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The Significance of Biomass Energy Strategies (BEST) for Sub-Saharan Africa

Background Paper for 1st Regional Workshop on Biomass Energy Strategy (BEST) Development held in Dar-es-Salaam, Tanzania, 12-14 September 2006

This paper has been written by Witold Teplitz-Sembitzky as a background paper for the first regional workshop of the Biomass Energy Strategy (BEST) Initative, a joint initiative of the EUEI Partnership Dialogue Facility (PDF) and GTZ (Energising Africa, Household Energy Programme [HERA]). The workshop was held 12-14 September 2006 and co-hosted by the Ministry of Energy and Minerals and the Ministry of Natural Resources and Tourism of the United Republic of Tanzania.

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Introduction

Africa is the world's largest consumer of biomass energy. The reliance on biomass energy, especially for cooking and heating, is strongest in sub-Saharan Africa where the majority of the population has no access to, or cannot afford to pay for, alternatives such as modern fossil fuels or electricity. While biomass plays a vital role in meeting basic energy needs and has the potential to contribute to sustainable development and rural livelihoods, it is often used inefficiently with adverse impacts on the environment and the health of women and children. Moreover, in many areas the sustainable supply of biomass energy is at risk because of poor resource management and the excessive clearing of forests and woodlands through logging activities and agricultural expansion.

The importance of the biomass energy sector and the challenge to ensure the sector's sustainable and cost-effective development require an appropriate policy response. While insufficient attention was often given to biomass energy issues in the past, the awareness of the need to deal with the crosscutting problems and opportunities associated with the biomass sector has been increasing in recent years. Efforts are required to devise, refine and implement comprehensive country-specific biomass energy strategies. Such strategies should aim to create favorable conditions for the supply and use of biomass energy and accommodate action plans, scaling-up activities and programs to redress imbalances in biomass demand and supply through better resource management and improvements in the efficiency of the handling, conversion and use of biomass energy.

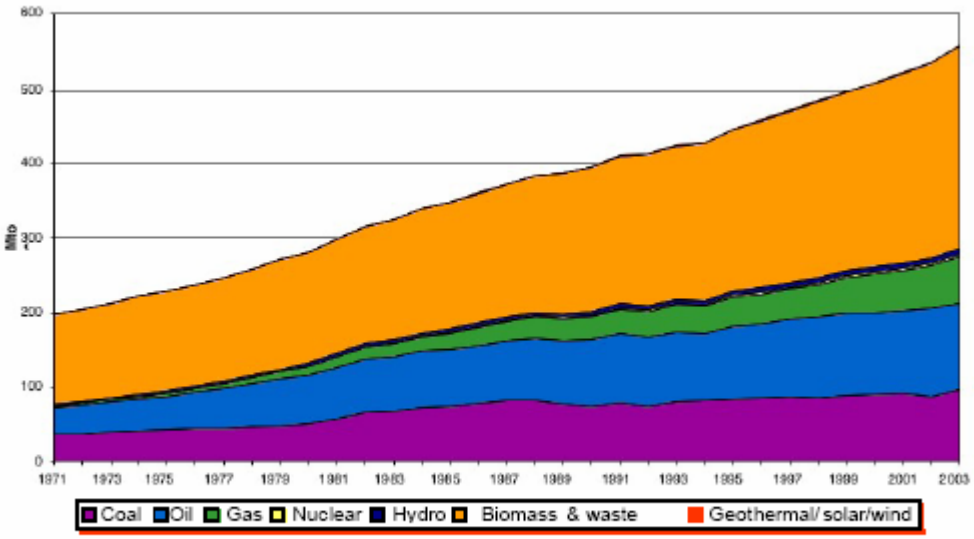
Biomass Energy Consumption in Africa

Biomass energy is of paramount importance in Africa. As is shown in Figure 1, the amount of biomass and waste used as primary energy has more than doubled since 1971. According to recent estimates (IEA, 2006), biomass made up 272 Mtoe (million tons of oil equivalent) or 49% of Africa's primary energy supply in 2003; in sub-Saharan Africa the share was close to 60% and in many countries biomass accounts for more than 70% of primary energy supply (see Annex 1) and satisfies the heating and cooking needs 90% of the population.[11] The biomass in question consists almost entirely of solid organic matter, ranging from wood fuels (firewood, wood chips, sawdust, charcoal etc.) and solid waste of agricultural origin (straw, husks, briquettes, dung etc.) to purpose-grown energy crops. It is often referred to as *traditional biomass energy*. Other forms of "refined" biomass energy and combustible material such as biogas, liquid biofuels and municipal waste are still fairly rare. In Africa, biomass energy serves mainly as fuel for

