Sustainability Indicators for the Tanzanian Energy Sector

The Sustainable Energy Watch Indicators 2001

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by

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Summary

Tanzania's energy demand and end-use patterns are characteristic to those observed in other developing countries and thus the sustainability energy indicators. Woodfuel and other forms of biomass dominate the energy balance and account for about 90% of total energy use. The per capita carbon emissions (indicator 1) are very close to the sustainability goal thus suggesting Tanzania as one of the valuable countries to invest in energy related activities. The figure is better because the country has very few energy intensive activities and can be established without altering the vector's position much beyond the sustainability goal. However, the vector values for 1990 is higher than the 1998 vector due to relatively low energy developments as compared to the population increase.

The country has several significant energy related pollutants namely carbon monoxide, methane, nitrogenous oxides to mention a few. The energy sector is categorized into four major sub-sectors, namely woodfuel, petroleum products, electricity and renewable energy recourses. The carbon monoxide emissions (indicator 2) are increasing due to increasing of population accompanied by use of traditional biomass in inefficient manner, coupled by imported mobile polluting sources being second hand cars with low combustion capacity.

Tanzania's household with access to electricity (indicator 3) is as low as 6% of the total population. The calculated vectors values are typical to the prevailing situation of access to electricity in Tanzania, i.e. 0.96 and 0.9 for year 1990 and 1999 respectively. The vector value has comparatively been dropping over years because the population has increased while the population with access to electricity has remained fairly stable. Rural electrification plans if implemented are expected to boost the number of population with access to electricity.

The energy demand forecast especially clean energy investment using an average year-by-year energy consumption of traditional energy for years 1990 to 2010 shows an increase of 2.4% per year. The government has realized that the exploitation of renewable energy resources will not only contribute to, but supplement further development of conventional energy sources. Thus efforts have been directed to hydroelectricity and natural gas reserves. Other clean energy technologies are small in scale and largely undocumented, constituting biogas, mini hydropower, windmills and solar. These technological options except hydropower have not been commercialized rather are used by individuals for their energy usage purposes is scarce as none than TANESCO projects is in national records. From limitation given in the guideline on clean investment of less than 100MW this indicator could be calculated by taking the average investment over the years when the project was being constructed. The investments after commission were not considered. .

The report has also featured that Tanzania is not exporting energy basing the available information. However, the country is used as a ferrying agent for petroleum products neighboring African countries. With scarce information on consumption pattern of imported petroleum products the vector especially for energy trade in Tanzania was almost unrealistic but represent the actual facts of low utilization of non-renewable sources, although due to data unavailability and timeframe required for algorithmic analysis of such information, the findings may lead to misinterpretation of the sustainability goal is small.

The required data to calculate the sustainability on energy investments vectors (indicator 6) could not be compared since investment in this case will be expenditure in procuring raw energy. Nevertheless, the costs and amounts of fuel oil from TPDC and TANESCO at any one time were difficult to be located due to poor storage of financial data. The company could not trust the way handling of the so called confidential company information otherwise the author was supposed to follow a bureaucratic clearance procedure which was not possible for the time in subject. Collected data available were found to compile either investment or running expenses that could not be merged together.

Energy intensity (Indicator 7) comparing vectors figures for 1990 and 2000 highlights a decrease in vector magnitude. Although there has been increase in energy production, there has been no proportion in increase of GDP. The high vector values reveals relatively high power prices in Tanzania as compared to other developing countries.

Estimates on the potentiality of the wood fuel supply differ greatly from one study to another with the exception of a few similarities As described earlier, Tanzania's renewable energy portion is predominantly biomass. This can be reflected by vector values that are very close to sustainability goal.

Eight Indicators of Energy Sustainability for Tanzania

Indicator	Eight Indicators of Energy Sustainability for Tanzania					
	1990		1999		% Change	
	Metric	Vector	Metric	Vector	Metric	Vector
1. Carbon emissions	22.59	-0.400	18.23 *	-0.406 *	19.3	1.5
2. Local pollutant	66.94	-	69.33 **	1.04 **	3.6	-
3. Households electrification	0.041	0.96	0.096	0.90	134	6.3
4. Clean energy investment	-	-	0	0	-	-
5. Resilience: energy trade	-	-	0.96	0.96	-	-
6. Burden of energy sector investments	0.0105	0.105	0.0043	0.043	59	59
7. Energy intensity	13.67	-	6.88	0.61	49.7	-
8. Renewable energy	0.9438	0.007	0.9453	0.0055	0.15	21.4

Note: Comparison data used in this report are for 1990 and 1999 years, except for the data marked X* and X** which is for 1998 and 2000 years respectively

Introduction

This report marks the first Sustainable Energy Watch Report (SEW) for Tanzania. The report preparation was engaged to the Stephen Mwakifwamba of the Center for Energy Environment Science and Technology (CEEST) and compiled with the assistance of Mr. Bartholomew Makiya Lyimo of Tanzania Greenhouse Gas Action Trust (TAGGAT).

The authors received significant assistance and contribution on reference, data and comments from colleague, Edward C. Kilawe of TAGGAT. It is anticipated that the compiled information is essential for a sound management of energy sector and in the development of relevant policies for sustainable development. Lastly, the team extends thanks to Dr. Lutengano Mwakahesya and Mr. Mwihava both of Ministry of Energy and Minerals for supplying necessary data that facilitated analysis and adoption of information acquired.

