



Biomass Energy Strategy (BEST) Tanzania

Tanzania Biomass Energy Strategy and Action Plan

Final Report



This strategy has been elaborated (in cooperation with Camco Clean Energy Tanzania Limited) on behalf of Ministry of Energy and Minerals (MEM) and the European Union Energy Initiative Partnership Dialogue Facility to assist the Government of Tanzania (GoT) to develop a national Biomass Energy Strategy and Action Plan that identifies means of ensuring a more sustainable supply of biomass energy to raise the efficiency with which biomass energy is used, to promote access to alternative energy sources where appropriate and affordable, and, to ensure an enabling institutional environment for implementing the BEST Tanzania Strategy and Action Plan.



Supported by:

European Union Energy Initiative
Partnership Dialogue Facility (EUEI PDF)
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Date of Publication:

April 2014



Acknowledgements

The Consultant Team would like to extend its sincere gratitude to all those who participated over the past year and a half in the Biomass Energy Strategy (BEST) Tanzania process. In particular, we would like to thank the Government of the United Republic of Tanzania and all the agencies and individuals representing the Government who participated with, and supported the BEST Team. We would like to extend special thanks to Eng. Ngosi Mwiha, **Deputy Permanent Secretary, Ministry of Energy and Minerals (MEM)**, who requested the EUEI PDF for BEST in 2010, Eng. Hosea Mbise, **Commissioner for Energy and Petroleum Affairs (MEM)**, for all his strong encouragement, guidance and support. Further, we would like to offer our sincere thanks to Mr. Edward Ishengoma, **Assistant Commissioner for Renewable Energy (ACRE)** and his colleagues, Mr. Paul Kiwele and Mr. Mkoma Masanyiwa, and the rest of his colleagues at the MEM for all their support and assistance.

We would like also extend special thanks to Dr. Felician Kilahama, former Director of Forests, **Forestry and Beekeeping Division (FCD)** at the **Ministry of Natural Resources and Tourism (MNRT)**, the Executive Director of the **Tanzania Forest Services Agency (TFS)**, Mr. Juma Mgoo, Mr. Charles Ng'atigwa, Head of Extension and Publicity, Directorate of Resource Management, and many other TFS and MNRT colleagues.

We owe particular thanks to the **BEST Steering Committee (BSC)** who kicked off this exercise with us at the beginning, late-July 2012 and provided valuable guidance and feedback throughout the BEST Project. While the institutions represented stayed the same, representatives of those often changed. In addition to representatives from the MEM and MNRT, we would like to give special thanks, in particular, to Dr. Julius Ningu, Director, **Division of Environment, Vice-President's Office (VPO-DoE)**, Ms. Agnes Namuhisa, Director, and her colleague, Ahadiel E. Mmubughu, **Tanzania Federation of Cooperatives (TFC)**, Mr. Estomih N. Sawe, Executive Director, **TaTEDO**, Dr. Innocent Mjema, **CAMARTEC**, Mr. Goodwill Wanga, Director, **National Development Corporation (NDC)**, Ms. Mary Majule and Ms. Theresa Massoy, EMU, **Ministry of Agriculture, Food Security and Cooperatives (MAFC)**, Prof. Peter Reuben Gillah, Deputy Vice-Chancellor, **Sokoine University of Agriculture (SUA)**, Mr. Anthony Kibopile, Head of Policy Analysis, **Ministry of Finance (MoF)**, and Eng. Elina N. Kayanda, **Prime Minister's Office-Regional Administration and Local Government (PMO-RALG)**.

The BEST Team would like to extend thanks and give our appreciation to all the members of the private sector, NGOs and CBOs, development partners, and other Government people, at all levels, for their support, information and feedback. A special word of thanks goes to the Tanzania Forest Conservation Group/TFCG (and MJUMITA), their Sustainable Charcoal Project Team, and to the SDC who provided support and excellent feedback over the past year.

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We would like to give sincere thanks to Ms. Ina de Visser, Project Manager, EUEI PDF, on this BEST Tanzania Project, and Ms. Mirka Bodenbender, EUEI PDF for her useful comments and support.

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Acronyms and abbreviations

Government institutions

FBD	Forestry and Beekeeping Division (of MNRT)
GoT	Government of Tanzania
IRA	Institute of Resource Assessment (University of Dar es salaam)
LGA	Local Government Authority
MEM	Ministry of Energy and Minerals
MAFC	Ministry of Agriculture, Food Security & Cooperatives
MoF	Ministry of Finance
MLHSD	Ministry of Lands and Human Settlements Development
NEMC	National Environment Management Council
NLUPC	National Land Use Planning Commission
MNRT	Ministry of Natural Resources and Tourism
PMO-RALG	Prime Minister’s Office – Regional Administration and Local Government
POPC	President’s Office Planning Commission
SUA	Sokoine University of Agriculture
TANAPA	Tanzania National Parks Authority
TFS	Tanzania Forest Service Agency (MNRT)
TRA	Tanzania Revenue Authority
VPO-DoE	Vice President’s Office, Division of the Environment
WD	Wildlife Division (MNRT)

Development partners

AfDB	African Development Bank
AFD	Agence Française de Développement
Dfid	UK Department for International Development
DPG	Development Partner Group
EU	European Union
EUEI PDF	European Union Energy Initiative Partnership Dialogue Facility
FAO	United Nations Food and Agriculture Organisation
FINNIDA	Finish International Development Agency
GIZ	German Agency for International Cooperation
GVEP	Global Village Energy Partnerships
NORAD	Norwegian Agency for Development Cooperation
SDC	Swiss Agency for Development & Cooperation
Sida	Swedish International Development Cooperation Agency
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development
WB	World Bank (International Bank for Reconstruction & Development/IBRD)

NGOs, CBOs, autonomous agencies and private firms

ALAT	Association of Local Authorities of Tanzania
ARTI Energy	Appropriate Rural Technology Institute
AWF	Africa Wildlife Fund
CAMARTEC	Centre for Agricultural Mechanisation and Rural Technology
CCFAT	Clean Cookstoves and Fuels Alliance of Tanzania
CIFOR	Centre for International Forestry Research
COSTECH	Commission for Science and Technology
CTI	Confederation of Tanzanian Industries
EABCL	East Africa Briquette Company Ltd.
EAC	East African Community
EEP	Energy and Environment Partnership (East Africa)
ELCT	Evangelical Lutheran Church of Tanzania
ESAUERP	Eastern and Southern Africa Universities Research Programme
ESRF	Economic and Social Research Foundation
IRA	Institute of Resource Assessment (University of Dar es Salaam)
MeS	Mkonge Energy Systems Ltd
MJUMITA	Mtandao wa Jamii wa Usimamizi wa Misitu Tanzania
NDC	National Development Corporation
ProBEC	Programme for Basic Energy Conservation in Southern Africa
REA	Rural Energy Agency
REF	Rural Energy Fund
SEI	Stockholm Environment Institute
SNV	Dutch not-for-profit development organisation
TANESCO	Tanzania Electricity Supply Company Ltd.
TANWAT	Tanganyika Wattle Company (Njombe Region)
TAREA	Tanzania Renewable Energy Association
TaTEDO	Tanzania Traditional Energy Development and Environment Organisation
TASONABI	Tanzania Specialist Organisation on Natural Resources & Biodiversity Conservation
TCCIA	Tanzania Chamber of Commerce, Industry and Agriculture
TFC	Tanzania Federation of Cooperatives
TFCG	Tanzania Forest Conservation Group
TFF	Tanzania Forest Fund
TPC	Tanganyika Planting Company (Kilimanjaro Sugar Corporation Ltd)
WWF	Worldwide Fund for Nature

Other

BEFS	Bio-Energy and Food Security
BEST	Biomass Energy Strategy
BSC	BEST Steering Committee
CBFM	Community-Based Forestry Management
CDM	Clean Development Mechanism
DFI	Direct Foreign Investment

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DNRAB	District Natural Resource Advisory Board
EIA	Environmental Impact Assessment
FMA	Forest Management Area
JFM	Joint Forest Management
LGA	Local Government Authority
MAI	mean annual increment
mcwb	moisture content wet-basis
MDG	Millennium Development Goals
MKUKUTA	Mkakati wa Kukuza Uchumi na Kupunguza Umaskini Tanzania (PRSP in Kiswahili)
NAFORMA	National Forestry Resources Monitoring & Assessment
NEP	National Energy Policy
NSGRP	National Strategy for Growth and Reduction of Poverty (MKUKUTA)
NWAP	National Wood Action Plan
ODA	Official Development Assistance
PES	Payment for Environmental Services
PF-CT	Private Forestry Carbon Trading Project (Finnish Aid Project)
PFM	Participatory Forest Management
PRSP	See NSGRP and MKUKUTA
SME	Small and Medium Enterprise
VFMP	Village Forest Management Plan
VLFR	Village Land Forest Reserve
VNRC	Village Natural Resource Committee
VWMC	Village Wildlife Management Committee
WMA	Wildlife Management Area

Units of measurement

Weight

kg	kilogramme
t	metric tonne (1,000 kg)

Volume

l	litre
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Energy

J	joule
MJ	megajoule (10^6 joules)
GJ	gigajoule (10^9 joules)
TJ	terajoule (10^{12} joules)
PJ	petajoule (10^{15} joules)

Wh	watt hour
kWh	kilowatt hour (10^3 watt hours)
MWh	megawatt hour (10^6 watt hours)
GWh	gigawatt hour (10^9 watt hours)
w.e.	wood energy equivalent

Power

W	watt
kW	kilowatt
MW	megawatt

Other

bi	billion
mi	million
mth	month
pa	per annum (per year)
%	percent
yr	year
TZS	Tanzania Shilling
USD	US Dollar
US\$	US Dollar
m	metre
m ²	square metre
m ³	cubic metre

Conversion Factors

Table 1: Conversion Factors Used in this Report

Material	Energy value	Units
Agro-residues	12.5	MJ/kg
Animal dung	13.5	MJ/kg
Firewood (air-dry)	15.5	MJ/kg
Ethanol	23.0	MJ/l
	29.1	MJ/kg
Coal	29.0	MJ/kg
Charcoal	29.0	MJ/kg
Paraffin/kerosene	36.3	MJ/l
	43.2	MJ/kg
LPG	45.0	MJ/kg
Electricity	3.6	MJ/kWh

0.7 t air-dry wood = 1 m³ air-dry wood

1.43 m³ = 1 t air-dry wood

19% = wood to charcoal conversion efficiency (tonne to tonne)

5.26 t of air-dry wood = 1 t of charcoal

7.52 m³ of wood (air-dry) [5.26 t] required to make 1 t charcoal

Moisture content of air-dry wood = 15% (wet basis = mcwb)

Moisture content of charcoal = 5% (wet basis = mcwb).

Exchange Rate

A rate of 1,600 Tanzania Shilling (TZS) to the US dollar (\$) is assumed throughout this report and action plan.

1. Executive Summary

1.1 BEST Tanzania

At the request of the Ministry of Energy and Minerals (MEM), the European Union Energy Initiative Partnership Dialogue Facility (EUEI PDF) has supported the development of a Biomass Energy Strategy (BEST) in Tanzania. The national Biomass Energy Strategy identified means of ensuring a more sustainable supply of biomass energy; raising the efficiency with which biomass energy is produced and utilised; promoting access to alternative energy sources where appropriate and affordable; and ensuring an enabling institutional environment for implementation.

The BEST Tanzania Project was led by the MEM, assisted by the BEST Steering Committee (see acknowledgements), and a wide range of other governmental, non-governmental, and private sector organizations and individuals (see Appendix 2 – “People Consulted”). Three major national stakeholder workshops were held in 2013 involving over 150 stakeholders, while the BEST Tanzania Team presented at six different national stakeholder forums during the course of the Project.

A national BEST Communication Strategy was developed and used to help build awareness and a common understanding of issues in the biomass energy sector, and to provide the media with information for public dissemination. A National BEST Tanzania Action Plan was developed that recommended biomass energy policy, supply-side and demand-side actions to be initiated in the two years following the BEST Tanzania Project, with a long-term view to the year 2030 (Sections 8 and 9).

The BEST Tanzania Project was designed to engage stakeholders to develop a two-year action plan to address key issues in the biomass energy sector, particularly deforestation and degradation caused by charcoal and commercial wood fuel production. It is anticipated that the outputs from the BEST Tanzania Project will be used primarily by the MEM, the Ministry of Natural Resources and Tourism (MNRT) and its Tanzania Forest Services Agency (TFS), by local government at all levels, by other central government agencies (Vice-President’s Office-Division of Environment (VPO-DoE), National Land Use Commission (NLUSC), other central government bodies, and by NGOs and the private sector active in the biomass energy sector.

1.2 Major Issues in the Biomass Energy Sector

Wood energy demand accounts for approximately 90% of Tanzania’s overall energy supply and demand.¹ Almost 90% of that demand comes from the household sector, with the remainder coming from household enterprises (often referred to as cottage industries), commercial, institutional and some industrial demand. Charcoal demand has nearly doubled over the past ten years (NBS, 2013b, MFEA, 2010) driven by rapid urbanisation and high relative prices or scarcity of energy substitutes, particularly kerosene, electricity, biogas, biomass briquettes and LPG. BEST baseline projections

¹ Various, including MEM, 2003 (National Energy Policy), MFEA, 2010, MNRT, 2013, NBS, 2013b, TACAIDS, 2013, UNDP, 2013, World Bank, 2013.

show that demand for charcoal, without supply- and demand-side interventions, will double by 2030, from approximately 2.3 million tonnes of charcoal in 2012².

Commercial biomass energy³ is a major source of rural and urban livelihoods. Charcoal and commercial fuel wood (firewood) generated approximately TZS 1.6 trillion (\$1 billion) in revenues for hundreds of thousands of rural and urban producers, transporters and wood energy sellers in 2012⁴. Commercial biomass energy is the largest source of cash income in rural Tanzania.

Additionally, biomass energy provides the major energy source for a wide range of rural and urban activities, including commercial, institutional and industrial uses. It is estimated that this non-household demand is equivalent to approximately 15% of urban household consumption amounting to 300,000 tonnes of charcoal in 2012.⁵

Initial results from the National Forestry Resources Management Monitoring and Assessment Report (NAFORMA) (MNRT, 2013)⁶ show that an estimated 44 million m³ of solid wood was available for all uses in 2012. On a national basis, rural household energy demand (some 47 million m³ in 2012) was roughly equal to national annual forestry yield outside protected areas.⁷ However, land clearing for agriculture, livestock, charcoal and commercial fuel wood production contributed to a significant national forestry deficit in 2012 (MNRT, 2013).

The main conclusion from the BEST Tanzania Project is that forestry biomass energy demand is unsustainable. Demand for wood energy has led to increasingly negative environmental, agricultural and other local and macro-impacts. Unsustainable biomass energy demand is accelerating year-on-year because of:

- The low priority that is accorded to biomass energy by almost all key government agencies;
- Perceptions that biomass energy is an inferior source of energy, synonymous with under-development;
- The lack of a national policy framework for biomass energy;
- Poor public awareness of biomass energy efficiency issues and options;
- Complicated, often contradictory and poorly-regulated governance of commercial biomass energy production and trade;
- A lack of replicable examples of, or models for sustainable charcoal; and,
- No mainstream commercially competitive biomass alternatives to charcoal and fuel wood.

² Assumes 50m³ per hectare national average (MNRT, 2013). If charcoal consumption in 2012 was 2.3 million tonnes, assuming 19% wood to charcoal conversion, then, the equivalent of nearly 350,000 ha of woodland was harvested to produce that charcoal.

³ The term commercial biomass energy refers to biomass energy produced and sold on a commercial basis.

⁴ BEST Team charcoal market surveys, TFCG, 2013; NBS, 2013b, Census data, others.

⁵ Malimbwi, R.E. and Zahabu, E., 2009. Norad, 2009.

⁶ MNRT (2013) has distributed a limited brief on initial results. More detailed NAFORMA results should be available in early-2014.

⁷ This does not include land clearing for agriculture, for grazing or other non-energy uses.

1.3 Key Recommendations - BEST Tanzania Action Plan

To address these issues, the following BEST Tanzania Action Plan recommendations shall be summarised at this point and elaborated more extensively in Section 9:

1.3.1 Coordination, Management and Policy

- The **BEST Steering Committee (BSC)**⁸ should be constituted as a standing body (adding the President's Office Planning Commission (POPC)) for two years (2014 to 2015), with an expanded mandate (relative to the current BEST Steering Committee) and support from parent agencies and development partners, to address the actions set out, herewith, in the BEST Tanzania Action Plan;
 - Government agencies represented on the BSC should make biomass energy a key element in their agencies' policies and activities, particularly:
 - The National Energy Policy (NEP) (MEM, 2003);
 - The Tanzania Forest Service (TFS) Framework Document (MNRT, 2010b)⁹ and forestry policy through the Forestry and Beekeeping Division (FBD) (MNRT, 1998a);
 - MKUKUTA/National Strategy for Growth and Reduction of Poverty (MoF);
 - Five Year Development Plan (POPC, 2011);¹⁰and,
 - Coordinating local government policies (PMO-RALG) with the National Land Use Planning Commission (NLUPC) support to local government (villages) and the TFS on village-level forest management and production organisation and policies.

1.3.2 Supply Side (led by the MNRT, supported by the BSC)

- The mandate for the Tanzania Forest Services (TFS) needs to be broadened, its budget expanded significantly, personnel recruited and other resources mobilised. This should enable TFS to place major emphasis on working with local authorities (district and municipal councils), villages and the private sector to develop and register forest management plans that will significantly increase participatory forest management (PFM), community-based forestry management (CBFM), joint forestry management (JFM) and overall sustainable wood energy production by an indicative target of 20% by 2030 (on 2012 levels);
- TFS, MEM and other national agencies should prioritize working with local authority (district and municipal) governments to rationalise, harmonise and simplify local biomass energy production and trade governance to increase local (district) and national revenues by an indicative target of 50% (on 2012 levels) by 2020;

⁸ The BEST Steering Committee (BSC) is chaired by MEM's Assistant Commissioner for Renewable Energy (ACRE). MNRT has two representatives on the BSC, one from the FBD and one from TFS. The Ministry of Finance (MoF) is represented by its tax policy office. The MAFC is represented through its Environmental Management Unit (EMU). The VPO-Division of Environment (DoE) is represented by the DoE's Director. The PMO-RALG has a representative on the BSC as does the National Land Use Planning Commission (NLUPC), the Tanzania Federation of Cooperatives (TFC), the Confederation of Tanzania Industries (CTI), Sokoine University of Agriculture (SUA), TaTEDO and CAMARTEC.

⁹ MNRT, 2010b. Tanzania Forest Service Framework Document. Creation of TFS as an Executive Agency. April 2010,

¹⁰ URT, 2011b. Five Year Development Plan (FYDP): 2011/12 to 2015/16: Unleashing Tanzania's Latent Growth Potentials. Office of the President, Planning Commission. June 2011.

- Local Government should support local NGOs and other activities (e.g., MEM and REA) that promote and commercialise biomass energy from agricultural wastes (e.g., rick husks, coffee husks, sisal residues, etc.) and the technology to utilise those wastes through briquettes, biogas, among others; and,
- Charcoal producers need to be organised commercially, their activities licensed, their wood supplies sourced sustainably and their production efficiencies increased substantially with a target of achieving an indicative target of 50% efficiency improvement at a national level by 2025 (TFS and MEM).

1.3.3 Demand Side (led by the MEM, supported by the BSC)

- Simultaneously, a major, commercially-oriented, mainstream improved cook stove programme needs to be funded and launched, prioritising urban households, and commercial and institutional consumers, with a target of reducing urban charcoal demand by an indicative 50% by 2030 (see Sections 7 and 9);
- Biomass energy alternatives (particularly biomass briquettes and biogas) need to be commercially mainstreamed with an indicative target of reducing current demand (2012) for charcoal and commercial fuel wood of 5% by 2030 (see Sections 7 and 9); and,
- Make non-biomass charcoal and commercial fuel wood alternatives, particularly kerosene (LPG and electricity as well), competitive on a non-subsidised basis in terms of availability and price, with a target of reducing demand for charcoal by an indicative target of 50% by 2020 (see Sections 7 and 9).

2. Structure of BEST Tanzania

2.1 BEST Process

The Biomass Energy Strategy (BEST) in Tanzania is a participatory approach. The underlying objective of the BEST Tanzania Project is to work with all key stakeholder groups to develop a common understanding of the issues surrounding biomass energy and to develop a common framework for addressing those issues. BEST Tanzania stakeholder engagement and communication is based on:

- The National BEST Steering Committee (BSC) comprised of twelve members representing government, civil society, the private sector and academia;
- National stakeholder meetings focused on three stakeholder groups critical to developing the strategy, namely parliamentarians, finance and revenue players, development partners, NGOs and civil society engaged in biomass energy; and,
- The inclusion of a range of stakeholders through their own meetings and sessions to promote discussion and dialogue around key biomass energy issues.

The BEST Steering Committee summarized the BEST Tanzania biomass energy overall vision as: “To ensure that Tanzania and its people benefit from sustainable biomass energy management and utilization for sustainable development.” The five most important elements for achieving that objective are to:

- Develop the policy and institutional framework to deliver the strategy;
- Improve sustainability of biomass energy supply;
- Improve efficiency of biomass energy utilisation;
- Make available commercially competitive, non-subsidised biomass alternatives to wood energy supplies (e.g., biomass briquettes and biogas); and,
- Make available commercially competitive, non-subsidised non-biomass alternatives to wood energy supplies (e.g., LPG, electricity, kerosene, etc.).

2.2 BEST Outputs

Beyond the BSC and the structured BEST national stakeholder workshops, the BEST Team has met with, and presented to, seven national groups (e.g., annual general meetings) over the past year. Structured stakeholder interviews and surveys have been held over the same period.¹¹ These have resulted in increased awareness amongst participants of issues surrounding non-sustainable biomass energy, and options available to make biomass energy sustainable. The BEST Tanzania Project produced an inception report, a BEST communication strategy comprising media messaging, three national stakeholder workshops and widely disseminated proceedings, state-of-play briefing papers on biomass energy, a proposed national BEST Tanzania Strategy, and a proposed two-year BEST Tanzania Action Plan.

¹¹ Survey topics include charcoal, commercial fuel wood (firewood), biogas, briquettes, improved cook stoves (ICS), non-biomass alternatives to charcoal and commercial fuel wood.

3. Context for Sector Development

3.1 National overview¹²

3.1.1 Administration

The United Republic of Tanzania (URT) is a unitary constitutional republic based upon multiparty parliamentary democracy. All state authority in Tanzania is exercised and controlled by the Government of the United Republic and the Revolutionary Government of Zanzibar. Each central government has three organs: the Executive; the Judiciary; and the Legislature that have powers over the conduct of public affairs. In addition, local government authorities (LGAs) assist each central government.¹³

The Legislature (Parliament) of the United Republic consists of two parts: The President and the National Assembly. The President exercises authority vested in him by the constitution to assent to bills passed by Parliament to complete the enactment process to enable them to become law.

The National Assembly of the URT is the principal organ of the Republic. It has authority, on behalf of the people, to oversee and advise the Government and all its agencies in the discharge of their respective responsibilities. The National Assembly consists of four categories of Members of Parliament:

- Members elected directly to represent constituencies across mainland Tanzania and Zanzibar;
- The Attorney General;
- Ten members nominated by the President; and,
- Female members being not less than fifteen percent of the members of all other categories on the basis of proportional representation among those parties in the Parliament.

As of the 2012 census, there were thirty regions (Figure 1) of Tanzania, divided into 169 districts. For administrative purposes, mainland Tanzania is divided into regions. Each region is administered by a commissioner who is appointed by the President.

Local Government and Decentralization

Tanzania embarked upon decentralized local government in the late-1990s. The 1999 Local Government Act (URT, 1999b) devolved considerable power to local governments. At district, division, and ward levels, there are popularly elected councils. Councils have their own chairpersons, secretaries and other officers.

¹² The Ministry of Energy and Minerals (MEM) requested BEST Tanzania to cover mainland Tanzania. Therefore, information, findings, strategy and proposed actions do not apply to Zanzibar.