[1] To put the figures into perspective it is worth noting that the share of biomass in primary energy supply is 30.3% in Asia and 18.3% in Latin America. The IEA reckons that biomass energy consumption in Africa will increase over the next two decades, although the share of biomass energy in primary energy supply may slightly decline. Figure 1 also indicates that nuclear energy as well as wind, solar and geothermal energy have played either no role or only a negligible role in Africa to date.

cooking and heating. Its principal users are households, notably those living in rural areas, which account for about 80% of total biomass energy consumption; the remainder is utilized as process heat by industry and services (including SMEs and the informal sector). While biomass may also play a role in electricity generation and as a transport fuel, these applications are as yet insignificant in Africa, but interest is increasing.

Figure 1: Total Primary Energy Supply in Africa, 1971 - 2003



Source: IEA

Advantages and Disadvantages of Biomass Energy Use

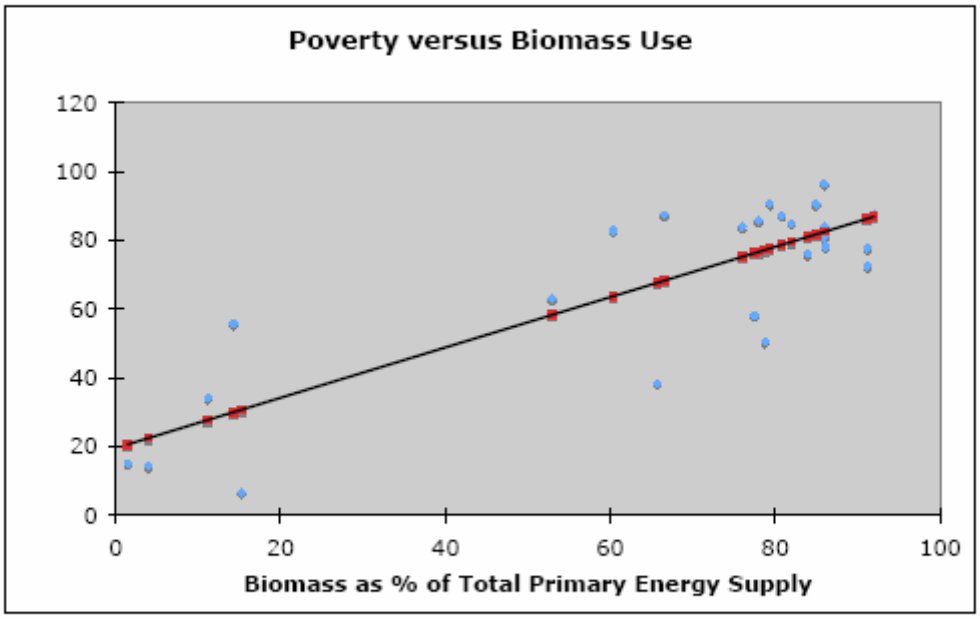
There are several reasons for the prominence of solid biomass energy in Africa, especially in sub-Saharan Africa. For major applications such as cooking and heating, close substitutes are often either not available or beyond the means of the majority of the population. Even where modern fuels like kerosene and LPG are widely available in the market, their high and rising costs, including that of complementary appliances, hinder their use for cooking and heating. Similar arguments apply to electricity: most households, particularly in rural areas, are not connected to the grid. For many households with access to electricity its use in thermal applications is prohibitively expensive and often not feasible. By contrast, biomass energy resources are diverse and widespread, may be available in large volumes, can be produced or grown and can be compressed to make handling and transport easier. Moreover, unlike other renewable energy sources such as wind and solar energy, biomass can be stored to be at hand when needed and in most cases is readily combustible (conversion into higher-end fuels is an option for special applications - e.g. use of biofuels in transport - but this potential still needs to be developed in most countries). Consequently, the costs of biomass supply tend to be low unless stocks are depleted or difficult to access.

In fact, available sample evidence suggests that where traded biomass energy has become more expensive, the price increases have been less pronounced than for modern alternatives such as kerosene and LPG (Falcão, 2002).

