.

3.4.3.3 End-users, agricultural and industrial enterprises, SME (capacities and access to capital)

- Poor targeting by project implementers e.g. targeting women as users without targeting men as those who make household purchasing decisions.
- High poverty levels of some end-users to benefit from the modern productive use services and technologies. Some end-users are so poor that they need other services prior to benefiting from modern energy access for productive services. Some end-users first need food, shelter, clothing and then you can engage them on energy for productive uses.
- Poor record keeping of some SMEs and enterprises, which are vital for access to capital and investments from FIs.

- Limited technical know-how of some SMEs, enterprises and end-users on the potential and management requirements for optimizing access to modern energy services for productive use.

3.4.4 Summary: Key gaps, barriers and additional requirements

3.4.4.1 Economic

- Dependence of the poor to earn income from biomass harvesting, processing and sales leaves governments with the dilemma of replacement options.
- Dependence on fiscal income from oil produces will need to be replaced with the increasing energy efficiencies and shift to renewable energy.
- Limited access to finance and limited financial instruments for both service providers and consumers.
- High cash poverty levels of most people, SMEs and communities in Tanzania.
- Existence of other low hanging business opportunities compared to longer term energy investments.
- High initial cost of most modern energy and energy efficiency technologies and services.
- Tariffs, duties and levies waiving needs to be evenly applied to renewable energy and energy efficiency technologies.
- Least-cost planning capacity needs skilled personnel and institutional capacity within EWURA.
- Mimimum Performance Standards at an agreed level need to be instituted to avoid dumping and the importation of substandard energy technologies.

3.4.4.2 Human capacity and awareness

- Low capacity to implement programmes and effectively utilise and account for the available public financing.
- Lack of awareness on the costs and benefits of RETs and EE technologies.
- Lack of awareness of international instruments that could contribute to low-carbon energy access and reductions in GHG emissions.
- Limited technical know-how on management and financing of RETs, EE and modern productive use technologies and services.
- Lack of knowledge of communities on close linkages between modern energy poverty and other poverty features such as limited economic activities, poor education and health services quality, limited water supply, and other livelihood and productive opportunities.
- General limited human skills and institutional capacity to address the energy opportunities and challenges in achieving a technological leapfrog to a low emissions energy economy avoiding large scale and fossil lock-ins.
- Need for early learning in new energy technologies through affirming demonstrations and informed energy decisions based on local needs, respecting indigenous knowledge and that is gender sensitive.

3.4.4.3 Governance

- Lack of a conducive legal and regulatory energy policy framework that is enabling, stable, reliable and enforceable.
- Lack of attention of policymakers' attention to the biomass energy resource abundance and its future align it with the desired modern energy sector vision.

- Low trust in governance system needs attention to achieve an adequate, affordable and sustainable energy sector for input to national economic development that is based on transparency and stakeholder consultations and informed decision making at all levels.
- Poor targeting of gender sensitivity by some project implementers e.g. targeting women as users without targeting men as those who make purchasing decisions.
- Supporting systems for development of Energy, RE, EE and modern energy services are centralised in Dar es Salaam. The fact limits access of majority of Tanzanians in remote districts of the country to services of REA, DP, EWURA, just to mention a few.
- Ineffective working relations between MNRT and MEM on biomass energy issues.

3.4.4.4 Sector based issues

- Tariffs: there is a need to have a cost reflective tariff structure for various RE sources. The current rate that is not technology specific is not financially viable for most technologies, but may provide opportunities for biomass residue power generation.
- Tariffs also are vulnerable to currency risks and here too some assistance. However, there has to be a strong justification why TANESCO should pay a higher tariff than the avoided cost, for example, factors such as diversity of generation is not considered in TANESCO planning and decision making but is valuable in the achievement of energy security.
- Capacity and risk issues with the off-taker: the under-recovery situation of TANESCO has created downstream issues for the project developers as the ability of the utility/off-taker to meet its FIT/PPA obligations. The government could explore setting up a risk guarantee to shore up the FIT/PPA commitments that guarantees such agreements as has been proposed for the SREP geothermal programme. Without such guarantees the appetite of private sector investors may evaporate.
- There is a need for a clear pathway for the private sector in the development of large RE in Tanzania. The current policy is not very detailed on this aspect; concerns are raised on the long-term impact of the new concessions being offered in geothermal. What is required is a long-term strategy that outlines the role of the private sector.
- The entire biomass value chain from fuel crops, through charcoal production, distribution and efficient stoves needs attention to achieve efficiencies inside or outside of policy.
- Measures are required to control the quality of energy using electrical technologies/appliances entering the Tanzanian market and once in the market the use of labels and/or rebates are required to advance the most efficient pumps, boilers, air-conditioners, lamps and refrigerators.
- Solar water heaters, efficient air-conditioners and insulation measures could be advanced with hotels, commercial and public buildings sectors (as part of an job creation ESCO initiative).
- The advancement of good urban planning for increased densification and associated convenient public transport systems are required to have energy efficiency spin offs.
- Rebates, subsidies, grants, tax breaks and feed-in tariffs information needs to be advanced amongst developers unaware of pre-investment support for generation and generation feasibility study and electricity connection grants available from REA/REF.