The SEWR for Tanzania is a challenging process that will assists policy and decision makers and all other stakeholders to assess whether the energy state is sustainable or is relatively improving, remaining stable or deteriorating in a given setting. The authors anticipate the provided information on energy utilization will later be employed to identify and assess trends, and measures progress towards maintaining or achieving cultural, social, economic and ecological health; and assists the nation in better understanding the linkages between humans and ecosystems in their activities. However available data for 1990 and projected estimates from 1994 studies by CEEST have contributed a great deal in this report.

SEWR as an environmental information tool, supports decision making through use of authentic environmental information; gives a scientific base to the national environmental related information; provides meaningful data for the public and the international community; and gives chance to environmental information to be understood and used with focus to spatial linkages.

General discussion of Tanzania

United Republic of Tanzania was formed in 1964 from unification of Tanganyika and Zanzibar. After independence of Tanganyika (1961) and Zanzibar (1964) the two governments were preoccupied with three development problems namely ignorance, diseases and poverty. Despite sustained efforts to address the country's economic and social problems in 1980s, as much as one half of all Tanzanians today are considered to be basically poor. It is generally accepted that the resulting economic crisis in 1980s was prolonged by Government adoption of inappropriate macro and micro economic policies. The Arusha Declaration adopted in 1967, which was widely acclaimed as a human-centered development vision, turned out to be an economic disaster in practice.

Today, about 40 years since declaring the war against poverty, Tanzania’s per capita income is $ 120 per year and is ranked as one of the poorest countries in the world. It is estimated that 50 percent of Tanzanians live under the poverty line, while 36 percent live in very poor conditions. Average earnings do not meet requirements for basic minimum needs. To many, a single meal in a day is common place. Malnutrition and underweight of infants are endemic among Tanzanians. About 7.2 percent of infants have severe malnutrition.

Educational programmes adopted in 1970s have succeeded to bring the literacy rate to 81 percent. The current literacy rate is believed to be lower than this figure since only 70 percent of school age going children can register for primary education in schools that are critically faced with inadequate facilities. The health sector is also poorly developed and managed. Most Tanzanians are then seriously affected with preventable diseases like malaria, diarrhea, cholera, and anemia. Maternal child and infant mortality rates are still high. In every 1,000 births, 96 infants die compared to only 7 infants for developed countries.

Tanzanians social life reflects the fact that approximately one-third of the population lives in abject poverty. People in villages spend more than 50 percent of valuable (day-time) time fetching for water and firewood. About 30 percent of all Tanzanians have to walk for more than 30 minutes to reach the nearest water and energy source. In most cases the quality of water fetched is not guaranteed. According to official figures, approximately 50 per cent of the Tanzanian population has access to reliable sources of clean and safe water. Major sources of water include rivers, springs, and shallow wells, bore holes, dams and limited piped water that is mostly confined to urban centres.

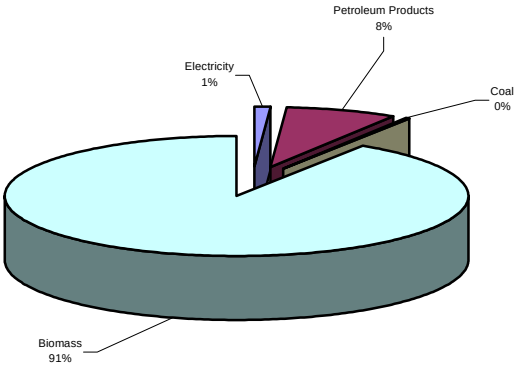
The country's main economic activity is subsistence agriculture for both food and cash crops. Many places in the rural areas do not have dependable means of transport, resulting in failure by farmers to send their produce to markets and consumers in urban areas. While some parts of Tanzania would be experiencing food shortage, the same would be in excess supply in another part of the country because of lack of reliable communication.

Energy Sector Overview

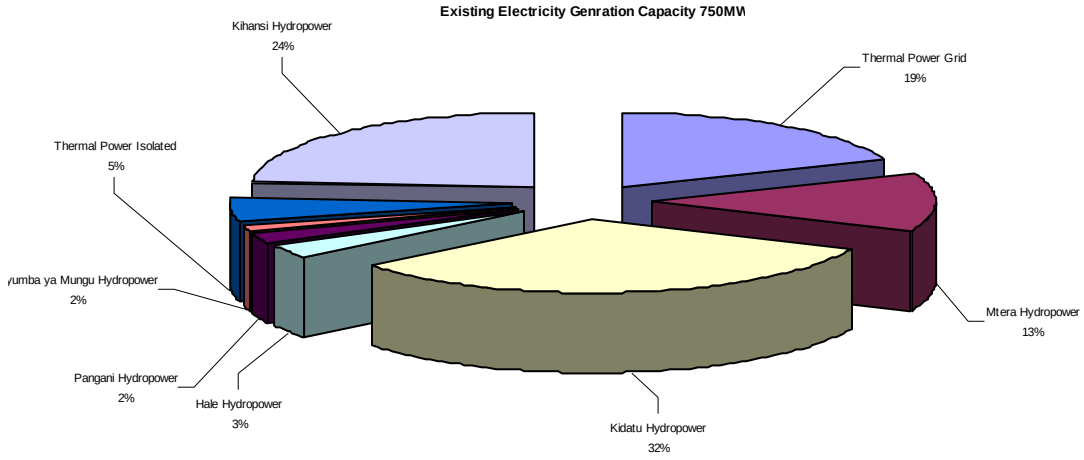
Tanzania's energy demand and end-use structures can be categorized into non-commercial primary energy sources (mainly biomass fuels) and commercial energy (petroleum, natural gas, hydroelectricity, coal and geothermal energy). The primary energy in the form of biomass, particularly woodfuel, is the main source of energy to both rural and urban areas. The total forested area of Tanzania is 44 million hectares where about 13 million hectares of these are reserved forests.