However, the reliance on traditional biomass energy also has drawbacks. The use of solid biomass is prone to considerable heat losses through incomplete combustion, inefficient equipment (e.g. in three-stone fires and traditional stoves) or inefficient conversion technologies (e.g. traditional charcoal production with earth mound kilns that have a conversion efficiency of 10% or less). There is a risk that excessive biomass harvesting and inadequate or non-existent resource management will undermine the sustainability of supply. In many cases, though, it is the expansion of agricultural frontiers that causes the loss of tree cover and leads to shortfalls in biomass supply that prompt higher fuel prices or increase the workload of acquiring biomass fuels. Moreover, non-energy uses of biomass (e.g. as construction material, manure or animal feed) may compete with its utilization as fuel. Resource competition may also affect the availability of land needed for the natural re-growth of the resource base or the establishment of energy plantations.

Biomass Energy and Poverty

Figure 2: Link between Biomass Use and Poverty



Source: IEA and World Bank

Notes: Poverty Index is defined as % of population living below 2 USD/day
Red points represent predicted values along a linear trend line

Apart from being labor, resource- and land-intensive, traditional biomass energy is often perceived in a negative light because its use correlates with low standards of living. Figure 2 does indeed confirm that African countries with a large share of biomass energy consumption tend to score badly on indicators of poverty.[2] Since poverty is inversely related to indicators of human development (e.g. life expectancy, health, educational achievement, gender equality), intense biomass energy use can be regarded as a sign of poor living standards.

Reliance on traditional biomass energy is not only a result of poverty; it may also act as a barrier to poverty alleviation or may even be a factor contributing to adverse living conditions: where biomass resources are scarce or used inefficiently, their procurement, especially woodfuel collection in rural areas, may devour a considerable portion of time that household members, especially women, could allocate more efficiently to other tasks. Unlike fossil fuels, refined liquid/gaseous biofuels or electricity, traditional biomass energy is less versatile and not readily adaptable to advanced energy-using processes and services that would be required to generate added value and income. In fact, without the thermo- or biochemical conversion into heat, steam, electricity or refined types of fuel for use in boilers, motors, compressors etc., biomass energy is not well suited for sophisticated industrial processes (food preservation, manufacture of textiles, furniture, etc.) that generate employment and income.

Biomass Energy and Health

Moreover, cooking and heating with solid biomass energy, notably with open fires and traditional stoves, is a major source of indoor air pollution triggering respiratory diseases that are a leading cause of mortality in African countries. It increases the risk of contracting asthma, bronchitis, influenza, pneumonia and other illnesses. Levels of exposure are particularly high among women and children who spend most of the time indoors near the domestic hearth.[3]

According to the WHO, indoor air pollution is the biggest health risk after malnutrition, HIV/AIDS, lack of clean water and adequate sanitation in developing countries. It is estimated that 1.5 million die because of the effects of indoor air pollution from cooking each year. This translates into 4,000 deaths per day. In sub-Saharan Africa alone 396 000 people, in particular women and children, reportedly died of indoor air pollution in 2002 (WHO, 2006).

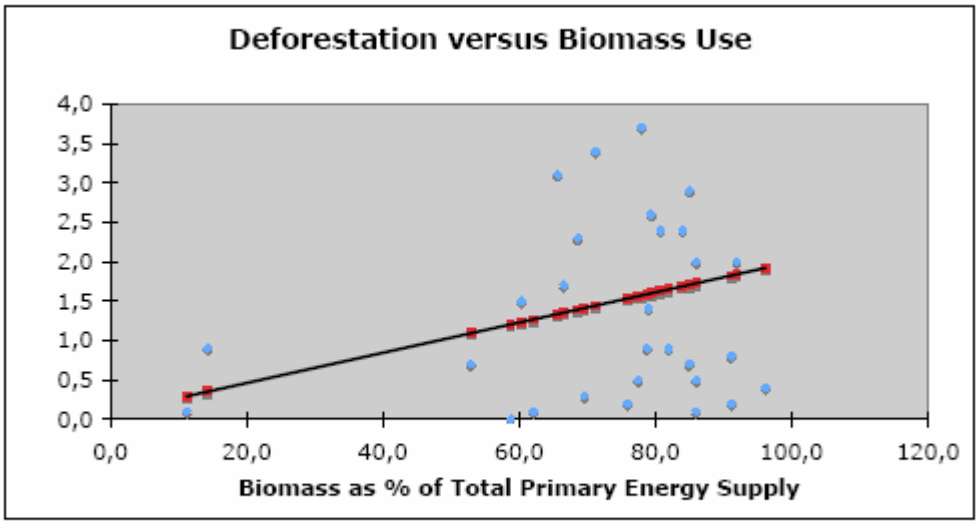
[2] The poverty vs. biomass-use plot is based on 25 observations in Africa (Source: IEA and World Bank). The coefficient of determination (R^2) is 0.7.