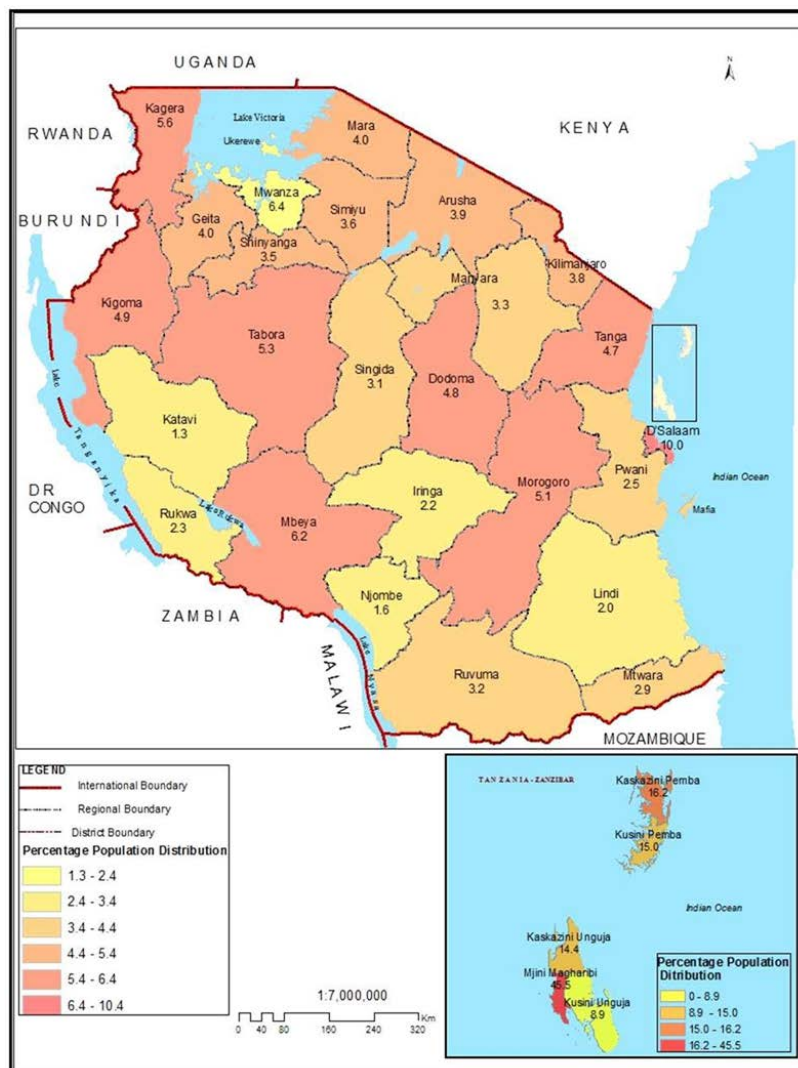
¹³ URT, 2013d. Government Portal. <http://www.tanzania.go.tz/>. United Republic of Tanzania, 20 November 2013.

Biomass Energy Strategy (BEST) Tanzania

Councils have the powers to levy taxes and fees and utilise the revenues they collect on the forests under their jurisdiction (i.e., local authority forests¹⁴). Forest fees, particularly the forest cess on timber, charcoal and firewood from both natural forests and local authority forests (see Section 3.3) are an important source of revenues for district authorities.

However, the forest cess is only a fraction of royalties which districts are required to collect on behalf of the central government (MNRT's Tanzania Forest Service). Cash-strapped local authorities believe that, if they have a management role in natural forests, which most do through their District Forest Officers, then, they should receive a portion of the forest royalties.

Figure 1: Tanzania Regions with Percentage of Total Population for each Region



Source: National Bureau of Statistics, 2012 Census Report on Administrative Units (NBS. 2013b)

¹⁴ The Forest Act of 2002 designates four types of forest: national forests, local authority forests, village forests and private forests.

Each district has executive officers (civil servants) such as District Forestry Officers (DFO), District Agricultural Officers (DAO), District Education Officers and District Health Officers (DHO), among others. These executive officers, while being civil servants under their respective central government ministries, report to their district councils. Their positions are financed by the councils as part of government decentralisation.¹⁵

The energy sector at a district level has no direct executive officers or officers responsible for energy matters. Energy matters are handled by different departments such as forestry, health, works, among others. This situation has resulted in a lack of serious consideration to energy matters at the district level.

3.1.2 Population

Table 2 shows the population of Tanzania at each post-Independence census.¹⁶ Dar es Salaam has grown over ten-fold since 1967, comprising about 10% of the country's population in 2012. Its relative size compared with the country's total urban population has stayed relatively the same over the past 45 years.

Table 2: Tanzania Population Trends: 1967 to 2012

Area	1967	1978	1988	2002	2012
Total Tanzania Population	12,300,000	17,500,000	23,100,000	34,400,000	44,928,000
Total Rural Populaiton	11,513,433	15,087,100	18,852,728	26,456,439	33,246,720
Total Urban Populaiton	786,567	2,412,900	4,247,272	7,943,561	11,681,280
Urban Tanzania as % Total Population	6.4%	13.8%	18.4%	23.1%	26.0%
Total Dar es Salaam Popultion	336,436	821,983	1,344,291	2,487,288	4,364,541
Dar es Salaam as % of Total Urban	42.8%	34.1%	31.7%	31.3%	37.4%

Source: National Bureau of Statistics (NBS), Censuses of 1967, 1978, 1988, 2002 and 2012.

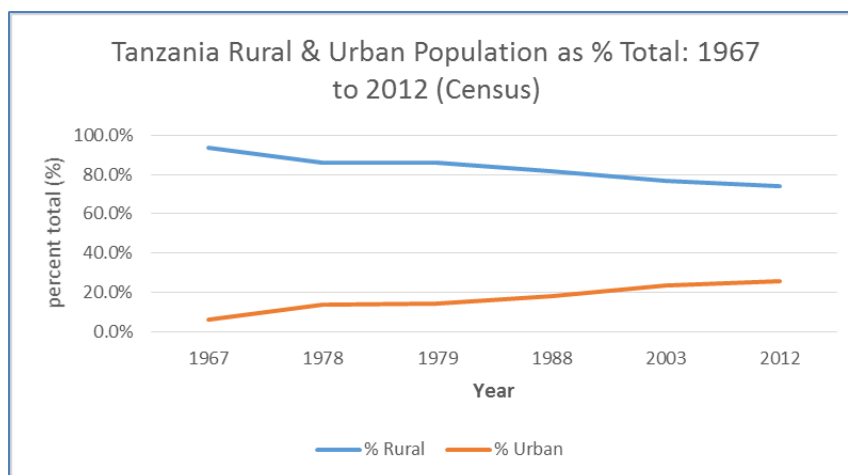
Tanzania's overall urban population has increased by a factor of 15 since 1967 (Table 2 and Figure 2), with a growth rate of 4.2% per annum between 2002 and 2012. Dar es Salaam's population has increased at a rate of 5.6% per annum during the same inter-censal period.

Figure 2 illustrates the trends in rural and urban population growth over the past 45 years. Increased urbanization has significant effects on demand for commercial biomass energy.

¹⁵ URT, 1999b. The Local Government Laws (Miscellaneous Amendments) Act, 1999. URT. Government Printers, Dar es Salaam, 1999.

¹⁶ Note that Tanganyika achieved independence from Great Britain in 1961 while Zanzibar achieved independence in 1963. The two merged as the United Republic of Tanzania in 1964.

Figure 2: Tanzania Rural and Urban Population Growth Trends, 1967 to 2012



Source: National Bureau of Statistics (NBS), Censuses of 1967, 1978, 1988, 2002 and 2012

The National Bureau of Statistics (NBS) forecasts, as shown in Table 3, that, going forward to 2030, Tanzania’s overall population is expected to grow by an average of 2.75% per annum to reach 73.2 million in 2030 (NBS, 2013b – see Section 7 on bottom-up BEST Tanzania Team population framework and projections).¹⁷ It is expected that the rural population will grow at an average rate of just under 2.3% per annum, compared to an urban growth rate of 3.9% per annum. This will continue the trend illustrated in Figure 2.

By 2030, Tanzania’s urban population is forecast to be 23.4 million, while the rural population should reach 49.8 million (68% of the total population) as shown in Table 3.

Table 3: Tanzania Population Estimates 2030 (compared to 2012 Census)

Year	Rural (mi)	Urban (mi)	Total (mi)	% Rural	% Urban
1967	11.5	0.8	12.3	93.6%	6.4%
1978	15.1	2.4	17.5	86.2%	13.8%
1988	18.9	4.2	23.1	81.6%	18.4%
2002	26.5	7.9	34.4	76.9%	23.1%
2012	33.2	11.7	44.9	74.0%	26.0%
2020	39.8	16.0	55.8	71.4%	28.6%
2030	49.8	23.4	73.2	68.0%	32.0%

Source: National Bureau of Statistics, Census of 1967, 1978, 1988, 2002 and 2012 (NBS, 2002, 2012a, 2013b)

¹⁷ Note that the World Bank forecasts that Tanzania’s total population will be over 81 million in 2030 (World Bank, 2013a). Their estimate for Tanzania’s 2012 population is 2.7 million higher than the NBS 2012 Census figures, which could account for their higher estimates of total population in 2030. The BEST projections are based upon the more conservative NBS census figures and projected growth rates (NBS, 2013b).

3.1.3 Land Use and Natural Resources

Tanzania is the third largest country in Africa with a land area of 945,203 km² (94.5 million hectares). Of that, 47 million hectares, or some 53% of the country's land area, is classified as forest. 44 percent of Tanzania's land area is covered by national parks and game reserves.¹⁸ The country has a wide variety of agro-ecological areas. These range from Afro-montane forests to coastal mangrove stands. Most of Tanzania's woodlands fit within the Southern Africa Miombo zone.

With Tanzania's agro-ecological diversity, agricultural production is also diversified. Tea, coffee, sisal, cashew nut, sugar, cotton, tobacco, high-value horticultural crops and forest timber are cash crops in Tanzania, reflecting the diversity of the country's agricultural conditions. Maize, rice and wheat are important cereal crops, with cassava playing a major part in the country's agricultural production.

Maize is the main cereal crop and is grown primarily as a subsistence crop. Over 70% of Tanzania's farmers are subsistence farmers, living and producing in relatively fragile ecosystems, subject to the vagaries of climate (MoF, 2009; NBS, 2013b).

Tanzania has extensive rangeland. It has the third largest population of livestock in Africa, after Ethiopia and the Sudan. Livestock is a main source of cash income. Tanzania's lake and coastal fisheries play a major role in the country's natural resources. Fishing is a major livelihood activity, both inland on Lake Victoria and Lake Tanganyika as well as along Tanzania's Indian Ocean coast. Fish provides the primary source of animal protein to rural Tanzanians. It is often smoked with fuel wood. Both fish and commercially sold and bought firewood are two of the largest cash-earning activities in rural Tanzania.

Beyond agriculture, Tanzania has the largest game reserves and national parks in Africa. It is one of the top tourist destinations in the world, earning the country over TZS 2 trillion (\$1.7 billion) or some 5% of GDP in 2011, the second largest foreign exchange earner in Tanzania, after gold exports (WTTC, 2012).¹⁹

Wildlife tourism is Tanzania's largest source of tourism, both for eco-tourism and for game hunting. Tanzania is the biggest game hunting destination in Africa, accounting for over \$700 million in foreign exchange in 2011 (URT, 2013e).²⁰ Wildlife, both inside and outside national parks and game reserves, is controlled by the Ministry of Natural Resources and Tourism.

The Wildlife Department (WD) is responsible under the Wildlife Conservation Act²¹ for working with villages, the private sector and local authorities on matters related to wildlife management and conservation.

The Tanzania Forest Service (TFS), under the Forest Act (MNRT, 2002) and the Forestry Policy (MNRT 2002) is responsible for working with villages, the private sector and local authorities to set the framework for village forests, tree growing associations (TGAs) on private forest land and to work together with the WD in the establishment of village forest management areas (FMA) and wildlife

¹⁸ VPO-DoE, 2012a. United Republic of Tanzania: National Report for the United Nations Conference on Sustainable Development. Rio+20. April 2012.

¹⁹ World Travel and Tourism Council (WTTC), 2012. Tanzania: Travel and Tourism - Economic Impact. WTTC, London, 2012.

²⁰ URT, 2013d. Government Portal. <http://www.tanzania.go.tz/>. United Republic of Tanzania, 20 November 2013.

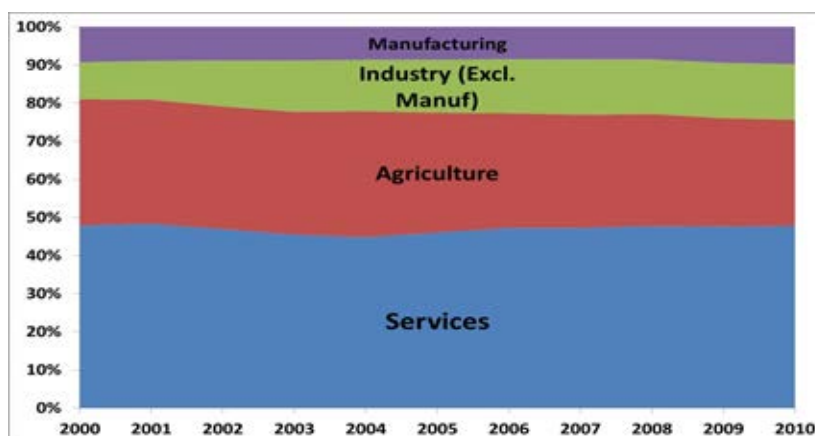
²¹ URT, 2013c. The Wildlife Conservation Act (Principal Legislation). MNRT. United Republic of Tanzania. July 2013.

management areas (WMA).²² These are discussed in more detail in the context of potential models for village level wood fuels in Section 2.1.8 and in Sections 8 and 9, BEST Strategy and Action Plan.

3.1.4 Economy and Development

Tanzania’s Gross Domestic Product in 2013 was estimated at US\$28 billion (TZS 48.8 trillion), with per capita GDP estimated at US\$586 (TZS 950,000).²³ Figure 3 shows the basic Tanzanian economic structure in the period from 2000 to 2010. Effectively, despite real growth rates above 6% for most of that period (6.5% in 2012), this structure has changed relatively little. Agriculture’s contribution to the economy has dropped below 25% while the rural population still comprises over 72% of all inhabitants (NBS.2013b). Mobile telecommunications has accelerated dramatically, with an estimated 29 million subscribers (MoF, 2012).

Figure 3: Contribution of sectors to GDP (percent) 2000-2010



Source: Bank of Tanzania, Quarterly Economic Bulletin and World Bank Tanzania Development Indicators, November 2013 (BoT, 2013b,²⁴ World Bank, 2013)

However, despite strong growth (see Section 4.2, Poverty Reduction Strategy)²⁵, Tanzania is currently ranked 152 out of 182 countries on the HDI (Human Development Index). Approximately one-third of the rural population is below the basic needs poverty level (NBS-THMISS, 2013, World Bank, 2013, MFEA, 2009).

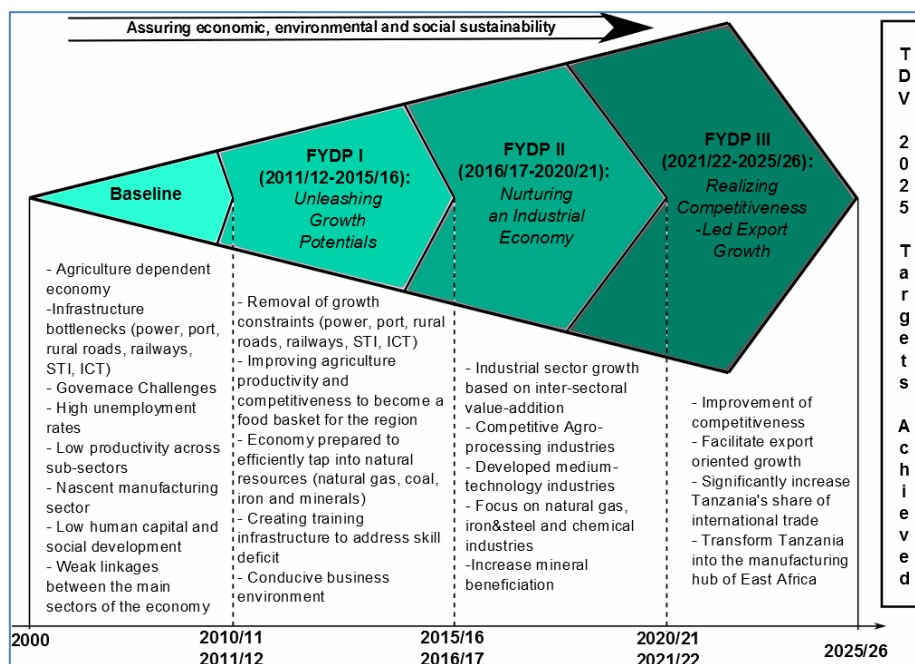
²² MNRT, 1998c. The Wildlife Policy of Tanzania. Government Printers. Dar es Salaam. United Republic of Tanzania.

²³ WB. 2013. Tanzania World Development Indicators, November 2013.

²⁴ Bank of Tanzania (BoT), 2013b. Economic Bulletin for Quarter Ending September 2013. Vol. XLV No.3. Dar es Salaam.

²⁵ The current National Strategy for Growth and Reduction of Poverty (NSGRP II, 2010/11 and 2014/15) is known widely by its Kiswahili acronym MKUKUTA (Mkakati wa Kukuza Uchumi na Kupunguza Umaskini Tanzania), under the MoF.

Figure 4: Vision of Economic Development through Consecutive FYDPs: 2011 – 2025/26



Source: Tanzania Five Year Development Plan, President’s Office for Planning Coordination (POPC. URT.²⁶ ESRF, 2009)

Tanzania’s Five Year Development Plan (FYDP), 2011/12 to 2015/16, seeks to provide more focus and concrete deliverables to MKUKUTA II²⁷ (see Figure 4).²⁸ It targets five main areas for the Plan’s focus:

- Infrastructure, in particular large investments in energy, transport infrastructure (port, railway, roads, air transport), water and sanitation and ICT;
- Agriculture, focusing on the transformation of agriculture for food self-sufficiency and export, development of irrigation particularly in selected agricultural corridors, and high value crops including horticulture, floriculture, spices, vineyards etc.;
- Industrial development, specifically targeting industries that use locally produced raw materials such as textiles, fertilizer, cement, coal, iron and steel, as well as development of special economic zones, using public-private partnerships;
- Human capital and skills development, with an emphasis on science, technology and innovation; and,
- Tourism, trade and financial services.

²⁶ ESRF, 2009. Study the Identification of Potential Growth Drivers II for Tanzania based on an Analysis of Tanzanians Competitive and Comparative Advantages; Growth Sectors and Growth Drivers: A Situational Analysis Report, Study submitted to POPC.

²⁷ See footnote 25.

²⁸ URT, 2011a. Five Year Development Plan (FYDP): 2011/12 to 2015/16: Unleashing Tanzania's Latent Growth Potentials. Office of the President, Planning Commission. June 2011.

3.1.5 Agricultural Sector

Tanzania's exports have grown by about 3% per annum since 2000 if one excludes gold exports. Tourism ranks after gold exports in terms of foreign exchange earnings. Agricultural exports have improved steadily over the past fifteen years, with cashews and tobacco showing the greatest increases (Table 4).

Table 4: Cash Crops with Potentially Significant Biomass Residues or Biomass Energy Demand

Product\Year	Production (tonnes)			% increase 2001/02 to 2011/12	Export (tonnes)	
	2001/02	2006/07	2011/12		2006	2012
Sugar (refined)*	184.0	228.0	249.0	35.3%	n/a	n/a
Coffee	37.5	34.3	33.3	-11.2%	15.2	17.9
Cotton	49.9	125.6	75.7	51.7%	36.6	19.6
Tea	28.7	30.3	31.5	9.8%	14.2	16.9
Cashewnuts	67.3	77.4	158.4	135.4%	26.1	94.8
Tobacco	28.0	52.0	126.6	352.1%	5.9	46.5
Sisal	23.5	27.8	36.8	56.6%	4.1	7.0

Source: Bank of Tanzania, Economic Bulletin for Quarter Ending September 2013 (BoT, 2013a²⁹)

Tobacco has a major impact on Tanzania's forests, both for land-clearing for the sector's rapid growth, and for fuel wood for drying tobacco. The number of producers has increased from some 10,000 in 2000 to some 55,000 in 2012 (TTB, 2013).³⁰ The production and the land cleared for tobacco has increased substantially since the Tobacco Industry Act of 2001. This is one of the priority areas for non-household energy efficiency proposed by BEST.

The sugar sector is performing well.³¹ The potential for increasing cogeneration from bagasse (sugar residue) is on the order of 30-40MW under current plant capacity. TPC, Kilimanjaro, is seeking to increase its cogeneration capacity by another 10MW from its current 16MW. The cotton sector has grown substantially over the past decade. While cotton produces considerable residue, there are a number of concerns about pest and disease contagion when cotton stalks are transported.

²⁹ Bank of Tanzania, 2013a. Economic Bulletin for Quarter Ending June 2013. Vol. XLV No.2. Dar es Salaam

³⁰ Tanzania Tobacco Board (www.ttb.or.tz). ESMAP.1989. Tanzania Smallholder Tobacco Curing Efficiency Project. Activity Completion Report. Number 102/89. May 1989. There is great scope to improve both production and energy efficiency in this rapidly-growing agricultural sector. The TTB says that it "As at present environmental conservation is being insisted in the tobacco production. Tobacco buyers have been urged to make sure that environmental conservation is being adhered to the maximum (tree planting, use of modern tobacco curing barn (use fewer wood fuel), water and soil security does not become a source of environment destruction" and claim that the number of trees planted by farmers has increased by 127%. There are many who doubt that. The World Bank operated a major tobacco curing wood energy efficiency improvement project in the 1980s under the World Bank/UNDP/Bilateral Aid.

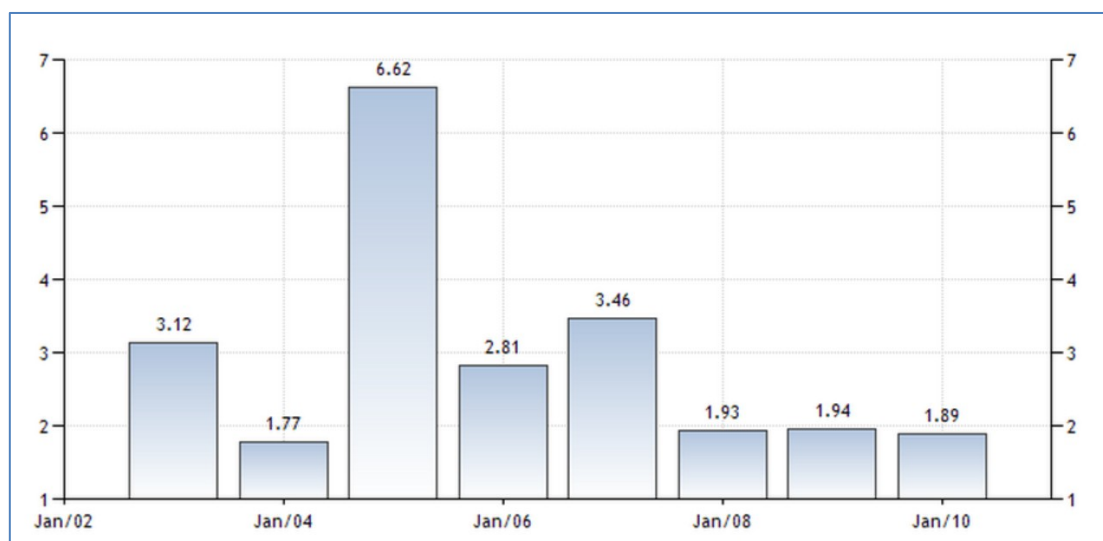
³¹ There is potential for the sugar sector to produce ethanol and/or ethanol gel as a cooking fuel as a replacement for kerosene and/or charcoal. This has been examined, as have ethanol cooking stoves by TaTEDO and others, and is highlighted in the draft MEM Liquid Biofuels Policy (MEM. 2012). However, the BEST Tanzania Project Team did not explore this in any detail as it was specifically outside the BEST Tanzania Terms of Reference (Appendix 1) and the Memorandum of Understanding (MOU) between the GoT and the EUEI PDF.