3.4.4.5 Commercial viability

- Feasibility studies: energy resource mapping exercises to determine/confirm the potential of the various RE sources and efficiency potentials is required, as has been done by REA for micro and

small scale hydro investment opportunities. Demand side studies (isolated and mini-grids) will help private sector to engage having a better understanding of energy uptake potentials.

- The commercial banks have highlighted a need for technology cost/performance information to inform their investment portfolios. [Note: training for bankers in small hydro and biomass power project due diligence has been provided by Triodos team with TEDAP/SIDA support. Updates and top-ups need to be provided on a regular basis.]
- Risk guarantees: both the project developers and commercial banks have requested for risk guarantee to enhance the attractiveness of projects/investments for Private sector investors.

3.4.4.6 Firm/project level

- Working capital is required specifically for new project developers working on results/outcomes based financing modalities.
- Capacity shortfalls in technical, financial modelling, planning, institutional, process, project structuring and packaging and feasibility assessments
- Lack of long-term/patient financing to enhance viability of the projects.
- High equity requirements of around 40% by banks (required by Bank of Tanzania rules) can be a barrier for firms.
- Several power suppliers (small and large) report significant payment delays for power supplied to TANESCO. Situation might be improving as recent tariff increase increases (still below cost) are approved). Unfortunately tariff increase coincided with low hydro electricity contributions and as a result TANESCO needs to use more costly emergency thermal plants.
- Uncertainties in policy implementation such as the MEMs plan to revoke the licenses that are already issued for Geothermal concessions awarded for six sites to Geothermal Development Tanzania Ltd., can reduce investor confidence in such inherently risky projects

Annex 1: Basic Donor Information

Institution Name	Grant	TA	Loan/Credit	Loan Condition			Budgeting Cycle
				Interest rate	Grace Period	Repayment Period	
AfDB	No	Yes	Yes	0.75% per annum	10 YEARS	50 YEARS	Annual budget (Jan-Dec)
EU	Yes	No	No				National Indicative Programme 2008-2013 (5 years)
Finland	Yes	Yes	No				Annual budget (Jan-Dec)
JICA	Yes	Yes	Yes	0.01% per annum	10 years	30 years	Annual budget (April-March)
Korea EDCF	No	No	Yes	0.01% per annum	15 years	40 years	Annual budget (Jan-Dec)
MCC	Yes	Yes	No	NA	NA	NA	Funding committed for 5 year grant (2008-2013)
Netherlands	Yes	Yes	No				N/A
Norway							
SIDA	Yes	Yes	Yes	Market	Market	Market	Annual budget (Jan-Dec)
UNDP							
WB (IDA)	Yes	Yes	Yes	0.75% per annum	10 years	30 years	Annual budget (July-June)

Annex 2: Current and Near-Term Donor Partner-supported Renewable Energy Projects

Projects	Implementing Agency	Objectives	Amount	Components and/or Results and Achievements Enhanced Up to August 2012	Linkages with SREP	Development Partner Supporting GoM	Date
Clusters PV Project	CAMCO	15,000 solar home systems financed through associations' members in Lake Victoria Region with microfinancing through local banks and with subsidy from REA (TEDAP).	Euro 950k	Approaching the end of year one, Project currently working with nine Cluster groups. Tenders for the SHS for the first three groups have been awarded and contract negotiations underway.		EU	2011- 2014
Up-Scaling Access to integrated modern energy services for poverty reduction	TaTEDO	Improve energy productivity	Euro 2.3 million	Installation and commissioning of 50 Multi-Functional Platforms, 50 Productive Use Containers and 25 combined MFP and PUC in 100 villages in northern Tanzania.		EU	2008 – 2013
Mwenga 3MW Hydro Power	Mufindi Tea Company Ltd.	Renewable energy-based rural electrification	Euro 7. 2 million	Construction and commissioning of a 3MW hydro power plant, transmission and distribution to surrounding rural communities	Model for SREP scale up	EU	2007 – 2012
Integrated Rural Electrification Planning in Tanzania	REA	Rural electrification planning methodology development	Euro 1 million	Formulation of a relevant Rural Electrification planning methodology through the use of modern and sustainable tools, capacity building for the target groups	Renewable energy projects identification for SREP support	EU	2011 – 2012
Yovi Hydro Power Project		Construction and commissioning of a 1MW hydro power plant on the Yovi River in Msolwa (Kilosa Disctrict), transmission and distribution to surrounding rural communities (min-grid)	Euro 4.2 million			EU	2011 – 2014
Sustainable Community-Based Hydro Power Supply in 6 villages of Ludewa District		Upgrading of the existing Mawengi micro hydro plant and mini-grid extension to surrounding communities	Euro 1.8 million		Model for SREP scale up	EU	2011 – 2014