Biomass fuels such as fuelwood, charcoal and agricultural residues account for about 90% of primary energy supply. While commercial fuels such as hydroelectricity and petroleum account for 1 percent and 8 percent of total energy consumption respectively. It is estimated that in Tanzania's final energy consumption was 15.0 million Tonnes of Oil Equivalent (TOE) by 1990. The per capita energy consumption is of the order of 0.65 TOE. Tanzania also consumed almost 1 million tonnes of petroleum products in the same year. The transport sector accounts for nearly 51 percent of the petroleum used while industry accounts for 26 percent, and households for 10 percent of the total fuel oil consumption.

Energy Supply by Fuel (1999)



Possibilities exist for the economic conversion of these resources into electricity and energy for industrial and domestic purposes. However, limited forest and agricultural residues are being used for electricity and mechanical power generation as well as fuelwood substitute in various parts of the country. Currently, account for at least 10 percent of the nation's energy requirements.



Coal and natural gas are the other commercial fuels with a high potential. Coal reserves are estimated at about 1,200 million tonnes, of which 304 million tonnes may be considered proven. A field of 29.02 billion cubic metres of proven, probable and possible recoverable high quality natural gas has been discovered at Songo Songo bay.

Hydroelectric energy is the single most important indigenous source of commercial energy with a potential of 4.7GW of installed capacity and about 3.2GW of firm capacity. Only 15 percent of the potential installed capacity has been developed. Solar, wind and geothermal energy are virtually untapped resources. The mean solar energy density is of the order of 4.5 kW per square meter per day, an indication of its potential for use as an energy source. Low speed windmills also have a potential in the country. Uranium deposits are known to exist in Tanzania.

Overview of other sectors:

Industrial:

The industry sector in Tanzania is still dominated by light manufacturing, mainly in food processing, beverages, textiles and chemically based products. A few heavy industries include petroleum refining, cement, pulp and paper and iron and steel are in the dire need of replacement. The ongoing industry reform programme including privatization, is said to have contributed to the slight increase in GDP contribution. Areas in which increases can be recorded include food processing, beverages, tobacco products, textiles, steel and galvanized iron sheets.

Agriculture:

The agricultural sector is the major source for food, industrial raw materials, exports, and in turn a major market for industrial products. The contribution of the sector to GDP which 90 per cent of land being small holders farmer excluding tea and sisal estates, was 52.5 and 52.8 percent in 1995 and 1996 respectively. The main food crops grown include maize, sorghum, cassava, beans, peas and bananas, Sugar, wheat and rice are grown in few government owned large scale farms. Important export crops include coffee, cotton, tobacco, tea, sisal, cashew nuts and cloves.

Population:

In 1967 the country had an estimated population of 12.3 million people. By 1990 the population had grown to an estimate of 24.3 million people. The annual population growth estimate is 2.8% (1988 census estimate). The past three censuses (1967, l978 and l988) indicate that Tanzania is sparsely populated although in some areas the population density and carrying capacity is high. In l988, the population was 23.1 million with a density of 26 people per km^2. Estimates indicate that in l996 these were 29.1 million people and by 2001 the population was estimated to reach 33.4 million.

Urbanization:

Historically, development has been associated with the urbanisation of society. The urban population growth rate was higher than the national average in both periods being 8.9% between l967 and l978 and 5.7% between l978 and l988. Half of this growth is attributed to rural urban migration. Before independence the proportion was 97%. It has decreased to 95%, 85% and 75% in 1665, 1978 and 1988 respectively linked with rural-to-urban migration, due to employment and other opportunities available in urban areas.

Environment:

Tanzanian environment is threatened by natural disasters, refugees, poor management, lack of finance and loss of biodiversity. The main threat to genetic diversity arises from anthropogenic activities including indiscriminate exploitation of closed rain forests resulting in erosion, loss of catchment areas, endangered species, monoculture, Increase in human population, use of agrochemicals i.e. fertilizers, pesticides and herbicides, overgrazing and overstocking, climatic

changes due to global warming, overexploitation of plant and animal resources and loss of habitats due to construction of dams.

Other Energy-Related Developments

In 1992 the government launched the National Energy Policy with the objectives of establishing an efficient energy production, procurement, transportation, distribution, and end-use system in an environmentally sound manner and with due regard to gender issues.

The policy also provided guidelines for reducing the use of petroleum based products for transport and the industry sectors by harvesting indigenous energy resources. In the case of exploitation and development of natural resources the policy directs sustainable use of hydroelectric, natural gas, coal and petroleum. The guidance is also extended to arresting woodfuel depletion by evolving more appropriate land management practices and more efficient woodfuel technologies, development and utilization of forest and agricultural residue for power and cooking energy production.

Apart from woodfuel, electricity and oil, there also exist other high potential alternative sources of energy at different degrees of development and utilization. Our matrix of energy include new and renewable energy sources such as solar, biomass, geothermal wind and hydropower. On the non-renewable sources we have hydrocarbons (oil and gas) and coal. The non-conventional alternatives include biogas, animal and agricultural waste. The table below shows the percentages of energy utilization basing on recent data from the Ministry of Energy and Minerals.