Consequently, the only potential for cotton residues on the biomass energy front is for use on a local basis, which is being explored.³²

The tea sector has grown steadily over the past ten years. Export value of Tanzania’s tea production has doubled in real terms since 2001. All the tea factories grow their own trees to meet their industrial heat requirements. Indeed, several sell their surplus firewood to other consumers, including Mbeya Cement in Southern Tanzania.

The other major source of international investment is in Tanzania’s tourism sector, which has grown fairly constantly since the early-1990s and in the telecommunications sector, which has grown significantly. With the decrease in ODA, Tanzania has increasingly shifted to non-concessional financing (primarily commercial banks), which has raised the country’s external debt.

Figure 5: Foreign Direct Investment (FDI) in Tanzania (2002 to 2010) in Constant US\$ ('000 million)



Source: World Bank, World Bank Indicators, Tanzania, Balance of Payments (World Bank, 2013)

3.1.6 Development Assistance

Revenues from Official Development Assistance (ODA) have dropped from US\$ 67 per capita (1999-2003) to US\$ 53 (2009-2013) in constant dollars (World Bank, 2013). Direct foreign investment (DFI) has varied considerably over the past decade. Most DFI during the past decade was in the gold mining sector, and recently in the gas exploration sector (World Bank, 2013, Figure 5).

Much of the reduction, in absolute terms, is caused by reduced balance of payments assistance and reduced debt servicing assistance, due to increased foreign exchange earnings, particularly in the gold and tourism sectors.

³² USAID Powering Agriculture Project – Benin and Tanzania, VIP and Camco Tanzania.

Most of Tanzania's development assistance targets the health, education, agriculture and energy (electricity) sectors. The Development Partners Group (DPG) was established in 2004 and comprises 17 bilateral and 5 multilateral partners.³³ All the UN agencies are counted as one. The DPG has worked hard to align their assistance to the priorities of MKUKUTA. The DPG also seeks to align its assistance with the Millennium Development Goals (MDG).

The development partner who is currently most active in the biomass energy sector is the Finnish Government (FINNIDA), which has been supporting forestry for fifty years. They actively support PFM and CBFM activities. They have taken an innovative approach for empowering Tree Growers Associations (see next section on PES) in the context of private plantations and REDD (Reducing Emissions from Deforestation and Degradation).

The Norwegians have been the most active development partner in the REDD sector. They have provided assistance to the VPO-Division of Environment, to SUA, and for the Tanzania National REDD Task Force. The Norwegians are supporting MEM in the field of sector policy and regulations in the natural gas sector. Furthermore, they are a major partner with the Rural Energy Agency (REA), particularly supporting development of small independent power producers (IPPs).

The EU in Tanzania is currently preparing its new Economic Development Fund (EDF) support programme. It has been very supportive of the BEST Tanzania Project. The EU, while interested in supporting sustainable activities along the entire wood energy value chain, intends to focus specifically on the charcoal and firewood areas of forestry management, reforestation, afforestation and improved production for wood fuels as a key component of their sustainable agriculture and environment activities.³⁴

The Swiss have a large programme with the Tanzania Forest Conservation Group (TFCG), an indigenous NGO forestry umbrella organization. The Swiss are particularly interested in the area of sustainable forestry and charcoal. They have been in regular contact with the BEST Team and have attended and actively participated at the BEST national stakeholder workshops. They provide considerable support to MJUMITA, which is the largest network of community-based forestry groups in Tanzania.³⁵

The Dutch SNV, while no longer being a government agency of The Netherlands, gets considerable funding from the Dutch Government and is very active in Tanzania's biomass energy sector. They have taken a lead in developing the Tanzania Domestic Biogas Programme (TDBP), breathing new life into that sector and stimulating considerable growth in activities.³⁶ They have also taken a very

³³ Bilateral partners include Belgium, Finland, Ireland, Korea, Spain, UK, Canada, France, Italy, Netherlands, Sweden, USA, Denmark, Germany, Japan, Norway, Switzerland, while multilaterals include: African Development Bank, European Commission, IMF, World Bank, United Nations. <http://www.tzdpdg.or.tz/dpg-internal/dpg-tanzania/dpg-members.html>

³⁴ BEST communications with the EU Delegation to Tanzania.

³⁵ <http://www.mjumita.org/>. MJUMITA currently has 80 affiliated local area networks, which are made up of Village Natural Resource Committees (VNRC) and Environmental User Groups. Local level networks are registered legal entities or are in the process of being registered. MJUMITA's members are present in 23 districts, 450 villages and represent around 500 user groups and VNRCs involved in participatory forest management (PFM) countrywide. The total number of MJUMITA members is around 6000, but the total number of people living in communities where MJUMITA works is as many as 900,000 people. MJUMITA has expanded rapidly over the past several years.

³⁶ See <http://biogas-tanzania.org/>

strong interest in improved cook stoves (ICS), first helping the ICS Task Force and now providing assistance to the Clean Cook stoves and Fuels Alliance of Tanzania (CCFAT).

Partners who have historically been very actively engaged in the biomass energy sector, including the World Bank, GIZ, the Swedes and the Danes, have not been very active in the sector over the past 2-3 years. They have not participated in any of the BEST fora since the BEST Tanzania Project began.

3.1.7 Payment for Environmental Services (PES)

Payment for Environmental Services (PES) is a fairly wide-reaching term which covers everything from governments, NGOs, private companies, and others, making financial payments to individuals and communities (even governments) for taking action in order to either prevent, reduce or remediate environmental impacts on areas they consider important. PES has a long history in Tanzania. It is currently thriving through a number of initiatives.

PES is an area that offers important opportunities in the forestry and wood energy sectors, particularly for village forests and private forests. TANESCO began paying local communities to protect key hydropower reservoir watersheds in the 1970s. These payments were tied to forestry watershed management plans to reduce siltation in water catchment areas of TANESCO's hydropower reservoirs.

The United Nations Framework Convention on Climate Change (UNFCCC) provides another framework for PES in developing countries through the Clean Development Mechanism (CDM). The CDM is a project-based mechanism whereby investors in eligible projects reducing greenhouse gas (GHG) emissions receive credits for those reductions. They can sell those certified emission reductions (CERs) to private companies, NGOs, foundations, or governments.

Furthermore, the UNFCCC is supporting pilot activities that involve PES in the forestry sector within the framework of REDD. These are proceeding with the support of various UN agencies, other multilateral development partners (e.g., World Bank, European Union), bilateral development partners (e.g., Norway) and international institutions and companies.

The Department of Environment (DoE) in the Vice-President's Office (VPO) has taken a strong lead in Government on the REDD and REDD-readiness front.³⁷ The Tanzania National REDD Task Force has been active in this area of PES for a number of years.³⁸ REDD projects are also being undertaken by NGOs and communities using the so-called voluntary emission reduction (VER) approach through international qualifying agencies such as the Verified Carbon Standard (VCS), Plan Vivo and others.³⁹

One REDD+ project is being developed by TFCG and MJUMITA in Kilosa, Morogoro district, with 16 participating villages that will combine a REDD component with a sustainable charcoal production component in, or near, the same villages. This is being supported by the Swiss SDC (see Text Box 1).

³⁷ VPO, 2013a. National Strategy for Reduced Emissions from Deforestation and Forest Degradation (REDD+). March 2013; and, VPO, 2013b. Action Plan for the Implementation of the National Strategy for Reduced Emissions from Deforestation and Forest Degradation (REDD+). March 2013

³⁸ See <http://www.reddtz.org/>.

³⁹ See <http://www.v-c-s.org/>, <http://www.planvivo.org/>

The REDD component will protect areas of village forest land under village forestry management plans (VFMPs), while sustainably developing (on a 16-year rotation period) natural forest (not under REDD) elsewhere in the villages. This is viewed by the TFS, and a number of NGOs and development partners, as an exciting forerunner for many other Tanzanian villages.⁴⁰

Verified emission reduction (VER) credits can be issued and then sold locally or internationally for avoided deforestation, reforestation and afforestation activities.⁴¹ Other similar projects are under design in Tanzania with Farm Africa, WWF and other NGOs.

Text Box 1: Local NGO & CBO Association Pilots PES in Several Ways: The Tanzania Forest Conservation Group (TFCG) & the national network of CFM/CBFM groups (MJUMITA) are pioneering payment for environmental services (PES) on several levels. First, as the VPO-DoE in its “REDD Readiness” report to the UNFCCC notes, TFCG has registered the first REDD+ project through the VCS in Tanzania. This focuses on avoided deforestation, reforestation/afforestation for community-based, forestry management activities in a number of villages in Kilosa District, Morogoro Region. Further, they are exploring the market demand for “sustainable charcoal” from those same villages using a straightforward market approach. If successful, the two flows of revenues (REDD+ revenues for avoided deforestation) and premium prices for sustainable charcoal could incentivise village councils to put in place both forestry management & improved charcoal. Given the fact that TFCG/MJUMITA represent over 200 community-based forestry groups, the results from these activities will be very closely monitored. The Swiss Government, through the SDC is supporting the sustainable charcoal marketing component, indeed, the entire framework.

Three small NGO-fostered REDD+ activities are being supported with villages and local PFM/CBFM groups in Kololo, Kagera and Babati where schemes for crediting avoided deforestation, for reforestation and afforestation are being put in place. Additionally, a local group, called TanCarbon, is working in the field of sustainable charcoal through PFM and village forest management committees.⁴²

The United Nations Biodiversity Convention provides another international framework for providing PES for protecting or improving biodiversity. There are many other international mechanisms for providing PES for forestry-related environmental projects. Groups, such as the Rainforest Alliance⁴³ and the Forest Stewardship Council (FSC)⁴⁴, are providing certification and market access to farmers

⁴⁰ <http://worldwildlife.org/stories/wildlife-management-areas-spread-the-wealth-in-tanzania>

⁴¹ See VCS, www.v-c-s.org.

⁴² See AWF for Kolo (<http://www.awf.org/projects/kolo-hills-redd>), Farm Africa for sustainable charcoal and REDD+ in Babati District, and TanCarbon for sustainable charcoal. Plan Vivo, through a UK-based non-profit organisation, has developed two Plan Vivo projects in Tanzania (Emiti Nibwo Bulora Plan Vivo, and, Reducing Emissions from Deforestation and Forest Degradation in the Yaeda Valley, see <http://www.planvivo.org/projects/registeredprojects/>, whereby farmers are provided finance (credits) ex-ante, for developing Plan Vivo (living plans) for reforestation and afforestation (coupled with avoided deforestation) in villages (See: www.planvivo.org). Green Resources AR (GRAR) has registered a project with VCS on avoided deforestation and reforestation: “Reforestation in grassland areas of Uchindile, Kilombero, Tanzania & Mapanda, Mufindi, Tanzania, GRAR. July 7th 2009” (VCS. 2009).

⁴³ See <http://www.rainforest-alliance.org/>,

⁴⁴ See <https://ic.fsc.org/index.htm>

producing timber, coffee, cocoa and tea sustainably in Tanzania, thereby enabling them to access international PES for sustainable forest and agriculture management.

As noted, the Finnish Government (FINNIDA) has been working with the MNRT, with the National Land Use Planning Commission (NLUPC), the PMO-RALG, the VPO-DoE (under REDD Readiness), and district and village authorities to establish Tree Growers Associations (TGAs). TGAs are designed to empower local people to form forest associations specifically to produce forest products by planting local tree plantations for multiple uses – by integrating indigenous trees into their plantations they also receive premiums from several international associations as PES.⁴⁵

This has important implications for the BEST Tanzania Strategy and Action Plan. Over 100 TGAs have been established since 2010, with a further 100 currently under development. TGAs have been set up through the village resource mapping and planning process, which the NLUPC has encouraged as an integral process of village certification (effectively giving villages title lands certified by the Ministry of Lands and Human Settlement Development - MLHSD).

Over 5,000 villages have been certified through a lengthy, multi-institutional and rigorous process set out under the Land Act (MLHSD, 1999a) and Village Land Act (MLHSD, 1999b)⁴⁶. Designating an area for forests, wildlife, agriculture, watershed management, settlement and other uses is required for a village to be certified. By designating areas for these uses and, more fundamentally, by developing forestry and/or wildlife management plans for these areas, villages set the stage for obtaining PES – without such designation, planning and registration, it is difficult, if not impossible, for Government, development partners or NGOs to obtain payment for environment services.

Hundreds of villages have developed village forest management plans (VFMP), village wildlife management plans (VWMP), and other environmental resource management plans after being certified by the MLHSD. Registering these plans with the MNRT and the NLUPC is a very participatory and lengthy process. However, village forest management plans are essential in order to set up TGAs on village lands. Over 100 villages have registered their village forest management plans.

These processes of developing forest management plans have been greatly facilitated and accelerated by the growth of PFM and CBFM. Both have been encouraged explicitly by the MNRT since the National Forestry Policy (MNRT, 1998a) and the Forestry Act (MNRT, 2002) were enacted. They are an integral part of the Tanzania Forest Services (TFS) Agency's approach.

Another very relevant example of PES with village level natural resource management is given through the Wildlife Department (WD) of the MNRT.⁴⁷ The WD, as well as the Tanzania Natural Parks Authority (TANAPA), have encouraged a number of villages in areas of major wildlife value (e.g., next to national parks, Game Reserves, in and along wildlife migration corridors, in areas of major wildlife

⁴⁵ National Land Use Planning Commission (NLUPC), 2011. Report on the Study to Develop a Strategy for Establishing Cost Effective Land Use Plans in Iringa and Njombe Regions. Gerald Mango and Deusdedit Kalenzi, NLUPC, Dar es Salaam, August 2011.

⁴⁶ MLHSD, 1999. Land Act. Government Printer. URT. Dar es Salaam, and, MLHSD, 1999b Village Land Act. Government Printer. URT. Dar es Salaam.

⁴⁷ MNRT, 1998c. The Wildlife Policy of Tanzania. Government Printers. Dar es Salaam. United Republic of Tanzania; URT, 2013c. The Wildlife Conservation Act (Principal Legislation). MNRT. United Republic of Tanzania. July 2013. URT.2013c calls for increased mobilisation of villages to establish wildlife management plans and to register WMAs.

dispersion and diversity) to establish Wildlife Management Areas governed by Wildlife Management Associations (WMA).⁴⁸

Over 40 WMAs have been established, with 13 of those registered with full wildlife management rights. Those WMAs that are registered collect revenues from tourists, hunters and others as PES for the protection and conservation of wildlife within and near designated villages.

There are close analogies between village wildlife management areas and village forest management areas in terms of empowering and incentivizing villages to organize themselves to receive payment for sustainable and improved environmental management and stewardship. There are a number of lessons to be learned both in the wildlife and the forestry sectors for the implementation of the BEST Tanzania Strategy and Action Plan, particularly in terms of sustainable forestry management, harvesting, and energy production, particularly sustainable charcoal production.

In the case of both forests and wildlife, the MNRT works with District Natural Resource Advisory Boards (DNRABs). These are new participatory governance structures being set up for both village and district wildlife and forest activities. They represent an excellent entry point for the TFS to work with local authorities and other stakeholders to improve charcoal and wood fuel supply (production, transformation and transportation). This is one of the key elements of the BEST Tanzania Strategy and Action Plan.

⁴⁸ The MNRT is in the process of enacting a Wildlife Management Authority Act, which will take on the responsibilities of WMAs, provide management, technical services and training to WMAs and expand the number of WMAs in the country.

4. Policy, Institutional and Regulatory Framework

4.1 Introduction

With wood energy accounting for 90% of Tanzania's energy demand, anything affecting the prices and availability of energy, whether that be energy policy, taxation, import policies, pricing, investment support, environmental legislation, also has an effect on the price of, and demand for wood energy. The government agencies being the most active in the sector of biomass energy, and in the policy and administrative and regulatory frameworks affecting biomass energy, are highlighted briefly below.

There are a large number of ministries and agencies that have a direct impact on the energy sector in Tanzania. Almost all policies and regulations that touch on the forestry, agriculture, natural resources, and the energy and environment sectors have an effect on the biomass energy sector.

For example, when electricity prices increase due to rising petroleum imports and prices, many households shift from cooking with electricity to cooking with charcoal. When kerosene prices increase, many households shift from using kerosene to using charcoal or firewood for cooking and heating. As shown in the 1990s, changing policies can shift energy demand in the opposite direction. When the Government reduced the relative price of kerosene, demand for charcoal fell significantly.⁴⁹

Interviews with hundreds of stakeholders in both focus group and workshop settings during the BEST Tanzania Project highlighted that, if household electricity prices fell, many households would substitute charcoal with electricity. But, with relative electricity prices having trebled between 2011 and today, tens of thousands of urban households shifted from electricity to charcoal. This demonstrates how policies and institutional approaches, particularly in the energy sector, affect demand for biomass energy.

Government revenues spent on developing the electricity, coal, natural gas, geothermal and other non-biomass energy sectors all have an impact on revenues available for the biomass energy sector, whether that be for increasing the forest resource base or for promoting or undertaking research and investment in improved wood fuel and other biomass energy end-use technologies.

4.2 National Poverty Reduction Strategy and Biomass Energy

The current National Strategy for Growth and Reduction of Poverty (NSGRP II, 2010/11 and 2014/15), known widely by its Kiswahili acronym MKUKUTA (Mkakati wa Kukuza Uchumi na Kupunguza Umaskini Tanzania),⁵⁰ is one of the most important national development documents in Tanzania. It forms part of a long-term development process which essentially began in 1999 with the Tanzania

⁴⁹ Hosier, R.H., Kipondya, W. 1993. Urban household energy use in Tanzania: Prices, substitutes and poverty. *Energy Policy*, Volume 21, Issue 5, May 1993, Pages 454–473.

⁵⁰ Ministry of Finance and Economic Affairs. MFEA, 2010. National Strategy for Growth and Reduction of Poverty II – NSGRP II [MKUKUTA II]. URT. July 2010.

Development Vision 2025 (URT, 1999) followed in 2012 by The Tanzania Long-Term Perspective Plan (LTPP), 2011/12-2025/26 - The Roadmap to A Middle Income Country (URT, 2012).⁵¹ It sets the overall Government and development partner framework that arguably has the most important impact of all policies on the biomass energy, particularly the wood energy sector.

MKUKUTA has three primary focal areas:

- Growth and reduction of income poverty;
- Improvement of quality of life and social wellbeing; and,
- Governance and accountability.

Both the current and previous NSGRP/MKUKUTA highlight the importance of electricity, LPG and other clean energy sources to address poverty. The strategy is closely aligned to the National Energy Policy (NEP) (MEM. 2003). Both view reducing forestry biomass energy consumption as key to economic growth and reduction of poverty, while both as well assess increasing electricity and LPG consumption as key to achieving these objectives.

Neither document, nor the current and past Five Year Development Plans (FYDP),⁵² acknowledge the positive rural economic livelihood and development contributions wood energy makes towards both rural and urban development. Wood energy is only mentioned briefly in the above mentioned national policy documents and almost always in the context of being an inferior fuel resource that needs to be replaced with modern, cleaner fuels.

No examination or evaluation of the benefits and costs of this transition is made. They do not mention the significant contributions wood energy makes to poverty alleviation, income generation and livelihoods to hundreds of thousands of Tanzanians in rural and urban areas. Wood fuel is only mentioned twice and charcoal once⁵³ in MKUKUTA II. Increasing access to clean and affordable substitutes for wood energy from 10 percent in 2010 to 20 percent in 2015 is a priority.

The Ministry of Finance (MoF), in its 2009 review of MKUKUTA, argues that it is a weakness in MKUKUTA II that wood fuels are not given attention (MFEA, 2009).⁵⁴ They state that a critical part of reducing poverty is bringing wood fuels into the mainstream of development policy. MKUKUTA monitoring comes under the MoF (formerly MFEA), arguing that the Government's primary strategy on poverty reduction should place strong emphasis on the contribution wood fuel and charcoal make to rural and urban livelihoods (MFEA, 2009).

However, this review does not appear to have been followed through in any subsequent MoF papers, nor do these points appear in the National Five Year Development Plan (FYDP).

⁵¹ URT, 1999. Tanzania Development Vision 2025. United Republic of Tanzania, and URT, 2012. The Tanzania Long-Term Perspective Plan (LTPP), 2011/12-2025/26 - The Roadmap to A Middle Income Country. President's Office, Planning Commission, June 2012.

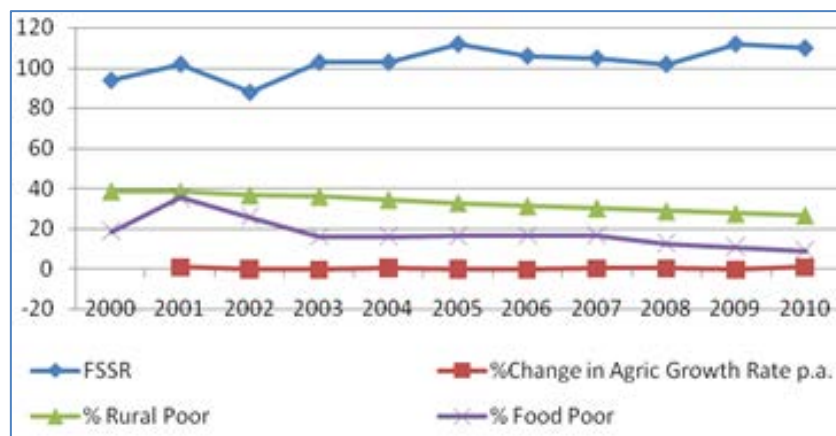
⁵² URT, 2011b. Five Year Development Plan (FYDP): 2011/12 to 2015/16: Unleashing Tanzania's Latent Growth Potentials. Office of the President, Planning Commission. June 2011.

⁵³ . In Section 1.2.3.8. "Strengthen infrastructure to support growth of employment generation and profitable crop farming, livestock, and fishing and fish farming", page 134.

⁵⁴ MFEA, 2009. Poverty and Human Development Report, 2009. MFEA, Research and Analysis Group, MKUKUTA Monitoring System. December 2009.

Figure 6 shows the trends in food self-sufficiency. Note that the percentage of people who are within the food poor category (those who do not have enough food to meet daily food requirements) and the percent of rural poor have steadily declined since 2000. However, the agricultural growth rate has not increased appreciably since 2010, averaging 4.3% over the 2000 to 2010 period.

Figure 6: Trends of Food Self Sufficiency Ratio and Poverty Indicators (%)



Source: Ministry of Finance and Economic Affairs (MFEA) National Strategy for Growth and Reduction of Poverty II – NSGRP II [MKUKUTA II] (MFEA, 2010).

It is clear that, with the exception of the MoF 2009 evaluation of MKUKUTA II, no Government office, agency or institution responsible for setting policy for economic and social development, for growth, livelihoods or poverty alleviation has realized the important contribution the wood energy business makes to Tanzanians in those areas.

It seems difficult to imagine that any of these policies can achieve their full objectives without changing their perspectives and approach to wood energy. With a more pro-active and positive approach, wood energy could become cleaner and more sustainable, and could contribute significantly more to meeting these development objectives than at present.

4.3 Energy Sector

4.3.1 Ministry of Energy and Minerals (MEM)

The Ministry of Energy and Minerals is the lead agency in Tanzania on the energy sector. The Ministry is organized with a Commissioner for Minerals and a Commissioner for Energy and Petroleum Affairs. Biomass like any other energy forms is under the Commissioner for Energy and Petroleum Affairs and within the Renewable Energy Section, headed by an Assistant Commissioner for Renewable Energy (ACRE).

A number of acts and policies govern the energy sector. The National Energy Policy (NEP) (MEM, 2003) is the most important one of them. It sets the framework for energy policy in the country. It highlights the role various energy sources should play in developing the sector.