Increasing access to modern energy services in Ikondo Ward		Upgrading of the existing Ikondo micro hydro plant and mini-grid extension to surrounding communities	Euro 1.8 million			EU	2011 – 2015
Introducing a new concept for affordable biogas system		Private sector development and market extension in order to reach at least 10,000 rural households for affordable and locally made new concept of plastic biodigester	Euro 1.5 million			EU	2011-2015
Best Ray Project	Oikos East Africa, Italian NGO (Matteo Leonardi, project manager)	Solar panels are to be installed in all primary and secondary schools in Oldonyo Sambu and Ngarenanyuki wards in Arumeru district to promote the use of renewable sources of energy	Euro 1.5 million	?	Review experience on approach, links to REA efforts as lessons for SREP	EC	~2010
Masigira hydropower	TANESCO	Feasability Study	NORK 7 million	Procurement		Norway	**?**
Operation and Maintenance	TANESCO	Operation and Maintenance at existing Hydropower generation	NORK 60 million	Not started		Norway	Approved
Kihansi minihydro	TANESCO	Construction of mini hydro	NORK 15 million	Not started		Norway	Proposed
Pinyiny small hydro	TANESCO	Construction of mini hydro		Not started		Norway	Proposed
Energy Small and Medium Enterprises	GVEP International in partnership with REA	Pre-investment support for six mini-hydro projects six projects with a combined capacity of ~ 7.5MW in regions of Mbeya, Iringa, Ruvuma, Arusha and Kigoma. Most are isolated mini-grids not connected to the main	US$XX million from Russian Federation via a World Bank Trust Fund	Six projects identified from long list of 2 and feasibility studies underway.	Approach could be replicable for project development. Financing for projects	Russian Federation (World Bank managed Trust Fund)	2010-?
Development services for solar companies in 16 regions	CAMCO	Technical and marketing training for solar retailers, technicians and vocational school instructors); marketing and awareness, networking among solar industry stakeholders; and policy and institutional support for the implementation of national quality control standards. Support for the strengthening of the Tanzanian Renewable Energy Association (TAREA)	USD 3.2 million	Builds on similar project conducted in Mwanza from 2004-2009, the Project was completed in 2011 (after six years). Over the period the national PV market grew from 100kWp to over 2MW. Over 150 new retailers established and an equal number of rural technicians trained. Tanzanian Renewable Energy Association (TAREA)	Builds capacity that could be used for off grid solar scale up with SREP support.	SIDA	2005-2011

				strengthened, and the Tanzanian Bureau of Standards (TBS) equipped and trained to control solar PV equipment quality.			
REF	REA	Rural Energy Fund support	SEK 203 million			SIDA	2010-2014
Capacity building	REA	Capacity Development to REA	SEK 28 million			SIDA	2010 – 2014
WB Trust Fund	REA	Support to REA and rural energy	SEK 30 million			SIDA	To 2013
Ruhudji & Kakono Hydro	TANESCO	Hydropower studies	SEK 30 million			SIDA	2011 – 2012
Hale Hydropower	TANESCO	Rehabilitation of 21MW Hale Hydro Power Plant in Tanga Region	SEK 160 million			SIDA	
Bio-fuel Project	MEM	Support in strengthening Policy, Legal, Regulatory and Institutional framework to the Development of a sustainable biofuels industry in Tanzania	SEK 13 million			SIDA	2009 – 2012
Mini-Grids Based on Mini/Micro-Hydropower Source to Augment Rural Electrification in Tanzania	UNIDO with REA	Develop nine mini hydropower projects with total capacity of 3.2MW to boost economic development activities in Ruvuma, Iringa, Mbeya and Rukwa regions. Establish centre of excellence for minihydro at the College of Engineering and Technology (CoET) of	US$13 million with US$XX form GEF through UNIDO	Could be scaled up by SREP to increase access		United Nations Industrial Development Organization (UNIDO)	2012-2016
Malagarasi Hydropower	TANESCO	Malagarasi Hydropower Feasibility Study	US$1.8 million	Implementation		US MCC	2010 – 2012
Kigoma Solar	REA with contractors CAMCO, Rex Investments	Kigoma Solar PV Programme. Installation at 45 secondary schools, 10 health centers, 120 dispensaries, municipal buildings and businesses across 25 village market centers.. Also encourage households to install SHS.	US$4.7 million	Contract awarded for supply and installation of PV systems for public/community facilities and programme management	Part of REA Sustainable Solar Market Packages. Could be scaled up under SREP.	US MCC	2012-2013
Lighting Rural Tanzania 2009	REA	Competitive grant programme to support private enterprises in developing and delivering a wide array of modern lighting products for rural households and businesses.	US $0.982 million. 10 grants up to US$100,000	In April 2010, a competition in Arusha, Tanzania, selected 10 recipients for implementation over 12 months. Awards made to private sector (including NGOs and community organizations).	Model for expanding modern renewable energy lighting solutions. SREP could	World Bank	2010-2012