Energy Use by Type of Source, sector wise (Percentages)

	Total Energy	**Oil**	**Electricity**	**Coal**	**Wood Fuel**
Household	79.0	20.6	18.5	-	82.0
Industry	2.0	23.2	37.0	56.7	0.07
Rural Industry	10.0	0.0	0.0	0.0	11.0
Transport	2.0	39.5	-	-	-
Commercial	4.0	4.3	38.0	-	4.3
Agriculture	3.0	11.6	7.0	44.3	1.5
Total	**100**	**100**	**100**	**100**	**100**

Source: Tanzania energy balance, Energy department, Ministry of energy and Minerals 1999.

The energy sector has continued to be plagued with drought problems and the subsequent reduction in water reservoirs for hydropower production. In recent years power rationing has become necessary during the drought periods. Efforts to increase power generation capacity currently being taken include the implementation of the Kihansi hydropower project, the Songosongo gas electricity project and the thermal electricity project under installation off the coast of Dar es Salaam.

Indicator 1: Per Capita Carbon Emissions

Introduction

Tanzania's energy demand and end-use patterns are characteristic to those observed in other developing countries in households, rural and urban alike. The country's dependence on biomass fuel is high. Woody biomass source of energy supply trend is currently projected to the annual consumption of 1 ha per person per year. Such an overwhelming and persistent dependence on biomass fuels for household energy has given rise to development concerns on several fronts; and has become a serious issue to the future of the country.

Biomass use for household energy adversely affects crops production and productivity with increased depletion of woody vegetation for fuel increased erosion of top soil has become glaringly evident; diminishing production potential of cultivated land. The share of energy sector emissions as observed during the greenhouse gas inventory for 1990 was only 6.36% of the total country greenhouse gas emissions (68,885 Gg). Thus the Per capita carbon emission for 1990 and 1998 is 22.59 kgC/capita and 18.23 kgC/capita respectively.

Metric (actual data) for 1990: 22.59 kgC/capita and 1998: 18.23 kgC/capita

Vector values for 1990: -0.40001 and 1998: -0.40552

Referring to calculations of per capita emissions of Tanzania, the vector values are below 0, the sustainability goal, indicating high global energy sustainability. Tanzania is an insignificant GHG emitter but with the current economic growth and industrial development, emissions will increase especially in energy sector. This makes Tanzania as one of the valuable countries to invest in less polluting technologies and developing sustainably through the use of clean and efficient technologies in energy related activities.

The setback in energy projects may well be in financing of these activities but through making use Clean Development Mechanisms, the sector can attract these investments from developing world. The GHG mitigation analysis for Tanzania suggests that sustainable energy development can be achieved through investments in energy supply and end use options. The vector values for 1990 is higher than the 1998 vector due to relatively low energy developments as compared to the population increase. The estimated population for Tanzania is 24.35 million and 32.92 million for 1990 and 1998 respectively

Discussion:

The data used for calculation of this vector for 1990 was taken from the greenhouse gas inventory of the base year 1990. It is quite normal to assume that the majority of the people will continue depending largely on biomass fuel right into the enforseable future. This is because of several socio-economic barriers that will hinder them using alternatives even when subsidized. In this context therefore, more emphasis has to be put on improving the current management of fuel wood stock that seems to be more feasible.

The improved charcoal stoves project as an energy efficiency alternative can still provide a range of technical and financial support to local artisans and entrepreneurs. These however needs facilitation of the transfer of know-how for production and dissemination of more efficient charcoal stoves and improving the living and working conditions of the rural people especially the women.

References:

1. IEA, Selected Energy Statistics for 1999
2. Tanzania Census Report, Bureau of Statistics, Dar es Salaam
3. Sources and Sinks of Greenhouse Gases in Tanzania, CEEST, 1997
4. Tanzania National Communication to UNFCCC (Draft report), 1999.

Notes to SEW or next year's Observer - Reporter:

The observer should harmonize data from different sources and national data especially from updated inventory. It is more likely that the greenhouse inventory will be updated regularly thus a reliable source should be established. This will eliminate use of estimates especially on year-by-year emissions and population as it was noted to vary from one reference to another. Equally important, energy, there is a big variation of what is the biomass contribution in energy balance hence the reported figures vary in the range from 80-90% of the total primary energy consumption.

Indicator 2: Most Significant Energy-Related Local Pollutant

Introduction:

The Tanzania's energy sector can be categorized into four major sub-sectors, namely woodfuel, petroleum products, electricity and renewable energy recourses. These sectors are normally grouped in either commercial energy (petroleum, natural gas, hydroelectricity, coal and geothermal) or non-commercial primary energy sources (woodfuels).

In either category the readily available data for leading local pollutant has been carbon monoxide accounts for 77% by weight of the total non CO2 emissions in energy sector. The rest of emissions estimates is attributed to methane and nitrogenous oxides at 20% and 3% respectively.

CO main contributor in energy sector is traditional biomass energy, mobile combustion activities and stationary combustion in industries with 1990 emission of 1550.00Gg, 51.80 Gg and 26.43 Gg respectively. For the case of this report carbon monoxide has been taken as the most significant local pollutant that is estimated at 1,628.88 Gg and 2,288 Gg for years 1990 and 2000 respectively. The per capita emissions for this pollutant is calculated to be 66.94 kgCO per capita for 1990 and an equivalent of 69.33 kgCO per capita for 2000.

Metric (actual data) for 1990: 66.94 kgCO/capita and 2000: 69.33 kgCO/capita

Vector values for 2000: 1.04

The CO emissions are increasing due to increasing of population accompanied by use of traditional biomass in inefficient manner. The mobile sources units in 2000 have also increased as compared to 1990 level. Most of mobile polluting sources being second hand cars with low combustion efficiency.