The NEP acknowledges that biomass energy accounts for over 90% of Tanzania's energy supply.⁵⁵ Biomass is listed as a renewable energy resource and receives relatively little attention in the NEP compared to electricity, gas and other energy sources. The NEP recognizes the importance of wood energy in Tanzania, notes the importance of biomass energy efficiency, but emphasizes the importance of expanding the use of electricity, LPG and other modern sources of energy to reduce demand for wood energy.

The MEM is responsible for activities covered by: The National Electricity Act of 2008 (URT, 2008a), The Petroleum Act of 2008 (URT, 2008b), the Natural Gas Policy of Tanzania (URT, 2013b), the Draft National Biofuels Policy (MEM, 2012), the Energy and Water Utilities Regulatory Authority Act URT, 2001, Cap 414), the Petroleum (Conservation) Act (Principal Legislation, as modified from time to time. URT, 1981), the Rural Energy Act (No 8 of 2005, URT, 2005b) among others.

With the exception of liquid biofuels, for which the MEM has developed guidelines and a draft national liquid biofuels policy,⁵⁶ MEM is not directly engaged in biomass energy policy formulation or regulation. MEM supports biomass energy development in such areas as biogas, biomass briquetting, or biomass cogeneration primarily through projects or programmes usually funded through a combination of MEM cofinancing with development partners and/or NGO financing. The MEM is in the process of updating the NEP and of developing a renewable energy policy.

MEM is BEST Tanzania's local government focal point. It currently has no budgetary allocation for taking BEST Tanzania forward, as a strategy activity, or for any other biomass energy policy or strategy other than concerning liquid biofuels and biogas. The last two budgets did not allocate finances to the BEST Project. In addition, the current MEM budget request to Parliament did not include resources for supporting the implementation of the BEST Tanzania Action Plan for the upcoming financial year.

In its budgetary submission to Parliament for the (current) 2013-2014 budget, MEM requested approximately TZS 1.000 billion for the energy sector (approximately 80% for electricity generation and transmission and for natural gas). MEM submission to Parliament included a request for biogas support of TZS 20 billion. Parliament agreed to the MEM request and added a further TZS 400 billion for electricity reinforcement and grid extension (particularly for rural electrification) for a total approved budget of TZS1,426.9 billion (US\$893 million) (MEM, June, 2013).

4.3.2 Rural Energy Agency (REA)

The Rural Energy Agency was established by Parliament under the Rural Energy Act No. 8 of 2005 (URT, 2005b). The REA is an autonomous agency subordinated to the MEM. The Permanent Secretary to the Ministry of Energy is Chairman of the Rural Energy Fund (REF) which was established

⁵⁵ MEM, 2003, National Energy Policy. Ministry of Energy and Minerals. Government Printers. Dar es Salaam. United Republic of Tanzania. February 2003, page 6.

⁵⁶ MEM, 2010a. Guidelines for sustainable liquid biofuels development in Tanzania. Ministry of Energy and minerals – Tanzania; and, MEM, 2012. Zero Draft. National Liquid Biofuels Strategy. February 2012.

to fund a range of rural energy activities. The fund obtains its finances from small levies on electricity (per kilowatt hour) and on petroleum products, as well as from support by development partners and development banks. REA is active in a number of areas, particularly rural electrification. It has undertaken some district and regional biomass energy studies, and has piloted several small biomass energy projects (e.g., small-scale gasification of crop residues in Manyata Village).

4.3.3 Energy and Water Utilities Regulatory Agency (EWURA)

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, Cap 414 of the laws of Tanzania. It is responsible for technical and economic regulation of the electricity, petroleum, natural gas and water sectors in Tanzania pursuant to Cap 414 and sector legislation.

The functions of EWURA include, among others, licensing, tariff review, monitoring performance and standards with regards to quality, safety, health and environment. EWURA is also responsible for promoting effective competition and economic efficiency, protecting the interests of consumers and encouraging the availability of regulated services to all consumers including low-income, rural and disadvantaged consumers in the regulated sectors.

4.4 Forestry Sector

4.4.1 Ministry of Natural Resources and Tourism (MNRT)

The MNRT has strong influence on the biomass energy sector. It is responsible for setting policy and regulations that affect biomass energy supply through the Forestry and Beekeeping Division (FBD), the Tanzania Forest Service (TFS), and through research and training institutions in the forestry, wildlife, wildlife conservation and tourism sectors.

The forestry sector is governed by three important pieces of legislation. The Forest Act (MNRT, 2003) provides the over-arching framework for activities in the sector. The Forestry Policy (MNRT, 1999) was the first major government document in the forestry sector that acknowledged the roles of participatory forest management (PFM), community-based forestry management (CBFM) and joint forestry management (JFM).

It clearly specifies the roles villages, the private sector and local authorities (district authorities) should and can play in forest management, afforestation and reforestation. The Forest Act goes into further detail by laying out the legal framework by which various stakeholders can participate in forestry activities.

The Tanzania Forestry Services (Agency) Framework formalized the mandate of the TFS. It clearly sets out the role of the FBD and the TFS. Under the new MNRT institutional arrangements, the FBD is primarily responsible for policy-making, while the TFS is responsible for implementation. As the creation of the TFS is relatively new, and so many FBD staff are in the field, these areas of responsibility are being defined at present. The sector is still in a transitional phase as TFS officers are deployed into the field and FBD officers either join the TFS or are deployed elsewhere.

From a policy and regulatory perspective, woody biomass falls primarily under the regulatory framework of the Forest Act of 2002 (MNRT, 2002) and the National Forestry Policy of 1998 (MNRT, 1998) which constitute the primary governing policy for the MNRT. The Tanzania Forestry Service Framework Document of 2010 (MNRT, 2010b) made the Tanzania Forest Services (Agency) the key executive agency in national forestry affairs. The Forest and Beekeeping Division (FBD) is the division in the MNRT responsible for forestry policy.⁵⁷ The forestry sector is in transition as many MNRT staff are being transferred from the FBD to the newly-operationalized TFS.

4.4.2 Local Government Forestry

Institutionally, local governments, primarily through the district councils, take responsibility for enforcing policy and regulations over local authority forests (see Section 3.3) and over village and private forests outside the jurisdiction of the TFS. Local authorities can set byelaws, which regulate the management, production, sale and transport of forest products, including firewood and charcoal. District Forest Officers (DFOs) work directly for district councils to enforce local legislation and regulations. They also carry out regulation and enforcement for the TFS which often leads to contradictions in their duties.

Villages have village councils setting regulation at a village level. They also have village natural resource committees (VNRC) advising the village councils and helping formulate village level regulations and byelaws. Private forests can be regulated by TFS, district authorities or village authorities depending upon where their forests are located. Section 3.3 provides a detailed framework for actual day-to-day biomass energy governance.

District Forest Officers are executive officers of the MNRT, although they report directly to the district councils. As central government executive officers working for local councils, they are also based under the Prime Minister's Office for Regional Development and Local Affairs (PMO-RALG), although the PMO-RALG does not exercise direct regulation over forests and forestry products, but it does work with local authorities to set policy and regulations that affect the biomass energy sector.

4.4.3 Charcoal and Commercial Fuel Wood Licensing, Permitting, Royalties and Fees

The modes of licensing, granting permission, paying royalties and fees, transporting and selling charcoal and commercial fuel wood depend upon the type of forest (source of wood) used for producing charcoal and fuel wood. These modes are outlined in Table 5.

The Forest Act Number 14, 2002, designates four types of forests:

- Natural forests;
- Local authority forests;
- Village forests; and,

⁵⁷ TFS has been given the mandate for the management of national forest reserves (natural and plantations), bee reserves, and forest and bee resources, on general lands. TFS is an Executive Agency to enhance the management and conservation of forest and bee resources for sustainable supply of quality forest and bee products and services. The Forest and Beekeeping Division remains responsible for developing forest policy, laws and regulations and overseeing their implementation in the sector.

- Private forests.

If anyone produces charcoal or commercial fuel wood on natural forest land (forest or natural forest reserve), a royalty, as set by the MNRT, should be paid to the Central Government. Furthermore, a fee (cess) of at least 5% of the royalty fee should be paid to the district council, through the District Forest Officer (DFO). It is common for district councils to set their own cess rates by formulating and implementing their own byelaws. If the wood is harvested on local authority forest land, then the royalty (as set by the MNRT) should be paid to the local council.

The royalty is charged on the type of product (e.g., charcoal, timber, fuel wood, etc.) according to a schedule set out by the MNRT, updated periodically. The indicator for the royalty is a bag of charcoal that is supposed to weigh no more than 28kg.⁵⁸

However, by focusing on the bag, rather than the weight, incentives are created for producers and sellers to increase the amount of charcoal, hence the weight, per bag. Many bags of charcoal exceed the MNRT (TFS) limit.

The royalty is paid per cubic metre of fuel wood to the DFO who should pass it on to the Central Government, if the wood source is natural forest, or paid to the district council, if it comes from local authority forest land. Currently the royalty rates (in Morogoro) are TZS 14,000 for a bag of charcoal (normally weighing between 56 and 80 kg) and TZS 5,120 per m³ of fuel wood plus 5% for tree planting. Rates are broadly the same across regions and districts. The current cess rates in Morogoro are TZS 2,000 per bag of charcoal and TZS 1,500 per m³ of fuel wood.

Table 5: Licenses, Permits, Fees, Royalties and Other Payments for Wood fuels

License/Permit/Payment	Forest Type			
	Natural	Local Authority	Village	Private
Royalty fee	√	√		
Local authority cess ⁵⁹ (at least 5% of royalty fee)	√	√		
Tree planting fee (charge 5% of cess)	√	√		
Local authority (product) license	√	√		
Local authority (product) license fee	n/a	n/a	n/a	n/a
MNRT transport permit & fee	√	√	√	√
TRA TIN ⁶⁰ required	√	√	√	√
Village authorisation form	√	√	√	

⁵⁸ In fact, as the Consultant's field surveys in February, March and April 2013, have shown, bags commonly weigh more than 60kg and often weigh more than 90kg.

⁵⁹ A cess is an old British term, particularly applied in British colonies, referring to a tax or levy. It remains widely used in Anglophone Africa to refer to levies or taxes applied to property and natural resources.

⁶⁰ Taxpayer Identification Number (TIN), provided by the Tanzania Revenue Authority (TRA), Ministry of Finance (MoF).

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Trade registration fee (Central Government)	√	√	√	√
District council trading license	√	√	√	√
District council transit fee	√	√	√	√
Wholesaler/Retailer trading license & fee	√	√	√	√

Source: Ministry of Natural Resources and Tourism, Royalty Rates for Forestry Products (MNRT. 2012)

These fees are designed to encourage local governments (districts) to provide good management of existing forest areas, and to promote afforestation/reforestation of land. In reality, however, receipts are used for general budgetary support, and very little is used to promote forestry management, afforestation or reforestation. Fees are, in practice, rents that accrue to councils and individuals. This makes it difficult, if not impossible, to incentivize the private sector and village or district level authorities to take the revenues and put them into forestry activities.

To produce charcoal or commercial fuel wood on national forest or local authority forest land, a product license must be obtained from the DFO (or representative) who can issue the license on behalf of the MNRT on natural forest land, or on behalf of the district council if on local authority forest land. No fee should be paid for obtaining a product license on any of the four types of forest land. No cutting or production can legally begin on forest land without obtaining a license from a DFO.⁶¹ This license is processed after approval of the District Committee.

With decentralization, this is a grey area where rules are not clear. Under decentralization, a DFO reports to the District Council, who is under the authority of the Prime Minister's Office, Regional Affairs and Local Government (PMO-RALG). Before decentralization, DFOs reported up the MNRT chain of command to Director of Forests and, ultimately, to the Minister for Natural Resources and Tourism.

Thus, in some cases, such as issuing licenses to produce on natural forest land, the DFO is working on behalf of the MNRT and collects the royalty fee for the Central Government after production has taken place. For the same activity on natural forest land, the DFO also collects a cess (fee) for the district council in addition to the royalty fee collected on behalf of the Central Government.

Thus, when it comes to natural forest land, the DFO acts, and collects fees, on behalf of two different authorities for the same activity. This definitely presents potential and real conflicts of interest. With the DFO reporting to the District Council, pressure is on to collect as much as possible for the districts. However, royalties and other payments are due to TFS, i.e. Central Government, so, not only are conflicts of interest imposed by the current policy and administrative structure, but, the potential for corruption is very high. As several DFOs said during BEST Stakeholder workshops and

⁶¹ No license is required for producing fuel wood or charcoal for one's own use when it is produced on private land. However, if the fuel wood or charcoal produced is to be transported and sold outside the district where it is produced, a license must be obtained from the DFO before wood can be cut and production started.

interviews, having more than one master is difficult, but, if they neither get paid what they think is their due, it is easy for them to blame the other agency rather than the civil servant.

If the charcoal or fuel wood is transported from the district, then the producer must obtain a transport permit from the MNRT. With the establishment of the Tanzania Forest Service (TFS), the permit is issued by the TFS. The transport permit must identify the product, the source of production, the transporting vehicle and the destination. The DFO may issue the transport permit, if there is no TFS or FBD officer there to issue it.

Thus, there are potentially several grey areas for payment of the transport permit fees. That is, transporters do not know, at present, who they should pay the fees to. Some transporters find they end up paying the fees twice, once to a TFS or FBD officer and once to a DFO. This needs to be regularized, stipulating exactly who charges a transport fee.

Any producer who has the intent to sell must make a payment of an annual trade registration fee of TZS 200,000 to TFS. The trade registration fee is independent from the amount of charcoal being produced and sold. A producer with the intent to sell must also obtain a district council trading license and pay a fee for that. In order to obtain the trading license, the producer must have a TIN (Tax Identification Number) from the Tanzania Revenue Authority (TRA, Ministry of Finance). He/she must present the TIN to the district council to obtain the trading license. Furthermore, in order to obtain the district council trading license, a producer must have a form signed by the relevant village council, stating if the charcoal or fuel wood is produced on local authority forest, village forest or private forest. This form must be presented to the relevant district council officer, with the TRA TIN, in order to obtain the district council trading license.

Proof of payment of all these royalties, cesses and fees must be on hand when the producer transports the charcoal or fuel wood. S/he must also obtain a transit fee from the district council that any police officer can demand to see along the route travelled from production point to sales point. There is no official payment for the transit fee.

This layout of licenses, royalties, permits and fees follow the value chain framework for wood fuels, as set out in Table 5 (above).

As the above shows, there are so many authorities (village, district, national) involved in the wood fuels management and regulatory framework, making it very confusing to most commercial players (producers, transporters, vendors) and providing many opportunities for double- or under-counting and delays, amongst other issues (such as corruption).

Governance at a local level is so complicated and with so many grey areas (between MNRT and district councils, between village councils and District Forest Officers, etc.), that almost all stakeholders at the national stakeholder workshops and in the interviews called for a radical simplification and restructuring of governance, licensing and control policies at this level.

The National Audits Office (NAO) wrote a very revealing and critical review of activities at the local level in their 2012 Performance Audit on Management of Forest Harvesting.⁶² They list a number of

⁶² National Audits Office. NAO, 2012, Performance Audit on Management of Forest Harvesting by the Ministry of Natural Resources and Tourism: Report of the Controller and Auditor General of the United Republic of Tanzania. January 2012.

discrepancies and a lack of follow-up procedures that clearly reinforce the BEST Team's recommendations.

The BEST Team sees this as the most essential area of strategy and policy intervention needed to lay the foundations for sustainable biomass energy, particularly in the charcoal sector that should be addressed now.

4.5 Other Institutions

Ministry of Finance (MoF)

Through the **Tanzania Revenue Authority (TRA)**, the **Ministry of Finance** has some regulatory and administrative authority over biomass when biomass is commercialized – that is, when forest products are commercially produced, transported for sale and sold.⁶³ The MoF sets policy, with the MNRT, on royalties, transport and sales taxes, while local authorities set cess duties and local license fees for forestry products.

Vice-President's Office – Division of Environment (VPO-DoE)

The Vice-President's Office has the mandate for environment in Tanzania. **The Environment Management Act (EMA)** (VPO-DoE, 2004), which is Tanzania's paramount legislation governing environmental management in Tanzania, is under the jurisdiction of the VPO's Division of Environment (DoE). They have actively supported the MNRT (Wildlife Division, FBD and TFS) in the REDD and other PES areas.

Prime Minister's Office – Rural Administration and Local Government (PMO-RALG)

The PMO-RALG is responsible for supporting regional and all local governments. That support to local authorities is provided through placement of executive officers with local authorities,⁶⁴ providing training, technical and managerial assistance, and financial management oversight.

National Land Use Planning Commission (NLUPC)

The National Land Use Planning Commission (NLUPC) within MLHSD supports land use planning at all levels, helping villages to identify the limits of their land and define (for example) Village Land Forest Reserves (VLFs), Wildlife Management Areas (WMAs), communal grazing areas or expansion zones for agriculture.

Ministry of Lands and Human Settlements Development (MLHSD)

The Ministry of Lands and Human Settlements Development (MLHSD) is responsible for coordinating and regulating land tenure, adjudication and planning for both urban and rural lands. As overseer of these functions, MLHSD is relevant for BEST because of differences in the way that revenue

⁶³ Note that in 2012 the TRA collected approximately TZS 100 billion from all forest products (including timber) out of total TRA revenue collections of TZS 8 trillion (BEST communications from BEST Steering Committee Member, Anthony Kibopile, Desk Officer, Ministry of Finance Revenue Collection Department).

⁶⁴ Working through the PMO-RALG and possibly through the Association of Local Authorities of Tanzania (ALAT).

collection and harvesting decisions with respect to wood fuel are handled for different categories of land. The MLHSD is crucial in the process of certifying villages, helping develop the village forest and wildlife management plans and providing technical assistance in demarcating, listing and registering those lands.

Ministry of Agriculture, Food Security and Cooperatives (MAFC)

MAFC has interests in the biomass energy sector, but does not have any formal framework for supporting those interests.

Academic Institutions

From among Tanzania's many centres of higher learning, the work of the Institute of Resource Assessment (IRA) and the College of Engineering and Technology (CoET) at the University of Dar es Salaam, and the Faculty of Forestry and Nature Conservation at Sokoine University of Agriculture (SUA) in Morogoro, are the most relevant for the biomass energy sector.

Centre for Agricultural Mechanisation and Rural Technology (CAMARTEC)

The Centre for Agricultural Mechanisation and Rural Technology (CAMARTEC) in Arusha is a parastatal founded in 1972, working on a number of biomass technologies to reduce charcoal and fuel wood consumption. They are working in collaboration with the Netherlands Development Organisation (SNV) and MEM, implementing the Tanzania Domestic Biogas Programme (TDBP) under the African Biogas Partnership Programme.

National Environmental Management Council (NEMC)

The Environment Management Act of 2004 (EMA, 2004) places responsibility for environmental impact assessments (EIAs). The NEMC is responsible for providing oversight on many aspects of biomass energy, from providing environmental impact assessments (EIAs) to project developers (e.g., charcoal producers, briquette companies), to any major land use activity, whether that be tree planting or forest harvesting. NEMC has a key role to play both in BEST and in any biomass energy development activities in Tanzania.

Commission for Science and Technology (COSTECH)

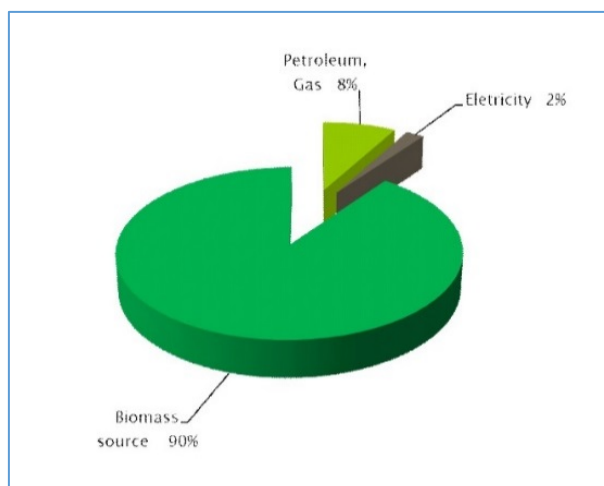
COSTECH is a subsidiary body of the Ministry of Communication, Science and Technology. It finances a number of activities in the biomass energy sector, including biogas and biomass briquetting, through direct grants.

5. Overview of Energy Demand and Supply

5.1 Energy Demand

Figure 7 shows the percentage of national energy consumption by different fuel types. Biomass has consistently figured around 90% of national energy demand for over 30 years.

Figure 7: Tanzania Energy Demand (2012)



Source: Bank of Tanzania, Economic Bulletin for Quarter Ending September 2013 (BoT, 2013b).

Table 6 shows the relative shares of cooking and heating energy in urban and rural Tanzania in 2012.

Table 6: Share of Different Fuels in Household Cooking Energy Consumption (2012)

Primary Cooking & Heating Energy	Percentage			Households (millions)			Population (millions)		
	Rural	Urban	Total	Rural	Urban	Rural	Rural	Urban	Total
Electricity	0.2%	1.0%	0.4%	0.01	0.03	0.04	0.07	0.12	0.18
LPG	0.1%	0.1%	0.1%	0.01	0.00	0.01	0.03	0.01	0.04
Biogas	0.1%	0.4%	0.2%	0.00	0.01	0.02	0.02	0.05	0.07
Paraffin, kerosene	0.4%	7.0%	2.1%	0.03	0.19	0.22	0.13	0.82	0.95
Charcoal	8.5%	71.0%	24.8%	0.54	1.97	2.52	2.83	8.29	11.12
Firewood	90.1%	20.0%	71.9%	5.76	0.56	6.32	29.96	2.34	32.29
Crop residues	0.4%	0.1%	0.3%	0.03	0.00	0.03	0.14	0.01	0.15
Other	0.2%	0.4%	0.3%	0.01	0.01	0.02	0.07	0.05	0.11
Total	100.0%	100.0%	100.0%	6.39	2.78	9.17	33.25	11.68	44.93

Source: National Bureau of Statistics 2012 Census, 2007 Household Budget Survey and NBS-Tanzania Commission for AIDS-Tanzania HIV/AIDS and Malaria Indicator Survey 2011-12 (NBS, 2009, 2012a, 2013a&b, NBS-TACAIDs, 2013).

Transport accounts for the largest share of non-biomass energy demand. It comprises approximately 7% of total energy demand, and over 75% of all non-biomass energy demand.⁶⁵ At present, all petroleum fuels are imported, with transport fuel imports (gasoline/petrol and diesel) accounting for approximately 25% of the country's total import bill (MEM, 2012). This is a primary driver for the Government's interest in encouraging liquid bio-fuel development.

Electricity generation accounts for a large amount of non-biomass energy demand. Approximately 57% of TANESCO's electricity generation in 2012 came from hydropower, with natural gas and diesel accounting for the remaining 43% (TANESCO, 2013).

Approximately 19% of the country's population has access to electricity.⁶⁶ Including connections to TANESCO (REA, 2013) and to other sources, including solar photovoltaics (PV), and diesel and petrol generators, and with grid electricity often unreliable, the number of generators has increased over the past 10 years to meet growing demand.

After transport and electricity generation, a number of Tanzania's industries consume both locally-produced natural gas and imported petroleum products, including liquefied petroleum gas (LPG). LPG demand has increased from 4,000 tonnes in 2007 to 30,000 tonnes in 2012 (EWURA, 2013). Commercial establishments, including hotels and restaurants, institutions likeschools, hospitals, prisons, ministry buildings and military establishments, consume LPG, primarily for cooking.

Kerosene, electricity, LPG and other energy sources meet about 9% of urban household cooking demand, with 75% of non-wood fuel energy provided by kerosene. Non-wood fuel energy accounts for about 1.2% of rural cooking and heating demand, with crop residues and kerosene providing about one third each of non-wood fuel energy. Only a small portion of the rural population consume LPG or electricity for household cooking or heating (NBS-THMIS, 2013, NBS, Agriculture Census 2007/2008, NBS, 2012b&c).