[3] It is estimated that indoor pollution accounts for 4-6% of the total disease burden in sub-Saharan Africa WHO, 2004).

Biomass Energy and Deforestation

Extensive use of biomass energy also correlates with deforestation. Figure 3 indicates that African countries with a large proportion of biomass in primary energy supply tend to experience comparatively high rates of deforestation.[4] The relationship is weak, however, and it does not signify that demand for biomass energy is the major driving force behind the removal of trees and the concomitant decrease in biodiversity and stress exerted on water resources. On the other hand, even in countries with large forest areas and a low rate of deforestation there may well exist regional imbalances in biomass supply and demand that are obscured by aggregate figures on the national level.

Figure 3: Deforestation and Biomass Energy Use



Source: IEA and World Bank

Notes: Deforestation is defined as % change in forest area; positive rate means decline
Red points represent predicted values along a linear trend line

While massive unsustainable fuelwood harvesting has contributed to the decimation of natural woodlands, large-scale clearing of forests and woodlands is in most part done for agricultural purposes (cattle grazing, planting of crops) or on account of commercial logging. While these activities increase biomass supply and are apt to support extensive biomass energy use in the short-term, they also erode the biomass resource base and thus may be seen as a symptom of impending deficits. In any case, given the pivotal role biomass energy plays in most African countries and considering the fact that many households have no choice but to rely on biomass for meeting basic energy needs, deforestation and other signs of shortages in biomass energy supply are a serious concern.

[4] The deforestation vs. biomass-use plot is based on 30 observations in Africa (Source: IEA and World Bank). The coefficient of determination (R2) is 0.2.

Policy Challenges and Opportunities

In sum it can be stated that it is not only the large share of primary energy consumption accounted for by traditional biomass that should prompt the attention of policy makers and planners dealing with the energy sector in Africa. It is also the fact that in many countries the majority of the population depends on biomass energy to meet their basic needs. This establishes a political liability to take appropriate action in the biomass energy sector. It is imperative to ensure that:

- Supply is adequate to meet demand at reasonable costs and on a sustainable basis;
- Biomass energy is used or processed in an efficient way so as to prevent wasteful consumption, reduce health risks as well as environmental hazards and remove energy-related barriers to economic development;[5]
- Appropriate support mechanisms and incentives are in place to facilitate a switch towards modern fuels where appropriate;
- The potential of the use of energy crops for transport and power generation should be appraised in light of land availability and competing land uses.

For policy makers it is important to be aware of the drawbacks and perils and the need for remedial action associated with the use of biomass energy as well as its genuine or potential advantages. In fact, in addition to the above-mentioned advantages associated with biomass fuels there are a number of non-energy benefits that a well-managed supply of biomass energy may entail:

- Sustainable and efficient biomass production, harvesting and processing can be a source of rural livelihoods by providing the basis for employment and income generation.
- Biomass supply schemes that involve the restoration of degraded land yield environmental benefits in that they improve groundwater replenishment and increase biodiversity.
- Efforts taken to ensure sustainable biomass supply may help develop efficient and equitable community-based land ownership and management structures that improve the utilization of natural resources.

[5] It is widely agreed that improvements in end-use efficiency for cooking and heating may lead to biomass energy savings of up to 80%. In the same vein, more efficient charcoal conversion technologies can reduce feedstock losses by up to 50%.

- Indigenous biomass energy substitutes for fossil fuels that a country would have to import or that it could export. To this extent the biomass saves or is instrumental in earning valuable foreign exchange.6

- In contrast to fossil fuels, sustained biomass energy utilization emits little or no greenhouse gases since the CO2 released during combustion will be reabsorbed from the atmosphere during biomass re-growth. If it replaces fossil fuels it also provides the opportunity for emission trading as an additional incentive for sustainable energy use.