Discussion:

The 2000 CO emissions were taken from projections using surveyed data from 1988-1994. The reason for this was principally timelines and unavailability of first hand data thus the quality of the reported figure may be low. However, the economic and industrial development for Tanzania has been fairly constant in recent years thus making its uncertainty low.

References:

1. The Economic Survey for the Year 1991, Bureau of Statistics, Dar es salaam
2. The Economic Survey for the Year 2001, Bureau of Statistics, Dar es Salaam
3. The National Communication Report of UNFCCC, Division of Environment, Vice President's Office, Dar es Salaam
4. Greenhouse Gas Sources and Sinks, CEEST, Dar es Salaam

Notes to SEW or next year's Observer-Reporter:

The observer should establish possibilities of combining more than one pollutant in this indicator especially methane. The observer can also identify a more significant pollutant than CO and CH4 in terms of warming potential or health hazard. Data quality should also be explored and make use of particulate data available especially from the mining industry or indoor air pollution of non-GHG.

Indicator 3: Households with Access to Electricity

Introduction:

Tanzania's main source for electricity generation is hydro based providing the base load while thermal plants provides the peaking load. Most urban centers in Tanzania are electrified. However, less than 9% of total population has access to electricity.

The 1996 survey shows that of the 29.086 million Tanzanian populations only 2.62 million people have been with electricity supply. Access to electricity is concentrated in urban areas where 36% of household have electricity, compared to about 2% of rural household. With high demand than supply most of the developments including commissioning of the 180 MW\ Kihansi in 1999, the majority of the population still continue to rely on biomass-based fuels. The addition capacity was connected to the national grid mainly for stabilizing the supply to connected consumers and a few to be connected along with the implementation of the undertakings considering the extension of the grid to other remote areas is capital intensive and cannot be easily achieved.

Metric (actual data) for 1990: 0.041 and 1999: 0.096

Vector values for 1990: 0.96 and 1999: 0.9

The values of calculated vectors are typical to the prevailing situation of access to electricity in Tanzania, i.e. 0.96 and 0.9 for year 1990 and 1999 respectively. The vector value has comparatively dropped over years because the population has increased while the population with access to electricity has remained fairly stable. This is attributed to availability and reliability of the services itself as well as house hold maintenance of the service (cost, billing, tariff, and fraud).

Discussion:

The income gap between urban and rural areas has contributed to have electricity mainly in urban areas. The government is planning to execute a rural electrification plan has been slow mainly due to financial reasons. Rural electrification on its own will not cause development but with conditions at present, it has a major impact on the form and trend of that development takes.

Looking at the percentage rise in sale of electricity in household, an average of 5.5% has been achieved in 1990s. In 1998, 1999 and 2000 electricity sales to household were 1059 GWh, 1126 GWh and 1192 GWh respectively. The gradual increase especially in urban areas has been due to the disappointing TANESCO's transmission and generation capacity that led to significant voltage fluctuations resulting into a lot of inconvenience for these few connected users.

References:

1. Technological and Other Options for the Mitigation of Greenhouse Gases in Tanzania, CEEST, Dar es Salaam,
2. The Economic Survey for the Year 1991, Bureau of Statistics, Dar es salaam
3. The Economic Survey for the Year 1998, Bureau of Statistics, Dar es salaam
4. Hosier, R.H and W.D. Kipondya, Urban Household Energy Use in Tanzania, Prices, Substitutes and Poverty, Energy Policy, Special Issue, Vol.21, No.5, Stockholm Environment Institute, Stockholm, 1993.

Notes to SEW or next year's Observer-Reporter:

The observer should review institutional and legislative reforms in the energy sector especially revised TANESCO's monopoly in electricity generation and transmission. The private sector involvement in electricity generation and the management transformation in the TANESCO can tremendously change the prevailing situation.

Indicator 4: Clean Energy Investment

Introduction:

With the increasing industrial and agricultural activities in the country, demand for energy is rising. The energy demand forecast using an average year-by-year energy consumption of traditional energy for years 1990 to 2010 shows an increase of 2.4% per year. The government realized that the exploitation of renewable energy resources will not only contribute to, but supplement further development of conventional energy sources.

Both Tanzania's energy supply and end use structure reflected in this report represents low level of expansion and development both in clean and non clean energies. The electricity sector highly monopolized by government owned company (TANESCO) literally limited huge private investment in the power sector. Based on TANESCO's power generation expansion program the most important option is hydropower generation. In this case both large and small scale hydroelectricity generating units. Other options include biogas both from domestic animals and waste management, solar and wind energy.

Clean energy technologies in Tanzania constitutes biogas, mini hydropower, windmills and solar. In 1990 the total investment in hydroelectricity generation was approximately 430MW and thermal generating units of 120MW with an investment cost of 2,100 US$ per kW and 1,300 US$ per kW respectively.

In 1994 and 1997 two combustion turbines using jet fuel were installed with a total cost of 90 million US$. The Kihansi hydropower project started in 1995 was commissioned in 1999 with a capacity of 180 MW had an investment cost of 173 million US$ is the only quantified clean energy in those five years. However due to report writing limitations the investment cannot be categorized under clean energy. The other clean technologies except hydropower have not been commercialized rather are used by individuals for their energy usage purposes and data from this source is not available as none than TANESCO projects is in national records. From limitation given in the guideline on clean investment of less than 100MW this indicator could not include Kihansi data.

Metric (Actual data) 1990: 0 and 1999: 0

Vector: in 1999: 0

Discussion:

It is believed that a number of clean investments in solar, biogas and mini hydropower projects have been placed in several areas in Tanzania. The Ministry of Energy and Mineral keeps records from TANESCO only that creates difficulties in identifying the real clean energy from private individuals of which investment could not be established. TANESCO power investments could not qualify for this indicator.