5.2 Energy Supply

5.2.1 Biomass Energy Supply

5.2.1.1 Wood energy Supply: Overview

Data and information on forestry resources is currently insufficient to develop a comprehensive forestry biomass supply-demand balance. Even with the release of preliminary results from the National Forestry Resources Management Monitoring and Assessment (NAFORMA, MNRT, 2013) it is still too early to draw detailed quantitative and geographical observations on forestry supply. Initial NAFORMA results are being discussed at present and the release of the full NAFORMA study is not anticipated before the second quarter of 2014.

However, initial results complement observations of forestry experts, particularly concerning trends and areas where forestry supply for charcoal is greatest (i.e. around Dar es Salaam, Arusha, Mwanza, Morogoro and other rapidly-growing urban areas). The BEST Team has consulted a number of

⁶⁵ MEM, 2012, Zero Draft. National Liquid Biofuels Strategy. February 2012.

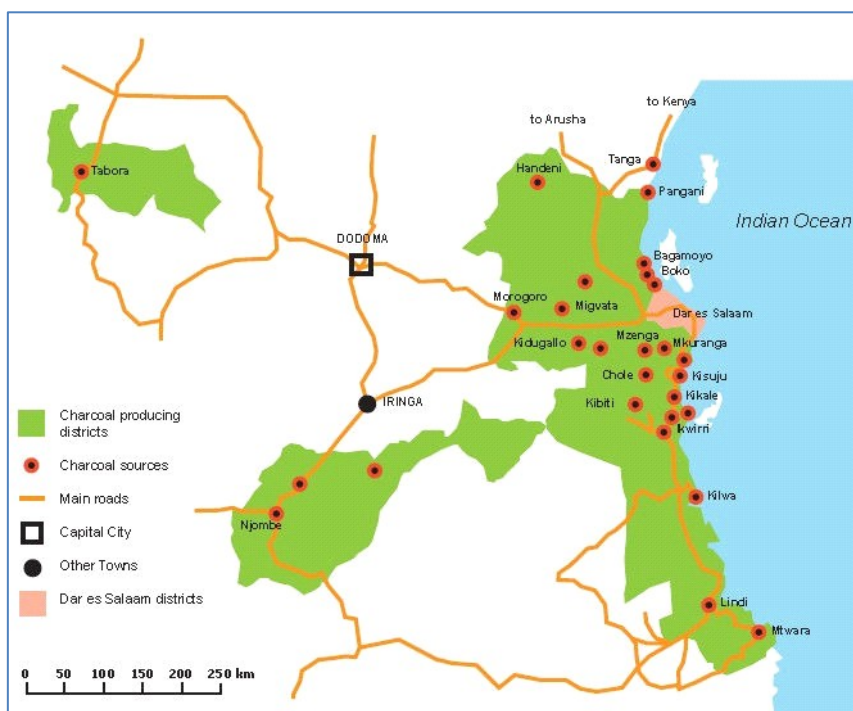
⁶⁶ MEM. 2013c. TANESCO, Power System Master Plan 2012 Update, March 2013.

Tanzania’s top forestry experts, including Dr. F. Kilahama, Professors P. R. Gillah and R. Ishengoma and Mr. Bariki Kaale. All agree that the forestry mean annual increment (MAI) has dropped on a national scale on an average of 2m^3 per hectare per annum ($2\text{m}^3/\text{ha}/\text{yr}$) and that average density per hectare in Tanzania is around 50m^3 per hectare ($50\text{m}^3/\text{ha}$).

Both sustainable yields (MAI) and density vary considerably on a site-specific level. Nonetheless, lacking detailed regional and district forestry cover and density data, these are the national averages used by the BEST Team to provide rough measures of the impact of current and projected demand on biomass supplies.

Forestry biomass supplies have increased with urbanization since the 1970s when kerosene prices increased dramatically due to the so-called oil price shocks of 1973 and 1978. Dar es Salaam is the greatest source of demand. Forests near Dar es Salaam have been considerably degraded with increased charcoal demand.⁶⁷ Forests from southern, western and coastal areas now provide much of Dar es Salaam’s charcoal (Figure 8). Forest areas are under pressure to supply charcoal and commercial fuel wood to other urban areas consuming twice as much energy from wood as demanded in Dar es Salaam (NBS, 2013a&b).

Figure 8: Charcoal Supplies to Dar es Salaam (2011)



Source: Malimbwi. R.E. & Zahabu. E. (2007).

⁶⁷ Malimbwi. R.E. and Zahabu. E., 2007, “Woodlands and the charcoal trade: the case of Dar es Salaam City. Working Papers of the Finnish Forest Research Institute 98: 93–114.

5.2.1.2 Forest Cover and Productivity

Tanzania has a forested area of 47 million hectares comprising a wide range of species, with miombo (*Brachystegia* spp.) dominating over half of the country (MNRT, 2003, Table 7). Most of Tanzania's densest forests (and its forestry plantations) are located in the southern and eastern parts of the country while the central, lake and northern areas of the country are less densely forested.

An area of 26 million hectares of forests falls under wildlife reserves and water catchment protection forests that are legally inaccessible for wood extraction by the community. Productive forests where harvesting can be conducted legally cover an area of approximately 21 million hectares (MNRT 2013).

Table 7: Tanzania Land Use Classification - Area and Standing Wood Volume (m³/ha)

Land use	Area (ha)	Standing wood volume m ³ /ha
Production forests	20,934,249	50
Protection forests	9,189,405	57
Wildlife reserves	18,009,277	46
Shifting cultivation	6,207,202	19
Agriculture	22,558,099	11
Grazing land	6,937,347	20
Built-up area	1,968,606	12
Water body or swamps	743,983	11
Other land	1,499,212	31
TOTAL	88,047,380	

Source: Ministry of Natural Resources and Tourism (MNRT), Tanzania National Forest Resources Monitoring and Assessment. NAFORMA. Brief report. Tanzania Forest Services Agency (MNRT 2013).

5.2.1.3 Growing Stock and Yields

Due to unsustainable management of wood supply resources in Tanzania, MNRT (MNRT, 2013) reports show that wood growing stock per unit area has declined both in terms of total standing volume and mean annual increment (MAI) per unit area. Data on wood standing volume and MAI for 1961 and 2012 are used to illustrate the change in wood standing volume per hectare and annual wood consumption.

In 1961, when Tanzania attained its independence, the estimated total standing wood volume per ha of productive forest was 180 m³ and the average MAI per ha was 5 m³ (Kaale 1983, Kaale & Temu 1985). However, as noted above, volumes on productive forest and yields have dropped dramatically since 1961.

In 1961, Tanzania had a population of 7 million people with total annual wood consumption of 14 million m³ while allowable wood harvesting (total supply based on MAI) was some 105 million m³. That left a surplus of 91 million m³ per year in the early-1960s.

Table 8: Summary - Comparison of Wood Fuel Demand and Yield Requirements (2012)

Wood Fuel Demand	Fuel Wood (firewood)		Charcoal		Total Charc & Firewood in m3 Fuel Wood (mi)	Forest Land Required for 2012 Sustainable Wood Fuel Consumption (mi ha)	Required for 2012 Non-Sustainable Wood Fuel Consumption (mi)
	tonnes (mi)	m3 Fuel Wood (mi)	tonnes (mi)	m3 Fuel Wood equiv (mi)			
Rural	20.97	29.96	0.52	3.88	33.83	16.92	0.677
Urban	1.64	2.34	1.51	11.38	13.72	6.86	0.274
Total	22.60	32.29	2.03	15.26	47.55	23.77	0.951

Source: Ministry of Natural Resources and Tourism, Tanzania Forest Services (Agency), with BEST Tanzania Team estimates of demand (TFS and BEST Tanzania) and yield (MNRT, 2013).

In 2012 Tanzania had a population of over 43 million with estimated total annual wood equivalent (charcoal and firewood) of 37.8 million m³ (Table 8). Assuming 2 m³ per ha MAI (sustainable yield), some 23.8 million ha of forest land would be required to meet 2012 wood fuel demand. Were that demand satisfied through clear-felling forest land (assuming 50 m³ per ha), that would require nearly 1 million hectares of forest land. NAFORMA initial results then suggest that production of wood to meet wood fuel demand in 2012 was significantly higher than sustainable yield.

This indicates that considerable wood fuel demand is being met through deficit harvesting, much of which is taking place in protected forests that are legally inaccessible for wood harvesting (MNRT 2013, Ishengoma 2013).

5.2.1.4 Forest Plantations

Approximately 90,000 ha of plantation forests are either leased from the Government or managed and developed on private land. These leased and private forests provide energy for timber curing, pulp and paper production, tannin extraction, electricity generation (from wattle wastes from tannin extraction, coconut wastes and sawdust) and tea drying.

5.2.2 Non-Wood Energy Supply

Other sources of biomass energy supply include:

- Sugar bagasse for four factories generating over 50MW of combined heat and power (CHP or generation);
- Wood waste for Mufindi Paper Mills (MPM), Sao Hill Industries (SHI) combined heat and electricity production for electricity and process heat for curing high quality timber;
- Sisal residues currently used for pilot electricity generation (150kW) at Katani Sisal Estates and used in some wood-deficit rural areas as a household cooking fuel;
- Coffee husks currently made into briquettes sold to household, commercial and institutional consumers for cooking, and also used as fuel to supplement fuel oil for cement production (Tanga and Mbeya Cement);
- Rice husks used widely to supplement firewood for small-scale brick and tile production, and some pottery production;
- Coconut timber and husks used for small-scale (2MW) electricity generation (Ng'ombenia Power Ltd., Mafia Island), for fuel briquette production, for supplementing fuel oil for

cement production, for fish smoking on the Indian Ocean Coast, and for supplementing firewood for brick and tile production; and,

- Animal wastes to produce biogas, used primarily in households and institutions (mainly schools).

5.2.2.1 Sisal for Heating and for Combined Heat and Power (CHP)

Tanzania is one of the world’s largest producers and exporters of sisal. Sisal is a fibrous plant which is cultivated primarily to extract fibres for a variety of uses, from making sacks to rope.

Tanzania produces 35,000 tonnes of the world’s 250,000 tonnes of sisal fibre per year. This provides over 30,000 tonnes of residue, which could support a number of smallholders in biogas production.⁶⁸ Sisal residues are used throughout Tanzania as a cooking and heating source, primarily in wood fuel poor areas.

The total area under smallholder sisal in estates increased from 32 ha in 1999 to 5,129 ha by December 2009, whilst plantings are continuing (TSB, 2013).

Table 9: Tanzania Sisal – Fuel Potential

Fuel	2012	2013	2014	2030
Sisal	10,000	11,500	13,225	142,318
Rural Wood equiv.	7,400	8,510	9,787	105,315

Source: Tanzania Sisal Board (TSB) annual statistics, and Mkonge Energy Services (MeS) Ltd. Information and reports (TSB, 2013; MES Ltd., 2013).⁶⁹

The potential for sisal residue as an energy source (biogas), particularly in arid and semi-arid areas of the country, is large.⁷⁰ The Tanzania Sisal Board is promoting investment in 14 new sisal biogas electricity plants to generate 50MW of electricity.⁷¹

Of the volume of sisal cropped, only 2-4% is decorticated for sisal – the rest is usually waste. Hence, there is considerable stock of residues available for both small-scale and larger-scale biogas production⁷².

5.2.2.2 Animal Wastes and Crop Residues for Biogas

In addition to wood fuels, biogas technology (anaerobic digestion of animal waste and/or crop residues) and biogas has been pioneered and promoted since the early days by CAMARTEC (see BEST

⁶⁸ Oxfam, “Tanzania Agricultural Scale-Up Programme: Sisal, Improving incomes, market access and disaster preparedness in Shinyanga region - Year End Report April 2012 to March 2013”, 2013.

⁶⁹ See TSB’s website: www.tsbtz.org, and MeS Ltd.’s website: www.katanitz.com.

⁷⁰ Common fund for Commodities (CFC); “Impact Evaluation of a CFC Funded Cluster of Sisal Projects (CFC/FIGHF/07, CFC/FIGHF/13/, CFC/FIGHF/15, CFC/FIGHF/26/FT): Final Reports (Tanzania and Kenya)”, submitted by Paola Fortucci and Shakib Mbabaali, CFC/FAO, 2009.

⁷¹ IPP Media, “TSB [Tanzania Sisal Board] set to install 50MW on 14 estates”, 29 June 2011.

⁷² <http://www.katanitz.com/Sisal%20Energy.html>, Katani Sisal Energy, and Tanzania Sisal Board, “Statistics”.

Annex 3, Biogas). They have worked with a number of NGOs and development partners over the past 30 years. However, NBS agricultural census figures for 2008 (NBS, 2011b), the latest census figures (NBS, 2012b) and the NBS-THMISS surveys in 2012, showed that the number of biogas digesters in use, up until 2010, was less than 4,000.

In 2011 began the Tanzania Domestic Biogas Programme (TDBP) with the support of the Dutch SNV. A programme with strong grassroots support was started, with ambitious targets.⁷³ TDBP, working with CAMARTEC has succeeded in supporting the installation of over 7,133 digesters over the past three years. Perhaps another 1,000 digesters have been installed additional to those reported by the TDBP.⁷⁴

If one estimates that another 4,000 digesters are operational from before 2009 (NBS, 2011b), then, there are probably not more than 12,000 household digesters operating on a constant basis in Tanzania, with 10,000 of those in rural areas (BEST communications with TDBP and ELCT-Evangelical Lutheran Church of Tanzania).

Table 10: Tanzania Biogas Digester Installation: 2012-2013 (July)

Biogas Digesters Installed Jan 2012 to July 2013		
Group/Location	2012	Jan-Jul 2013
TDBP	624	658
FIDE	416	350
ELCT	304	206
NRCF	179	161
MIGESADO	164	117
KDA	151	89
MNDULI-ORON	21	
MBOZI	29	
CARITAS	343	329
All Other BCEs	171	236
Zanzibar Ministry	7	10
Total	2,409	2,156
Total Jan 12 to Jul 13		4,565

Source: Tanzania Domestic Biogas Development Programme (TDBP) supported by the SNV (TDBP, 2013).

However, almost all of those have been donor-supported, such that only a few of the 12,000 digester owners have paid a commercial price for their equipment. The TDBP has a strong commercial focus. Their Board is working hard to transform the sector into a private-sector-led one. However, even with that, it will be difficult to penetrate the market without the prevailing type of NGO subsidies (training, paying for equipment, operating workshops, etc.).

⁷³ See www.biogas-tanzania.org.

⁷⁴ This contrasts to slightly less than 4,000 that were in use when the Tanzania National Bureau of Statistics (NBS) conducted the 2007/2008 Agricultural Census throughout Tanzania, NBS, 2011b, "National Sample Census of Agriculture 2007/2008 Volume 1: Technical and Operation Report", URT, December 2011.

Table 11: Indicative Biogas Digester Wood Fuel Displacement (m3, tonnes and hectare equivalent)

Equivalents per Digester per Year	
Tonnes charcoal displaced per digester per year	0.72
Tonnes wood equiv displaced per digester per year	5.04
Hectare woodland equiv saved by 1 digester	0.20

Source: Various, including GTZ’s Special Energy Programme in the 1980s to 1992, the SNV-supported Tanzania Domestic Biogas Programme (GTZ. SEP.1993, TDBP, 2011)

Biogas could make a difference in reducing demand for wood fuels. Table 11 shows how much wood an average digester can displace, including the forest land required for that wood. If all of the estimated 12,000 digesters that are operational were used for household cooking, biogas would be displacing over 8,600 tonnes of charcoal, or the equivalent of almost 60,000 tonnes of firewood per year.

The BEST Team estimates that if 120,000 digesters were in use in Tanzania, they would displace almost 500,000 tonnes of fire wood per year. This is a target set in the BEST 2030 Alternative Biomass Supply Scenario (Section 7).

5.2.2.3 Biomass Briquettes

Biomass briquettes were first piloted in the 1980s. CAMARTEC, as with biogas, was the lead agency for piloting briquettes (see BEST Annex 4, “Biomass Briquettes”). While new techniques and technologies were introduced to Tanzania, initial work was not commercially successful.

Later, the private sector, in both Moshi and in Tanga, began to commercially produce biomass briquettes primarily for high-end household consumers, and for institutional and commercial buyers. Increasing interest in biomass briquettes is shown as the prospect of future charcoal shortages looms. There are a number of companies and NGOs now engaged in briquette production, although the sector has still not taken off on any large-scale.

Briquettes can be made from almost any type of biomass source with sufficient energy content and density and other desirable characteristics, such as low moisture content, low ash content and uniform formation (granular) (Grover & Mishra, 1996). The main sources of feedstock for briquette production in Tanzania include:

- Agricultural residues including husks (rick, coffee, coconut), bagasse, pineapple pulp and sisal;
- Fibre, maize cobs, maize stalks and nut shells (macadamia, ground nuts);
- Wood processing residues including sawdust, woodchips, tree barks and wood shavings;
- Household and municipal waste including paper, food waste and wood;
- Charcoal wastes (often referred to as chardust) at points of production, or, more frequently at sales sites where charcoal dust has accumulated over many years; and,
- Dried animal manure.

Limited quantities of charcoal briquettes are available on the market. BEST surveys of ten supermarkets in Dar es Salaam (March to May, 2013) found that imported South African and American (USA) briquettes available in 5kg bags are priced 10 times higher than the local Tanzania retail wood charcoal. Briquettes from East Africa Briquettes Ltd. (Mkaa Bora) were also available in four of the ten supermarkets at prices 4-5 times the price of local Tanzania retail charcoal in traditional markets.

Biomass briquettes are produced and sold on a relatively small scale in Bagamoyo, Moshi and Arusha by several NGOs and small-scale private producers. These briquettes are made from a range of stocks including charcoal waste (chardust), coffee husks, maize cobs and other crop residues.

Considerable commercial organisation is required to aggregate and consolidate the biomass residues used for briquettes. Furthermore, strong efforts are needed to commercially market the briquettes. Both these issues remain the biggest obstacles to successful biomass briquetting.

5.2.3 Non-Biomass Energy Supply

Tanzania has large quantities of natural gas, coal, uranium,⁷⁵ hydropower, wind, solar, geothermal and other non-biomass energy resources.

Tanzania exploits less than a quarter of its hydropower resources, primarily for large hydropower electricity feeding into the national grid. Small-scale hydropower is being exploited increasingly for rural electricity grids, for agro-industrial use and for feeding into the main grid.

As noted, imported petroleum products make up about 8% of the country's energy consumption, primarily in the transport sector (MEM, 2012).

5.2.3.1 Imported Petroleum Products

Kerosene is imported primarily for lighting instead of cooking. Kerosene imports have decreased by 50% since the major price liberalization and policy changes from 2007 to the present that have led to a ten-fold increase in retail kerosene prices since 2002 (EWURA, 2013). Imported LPG supplies have increased considerably over the past five years, primarily to meet industrial and commercial demand (EWURA, 2013).

There are several acts and policies that govern the petroleum sector in Tanzania.⁷⁶ Tanzania, as yet, has no known petroleum reserves. All policies in the petroleum sector concern importation of products, modes of importation, safety, transport and sales. EWURA regulates the petroleum sector.

⁷⁵ In April, MEM issued a special licence to mine uranium Mantra Tanzania Ltd, which is owned by Mantra Resources, an Australian subsidiary of AtomRedMetZoloto (ARMZ), a Russian mining firm. Currently, four international firms (Canadian, US, Australian and Russian) are exploring for uranium in Tanzania. Coal reserves are extensive and are being mined by three companies at present, and generating 50MW of electricity. Proven natural gas reserves are estimated as being the third largest in Africa, after Algeria and Nigeria. Wind and geothermal resources are currently being mapped for possible future development.

⁷⁶ URT, 2008. The Petroleum Act, 2008. United Republic of Tanzania.; URT, 2001a. The Energy and Water Utilities Regulatory Authority Act, 2001, Cap 414. Dar es Salaam; MEM, 2003; URT, 1981. Petroleum Products Act (Principal Legislation) - as modified from time to time. URT.

It established its own special import oversight body, the Petroleum Import Coordinator (PIC Ltd.), which governs bulk petroleum supply procurement.

The petroleum sector has been liberalized continuously since the late-1990s such that non-transport petroleum products, particularly kerosene, have increased in price dramatically over the past decade. Liberalization has attracted many new, and many local players in the sector.

This explains why kerosene prices rose in Tanzania to track world prices, thereby increasing the nominal price from TZS 400 a litre in 2004 to just over TZS 2,000 today. The proportion of Dar es Salaam's households cooking with kerosene went from nearly 10% in 2002 to just under 1% today (NBS, 2003, 2013b).

5.2.3.2 Natural Gas

Domestic natural gas supplies meet approximately 45% of Tanzania's electricity generation needs (TANESCO, 2013). The current natural gas discoveries in Tanzania is 46.5 trillion cubic feet (TCF). The Government has commenced construction of the 542 km gas pipeline from Mtwara to Dar es Salaam.

The gas discoveries and gas infrastructure development will enhance power generation in the country. Tanzania Petroleum Development Corporation (TPDC) is implementing a pilot project on utilization of natural gas for cooking. The results, so far, are impressive and this will result into significant savings on utilization of forest resources for cooking energy.

Tanzania passed The National Natural Gas Policy, amid considerable debate, in October 2013 (URT, 2013b).⁷⁷ There are several references in the Policy to household energy use of natural gas, including relieving rural women of the tasks of gathering fuel wood.

The Policy clearly sees gas for electricity generation as a short-term priority. Natural gas could potentially substitute for charcoal in urban areas, particularly in commercial, institutional, industrial and electricity-generation applications. It is not clear, however, what means of delivery would be cost-effective for households. This is an area for further study within the two-year BEST Tanzania Action Plan period.

Domestic natural gas supplies meet approximately 45% of Tanzania's electricity generation needs (TANESCO, 2013). Natural gas is also utilized by Tanzanian industries. Recent discoveries of major natural gas reserves seem certain to change Tanzania's non-biomass energy supplies. New natural gas policy seeks to boost natural gas supplies to industrial, transport and commercial consumers. This will primarily affect imports, although the Natural Gas Policy of 2013 also seeks to displace forestry biomass supplies to the household sector in the long-term (URT, 2013b).

Significant deposits have been discovered and are being developed in South East Tanzania, in the Mtwara-Mnazi Bay area where a pipeline is being built to Dar es Salaam. The British Gas (BG) Group is in partnership with Ophir Energy. Norway's Statoil is in partnership with ExxonMobil. Both are leading exploration activities in offshore Tanzania. To-date, BG and Ophir have made seven

⁷⁷ URT, 2013b. The National Natural Gas Policy of Tanzania - 2013. October 2013. The Policy states that: „In order to maximize the benefits accrued from the natural gas resource, the implementation of this Policy will be aligned with the Tanzania Five Year Development Plan (2011/12-15/16), the National Strategy for Growth and Reduction of Poverty 2010-15 [MKUKATA II] and other sectoral and cross-sectoral policies aiming at eradicating poverty in Tanzania“.

discoveries of recoverable natural gas resources. Statoil and ExxonMobil have made four discoveries of recoverable natural gas resources.

A Chinese consortium has signed an agreement with the Government to build a major gas pipeline from South Eastern Tanzania to Dar es Salaam. The Government's recently passed Natural Gas Policy (2013b) sets out an ambitious framework for gas exploitation for all sectors as well as for exports. Natural gas will be Tanzania's first official energy export.

5.2.3.3 Coal

Tanzania has significant quantities of coal. The MEM revised its estimates of coal reserves from 1.5 billion to 5 billion tonnes in July, 2013 (IOL, 2013).⁷⁸ It produced 80 thousand tonnes of coal in 2011. Most of this is currently being utilized for electricity generation. Increasing quantities are being sold commercially to institutions (prisons and schools) and to industry. Tanzania also imports small amounts of coal (some 4 thousand tonnes in 2011) to supplement domestic demand, mainly in the cement industry.

In 2011 China's Sichuan Hongda Co. Ltd. signed a \$3 billion deal with Tanzania to mine coal and iron ore and build a 600-megawatt coal-fired power plant. Tancoal Energy⁷⁹, a joint venture between Australian-listed Intra Energy Corporation and the Tanzanian Government, runs the Ngaka coal project, while Tanzania's other mine at Kiwira is run by the state (MEM, 2013).