				Subprojects demonstrated innovation and built local capacity in delivering energy services to rural areas in Tanzania, increasing the potential for replicability and scale up of these activities. . Based on the success of the activity, REA has raised funds and organize a second LRT. .	support successful business models scale up		
Lighting Rural Tanzania 2010	REA	Competitive grant programme to support private enterprises in developing and delivering a wide array of modern lighting products for rural households and businesses. · Increase access to modern lighting systems for households, schools and health centres. · Improve technology for production of low cost renewable energy products. · Bring to the market, products that are competitive in terms of price.	Maximum grant per winner Tsh 150 million Maximum 20 winners US$2 million	Continuation of the Lighting Rural Tanzania Competition (LRTC) programme. WB-IFC Lighting Africa team will continue to advice REA based on its experience in other countries.	Model for expanding modern renewable energy lighting solutions. SREP could support to successful business models scale up	World Bank	2012-2014
ARGEO	UNEP, World Bank	Promote the development of geothermal energy in the selected countries, including Tanzania. It is expected that this will add low-cost power generation capacity and increase the security of power supply. The global objective of the project is to facilitate reduction of green-house gas emissions in these countries.	Total project US$136.6 million (?) for Djibouti, Eritrea, Ethiopia, Kenya, Tanzania, and Uganda. GEF grant: US$18 million (or 36?). co-financing of about US$41.5 million from KfW, Iceland, Italy, USA; and recipient countries.	1. The creation of a Regional Network managing a geothermal information system and capacity building and awareness raising programmes. (UNEP) 2. A Risk Mitigation Fund will provide financial instruments to assist in mitigating the exploration and appraisal risks (World Bank). 3. Technical Assistance, a. Institutional and technical capacity building (UNEP) b. Risk Management Fund related activities (World Bank). c) No country including Tanzania (ARGEO member have already	If resource is confirmed, potential support from SREP for production wells and power generation	World Bank	2010-2015

			Remainder from private sources.	secured fund to assist in mitigating the exploration and appraisal risks			
Energy Small and Medium Enterprises (ESME) Trust Fund	REA	Provides green generation performance grants (in the value of future Carbon Emission Reductions) to support small renewable energy projects reach financial closure.	6.5 million from Russian Trust Fund executed by the World Bank	Grant approved this year. Several developers have expressed interest in this facility. The first transaction is expected to be for the 10MW Mapembasi project.	The facility could be supplemented by SREP funding taking into consideration the interest expressed by	World Bank	Dec 2010; to be extended to 2014
Singida Wind Power	Wind East Africa JV Telecoms, UK-based Aldwych International and Danish wind consultancy KenTec Denmark)	The proposed project consists of a 100MW wind farm to be built, owned, and operated by Wind EA. This privately financed project will supply power into the Tanzanian national grid under a long term PPA with TANESCO. The wind farm will be constructed along the Rift Valley on a site located east of the town of Singida. The Project will include the construction of any necessary transmission line to connect the plant to the grid.	Total project cost US$300 million. World Bank: US$100 million PRG to cover commercial lenders against debt service payment defaults.	Decision Meeting scheduled for September 2013.	SREP partner financing	World Bank	2013- ?
CDM Programme of Activity (PoA)	REA	To provide additional revenues to the small renewable energy projects (up to 10MW) to fill the equity gap and reach financial closure	US$10 million	REA submitted request to the World Bank to become a Seller Participant under CPF Several projects submitted letters of interest to REA to register under the PoA that is expected to reduce their carbon finance transaction cost	Supports the development of small renewable energy projects that could be co-funded by SREP	World Bank, Carbon Partnership Facility (CPF)	
Tanzania Energy Access and Development Project	REA and MEM	Off grid component to support an institutional set-up for the newly established Rural Energy Agency (REA) and to develop and test new off grid electrification approaches for future scale-up.	US$59.6 million. US$16 million IDA. US$6.5 million GEF	1. Standardized Power Purchase Agreement for renewable power to supply TANESCO main and mini-grids. a. Tariffs, and SPPA implementation and guidelines issued by EWURA. b. TANESCO set up Small Power Project Office to facilitate project development. c. REA: Matching grants to support pre-feasbility for new projects.	Good regulatory framework, institutional capacity and strong project pipeline that could be developed with SREP cofounding. SSMP and Clusters models could be scaled up for off-grid	World Bank, GEF	2007-2015