The data used in computing this vector was accumulated in a year and no specific breakdown for activities type or end use consumption. Improvement of the data and analysis need more input from investments in private & public sectors.

References:

1. Technological and Other Options for the Mitigation of Greenhouse Gases in Tanzania, CEEST, Dar es Salaam
2. Tanzania Petroleum Development Company (TPCD) /Ministry of Energy and Minerals,
3. , Power sector in Tanzania, TANESCO, Report by Acres International Ltd, 1990.
4. TANESCO, Electricity Tariff final report, London Economics and Kennedy and Donkin Power Ltd, 1993
5. Ministry of Water Energy and Minerals, Songo Songo gas Development Project Brief, Prepared by Norwegian Petroleum Directorate, 1993
6. World Bank, Staff Appraisal report for the Tanzania Petroleum Sector Rehabilitation Project, Washington DC, 1992.
7. Crude Oil Price 1991-99: Berry Petroleum Company http://www.bry.com/

Notes to SEW or next year's Observer-Reporter:

TATEDO is constructing a renewable energy database that can be useful for the next year's observer. It is also envisaged that with the current liberalization of energy sector Tanzania Investment Center (TIC) can have at that time the most recent and reliable data on private clean energy investments that could not be identified this year.

Indicator 5: Energy Resilience: Energy Trade

Introduction:

As said earlier, the structure and size of the Tanzanian commercial energy sector reflects the size of the economy, and the low level of development of the industrial and mining sectors. It also reflects the low level of disposable income in the household sector. Electricity energy consumption constitutes slightly above 1% of total energy consumption. Commercial and industrial consumers constitute 53%. Tanzania imports about 22 000 TJ of oil out of total non-renewable primary energy supply of 23 000 PJ.

The oil data available at TANESCO is only for the Ubungo diesel fired units of capacity 115MW. The two units owned by TANESCO were established as part of the long term development plans combined with reactions to the load-shedding experiences in mid 1990.

Metric: 1999: 0.96

Vector: 1999: 0.96

Discussion:

Tanzania is not exporting energy basing the available information. However, the country is used as a ferrying agent for petroleum products neighboring African countries. With available information on consumption pattern of imported fuel oil the vector for energy and related trade in Tanzania is very close to 1. This is due to the fact that the energy sector in Tanzania is basically hydroelectric and diesel oil is only used rarely during peak hours and in drought seasons. However, data quality and availability may improve calculations of this vector and including timeframe required for algorithmic analysis of such information.

If the current information is not synthetic enough to incorporate data from oil companies importing fuel the vector will continue to be unrealistic and may lead to misinterpretation of the sustainability goal. Until 2000 the government has licensed more than 20 private companies to import and sale petroleum and petroleum products.

References:

1. The Economic Survey for the Year 2001, Bureau of Statistics, Dar es Salaam
2. Tanzania Petroleum Development Corporation (TPDC), Annual Report, 1991.
3. The Electricity Sector and Competitiveness of Tanzanian Industry in a Global Economy, Presidential Parastatal Sector Reform Commission, Dar es Salaam, 1999.

Notes to SEW or next year's Observer-Reporter:

Petroleum imports and distribution has been liberalized. The observer should reconcile the data from TPDC, Ministry of Energy and Mineral and Imports related institution where applicable.

Developments in the power sector should also be incorporated in this vector especially energy import-export through SADC grid.

The accurate figures for fuel imports may be established from the TRA which deals directly with the companies in collecting tax also there is a need to establish how is the spending from few individuals including industries with small power generating units.

Indicator 6: Burden of Energy Investments

Introduction:

The non-renewable energy investment in Tanzania is largely dominated by industrial diesel oil thermal generation. Thermal generation amounting 32% in the national grid has been used for peaking purposes to supplement the hydro generation. However, the increase in demand for power has called for more thermal generation to augment power shortfalls. This is due to the long lead times required to commission new hydropower schemes, draught condition in the main water catchment areas and ever increasing competition for water sources.

The main public investment in energy sector In 1990s has been on a $ 173 million TANESCO's Kihansi hydroelectricity power project commissioned in 1999. Proper figures on year-by-year investment could not be found. This was due to the fact that the company could not trust the way handling of the so called confidential company information otherwise the author was supposed to follow a bureaucratic clearance procedure which was not possible for the time in subject. In fact there seemed to be two data sources depending on which application you are focusing at.

The Government investment in non-renewable energy in 1999 was computed as an average investment to Kihansi in five years of development that was $ 34.6 million. The total gross domestic product (GDP) in 1990 was $ 4, 220 million and in 1999 = $ 8, 800 million.

Metric (Actual data) 1990: 0 and 1999: 0.0039

Vector values: 1999: 0.039

Discussion:

Since energy production from fuel oil that accounts only to 8% of the total energy balance the vector values typically express the low level in fuel oil energy investment. The main reason for this can be attributed from unavailability of the data for the petroleum sector. The other reason of having the vector values close to sustainability goal is an increase in GDP that was almost double because of the changes in macro and micro economic policies adopted in early 1990s.

Following the government abolishment of the government's monopoly of the power sector has prompted the public and private sector to consider developing, generating and distribution of electricity in the country. A recent example has been a Malaysian company, Independent Power Tanzania Ltd (IPTL) that has commissioned a 100MW thermal power plant in Dar es Salaam. Thus, more refined and useful data can be obtained from private sector surveys.