The Ministry of Energy and Minerals supports coal production for domestic energy demand and exports (NEP, MEM, 2003). MEM would also like to explore coal as a charcoal substitute in a number of sectors. Currently coal is used in several industries (e.g., Mbeya Cement), and in a number of prisons, hospitals and schools on a pilot basis. MEM is also interested in exploring coal as a household charcoal substitute.

5.2.3.4 Non-Biomass Renewable Energy Sources

Additional to biomass and hydropower, Tanzania has untapped geothermal and wind energy resources. Both are accorded more emphasis than biomass in the 2003 NEP. At present, there is considerable interest in geothermal energy exploration and development with support from the UK, USA and German side. The primary interest in geothermal energy is related to electricity generation. In so far as increased supplies of electricity will affect electricity prices, geothermal energy development could have an impact on biomass energy demand and prices.

5.3 Relative prices of energy

Table 12 shows the relative prices of energy used for household cooking in Dar es Salaam, 2013.

⁷⁸ IOL, 2013. Tanzania Revises up Coal Reserves. IOL, Business, 3 July 2013. www.iol.co.za/business/international/tanzania-revises-up-coal-reserves-1.1541594#.UqwK_N_RdWSo.

⁷⁹ See <http://www.tancoalenergy.com/> and <http://www.intraenergycorp.com.au/>.

Table 12: Relative Prices of Energy for Cooking (November 2013)⁸⁰

Energy Source	Unit price (TZS) Nov 2013	kWh/kg	TZS/kWh equiv	End Use (Cooking) Efficiency	TZS/kWh equiv (effic factor)
Kerosene (per litre)	2000	11.8	169.5	0.4	424
Tanesco Electricity	273	1	297.0	0.7	424
LPG					
3kg	16600	13.6	406.9	0.6	678
6kg	20000	13.6	245.1	0.6	408
15kg	50000	13.6	245.1	0.6	408
36kg	122909	13.6	237.8	0.6	396
Charcoal Briquettes (per kg)					
High	800	9.1	87.9	0.15	586
Low	400	9.1	44.0	0.15	293
Charcoal (per kg)					
Traditional cookstove	437.5	9.1	48.1	0.15	321
ICS	437.5	9.1	48.1	0.3	160
Fuel Wood (per kg)					
Open Fire	150	4.5	33.3	0.1	333
ICS	150	4.5	33.3	0.2	167

Sources: Market surveys (2013). BEST Tanzania Team correspondence with Oilcom, GAPCO, BP, Addax/Oryx, EWURA, TANESCO and COSTECH (2013).

Kerosene prices have increased in relative terms by a factor of over 10 since 2002. Likewise, the price of electricity has increased several-fold since the late 2000s. Most urban consumers who were using kerosene and electricity in 2002 had switched to charcoal by 2012 (NBS, 2012b, 2013a&b).⁸¹

LPG demand is driven less by price than by availability, both for LPG and LPG cylinders. The number of small cylinders (3 and 6 kg, as shown in Table 12) in circulation has decreased over the past five years. The number of larger cylinders, used by upper-end households, and commercial, institutional and industrial establishments, has increased (BoT, 2013b, communications with private oil companies and EWURA).

Table 12 summarises the comparative costs of alternative fuels, including biomass briquettes. Note that when biomass briquettes are used with improved cook stoves (ICS), their relative price per unit of energy for cooking decreases, as do the relative prices of charcoal and firewood.

Thus, with these developments, the relative prices of firewood and charcoal, on an end-use, cooking efficiency basis, are lower than any other major household fuel. This results without counting the upfront costs of the fuel used, which includes stoves, piping, connections, meters, and so on. Based upon upfront costs, electricity was 1.2 times more expensive than LPG and 16 times more expensive

⁸⁰ Prices take the average end-use efficiencies for each device (as set out in the table) to come up with the relative prices of useful energy (energy that is required to cook the same food, heat the same amount of water, etc.) These relative prices do not include the cost of the end-use device (stove) and other costs (e.g., TANESCO connection costs, costs of LPG cylinders). Were those factored in, the final useful energy cost of charcoal and fuel wood would be even lower.

⁸¹ NBS, 2012b. "National Panel Survey. NPS. Report - Wave 2, 2010/11,". URT. Dar es Salaam. September 2012.

than kerosene in 2011.⁸² Given the increase in prices of electricity since 2011, the relative prices of firewood and charcoal are even lower today.

When an improved cook stove (ICS) is used to burn firewood or charcoal, wood fuels become even less expensive and more complete, in relative terms, compared to other fuel sources. Table 12 clearly demonstrates the financial benefits of ICS, decreasing fuel wood and charcoal consumption by 50%⁸³. This shows that wood fuels used for firing ICS are, by far, the most competitive sources of cooking energy in Tanzania today.

If energy and forestry policies change such that charcoal becomes a sustainable, formal sector, energy source, then, the price of charcoal will rise. The BEST Team's work on sustainable charcoal production and marketing with WWF and the TFCG shows that producing charcoal sustainably raises the price of charcoal by 2-3 times (ESD, 2007b;⁸⁴ TFCG, 2013).

The BEST Steering Committee has insisted, since the beginning of the BEST Tanzania Project, that any BEST recommendations for supply side actions raising the prices of wood fuels to consumers, particularly urban and rural low-income consumers, should be accompanied by affordable end-use technologies or other inexpensive means to keep wood fuel prices at the same relative prices to consumers.

Taking a value chain approach, it is important to examine the potential impact on the demand side when recommending actions on the supply side. Recommending farmers and charcoal producers to shift from non-sustainable to sustainable charcoal or fuel wood production makes it important to recommend demand-side actions. In the case of charcoal and commercial fuel wood, improved cook stoves (ICS) are one of the best demand side measures to meet a supply side intervention (see Section 7, ICS Scenario). Table 12 shows that consumers can pay sustainable charcoal prices and use ICS to maintain the same relative prices as they would when buying non-sustainable charcoal or fuel wood and using traditional cook stoves.

⁸² Maliti, Emmanuel and Raymond Mnenwa, Affordability and Expenditure Patterns for Electricity and Kerosene in Urban Households in Tanzania, REPOA (Research on Poverty Alleviation), Research Report 11/2, Dar es Salaam, 2011.

⁸³ ProBEC, 2010a. Tanzania Household Impact Assessment Report. Dar es Salaam; SNV & RTA, 2011b. Improved Cook Stove. ICS. Sector in Tanzania. First Multi-Stakeholder Workshop Report; 1. Improved Cook Stove. ICS. Sector in Tanzania. First Multi-Stakeholder Workshop Report. Arusha Corridor Springs Hotel, 25 March 2011; TaTEDO, 2009. Annual Report 2009. Dar es Salaam. Tanzania. TaTEDO Dar es Salaam.

⁸⁴ ESD, 2007b, Situation Analysis of Charcoal Dynamics. Energy Policies and Possibilities of Switching to Alternatives - Draft WWF Dar Charcoal Project Study. WWF Tanzania. Dar es Salaam. 30 June 2007.

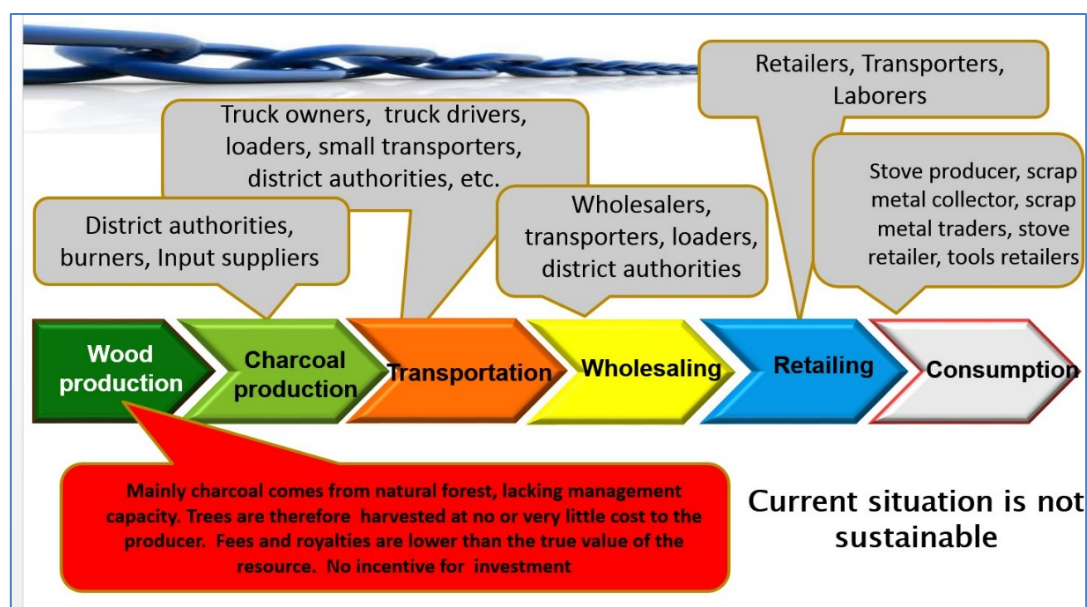
6. Biomass Energy Demand

6.1 Estimated Biomass Energy Demand

6.1.1 Introduction

Charcoal and commercial wood fuels provide revenues to hundreds of thousands of rural and urban families.⁸⁵ Almost all of them are employed on an informal basis, effectively unregulated. There are almost no barriers to entry along the value chain. As Figure 9 shows, the vast majority of Tanzanians engaged in the value chain are at the wood production, harvesting and charcoal transformation end of the chain, and at the retail, consumer interface end of the chain.

Figure 9: Charcoal Value Chain



Source: BEST Tanzania Team, 2013

6.1.2 Overall Household Energy Demand

As Table 8 shows, fuel wood (firewood) meets some 22.6 million tonnes (33.3 million cubic metres) of fuel wood (firewood) demand (rural and urban). Approximately 2 million tonnes of charcoal are consumed by urban and rural households for cooking and heating, the equivalent of some 15.3 million cubic metres of fuel wood.

⁸⁵ World Bank. 2009. States that charcoal plays “an important role in the national economy— particularly in its role providing employment to hundreds of thousands of people.” (page 2), also, World Bank, 2010, p. 7.

Using a rough assumption of rural firewood consumption (one cubic metre per person, per year),⁸⁶ a similar assumption on consumption for the 20% of urban households who consume firewood indicates that some 6 million rural and urban households (31.4 million people (Table 13)) were supplied with approximately 31.4 million cubic metres of fuel wood (firewood) in 2012 (TACAIDS, 2013, NBS, 2007, 2009, 2013a&b).

Table 13: Tanzania Fuel Wood Consumption by Rural, Dar es Salaam and Other Urban (2012)

Area	Total Pop	% Pop Using Wood	No. Using Wood
Dar es Salaam	4,364,541	3.0%	130,936
Other Urban	7,316,739	19%	1,381,334
Rural	33,246,720	90.0%	29,922,048
Total	44,928,000	70.0%	31,434,318

Sources: National Bureau of Statistics 2002 and 2012 Census, and 2007 Household Budget Survey, and Tanzania Commission for AIDS, Tanzania HIV/AIDS and Malaria Indicator Survey 2011-12 (NBS, 2007, NBS, 2009, NBS, 2013b and TACAIDS, 2013)

When combined with urban and rural charcoal demand, the amount of wood fuel supply required to meet rural and urban household wood energy demand (charcoal) is estimated at almost 48 million cubic metres of fuel wood consumed in 2012 (Table 8).

6.1.3 Urban Household Energy Demand

In urban areas, about 71% of all urban households consume charcoal and about 19% consume firewood. In Dar es Salaam, 91% of all households consumed charcoal in 2012, and 3% consumed firewood. In other urban areas, 59.1% of households consumed charcoal, while 19% consumed fuel wood (Tables 13 and 14).

The BEST Tanzania Team assumes that all charcoal consumption in Tanzania is commercial. Virtually all urban households who consume firewood (approximately 560,000 households) purchase it primarily from retailers (TFCG, 2013).

⁸⁶ Kaale, B. 2005. Baseline study on biomass energy conservation in Tanzania. Consultancy report for ProBEC and MEM, 2005. Malimbwi, R.E., and Zahabu, E., 2008a, The analysis of sustainable fuelwood production systems in Tanzania. FAO. SUA Faculty of Forestry & Nature Conservancy. 2008.

Table 14: Tanzania Charcoal Consumption by Rural, Dar es Salaam and Other Urban (2012)

Area	Total Pop	% Pop Using Charcoal	No. Using Charcoal
Dar es Salaam	4,364,541	91.0%	3,971,732
Other Urban	7,316,739	59.1%	4,321,976
Rural	33,246,720	8.5%	2,825,971
Total	44,928,000	24.8%	11,119,680

Sources: National Bureau of Statistics 2002 and 2012 Census, and 2007 Household Budget Survey, and Tanzania Commission for AIDS, Tanzania HIV/AIDS and Malaria Indicator Survey 2011-12 (NBS, 2007, NBS, 2009, NBS, 2013b and TACACIDS, 2013)

6.1.4 Rural Household Energy Demand

Approximately 90% of all rural households (5.8 million) cook with firewood (Table 13). Most rural households collect the firewood they consume. About 8.5% of rural households (approximately 540,000 households, Table 14) purchase their charcoal from rural retailers.⁸⁷

Fewer than 100,000 households collect crop residues and other biomass resources on a subsistence basis for cooking and heating needs (NBS, 2011b).

6.2 Non-Household Biomass Energy Demand

Demand for non-household wood fuel in Tanzania is primarily present in the commercial, institutional and industrial sectors. No comprehensive studies have been undertaken on non-household fuel wood demand. However, several sector-specific studies have been carried out over the years.⁸⁸ There are very few data for energy demand in the commercial and institutional sectors.

6.2.1 Commercial and Institutional Biomass Energy Demand

BEST Tanzania estimates are based upon limited qualitative surveys. These include BEST's work with TFCG on sustainable charcoal (TFCG, 2013), with WWF on sustainable charcoal (WWF, 2009, 2012), and on biomass briquetting (USAID study, ESD/Camco, 2010).⁸⁹ Estimates also draw upon work

⁸⁷ NBS, 2007, 2008, 2011b, 2013a&b, TACAIDS, 2013.

⁸⁸ The term household enterprise is used to characterise essentially informal activities such as cooking for public sale, beer brewing, fish smoking, among others. It is difficult to define whether this should be categorised as household energy consumption of non-household energy consumption. Studies on household beer brewing in Tanzania, for example, utilise an average of 1m³ per brewing household per annum, and that there are this could, on an aggregate national basis, add millions of cubic metres to household energy consumption. See: McCall, Dr. Mike, 2001. Brewing rural beer should be a hotter Issue. Boiling Point No 47 Autumn 2001.

⁸⁹ ESD/Camco, 2010. Marketing Assessment of Biomass Briquetting in Tanzania. USAID, April 2011.

carried out by NORAD⁹⁰ estimating wood fuel and charcoal demand in the commercial and institutional sectors in urban Tanzania.

This work shows that commercial and institutional demand for wood fuels amounts to approximately 15% of total urban household demand. This implies that some 900,000 cubic metres of fuel wood (firewood) are consumed by commercial and institutional consumers in urban Tanzania, along with some 2 million tonnes of charcoal.

6.2.2 Agro-Industry Biomass Demand

Table 15 sets out the major agricultural industries that either use biomass residues and/or consume biomass residues they produce. Sugar industries consume virtually all their own residues. Only one company, TPC Kilimanjaro, is a net exporter of electricity. Tea industries have their own plantations to meet their wood energy demand.

Most coffee residues are either spread on fields as green manure or are allowed to decompose near thousands of pulperies (where coffee beans are cleaned and dried). Cotton stalks are almost always left in the fields, and most are burned to destroy various cotton diseases and pests.

Cashew nuts produce considerable residues. Few of these residues are used for energy production, except on a pilot basis.

Tobacco produces no biomass wastes being utilized for biomass energy. However, tobacco curing is the largest industrial consumer of fuel wood of all agro-industrial consumers. Wood fuel (firewood) is used for tobacco curing. Almost all tobacco is flue-cured (fire-cured). This requires considerable firewood.⁹¹ The Tobacco Board of Tanzania states that more wood is planted by tobacco farmers than is used for curing. However, this has not been independently-verified and is challenged by some.⁹²

⁹⁰ NORAD, 2009. Environmental and Socio-Economic Baseline Study - Tanzania. Study 4/2009. Norwegian Agency for Development Cooperation. P.O.Box 8034 Dep. NO-0030 Oslo. Ruseløkkveien 26. Oslo. Norway

⁹¹ World Bank/UNDP/Bilateral Aid. ESMAP.1989. Tanzania Smallholder Tobacco Curing Efficiency Project. Activity Completion Report. Number 102/89. May 1989.

⁹² Tanzania Tobacco Board, 2013. Tobacco Production Figures 2010/2012. <http://www.tobaccoboard.or.tz/>. See Abdallah. J.M., 2007. Economic and Productive Efficiency Analysis of Tobacco and Impact on Miombo Woodlands of Iringa Region in Tanzania. PhD thesis. SUA. Morogoro. Tanzania; and, Kaale, B.K., 2013. Summary Analysis of Wood Fuel Supply and Demand in Tanzania. BEST Tanzania. November 2013.

Table 15: Agro-Industry Biomass Demand and Supply Summary

Product\Year	Production (tonnes)			% increase 2001/02 to 2011/12	Export (tonnes)	
	2001/02	2006/07	2011/12		2006	2012
Sugar (refined)*	184.0	228.0	249.0	35.3%	n/a	n/a
Coffee	37.5	34.3	33.3	-11.2%	15.2	17.9
Cotton	49.9	125.6	75.7	51.7%	36.6	19.6
Tea	28.7	30.3	31.5	9.8%	14.2	16.9
Cashewnuts	67.3	77.4	158.4	135.4%	26.1	94.8
Tobacco	28.0	52.0	126.6	352.1%	5.9	46.5
Sisal	23.5	27.8	36.8	56.6%	4.1	7.0

Sources: See footnote for various sources of data.⁹³

6.2.3 Wood Industry Demand

There are several large forestry timber companies and one pulp and paper company (Mufindi Paper Mills). Between them, they own or manage some 90,000 ha of forests, primarily in the Iringa Region of Southern Tanzania. Most sawmills are small-scale. None uses its residues/waste.

TANWAT (Tanganyika Wattle)⁹⁴, one of the largest plantation companies in Tanzania, set up Tanzania's first wood residue cogeneration facilities using wood wastes in 1995 in Njombe. The 2.5MW facilities sells approximately 800kW to TANESCO through the Njombe local grid. It could double its electricity generation capacity, but, cannot obtain a high enough price to do so.

However, the largest sawmill complex in Tanzania, Sao Hill Industries (SHI) are currently using wood residues from their estates to produce charcoal (7,500 tonnes anticipated in 2014), primarily to sell to Mbeya Cement in Southern Tanzania. They are also seeking to build a 15MW cogeneration system (5MW plus 10MW) for own use and for exporting to the TANESCO grid. Mufindi Paper Mills has purchased a 36MW cogeneration system (combined heat and power/CHP unit) primarily to export to TANESCO.

However, in the cases of both SHI and Mufindi Paper Mills, TANESCO is not offering a price that either consider sufficient to install and operate their units, which would add over 45MW to TANESCO's supplies. Consequently, Mufindi Paper Mills' unit sits unpacked and uninstalled at their factory and SHI have put their investment in the 10MW plant on hold.

⁹³ BEST sugar industry interviews (TPC, 2013, Kilombero, 2012, Sugar Board of Tanzania, 2013, www.sbt.go.tz), Tanzania Coffee Board, 2013 (www.coffeeboard.or.tz), Tanzania Sisal Board, 2013 (www.tsbtz.org), Tanzania Cashew Nut Board (www.cashewnut.tz.org), Tanzania Tobacco Board, 2013, www.tobaccoboard.or.tz), Rift Valley Holdings, 2013, Unilever, 2013, www.teaboardtz.org, Cotton Board of Tanzania (www.cotton.or.tz), BEST communications with numerous industrial stakeholders.

⁹⁴ TANWAT was founded in 1949, when the Commonwealth Development Corporation (CDC) took responsibility for a forest development project set up two years earlier by the Forest, Land Timber and Railways Company, located in the Southern Highlands of Tanzania with 15,000 hectares of private forest business. See Annex 5, Biomass Cogeneration, Section 6.2, p. 89.

6.2.4 Other Industries Biomass Demand

Tanga Cement has been utilizing both crop (coffee, coconut) and wood residues to fuel their back furnace since 2003. Mbeya Cement has experimented with a range of biomass residues since 2004, and currently has a contract with SHI to purchase charcoal to offset approximately 20% of their fossil fuel demand. Katani Sisal use their own sisal residues to generate 150kW of electricity, and are looking to expand that to 1MW by 2015.

Nyanza Bottling (Coca Cola Tanzania) have installed a small (20kW) biomass waste boiler at their main plant where they collect and use various biomass residues for firing one of their boilers.⁹⁵ A number of other industries in various sectors in Morogoro, Tanga, Arusha, Mwanza, Mbeya and Moshi use some biomass residues to substitute for fuel oil and electricity in their operations.

There are no central data available on these and, as shown in 21st Century Textiles, Morogoro, biomass use is often opportunistic – i.e. one utilizes the residues when alternative energy sources are expensive (or supply is either unreliable or short) and then reverts back to non-biomass energy when prices go down (or supplies improve).

6.2.5 Household Enterprise Biomass Demand

Numerous household enterprises (often referred to in literature as cottage or artisanal activities) utilize charcoal and firewood for business which includes small-scale brick and tile production, lime production, fish smoking, salt drying, as well as cooking, baking and brewing activities. No accurate estimates exist on these activities. Thus, for the purpose of the BEST baseline and scenario, this wood fuel consumption is assumed to be within both household fuel wood, and commercial and institutional fuel wood consumption.

6.3 Commercial Biomass Energy Demand

6.3.1 Charcoal

Charcoal demand in rural areas has increased from 4% in 2000 to 8.5% in 2012 (NBS, 2009, NBD, 2013a&b, NBS-THMIS, 2013) and in Dar es Salaam from 71% in 2007 to 91% in 2012 (NBS, 2013a&b, NBS-THMIS, 2013). Charcoal demand in other urban areas has increased from 53.9% in 2007 to 59.1% in 2012 (NBS, 2013a&b).

Estimated 2012 charcoal consumption for rural and urban households and non-households is set out in the Tables 16 and 17. The large rural population size has brought about a significant increase in overall national charcoal demand.

Table 16: Estimated Charcoal Consumption and Wood Fuel Required to Produce Charcoal (2012)

⁹⁵ UNFCCC, 2012. Nyanza Bottling Company Clean Drinks CDM Project. Project Design Document, Registered Project 8059, November 2012.

Estimated Tanzania Charcoal Consumption 2012	Tonnes
Total Urban Household Charcoal	1,513,602
Total Rural Household Charcoal	515,740
Non-Household (Commercial, Institutional, etc.) All Urban	304,401
Estimated Total Tanzania Charcoal Consumption	2,333,743
Estimated Total Tanzania Wood Used for Total Charcoal Consumption (m3)	17,546,939

Sources: National Bureau of Statistics 2002 and 2012 Census, and 2007 Household Budget Survey, and Tanzania Commission for AIDS, Tanzania HIV/AIDS and Malaria Indicator Survey 2011-12 (NBS, 2007, NBS, 2009, NBS, 2013b and TACACIDS, 2013)

Recent household budget surveys, census and other data show that, currently, a quarter of all Tanzanians consume charcoal as their primary cooking and heating fuel (Table 17). Dar es Salaam makes up one third of total consumption (NBS 2002 and 2012 Census).