				d. REA: US$500/connection (max 80% of distribution cost) for mini-grid connections. e. Several projects operating or under construction (TPC, TanWatt, Mafia Island). f. Several mini-hydro and biomass power projects under development. g. Strong pipeline of projects 2. Sustainable Solar Market Packages (SSMP) provide off grid solar electricity for public facilities and households. a. Four SSMP in Rukwa Region under implementation. b. New SSMP packages being prepared for eight more regions. 3. Clusters Projects: Solar home systems for member of associations (coffee, tea, cashew,…) with financing through NMB/Stanbic 4. Other TA includes low cost electrification methods, renewables financing training for bankers, project developers and sector institutions, wind resource assessment at 4 sites.			
Tanzania Energy Access and Development Additional Financing Project	REA and TIB	Credit line for financing renewable energy projects	US$25 million IDA	Credit line overseen by REA and managed under trust arrangement by TIB. Commercial banks approved for on-lending funds: CRDB, NMB, Azania Bank Limited, Twiga Bancorp First loan for Mwenge mini-hydro and mini grids approved and disbursing. The second mini-hydro project, Mapembasi is near financial closure.	Credit line facility can be used to provide SREP and other co-financing for additional renewable energy investments	World Bank	2011- 2015

CDM Projects	Tanzania DNA	Carbon emissions reductions		1 Registered project: Landfill gas and Electricity generation at Mtoni dumpsite (202,271 CERs, 3.5MW annually) 3 PINs (PIN = Project Idea Note) – given Letter of No Objection: 1. Wind Energy project - Singida 2. Energy efficiency project- TaTEDO 3. Power generation from sisal biogas project - Katani Ltd.	Additional revenues to improve viability of SREP supported projects		

Source: Scoping Mission Aide Memoire, 2012, Scaling-up Renewable Energy Programme in Low Income Countries: SREP Tanzania

Annex 3: Constraints to Renewable Energy Development

Key Barrier	Main barriers and constraints hampering the development of RE in Tanzania	Strengths of the Sector and how far they got already	Additional "mitigation" measures to which SREP activities may contribute
Institutional, regulatory and legal constraints			
Planning uncertainties	Uncertainty on the future direction of power sector hampers stakeholders' investment planning. · Lack of information on grid extension plans reduce incentive to develop mini-grid projects, including supply of renewable electricity to TANESCO isolated grid (those developing projects feeding mini-grids get higher tariff. One isolated grid connected to main grid, gets only lower main grid tariff) · There is mismatch between renewable energy resource distribution relative to existing grid/load centres	· MEM in final review phase of Power Sector Development Master Plan (due end 2012) · REA launched National Rural Electrification Prospectus (due mid 2013) Both these should give greater clarity to energy development plans and opportunities for renewable energy.	· Publicly issue Master Plan and Prospectus without delay. · Recognizing the role for and incentivizing the ability of RE to contribute significant electricity quickly, to complement to the forthcoming national plan and prospectus. · Need greater transparency and early notification by TANESCO as to grid network expansion plans.
Pre-investment time is long	RE project approval process takes time and requires coordination and approvals from NEMC, TANESCO, REA (if project development and co-financing support is needed), as well as financing mobilization.	Regulatory frameworks, legal agreements and tariff, implementation guidelines issued by Regulator EWURA and effectively administered. TANESCO has set up private power cell to facilitate support for small (up to 10MW) renewable project approvals.	Further strengthening capacities of key institutions beyond that undertaken with TEDAP and related assistance
Quality is low	Solar market spoilage through poor quality and counterfeit products at very low prices flooding market. Consumers highly price sensitive. Market spoilage is happening.	Lighting Africa has engaged with Customs to inform them of quality requirements and to determine how to stop poor quality/mislabeled products entering markets. But border higher porous and near impossible to stop such products entering market.	· Engage further with border controllers, with wholesalers, distributors and retailers and have expanded awareness programmes launched in key target market areas · Development of standards by Tanzania Bureau of Standards and regulations by EWURA Enforcement
Technical capacities and human skills			