References:

1. TANESCO, Power Sector in Tanzania, Report by Acres International, Ltd, 1990).

2. Word Bank database: Website: www.worldbank.org, and World Development Indicators 1990-99 publications.
3. Tanzania Planning Commission, Dar es Salaam Tanzania.
4. Tanzania Bureau of Statistics, Dar es Salaam, Tanzania

Notes to SEW or next year's Observer-Reporter:

Capital investment, data availability from government owned TANESCO, private owned sources, the linkage between the two, A closer link and follow-up between data collection and analysis would also facilitate the work of assessing the expected impacts of policies, so as to be able to make informed choices among alternatives. In this sense, and more generally, improved routine management information systems of sectoral ministries can play a key role. However poverty and social impact analysis faces a range of challenges - both institutional (how to effectively engage multiple stakeholders) to technical and substantive (how to estimate gender impacts was a specific concern raised).

Indicator 7: Energy Intensity

Introduction:

Tanzania's energy profile being low intensive, the energy consumption and productivity follows the same trend. The total energy consumption has been fairly stable for the past decade. In 1990 the total energy consumption was 57.7 x 10^9 MJ and in 1999 = 60.5 x 10^9 MJ with the country's total GDP of 4,220 million $ and 8,800 million $ respectively.

Metric (actual data) in 1990 is 13.67 MJ/U$ GDP and in 1999 is 6.88 MJ/U$ GDP

Vector: 1999: 0.61

The vector suggests an average sustainability goal achieved. Comparing vectors figures for 1990 and 2000 highlights a decrease in vector magnitude. Although there has been increase in energy production, there has been no proportion in increase of GDP due to more economic growth. The high vector values reveals relatively high power prices in Tanzania as compared to other neighbouring countries.

As an indication, Kenya could have been a potential, though limited market for Tanzanian power exports, given the latter's higher potential for hydro generation schemes. However, this reality is negated by a Tanzanian cost-structure that is almost twice as high as in Kenya. The average industrial tariff in Kenya is an average of $ 7.6 cents/KWh compared to $ 12 cents/KWh in Tanzania.

Discussion:

The main assumption here is that all energy produced was 100% consumed in productive manner. It should be acknowledged here that these figures are basically from a single source, TANESCO, with which here information can easily located from the Ministry of Energy and Minerals.

Energy services have an impact on all rural economic activities, including agriculture, business, social services, gender equality and poverty. Addressing energy requirements in rural areas is in line with the provisions contained in the Tanzania Development Vision 2025. An improved energy supply in the rural areas will ensure improvement of the welfare of the rural population and the attainment of sustainable economic growth.

More than 80% of the total energy is consumed in the rural areas where the majority of Tanzanians live. Biomass, particularly wood-fuel, constitutes 95% of rural energy consumption, which has significant impact on the process of environmental degradation. The balance 5% is met by other options such as kerosene, diesel, dry cells, grid and non-grid electricity, biogas, solar, wind and other renewable energies.

References:

1. Technological and Other Options for the Mitigation of Greenhouse Gases in Tanzania, CEEST, Dar es Salaam
2. Tanzania Economic Survey for 2001, Bureau of Statistics, Dar es Salaam.

Notes to SEW or next year's Observer-Reporter:

Liberalization of energy generation sector can reduce energy tariffs that can have advantages in pricing competitiveness. However, there are issues regarding regulation of independent power producers and appropriate power pricing policies that have been in discussion for quite some time. If well conceived, the involvement of private sector in power production will increase capacity and raise the level of service. Hence more information on private sector participation in terms of generation may improve the quality of data.

Indicator 8: Renewable Energy Deployment

Introduction:

All talks and researches about renewable energy deployment in Tanzania refer to biomass fuels and to a lesser percentage hydroelectricity. Woodfuel accounts for the bulk of the biomass energy supply in the country. On average every person in Tanzania consumes about 1 cubic meters of wood biomass as a primary energy. The per capita consumption of woodfuel has been estimated to be about 0.35 TOE.

Estimates on the potentiality of the wood fuel supply differ greatly from one study to another with the exception of a few similarities. This shows the complexities existing in trying to estimate the potential supply and rate of consumption of forest products. However it is commonly accepted that approximately 92% of the total primary energy is renewable.

Thus for 1990 the total Primary energy was 171,690,000 GJ and renewable energy deployed 162,045,300 GJ and for 2000 the total renewable energy deployed 264,325,200 GJ where primary energy (mainly Charcoal and fuel wood) was 287,310,000 GJ. Total renewable energy consumption in 1999 was 594,947.04 TJ whereas the total primary energy consumption was 629,381.5 TJ.

Actual data 1990: 0.9438 and 1999 : 0.9453

Vector values: 1990: 0.007 and 1999: 0.0055

As described earlier, Tanzania's renewable energy portion is predominantly biomass. This can be reflected by vector values that are very close to "0" the sustainability goal.

Discussion:

It is estimated that 98% of the total fuelwood production in Tanzania is harvested unsustainably from natural forests which are usually poorly stocked. These forests are dwindling at a fast rate because of the great imbalance between harvested area and afforested area each year. Thus it is highly unsustainable in terms of renewable energy to continue harvesting woodfuel without an equal replacement proportion. However, there are local companies and individuals interested with establishing carbon sinks under CDM. This may promote establishment and management commercial plantations for production of sawn timber, poles and other wood related products on a sustainable yield basis.

Undertaking a carbon sequestration project through the afforestation activities will contributing to reducing greenhouse gases effect globally and if tailored by energy production facility at the end will promote environmental conservation and facilitate socio-economic development to the area.