Table 17: Tanzania Population Using Charcoal in 2012 (by area)

Area	Total Pop	% Pop Using Charcoal	No. Using Charcoal	% Total Charcoal Demand
Dar es Salaam	4,364,541	91.0%	3,971,732	35.7%
Other Urban	7,316,739	59.1%	4,321,976	38.9%
Rural	33,246,720	8.5%	2,825,971	25.4%
Total	44,928,000	24.8%	11,119,680	100.0%

Sources: National Bureau of Statistics 2002 and 2012 Census, and 2007 Household Budget Survey, and Tanzania Commission for AIDS, Tanzania HIV/AIDS and Malaria Indicator Survey 2011-12 (NBS, 2007, NBS, 2009, NBS, 2013b and TACACIDS, 2013)

While there is a price differential for charcoal between the respective geographic areas, the difference is not as great as it is between charcoal bought in small quantities and charcoal bought in bags in whatever urban or rural area one is in. Most consumers purchase charcoal in small quantities; the urban poor do not have the cash to buy bags of charcoal, even though doing so would reduce the price per kilogram. At an average price per kilogram of TZS 750, Tanzanian rural and urban consumers paid over TZS 1.5 billion in 2012, or the equivalent of over US\$ 950 million.

6.3.2 Fuel Wood

Almost all urban households purchase their firewood. Assuming a per capita consumption of firewood for urban and rural consumers of about 1 cubic metre per year, approximately 32 million

cubic metres, or 22.6 million tonnes of wood were consumed as firewood by rural and urban households in 2012 (Table 18).⁹⁶

As with charcoal, thousands of rural producers and transporters, and urban wholesalers and retailers are involved in this commercial fuel wood business. While not as significant as charcoal, it is an increasingly significant economic activity for rural and urban Tanzanians.

Table 18: Estimates of Household Wood Fuel Demand in 2012 (m³ wood equivalent & tonnes)

Wood Fuel Demand	Fuel Wood (firewood)		Charcoal	
	tonnes (mi)	m3 Fuel Wood (mi)	tonnes (mi)	m3 Fuel Wood equiv (mi)
Rural	20.97	29.96	0.52	3.88
Urban	1.64	2.34	1.51	11.38
Total	22.60	32.29	2.03	15.26

Sources: Tanzania Forest Services Annual Plan, 2013, National Bureau of Statistics 2002 and 2012 Census, and 2007 Household Budget Survey, and Tanzania Commission for AIDS, Tanzania HIV/AIDS and Malaria Indicator Survey 2011-12, Tanzania Forest Conservation Group (TFCG), Study on Sustainable Charcoal Marketing Survey, 2013 (MNRT, 2013, NBS, 2007, NBS, 2009, NBS, 2013b, TACACIDS, 2013 and TFCG, 2013)

When one accounts for the fact that there are also many non-households consuming firewood, then, the wood fuel business assumes even more significance. The tobacco sector consumed an estimated 1 million m³ in the 2011/12 growing season (Tobacco Board of Tanzania, 2013).⁹⁷ Tea factories use firewood for all their heat processing needs. The timber and pulp and paper industries use wood waste to meet almost all of their own (and their staff's) heating requirements.

6.3.3 Other Biomass

Census and other data show that, in 2012, fewer than 10,000 households were using biogas and approximately the same number were using biomass briquettes in Tanzania (NBS, 2007, 2009, 2013a&b; NBS-TACAIDS, 2013). All biogas and briquettes are considered commercial as they are commercially produced and purchased.

The 2007/08 Tanzania Agricultural Census showed that less than 1% of rural households used crop residues, animal waste or other biomass.

⁹⁶ Kaale. B., 2005. "Baseline study on biomass energy conservation in Tanzania". Consultancy report for ProBEC and MEM, 2005; Amous, S., 1999. The role of wood energy in Africa. FAO 1999.

⁹⁷ Bank of Tanzania, 2013, "Economic Bulletin for Quarter Ending June 2013, Vol. XLV No.2", Dar es Salaam, Tobacco Board of Tanzania (2012), ESRF Quarterly (May 2012).

6.4 Employment Generation for Commercial Biomass Energy

No exact figures exist on either the number of people who are employed along the biomass energy value chain, or the amount of revenues that are generated. The World Bank (World Bank, 2009; World Bank, 2010) estimated that, in 2009, „several hundred thousand“ rural and urban people were engaged in supply (Figure 10).

They estimated man years involved in production, and transport and trade and retail. These figures have not been updated or verified, but, given the fact that charcoal consumption has increased by at least 30% since 2009, their employment and revenue estimates have also increased.

Interviews with participants and stakeholders in the charcoal business show that, as charcoal demand has increased, there has been significant influx of new players on the production side. Producers and local authorities say there are many more charcoal producers than five years ago (TFCG, 2013).

Furthermore, all said that there were also many more small transporters (bicyclists, motorcyclists, private vehicles and small trucks) and many more retailers than in 2009. This would imply that the margins accruing to intermediaries, particularly transporters and vendors, have decreased over the recent past. This would explain why higher value is accruing both to producers and to consumers relative to the past.

There are many estimates of the number of people employed in the charcoal and commercial fuel wood business. The World Bank estimated in 2009 that there were over 43,000 full-time charcoal producers (with around one-quarter employed by others and three-quarters self-employed) with a further 50,000 “man years” of production, implying at least another 100,000 rural producers engaged in charcoal production on an occasional basis (WB, 2010, p. 7).

With no complete survey available on charcoal producers and with charcoal rarely a full-time activity, the BEST Team believes that as many as 300,000 Tanzanians participated in the charcoal value chain in 2012.⁹⁸ This estimate has been built up from the bottom-up interviews (WWF in Rufiji, TFCG in Kilosa and Morogoro, 2013), census data, household budget surveys, and other detailed surveys done for health, agriculture and poverty (NBS-THMISS, 2013, NBS, 2007, MFEA, 2009, NBS, 2011a&b, and NBS, 2013a&b).

A key recommendation from BEST is to undertake a country-wide study on producers at a district level. The information from this survey will be essential to build up a training, extension, technical assistance and technology-change package.

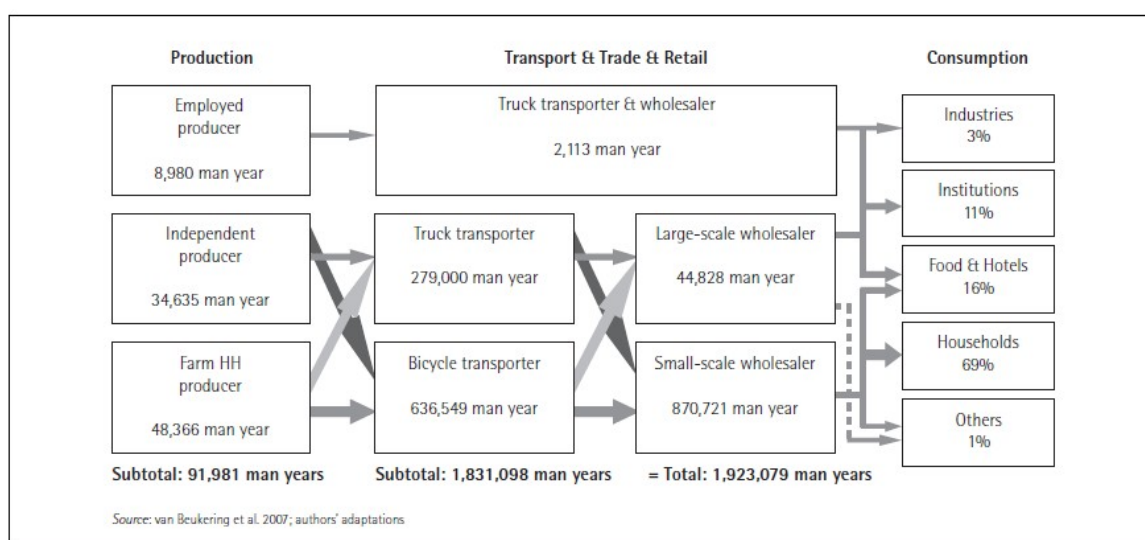
⁹⁸ Bags vary in weight, with some over 100kg, but most in the 60-80kg range (WWF, TFCG, 2013). Taking 60kg as an average bag size, and an average of TZS 7,500 being paid to farmers (TFCG, 2013), if 400,000 farmers produce charcoal, that would be the equivalent of some 80 bags per year per farmer. That would earn a farmer TZS some 600,000 (nearly US\$400) per year.

6.5 Commercial Value of Biomass Energy

There are numerous estimates as to the value of charcoal sales that range from extrapolating World Bank 2009 and 2010 work⁹⁹, to TFS¹⁰⁰, and BEST estimates based on NBS and other national statistics and surveys on household energy demand.

The World Bank estimated that the charcoal business (along the value chain from woodlands to consumer) was worth some \$650 million in financial terms in 2009 (World Bank, 2009). BEST work with TFCG in February and March 2013 on the charcoal value chain from Morogoro District to Dar es Salaam examined each component along the supply to build a picture of who participates in the business, and how frequently and how formally s/he does so.¹⁰¹

Figure 10: Tanzania Estimated Labour in Charcoal Supply & Share of Demand, 2009



Source: World Bank, Environmental Crisis or Sustainable Development Opportunity? Transforming the Charcoal Sector in Tanzania - A Policy Note. March 2009 (WB, 2009, page 7).

This and other work shows that the value that accrues to participants along the value chain has changed over the past several years. Charcoal producers (and their wood fuel suppliers – who are often the same people or families) make up about 25% of the final sales value to consumers in Dar es Salaam, slightly higher than in urban areas closer to production. Dar es Salaam consumers are paying approximately the same relative price for charcoal as they were in 2009.

⁹⁹ World Bank, 2009, Environmental Crisis or Sustainable Development Opportunity? Transforming the Charcoal Sector in Tanzania - A Policy Note. March 2009, World Bank, 2010, Enabling Reforms: A Stakeholder-Based Analysis of the Political Economy of Tanzania's Charcoal Sector and the Poverty and Social Impacts of Proposed Reforms. June 2010.

¹⁰⁰ Tanzania Forest Services (Agency) TFS, 2013. The Second Strategic Plan, 2014/2015 – 2018/2019. November 2013.

¹⁰¹ Over 200 interviews were conducted with those involved in the value chain from woodland manager, village and local authorities, those engaged in harvesting, cutting and stacking wood for charring (pyrolysis), to firing for charcoal, bagging that charcoal, and then transporting, wholesaling (where relevant) and retailing to consumers.

7. BEST Baseline

The purpose of developing the BEST baseline is to:

- Examine historical and current trends in the biomass energy sector, and in policy, economics and development that have affected historical and current trends in biomass energy;
- Set the framework for examining what could happen up to 2030 in the energy sector under a current actions, „business-as-usual (BAU)“ approach and examine potential impacts on biomass energy, particularly wood energy, and biomass and non-biomass energy alternatives to wood energy;
- Develop scenarios that examine relatively easy-to-implement policies and measures that could affect the supply side and the demand side of wood energy, and that could have a significant effect on the current non-sustainable wood energy situation; and
- Use these scenarios to prioritise actions in the two-year BEST Tanzania Action Plan (Section 9). It is hoped these will be examined in more detail and, if proven politically, socially and economically beneficial, will be put into action.

It should be noted that the BEST Tanzania Terms of Reference (TOR) call for developing a two-year BEST Tanzania Action Plan that would support a longer-term BEST Strategy. Thus, while actions are highlighted below to examine possible impacts for 2030, the primary focus of this activity is to determine what can be put in place over the next two years that could have significantly positive effects in the longer-term.

7.1 BEST Tanzania Baseline

The BEST Tanzania baseline starts with Tanzania’s population and its transformation over the past 45 years. Population is viewed from a sectoral (urban, rural, total) perspective. Urban population size and growth rates are major determinants of energy demand, particularly household energy demand. In the case of Tanzania, with nearly 95% of Tanzania’s cooking energy sourced from forestry resource, wood energy is given particular attention.

Urban populations utilize far more charcoal than rural populations, both in relative and in absolute terms. Urban populations also use far more kerosene, LPG and electricity than rural populations. Their impact on forestry resources, through charcoal consumption, in particular, is far more significant than the impact of rural energy consumption.

7.1.1 Historical Population Growth Rates

The BEST Tanzania Team further highlights Dar es Salaam, given the fact that, while its average growth rate since 1967 has been slightly less than other urban areas (Table 19 and Figure 11), its absolute size is growing to a point where no urban area even has a tenth of Dar es Salaam’s current population (2012 Census, NBS, 2009, 2013b; NBS-TACAIDS, 2013, and MFEA, 2009).

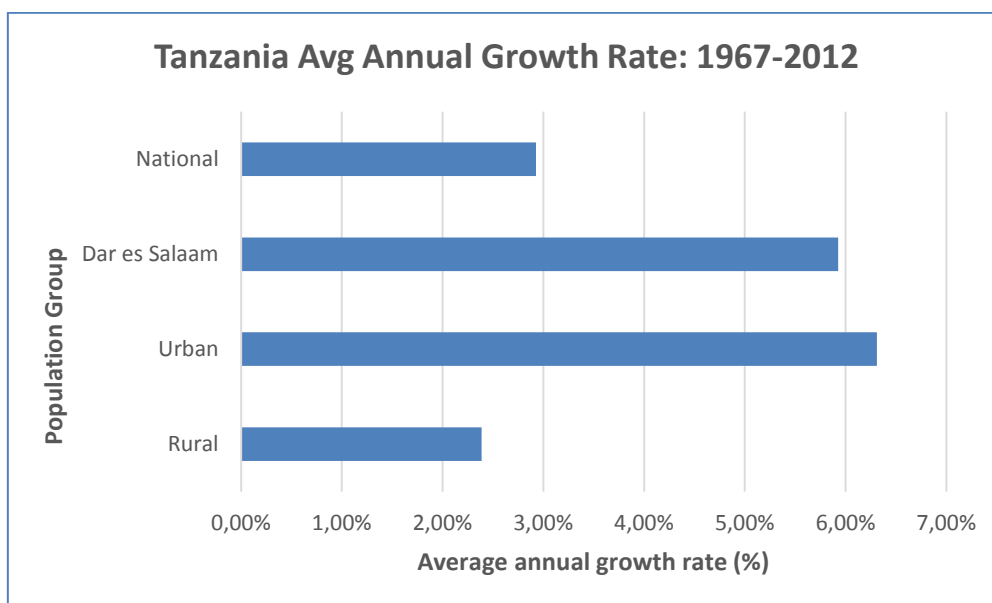
Table 19: Average Annual Growth Rates - 1967 to 2012

Area	Avg Annual Growth Rate
Rural	2.39%
Urban	6.31%
Dar es Salaam	5.93%
National	2.93%

Source: NBS Census of 1967, 1978, 1988, 2002 and 2012 (NBS, 2003, 2007 & 2012a)

The baseline is disaggregated into rural and urban population and households (NBS 2009, 2013b), with special examination of Dar es Salaam’s growth and energy mix (Figure 12 and Table 20). Tanzania’s capital city is the largest and fastest growing urban area in the country (5.6% per annum, minimum). It draws disproportionately heavily on the country’s wood energy resources (indeed, all energy resources), and requires careful attention in the baseline as well as in any other scenario.

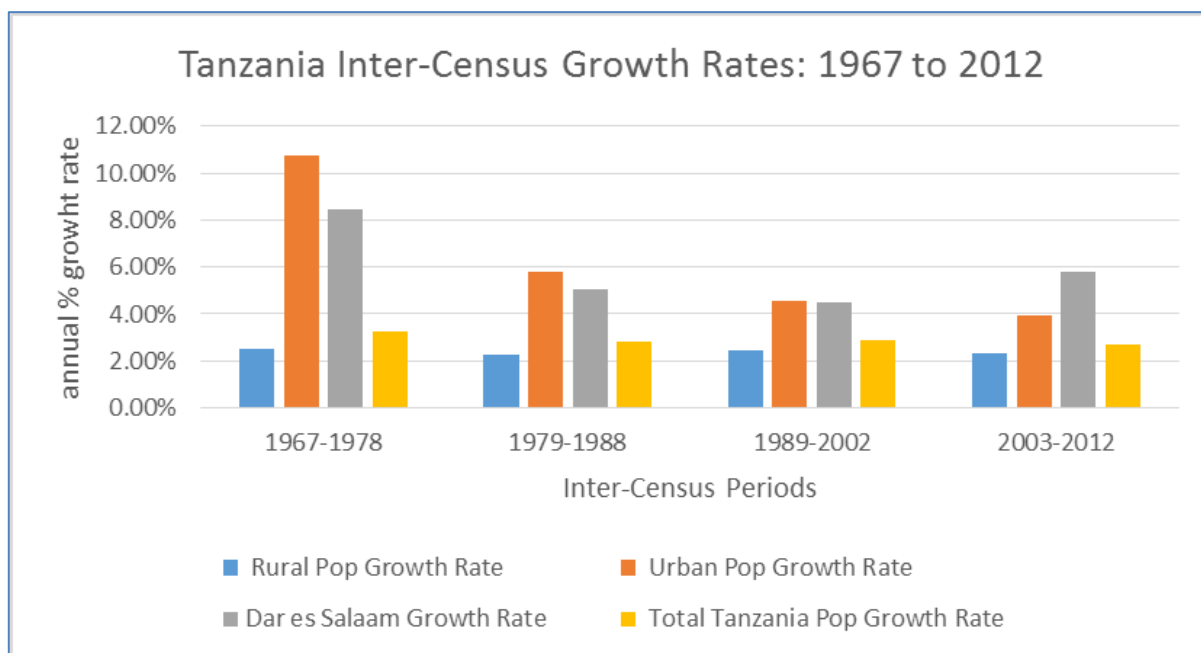
Figure 11: Tanzania Population Projected Population Growth by Demographic Sector: 2012 to 2030



Source: NBS Census of 1967, 1978, 1988, 2002 and 2012 (NBS. 2003, 2007, 2012a)

Dar es Salaam is also where commercial, consumer and technological change occurs fastest in Tanzania. This is important for the BEST Tanzania Strategy and Action Plan. Dar es Salaam adopts change more rapidly than any other area in Tanzania. Therefore, commercial programmes for wood energy efficiency, fuel switching to alternative energy sources, and adoption of new technologies and energy sources will, on the demand side, occur most rapidly in Dar es Salaam.

Figure 12: Rates of Population Growth Rate at each post-Independence Census (1967 to 2012)



Source: National Bureau of Statistics, 1967, 1978, 1988, 2002, 2012 Census (NBS, 2013b)

7.1.2 Analysis of Historical Population Sectoral Growth Variations

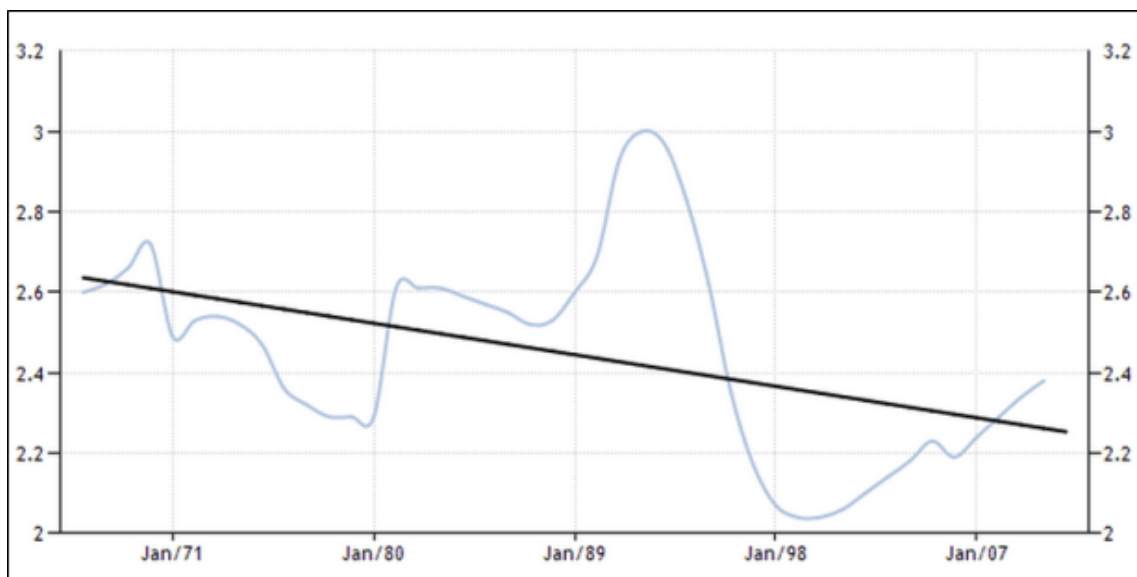
There are slight variations between the National Bureau of Statistics (NBS) population figures, based on the 2012 census and its projected growth rates, and those of the World Bank. The World Bank estimates that Tanzania’s 2012 population was 47.8 million¹⁰², while the NBS 2012 Census shows a number of 44.9 million for Tanzania’s population in 2012, nearly 3 million less than the World Bank.

Figure 13 illustrates the variation in estimated rural growth rates from various censuses and studies from 1967 to 2012. The World Bank plots a regression that shows the decrease in anticipated rural population growth rate over that period. It shows a drop in the rate from over 2.6% per annum at the 1967 Census, to approximately 2.25% in 2012 (WB, 2013a&b).

Again, there is a slight different between the NBS Census inter-census (2002 to 2012) rate (2.31% per annum to 2012) and the World Bank’s. The BEST Tanzania Team has chosen to utilize the Tanzania National Bureau of Statistics figures in the baseline and all projections. They are slightly more conservative (lower) than the World Bank’s.

¹⁰² World Bank, 2013a, Tanzania Country Indicators, December 2013 (Development Economics LDB database: http://data.worldbank.org/country/tanzania#cp_wdi).

Figure 13: Tanzania Rural Population Growth Rate, 1967 to 2012 – Adjusted to Linear Curve



Source: World Bank Tanzania Country Indicators, from World Development Indicators (WB, 2013b)

7.1.3 Presentation of Population Sectoral and Total Growth Projections to 2030

The BEST Team has used the National Bureau of Statistics inter-census rural, urban and total population growth rates, and the NBS projected growth rates to provide growth estimates from 2013 to 2020 and from 2021 to 2030 (Table 20). The Tanzania national average population growth rate is projected for 2012 to 2030 as an average of 2.75% per annum. This compares to the World Bank’s projections, starting at 3.01% in 2010 to 2.96 in 2030 (WB, 2013b).

Table 20: Tanzania Historical & Projected Population Growth Rates, 1967 to 2030

Period	Rural Pop Growth Rate	Urban Pop Growth Rate	Dar es Salaam Growth Rate	Total Tanzania Pop Growth Rate
1967-1978	2.49%	10.73%	8.46%	3.26%
1979-1988	2.25%	5.82%	5.04%	2.82%
1989-2002	2.45%	4.57%	4.49%	2.89%
2003-2012	2.31%	3.93%	5.78%	2.71%
2013-2020	2.28%	4.00%	5.60%	2.75%
2021-2030	2.26%	3.90%	5.40%	2.75%

Source: National Bureau of Statistics, 1967, 1978, 1988, 2002, 2012 Census (NBS, 2013b)

These projections give an estimated population of 73.2 million in 2030, as Table 21 and Figure 14 show. This is more conservative than the World Bank’s population estimate for 2030 of 81.6 million (WB, 2013b).