Low human skills and institutional capacity	Technical, institutional and financial capacities are still relatively low.	- REA has undertaken capacity building in the banking sector. · TANESCO supported in strengthening its private small power cell. · REA offering advisory services and cost shared (up to 80%) funding for pre-investment work. · SIDA and UNDP have supported solar training in several areas that have been very effective. · Incorporating solar technology in VETA'S curriculum.	Initiate further and expanded systematic programme aimed at building the capacities of all the stakeholders on issues related to RE to banking sector as well as product and service providers (information, project due diligence/appraisal, new financial instruments, awareness building, marketing, sales and repair)
Low human skills and institutional capacity	There is limited experience and expertise in country for undertaking feasibility studies, detailed designed, construction etc. Existing capacities of experts over stretched.	· REA offers cost shared support to developers to undertake feasibility and detailed engineering studies. · GVEP supporting the developing of 6 small hydro mini-grid projects. · GEF through UNIDO supporting the development of nine (9) small hydro mini – grid projects · Some developers setting up JV arrangements with foreign partners to fill expertise gap.	· Specialized training to building required experience in mini-hydro and biomass technologies. · Expand training through appropriate university and technical schools. · Support partnerships with international firms through South-South exchanges.
Low human skills and institutional capacity	Off grid solar for public service facilities difficult to service/maintain due to limited technical capability in area, theft of modules and batteries from public facilities, users do not have adequate capacity to use/operate and do routine maintenance due to staff turnover.	REA has piloted with the "Sustainable Solar Market Packages" (SSMP) approach that issues supply and installation contracts to a large group of public facilities in a contiguous area, with incentives to sell/service SHS to public customers. Some signs of success but problems remain. REA preparing packages in seven other regions. Also incorporating solar technology in VETA'S curriculum.	· Future SSMP packages must be designed to overcome contract- and contract-performance problems. · Greater attention to contractor capability and less to "lowest cost" in contractor selection. · More effective methods of making SHS affordable to private customers.
Renewable resource uncertainty	Renewable resource information of a quality and duration is lacking	Wind resource monitoring supported by REA in six areas. · Hydro resource data collection being	· Expand resource monitoring to cover biomass and verify solar resources (currently depending on data from NASA,

		undertaken by developers with cost-shared assistance from REA at specific project sites and assessment of Small hydro by MEM and TANESCO in 5 regions. Norway supporting more extensive hydro potential characterization (but may focus on larger scale RE) Geothermal Power Tanzania given concession in Lake Ngozi and Rufiji and investing $5 million in geotechnical, geological and drilling work. · Surface exploration done at Lake Ngozi · Area special for energy crops to be identified in the country	EU satellite-based sources). · More resources for hydro resource characterization for mini grids to feed mini-grids (TANESCO and private). · Expand geothermal resource assessment work. · To support Agro – ecological zoning
Renewable resource uncertainty	Climate change impacts increase variability of hydro flows (REA IP)	Afforestation efforts are underway.	
Economic and financial context			
High pre-investment and transaction costs	High cost of resource assessment and feasibility studies.	· REA offering cost-shared support for pre-investment studies. · EWURA has issued guidelines for renewable project development up to 100MW. · REA supporting wind resource assessment and mapping hydro resources. · REA offers cost shared funding for feasibility studies Exploration concession awarded to Geothermal Power Tanzania Ltd.	Continue REA support programmes. Support expanded and well-designed geothermal resource assessment - surface exploration and appraisal drilling Default note have been issued to all geothermal licensees to make geothermal resource develop in a better way.
High capital cost renewable energy technology and development	· Upfront investment costs of RE are high due to intrinsic capital intensity of technology. · High also due to limited number of projects, lack of competition, currency depreciation etc. · High transport costs due to long distances to sites. · Unduly long time for pre-investment, financial closure and construction include costs as well as increase IDC	· Designed incentive packages to promote private sector investments by zero rating import Duties and Taxes on equipment and accessories. · Annual budget allocation of approximately USD 625,000 to develop geothermal	· Increased implementation scale can help reduce costs. In the case of geothermal, comprehensive geo-scientific investigations that precede test and production well drilling reduces risks of expensive dry wells. · Little can be done to overcome some

	requirements · For grid connected projects including electricity distribution networks, customer connection costs are very high	· Partnering with Development Partners in funding geothermal development · REA supporting better project designs through cost-shared pre-investment support encourages international partnerships. · REA offers $500/connection (up to 80% of connection cost), to mini-grid developers. · Low cost rural electrification study underway, include pilot to demonstrate lower cost methods	constraints, but support to streamlining processes, especially pre-investment requirements, financial closure. · Support best practice through encouraging international partnerships. · If low cost electrification pilot successful, mainstream approaches emerging from low cost electrification study. For a limited time, support connection subsidies to those adopting low cost methods.
Financing unavailability	Domestic banks require high equity share (40%) for investments and makes mobilizing project financing difficult and expensive.	Those requiring additional equity are bringing in foreign equity partners (e.g. green funds or other investors). Others getting local investors	· Guarantee instruments to cover currency and other commercial risks that foreign equity partners may require. · Quasi equity facility
Financing unavailability	Domestic banks mobilize only short term funds and so hesitant to lend long term. Limited or no long term financing available.	· TEDAP has established a US$22 million credit line. It offers long term financing to banks at AWDR plus a margin to cover forex risk. · Introduction of the Green Energy Facility (REA)	· Increase funding to credit line. · Encourage and facilitate international green funds and socially-oriented investors to invest in Tanzania's renewable energy sector.
Investment risk high	International private investors consider the energy sector in Tanzania a risky sector. Those who do come seek higher risk premiums which make projects financially unviable.	TEDAP credit line and World Bank engagement has helped attract international investors, but significant risks remain.	Provide greater guarantees and security to private investors and define conditions to improve public-private partnerships for utility scale projects, such as grid connected RE investments
Revenues inadequate	Off-grid solar electrification, though a thriving business in some areas is limited by affordability to higher income consumers.	· REA and World Bank have funded pilot efforts to engage SACCOS to lend to solar, undertaken "Cluster" projects to aggregate SHS loans to association members (group lending), with some positive results, but too early to declare success. · GOVERNMENT OF TANZANIA has removed all taxes and duties from SHS REA offers grants ($2.5/Wp)	· Further engagement with banks and MFIs as well as large agricultural or mining operations, with appropriate incentives and training to engage in such credit schemes. · Mobilization of additional funding (grants) from development partners (to subsidize initial investment costs)