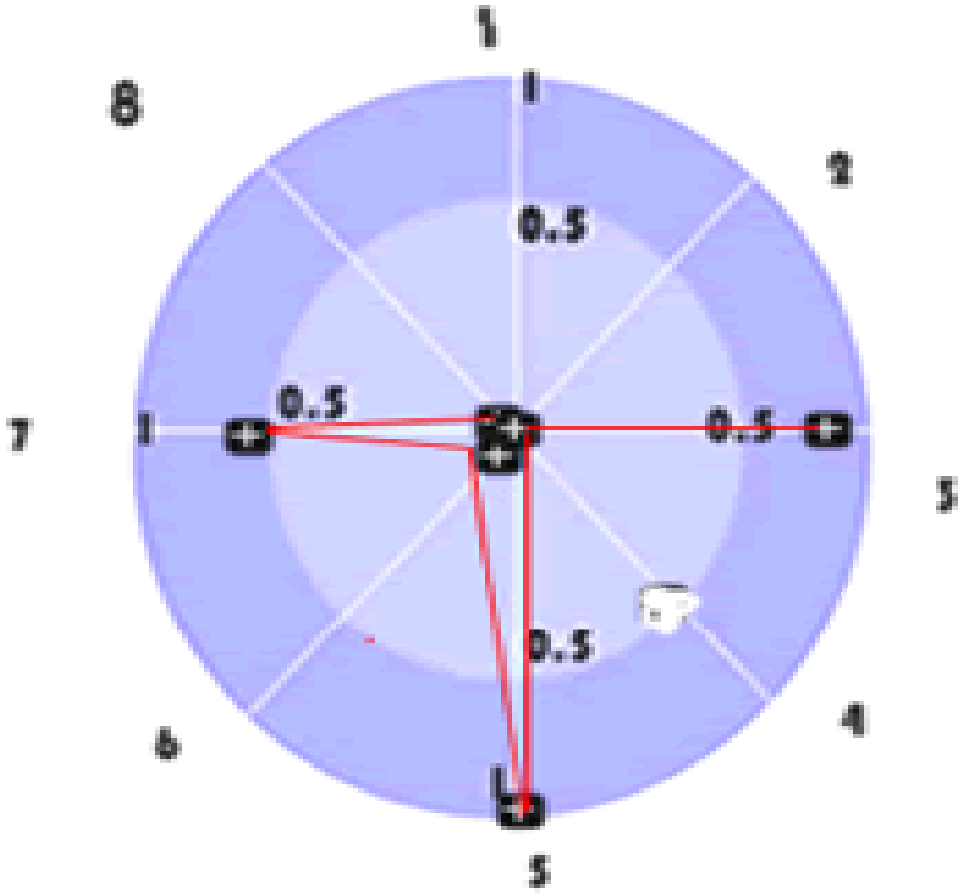
References:

1. UNDP/World Bank, Tanzania Issues and Options in the Energy Sector, 1984
2. Ministry of Natural Resources and Tourism, Dar es Salaam.
3. IEA Database, Tanzania 1999 Energy Balance.

Notes to SEW or next year's Observer-Reporter:

Consult the Ministry of Energy and Minerals that is currently establishing the level of renewable energy deployment in Tanzania for any further developments.

Presentation of Tanzania's Snowflake



Discussion

Most of indicators show that Tanzania is very close to the sustainability goal. However, this is due to low level of economic development. Referring to the snowflake, only indicator 2 is above 1 and the reason can be the choice of the most significant pollutant.

Recommendations to the SEW

The authors have observed difficulties in obtaining data and necessary information from both governmental and non-governmental agencies. It is author's confidence that more information could have been gathered if a thorough survey and time was available. Data acquisition has been a challenging task and calls for centralization of energy related information. Even in countries with relatively few energy related activities like Tanzania, when data handling and storage is poorly managed the quality of work is jeopardized.

Indicator 1: Per Capita Carbon Emissions

An indicator for per capita emissions is a straight forward and easy determinant on whether the country's energy and emissions situation is sustainable. However, the determination of greenhouse mitigation strategy starts with evaluation of sectoral development trends under the current economic plans.

Indicator 4: Clean Energy Investment

Tanzania needs a careful research and analysis to realize investments in clean energy done so far. Limitations given in report preparation guidelines can significantly disqualify many perceived to be investments especially in developing countries. If a country wide inventory of smaller energy investments units of the capacity below 100MW is done, reliable information on this indicator can be obtained. The plan to undertake such comprehensive study may be unfeasible in several years to come.

Indicator 5: Resilience to External Impacts: Energy Trade

Tracking energy trading is challenging. It is possible to analyze sustainability from imported non-renewable energy if data from different importing sources but the extent of consumption is really tricky. In Tanzania the renewable energy imports is equally complicated to be compiled. However, looking at computed vector, this is an area of vulnerability to Tanzania's energy sector.

Indicator 6: Burden of Energy Investments

A clear line should be established which where actually the burden of energy should be based. If reference is made to initial investment there is maintenance cost that develops as running cost in a specific project. Many data available are found to compile either investment or running expenses that could not be merged together.

Indicator 8: Renewable Energy Deployment

Although all information surveyed acknowledged existence of abundant renewable energy resources in the country none cites specific developments in this sub sector. This indicator is useful in determining environmental sustainability on progressive deployment these resources.

Notes to Future Observer-Reporters

Comments and notes for the future observer(s) regarding each indicator have specified for respective indicator. Calculations, synthesis and important contacts of all reported information can be obtained from the report authors via email communication (Mr. B.M. Lyimo: lyimo@hotmail.com and Mr. S. Mwakifwamba: ceest@intafrica.com).