Biomass Energy and the Millennium Development Goals

Although none of the Millennium Development Goals (MDGs) explicitly relates to biomass energy or energy at large, reliable and affordable biomass energy supply as well as efficient biomass energy use will be instrumental in meeting some of the goals:

- Improved access to and more economic use of biomass energy lessens the burden of time-consuming domestic labor and therefore eases a constraint to engaging in productive activities which help generate income and reduce poverty (MDG 1).

- Reducing the workload placed on women also fosters gender equality and helps empower women (MDG 3).

- Enhancements in biomass combustion facilitated through more efficient appliances (e.g. improved stoves), good housekeeping measures (e.g. woodfuel drying and cutting), higher-grade woodfuels (e.g. higher-quality charcoal with low volatiles and ash content) or modern fuels stem respiratory diseases. This diminishes the risk of child mortality and improves maternal health (MDG 4 and 5).

- Finally, prudent biomass use and resource management contributes to environmental sustainability (MDG 7).

The Millennium Project that was commissioned by the UN Secretary-General to develop a concrete action plan for achieving the MDGs highlights the importance of improved household energy. It proposes the following target to be achieved by 2015: “Reduce the number of people without effective access to modern cooking fuels by 50 percent and make improved cook-stoves widely available”. In absolute terms,

[6] A seemingly contradicting trend is that many countries (e.g. Botswana, Senegal, Sudan) have embarked on a policy to promote the use of (imported) LPG as a substitute for biomass energy. However, both LPG and its supply infrastructure are comparatively costly. Therefore the transition towards cooking with LPG will be confined to urban areas and/or affluent households for some period of time, and biomass will continue to displace modern fuels to a large degree.

this would mean to provide access to cleaner fuels and improved technologies for 1.6 billion people until 2015 (i.e. 485,000 people per day).

The Need for Biomass Energy Strategies

Despite the crucial role woodfuel plays in Africa and notwithstanding the challenges and opportunities associated with biomass energy, a lack of attention and understanding among policy makers and energy planners continues to prevail. For supranational organizations like the African Energy Commission (AFREC), biomass energy does not rank high on the policy agenda. Initiatives like the "New Partnership for Africa's Development" (NEPAD) have launched action plans that address biomass energy as an infrastructure issue, but their implementation is not well advanced and fails to have a proper biomass focus. While the "Forum for Energy Ministers of Africa" (FEMA), which was created to raise the profile of the energy sector in national and regional planning, has recognized biomass dependency as a problem, its preliminary work program and underlying memorandum of understanding propose a target of 50% of households to have access to modern energy services for cooking (meaning improved stoves or LPG) by 2015. The World Summit on Sustainable Development (WSSD) held in Johannesburg in 2002 clearly acknowledged the significance of biomass energy, but the priorities and efforts delineated for the energy sector concentrate on access to modern forms of energy. While the main focus of the ECOWAS White Paper on "Access to Energy Services for Rural and Peri-Urban Populations", which was issued in 2005, is on increasing the supply of modern forms of energy (e.g. LPG, electricity), it also pursues the very ambitious goal of giving 100% of households access to improved cooking energy technology, including the use of improved stoves, by 2015, and the Central African Economic and Monetary Community (CEMAC) has set itself the target of providing access to improved cooking energy to 80% of the population within the same time span. In the same vein, the East Africa Community has established a target of 50% of households to have such access by 2015. The detail of how to bring about these changes has not, though, been seriously tackled.

Even though multilateral initiatives like the WSSD, FEMA and NEPAD did not bring biomass energy to the center stage, they at least involve attempts to address the challenges posed by the widespread use of biomass energy. They have contributed to the growing awareness of the need to cope with biomass energy on a strategic level. The same is true for regional initiatives like ProBEC (Program for Biomass Energy Conservation), a SADC-led program executed by GTZ, that concentrates on the design and implementation of comprehensive biomass energy interventions. Similarly, GTZ and the EU are assisting

the Sahelian countries to organize the sustainable supply and rational use of domestic energy in the Sahel region through the CILSS-based PREDAS program[7].