Revenues inadequate	Renewable energy tariff, based on avoided cost is distorted by gas price subsidies, preventing otherwise economically viable renewables not being developed.	EWURA has established, and transparently and effectively manages the RE tariff setting process. But pricing is based on financial prices and not economic pricing.	Policy dialogue with GOVERNMENT OF TANZANIA and EWURA on a pricing formula to recognize true economic avoided costs. Consider pool of funds to cover payments for difference between economic and financial avoided cost as TANESCO should not bear that cost. · Consider technology-specific Feed in Tariffs (FiT) to support energy supply diversity.
Revenues inadequate	CDM project prospects exist but progress slow to non-existent due to complexities of CDM process, lack of country capacity, small scale of projects and bureaucracy in Tanzania.	· Several CDM training sessions held in Tanzania. · One project registered and 3 PINS prepared. · REA submitted request to the World Bank to become a Seller Participant under CPF. Several projects submitted letters of interest to REA to register under the PoA.	· Greater pro-activity and effectivity of DNA required. · REA to be approved as Seller participant in PoA.

Source: Scoping Mission Aide Memoire, 2012, Scaling-up Renewable Energy Programme in Low Income Countries: SREP Tanzania

Annex 4: Summary of Renewable Energy Resources in Tanzania

Renewable Energy Sources	**What type of Mapping is available?**	**Key Mapping Data** (Zones and potential in terms of MW)	**If not available, is there any mapping planned to be done shortly?**	**Sources where information is available**
Geothermal	Identified through surface manifestations except at Lake Ngozi – Songwe Mbeya region where detailed geological, geophysical, and geochemical studies done) (June 2006-July 2007 and July 2010).	According to Government of Tanzania sources, potential is more than 650MW. More than 50 potential geothermal sites are identified along the Rift Valley, Lake ngozi (Songwe), Lake Natron (Manyara), Luhoi (coast region) and Kisaki ranked as first four. Geothermal potential areas in Tanzania are divided into four zones; this is due to two arms of rift formation (eastern and western rift) The Lake Ngozi – Songwe potential ~100MWe.	Geothermal Power Tanzania Ltd. granted prospecting licenses for geothermal exploration in the Mbeya area and Rufiji. Announced plans in May 2012 to invest $5 million in geotechnical, geological and drilling work. Contracting a dedicated geothermal drilling rig with capacity to drill to 2.5 km. Expects drilling to commence at end 2012. Main target: geothermal reservoir at the Ngozi volcano ~100MWe.	MEM, Geological Survey of Tanzania, Federal Institute for Geosciences and Natural Resources (BGR) of Germany and TANESCO. SWECO – Swedish company based in Sweden
Solar	Meteorology and solar radiation for NASA SSE from the NASA satellite and re-analysis research programmes. Parameters based upon the solar and/or meteorology data were derived and validated based on recommendations from partners in the energy industry. PV system sizing based on solar radiation maps available from EC JRC (less useful than NASA for planning and system design)	Tanzania is situated in the solar belt with high levels of solar energy with global radiation of 4 - 7kWh/m2day (REA).  **Figure 1 Solar Radiation – 2250-2750kWh/m2/year (EC-JRC PVGIS)**		NASA Surface meteorology and Solar Energy http://data.nasa.gov/surface-meteorology-and-solar-energy/ European Commission, Joint Research Centre, Photovoltaic Geographical Information System-Interactive Maps http://re.jrc.ec.europa.eu/pvgis/apps4/pvest.php?map=africa
Hydro -Large		Large hydro potential about 4700MW, only 12 % exploited. Increased rainfall variability has led to unpredictability in output. Saiguran Loisulie reports "There is a general decrease of the amount of annual rainfall. The frequency of below average rainfall is generally going up. It is also evident that the severity of extreme weather events like dry and wet spells is intensifying. The predictability of seasonal weather patterns is becoming more challenging."	Norway-supported the survey.	TANESCO Saiguran Loisulie, Vulnerability of the Tanzanian Hydropower Production to Extreme Weather Events, Sokoine University of Agriculture, Faculty of Science Department of Physical Sciences, Morogoro. saiguran@suanet.ac.tz, +255 757 876603