The 14th Commission on Sustainable Development (CSD 14) held from 1st until 12th May 2006 in New York brought some steps forward. A high commitment from the donor side was visible. EU member countries such as Great Britain and the Netherlands as well as Denmark, Austria, and Germany emphasized their interest in drawing more attention to this topic and in supporting biomass and household energy initiatives and activities. This can be an entry point for an alliance of willing countries to improve biomass and household energy access. Biomass energy strategies provided by the partner countries could form a basis for these activities. Neglect or inappropriate treatment of biomass energy issues can still be found on the national policy level, even in countries that have developed energy sector strategies and policies. Apart from the insufficient political attention given to the biomass sector, the shortcomings may range from non-intervening or target-free armchair policies, half-hearted political commitment, lack of consensus building, unsatisfactory coordination and stakeholder involvement, to the disproportionate allocation of efforts and resources.[8] However, the number of policy makers, energy planners and other concerned actors who are pushing for a more comprehensive approach to biomass sector management and planning is increasing. Countries like Ethiopia, Senegal, Tanzania and Uganda have adopted national policies giving due consideration to the biomass sector and/or set up institutions dealing with biomass energy issues. A good example is Uganda, which has taken serious steps to forge a coherent, crosscutting strategy for biomass energy development (MEMD, 2001) and has launched sizeable biomass sector operations such as the dissemination of improved stoves (with more than 100,000 units brought into use in 2005). The countries that have been most successful at disseminating improved cook-stoves are Ethiopia and Kenya, each with a market volume of more than 1.5 million units.

To seriously address these issues efforts need to be made to devise and implement country-specific biomass energy strategies as part of national energy policies. The strategies should take account of overall development goals, be commensurate with the significance of the biomass energy sector and live up to the multi-faceted challenges of finding appropriate courses of action. Laying out such strategies should be understood as a continous process marked by gradual adjustments. They should identify actions and assign responsibilities as well as time scales for their implementation. The development of biomass energy strategies should be a participative, consensus-based effort that provides for stakeholder involvement

[7] CILSS is the Permanent Interstate Committee for Drought Control in the Sahel. It includes Cape Verde, Mauritania, Senegal, Gambia, Mali, Chad, Guinea Bissau, Burkina Faso, and Niger. PREDAS is the CILSS- based Regional Programme for the Promotion of Household Energy and Alternatives to the Use of Traditional Biomass in the Sahel.

[8] A recent example of the disproportionate treatment of biomass energy is the proposed energy policy for Sierra Leone, where biomass accounts for more than 80% of primary energy supply: less than 5% of the funds earmarked

down to the local level. It also requires high-level decision-making, notably the involvement of ministries responsible for relevant policy areas such as energy, environment/forestry, agriculture and rural development, and the employment of legislative power to establish rules and laws designed to provide supportive conditions for the development and use of biomass energy resources.

for the implementation of the priority actions defined by the policy are allocated to the biomass sector. (http://www.uneca.org/eca_resources/Conference_Reports_and_Other_Documents/sdd/cemmats_study.pdf).

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Annex: Primary Energy Supply in African Countries (2003)

	Solid Biomass as % of TPES	TPES (Mtoe)
Algeria	1.5	33.00
Morocco	4.0	10.89
Tunisia	15.3	8.24
Angola	66.3	9.12
Benin	68.6	2.31
Burkina Faso	86.0	2.53
Burundi	92.0	2.38
Cameroon	78.8	6.75
Central African Rep	86.0	1.07
Congo	62.1	1.03
Ivory Coast	65.7	4.41
Congo, Dem. Rep.	96.2	15.88
Eritrea	69.6	1.00
Ethiopia	91.2	20.51
Gabon	58.8	1.60
Gambia	76.0	0.63
Ghana	66.6	8.49
Kenya	77.5	16.17
Madagascar	82.0	1.36
Malawi	84.0	4.00
Mali	85.0	2.20
Mozambique	86.1	8.20
Namibia	14.3	1.19
Niger	78.0	0.90
Nigeria	79.4	97.79
Senegal	53.0	3.19
Sierra Leone	85.0	1.10
South Africa	11.2	118.57
Sudan	79.0	16.62
Tanzania	91.2	17.15
Togo	71.3	2.60
Uganda	86.0	5.80
Zambia	80.8	6.69
Zimbabwe	60.4	9.67
Total	52.6	443.04
Sub-Sahara	59.0	390.91

TPES: Total Primary Energy Supply
Mtoe: Million Tons of Oil Equivalent
Source: IEA