Hydro - Small	TANESCO desk studies and fieldwork. New sites identified via topographical map reading of the standard 1:50,000 sheets. Reconnaissance studies of new potentials and confirmation of existing information are completed for Rukwa, Kagera and Ruvuma regions (2007). Also field studies were done 2007 in Iringa, Mbeya andMorogoro The next will be Kigoma regions.	The assessed potential for small, mini and micro-hydro system (with capacities of less than 10MW each) is 480MW. A survey by TANESCO identified 85 specific sites is187MW (TANESCO)	Norway supporting large hydro development survey and planning (check status!). REA supported by WB and GVEP funding feasibility studies for SHP based rural electrification and grid supply projects MEM and TANESCO is assessing small hydro potential in 7 regions and 5 regions already completed	TANESCO surveys. Kato T. Kabaka and Florence Gwang'ombe, Challenges in Small Hydropower Development in Tanzania: Rural Electrification Perspective, International Conference on Small Hydropower - Hydro Sri Lanka, 22-24 October 2007. GTZ, Tanzania`s Small-Hydro Energy Market, 2009. Table 6 gives location of 56 SHP sites with estimated capacities, head, flow etc. REA SHP database gives more specific data on SHP sites.
Biomass	Forest 35 million hactares are available	Biomass consumption estimated at 40 million m3 of wood equivalent leading to clearing nearly 400,000 ha of forest annually.		MEM
Biomass – Point sources Industrial/Power, MSW	Factory data, survey reports MSW in major cities	Biomass production estimated at more than 2 billion m3 of solid wood/annum (2000). Largely from sugar, timber, paper, tannin, and sisal processing. TPC-Moshi, TANWAT, Sao Hill, Mtibwa, Kilombero and Kagera sugar factories, Mufindi Paper, etc. Sugar Industry: Production in 2011 ~320,000 MT. 4-5 MT of bagasse/MT sugar. Bagasse production 1.5 million MT. AfDB funded 2004 study: Sugar (see update, above) Sisal Industry: 200,000 tons sisal waste Coffee Curing: Present production is 45,000 MT, to increase to 65,000 MT by 2010. About 20% of the gross weight is coffee husks, which are not utilized so far. There are plans to convert the husks into charcoal. Rice Milling: Annual rice production (2004) ~800,000 tons. Forest/wood industry: slight surplus of wood biomass available (2004) for energy use will shift		M. A. Kishimba, The Potential of Energy From Sugar Cane Wastes in Tanzania, AFREPREN, October, 2000. DECON – SWECO – Inter-Consult, Tanzania Rural Electrification Study, for MEM and TANESCO, 2004, funded by AfDB M.A. Kishimba, Energy Recovery from Municipal Waste, Chemistry Department, University of Dar es Salaam Daily News Online Edition, http://dailynews.co.tz/index.php/biz/1459-sugar-production-potential-yet-to-be-fully-exploited

		into a deficit by 2020. Major potential at TANWATT, Saohill. MSW: Kishimba estimates only about 10% of Dar es Salaam MSW ends up in landfills. Forecasts 4.7 million MT of urban MSW by 2015 with energy potential of 1200 GWh/year		
Biomass – Distributed	Research/survey data, REA	Agricultural, municipal, and industrial wastes and residues, and animals waste ~ 15 million MT/annum. 17.5 million cattle, 12.5 million goats, 3.5 million sheep (1998 Census) 1.1 million tons forest residues. Available nationwide as fuelwood, charcoal from forest resources for urban consumers (contributes to deforestation) and agricultural waste. Biomass contributes 80% of Tanzania's final energy demand. Provides for more than 90 % of rural household energy needs.		
Wind	Anemometer measurements. Also estimates based on satellite data available from NASASurface meteorology and Solar Energy	Assessments in Kititimo (Singida) and Makambako (Iringa) areas. Average wind speed estimated 9.9 m/s at Kititimo and 8.9 m/s at Makambako (50m?).	REA supporting wind mapping in six areas: Makambako in Iringa region, Karatu in Arusha region, Mkumbara in Tanga region, Mafia in Coast region (off-grid), Sumbawanga in Rukwa region (off-grid) and Singida. MEM with TANESCO conducting a Wind Assessments in Mkumbara (Tanga), Karatu (Manyara), Gomvu (Dar es Salaam),Litembe (Mtwara), Makambako (Iringa), Mgagao (Kilimanjaro), and Kititimo (Singida). Plans for assessment in Usevya area (Mpanda).	MEM, TANESCO, REA, DANIDA

Source: Scoping Mission Aide Memoire, 2012, Scaling-up Renewable Energy Programme in Low Income Countries: SREP Tanzania

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