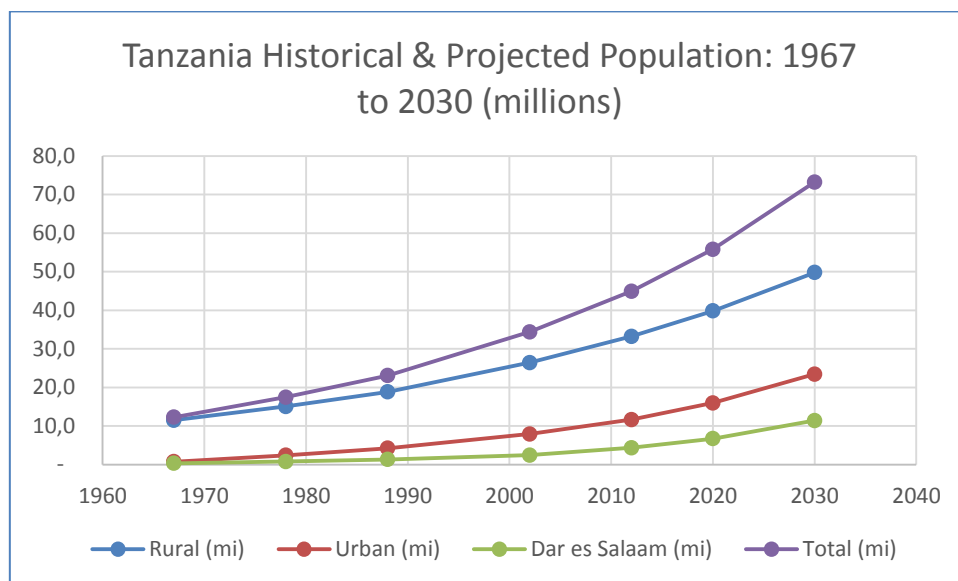
Table 21: Tanzania Historical & Projected Population, 1967 to 2030

Year	Rural (mi)	Urban (mi)	Dar es Salaam (mi)	Total (mi)	% Rural	% Urban
1967	11.5	0.8	0.34	12.3	93.6%	6.4%
1978	15.1	2.4	0.82	17.5	86.2%	13.8%
1988	18.9	4.2	1.34	23.1	81.6%	18.4%
2002	26.5	7.9	2.49	34.4	76.9%	23.1%
2012	33.2	11.7	4.36	44.9	74.0%	26.0%
2020	39.8	16.0	6.75	55.8	71.4%	28.6%
2030	49.8	23.4	11.42	73.2	68.0%	32.0%

Source: National Bureau of Statistics, 1967, 1978, 1988, 2002, 2012 Census (NBS. 2013b)

Even using the National Bureau of Statistics’ more conservative estimates, the scale of increase in urbanization and its consequent effects on energy demand are substantial. This is illustrated in both the Business as Usual (BAU) and other scenarios developed in this section to illustrate key areas for the BEST Tanzania Action Plan.

Figure 14: Project Tanzania Population Growth, 2012 to 2030 (Total, Sector & Dar es Salaam)



Source: National Bureau of Statistics, 1967, 1978, 1988, 2002, 2012 Census (NBS. 2013b)

Table 21 shows that, by using NBS Census and projected demographic trends, Tanzania’s rural-urban mix will change over the next two decades, with 32% of the population in urban areas by 2030 compared to the current 26%, and with 68% of Tanzania’s population in rural areas by 2030 compared to 74% in 2012. Urban Tanzania will grow from the current population of 11.7 million

inhabitants to a projected 23.4 million inhabitants in 2030 (Figure 14). Dar es Salaam's population is projected to be over 11 million in 2030.

7.2 BEST Scenarios

A baseline scenario and a set of three alternative scenarios are developed here. The alternative scenarios are based upon potential interventions (actions) that could relatively easily be made in the energy sector which would have fairly substantial impacts on reducing wood energy, particularly charcoal demand, relatively quickly and at a relatively low cost both to consumers and to the country.

These form the BEST Tanzania scenarios. They are designed to provide the basis for comparing strategic options within the BEST Strategy. The two sets of scenarios are:

- Business as Usual (BAU); and,
- Concerted Actions (CA), which focus on:
 - Improved Cook Stoves (ICS);
 - Alternative Biomass Energy Sources; and,
 - Alternative Non-Biomass Energy Sources.

They focus on the household energy sector, which constitutes over 80% of Tanzania's energy consumption and which accounts for approximately 90% of Tanzania's wood energy demand.

The scenarios are set out below for the period 2012 to 2030. Their primary focus is to examine the effects of actions (or no actions) on the short-, medium- and long-term prospects for wood energy (charcoal and fuel wood) and other biomass (i.e. biogas and biomass briquette). The non-BAU scenarios provide one demand-side, energy-efficiency option (a major programme for introducing improved cook stoves (ICS)) and two supply-side options.

7.2.1 Business as Usual (BAU)

Business as usual is basically a projection of the current energy situation. No assumptions are made, for example, concerning the question whether a larger or smaller percentage of the rural or urban population use fuel wood or charcoal, for example, than the proportion currently using wood and charcoal. The proportion of rural and urban population using particular energy sources for cooking and heating stays the same in the BAU scenario.

The BAU is driven by population growth on an urban and rural sectoral basis. The BAU assumes programmes or activities being currently underway, including current or projected Government policies, NGO, private sector, and development partner programmes as given.

Thus, for example, the REA's and TANESCO's rural electrification programme, supported by the World Bank, the Norwegian Government, the Swedish Government, and others, and the projected number of connections are taken as given.

However, there is no assumption that TANESCO's household tariff, for example, will increase or decrease up to 2030. Thus, the percentage of households currently cooking with electricity stays the same under the BAU scenario. The absolute number of households using electricity for cooking,

under the BAU, increases with population growth rates and with the number of people who are connected to TANESCO. So, while total electricity consumption increases up to 2030, household electricity consumption increases with the population growth rate and projected connections, rather than by any switching from, say, charcoal to electricity due to prices.

Likewise, under the BAU scenario, LPG and kerosene use are treated the same as electricity. That is, the absolute number of households using these energy sources increases each year, but the percentage using each fuel source stays the same up to 2030.

As set out in the BEST’s Terms of Reference (Appendix 1), liquid biofuels are not considered in the BEST Strategy or Action Plan, although, for example, ethanol for cooking or ethanol gel for cooking could potentially come on to the market. Again, the ToR for BEST have not enabled the BEST Team to explore liquid biofuels in either the BAU or in any of the CA scenarios.

Table 22 and Figure 15 show the number of people in Tanzania who are projected to use each fuel type from 2012 to 2030. The number of people using charcoal (both urban and rural) nearly doubles from 2012 to 2030 under the BAU scenario, with charcoal rising as a percentage of total household consumption from approximately a quarter of all households today to nearly 30% in 2030. In absolute terms, this implies that, under the BAU scenario, household charcoal consumption will increase from just below 2 million tonnes in 2012 to nearly 4 million per year in 2030.

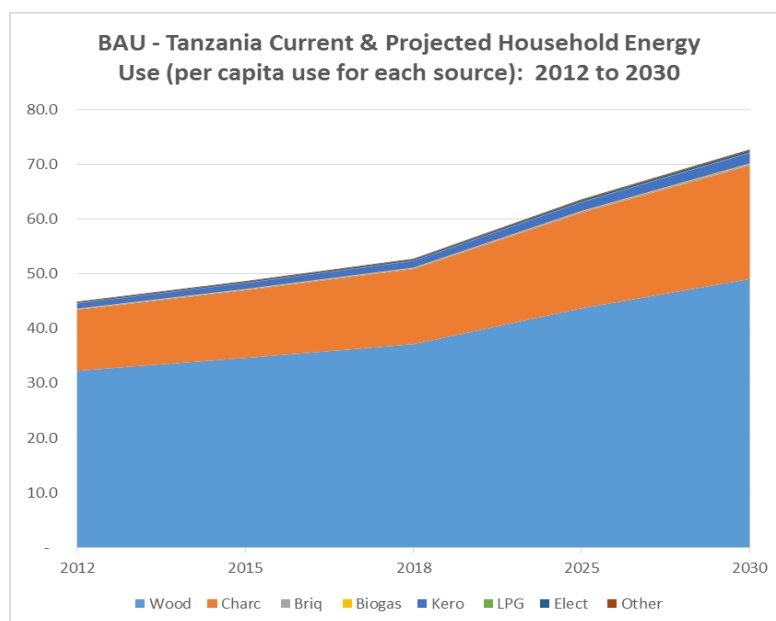
Table 22: Projected Household Cooking Fuel Demand - 2012 to 2030 (in millions of people)

Energy Source	2012	2018	2020	2025	2030	% 2030
Wood	32.3	37.1	38.9	43.7	49.0	67.0%
Charc	11.1	13.7	14.7	17.5	20.7	28.3%
Briq	0.2	0.2	0.2	0.2	0.3	0.4%
Biogas	0.1	0.1	0.1	0.1	0.1	0.1%
Kero	1.0	1.2	1.3	1.6	1.9	2.6%
LPG	0.0	0.1	0.1	0.1	0.1	0.1%
Elect	0.2	0.2	0.3	0.3	0.4	0.5%
Other	0.1	0.1	0.1	0.2	0.2	0.3%
Total	44.9	52.9	55.8	63.9	73.2	100.0%

Source: National Statistics Bureau, 2012 Census Data and Projections (NBS. 2009, 2012a&b), World Bank, World Development Indicators (WB. 2013a&b). and BEST Team Projections

While it is clear that the BAU assumptions about the relative fuel mix remaining the same up to 2030 are simplistic and unrealistic, the BAU is intended to represent the base case as a point of reference. It is not intended as a prediction. There are too many factors that could, and will, affect the relative fuel mix between now and 2030. The BAU is simply the reference case.

Figure 15: Projected Demand for Difference Household Fuels, 2012 to 2030 (in per capita consumption)



Source: National Statistics Bureau, 2012 Census Data and Projections (NBS. 2009, 2012a&b), World Bank, World Development Indicators (WB. 2013a&b) and BEST Team Projections

The following three scenarios build upon the BAU and provide opportunities to examine what could happen if certain actions were taken. These help to formulate some of the major proposed actions within the BEST Tanzania Action Plan (Section 9).

Table 23: Business-as-Usual (BAU) Household Energy Consumption by Fuel Type (in PJ)

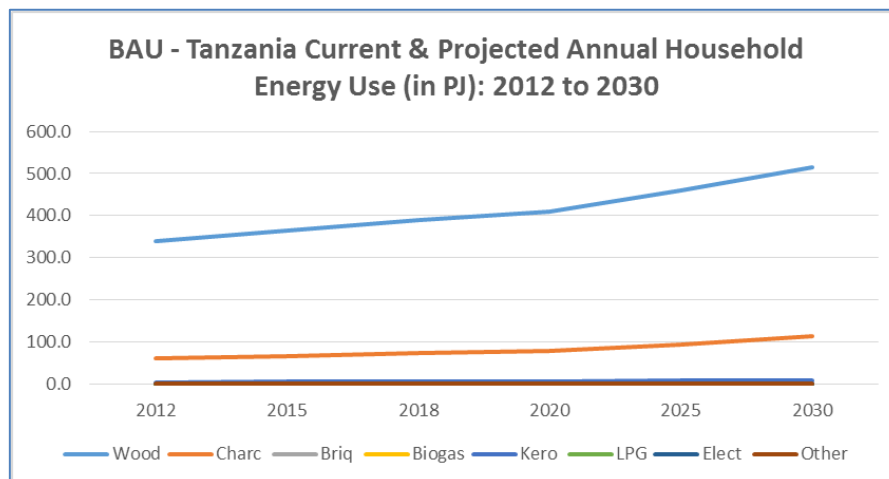
Energy Source	2012	2018	2020	2025	2030	% 2030
Wood	339.1	390.1	408.7	458.8	515.0	79.7%
Charc	60.9	75.1	80.6	95.6	113.5	17.6%
Briq	0.8	1.0	1.1	1.3	1.5	0.2%
Biogas	0.2	0.2	0.3	0.3	0.3	0.1%
Kero	5.3	6.7	7.2	8.7	10.6	1.6%
LPG	0.2	0.3	0.3	0.4	0.5	0.1%
Elect	1.4	1.8	2.0	2.4	2.9	0.4%
Other	1.3	1.6	1.7	1.9	2.2	0.3%
Total	409.2	476.8	501.7	569.3	646.4	100.0%

Source: National Statistics Bureau, 2012 Census Data and Projections (NBS. 2009, 2012a&b), World Bank, World Development Indicators (WB. 2013a&b). and BEST Team Projections

Electricity, kerosene, LPG, biogas, biomass briquettes and others (including all other sources of household fuels) represent less than 3% of total household energy use in 2030, showing an increase

in absolute terms, and a proportional increase from some 2.3% of 2012 in household energy (in useful energy terms) to just over 2.8% in 2030.

Figure 16: Business-as-Usual (BAU) Household Energy Consumption by Fuel Type (in PJ)



Source: National Statistics Bureau, 2012 Census Data and Projections (NBS. 2009, 2012a&b), World Bank, World Development Indicators (WB. 2013a&b). and BEST Team Projections

7.2.2 Concerted Actions

Three scenarios are developed here to represent either acceleration and intensification of activities already underway, or to demonstrate the effect of non-biomass fuel (kerosene) substitution that has been used as a means to reduce wood energy (specifically charcoal) consumption in the past.¹⁰³ The former are represented by improved cook stoves (ICS)¹⁰⁴ and biomass alternatives to charcoal and firewood (carbonized briquettes and biogas, respectively). The latter is represented by increasing the importation of kerosene for cooking.

Charcoal consumption is addressed by ICS (targeted at urban charcoal users), by increasing briquette consumption, and by increasing kerosene consumption. Fuel wood (firewood) is addressed primarily by increased biogas utilization.

7.2.2.1 Demand Side Scenario – Improved Cook Stoves

The BEST Tanzania Team views improved charcoal cook stoves as a key area for action to reduce charcoal energy demand in one of the quickest, least expensive ways. Further, charcoal ICS are also

¹⁰³ See Hosier, R.H., Kipondya, W. 1993. Urban household energy use in Tanzania: Prices, substitutes and poverty. Energy Policy, Volume 21, Issue 5, May 1993, Pages 454–473.

¹⁰⁴ ICS here focuses on urban improved cook stoves. This is simply because almost all urban households purchase both fuel and stoves used for that fuel. Rural households primarily consume fuel that they collect (do not pay for) and utilize the three-stone fire with only a relatively small number purchasing stoves. The BEST Tanzania Team believes that swift action is necessary to reduce demand for charcoal, and the potential for significant, successful urban charcoal cook stove programmes are much higher than for rural stoves, in the short- to medium-term.

an important way to reduce charcoal expenditures to families, which would be a key equity and distributional issue if sustainable charcoal becomes widespread, as the BEST Tanzania Team proposes as an urgent priority.

Producing charcoal sustainably will easily double the consumer price for charcoal. Therefore, ICS with 50% efficiency improvements over traditional charcoal stoves are not only possible, but, have been shown to be successful in reducing urban charcoal demand in a number of countries (e.g., Kenya, Ethiopia, Malawi, and Cambodia, among others).

Table 24: Improved Cook Stove (ICS) Demand Side Management Scenarios (in PJ)

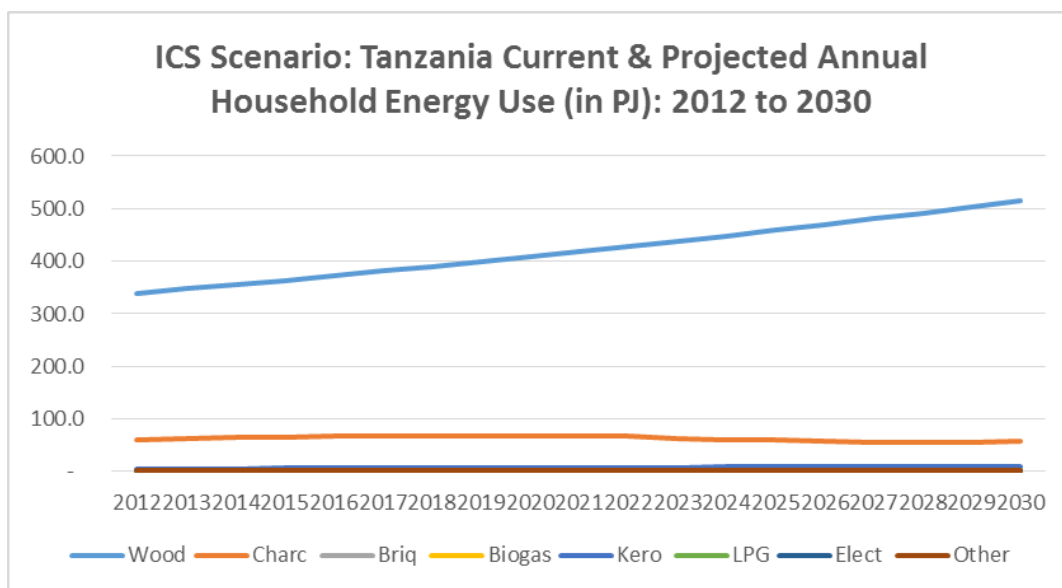
Energy Source	2012	2018	2020	2025	2030	% 2030
Wood	339.1	390.1	408.7	458.8	515.0	87.3%
Charc	60.9	68.4	68.5	59.3	56.7	9.6%
Briq	0.8	1.0	1.1	1.3	1.5	0.3%
Biogas	0.2	0.2	0.3	0.3	0.3	0.1%
Kero	5.3	6.7	7.2	8.7	10.6	1.8%
LPG	0.2	0.3	0.3	0.4	0.5	0.1%
Elect	1.4	1.8	2.0	2.4	2.9	0.5%
Other	1.3	1.6	1.7	1.9	2.2	0.4%
Total	409.2	470.0	489.7	533.0	589.7	100.0%

Source: National Statistics Bureau, 2012 Census Data and Projections (NBS. 2009, 2012a&b), World Bank, World Development Indicators (WB. 2013a&b). and BEST Team Projections

Table 24 and Figure 17 demonstrate that a programme seeking to achieve a 50% stove efficiency with 50% urban penetration (i.e. 50% of all urban households using ICS) by 2030 would actually reduce the total amount of household charcoal use from approximately 2 million tonnes today to less than 2 million tonnes in 2030. Experience in other countries shows that this can be achieved relatively easily through government policy and promotion, development partner support, and, most fundamentally, significantly increased local production of high efficiency stoves at prices that all consumers can afford.

This scenario protects consumers from increasing prices of charcoal, while reducing consumption, with few negative distributional (rich-poor) or foreign exchange implications. It is for this reason that promoting a major commercial campaign for improved charcoal cook stoves is such a high priority in the BEST Tanzania Action Plan.

Figure 17: Improved Cook Stove (ICS) Demand Side Management Scenarios (in PJ)



Source: National Statistics Bureau, 2012 Census Data and Projections (NBS. 2009, 2012a&b), World Bank, World Development Indicators (WB. 2013a&b). and BEST Team Projections

7.2.2.2 Supply Side Scenario 1: Alternative Biomass Sources – Biomass Briquettes & Biogas

The second non-BAU scenario involves significant commercial scaling up of biomass briquette production and sales, and of biogas commercialisation. Both activities have been ongoing for over 30 years and are currently receiving close attention from local and international NGOs.

This scenario entails the growth in number of biogas digesters in use from approximately 12,000 today to over 120,000 in 2030. As noted, biogas will primarily replace fuel wood in rural areas, although there are important opportunities in urban areas.

Biomass briquettes are presently being promoted by a number of organizations. Their production (pyrolized briquettes from crop and other biomass residues) could be scaled up significantly from the present. While the potential, particularly in the short-term, for large-scale penetration is in the commercial and institutional sectors, they substitute primarily for charcoal and, with the right commercialization and promotion, could begin to make major inroads into the urban household energy market.

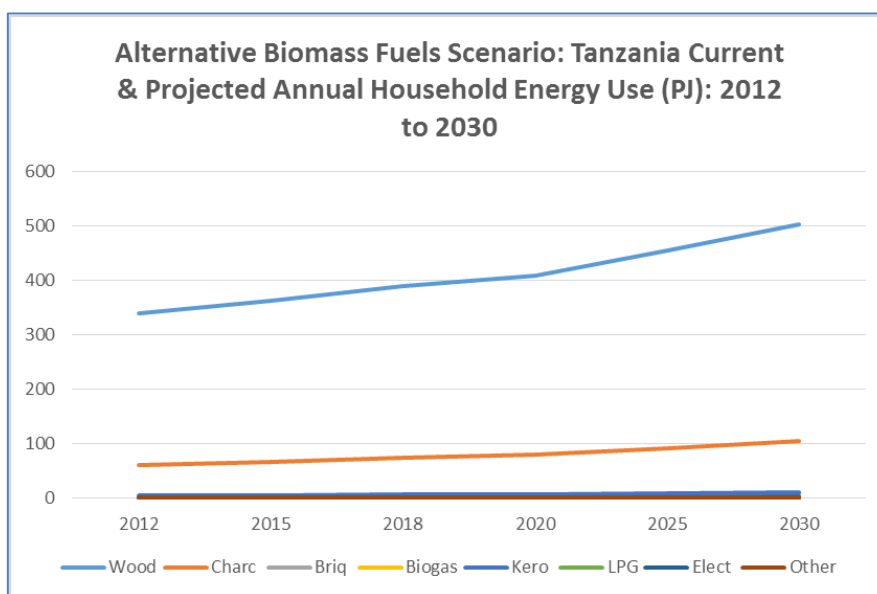
Table 25 and Figure 18 illustrate the impact such scaling up of biogas and biomass briquettes could have. In the case of briquettes, the scenario sets a ten-fold increase in the volume of production and sales from 2012 to 2030. With this, briquettes displace about 5% of household charcoal by 2030.

Table 25: Alternative Biomass Sources: Biomass Briquettes and Biogas

Energy Source	2012	2018	2020	2025	2030	% 2030
Wood	339.1	389.9	408.4	455.9	503.8	79.1%
Charc	60.9	74.8	79.7	92.4	105.8	16.6%
Briq	0.8	1.3	1.8	4.4	8.9	1.4%
Biogas	0.2	0.3	0.4	1.1	2.2	0.4%
Kero	5.3	6.7	7.2	8.7	10.6	1.7%
LPG	0.2	0.3	0.3	0.4	0.5	0.1%
Elect	1.4	1.8	2.0	2.4	2.9	0.4%
Other	1.3	1.6	1.7	1.9	2.2	0.3%
Total	409.2	476.7	501.5	567.2	636.7	100.0%

Source: National Statistics Bureau, 2012 Census Data and Projections (NBS. 2009, 2012a&b), World Bank, World Development Indicators (WB. 2013a&b) and BEST Team Projections.

Figure 18: Alternative Biomass Scenario: Biomass Briquettes and Biogas



Source: National Statistics Bureau, 2012 Census Data and Projections (NBS. 2009, 2012a&b), World Bank, World Development Indicators (WB. 2013a&b) and BEST Team Projections.

Table 25 shows that an even more ambitious target of increasing briquette production and sales by a factor of 20 will reduce household charcoal consumption by almost 10%, relative to the BAU scenario. However, this will account for less than 3% of household energy consumption by 2030. This is far higher than the 0.2% today, but, will require major policy attention and significant investment.

Likewise, scaling up biogas digester production, sales and use by a factor of 10 will require major policy attention and significant growth in commercial production. Relative to current biogas use and to projected BAU biogas use, this could have important effects on firewood consumption in certain areas. The overall national effect will be relatively low, compared to the BAU case, as Table 26 shows.

7.2.2.3 Supply Side Scenario 2: Alternative Non-Biomass Source – Kerosene

The last scenario developed by the BEST Tanzania Team is shown in Table 26 and in Figure 19. This represents an increase in household kerosene consumption by a factor of nearly 12 relative to 2012.

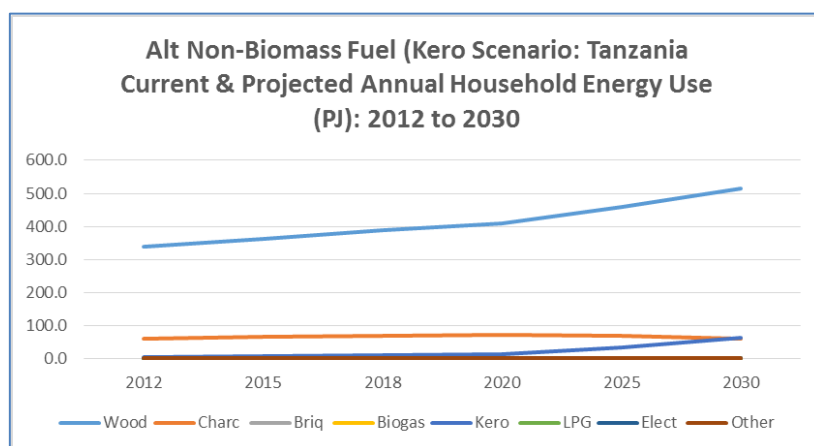
Table 26: Alternative Non-Biomass (Kerosene) Scenario

Energy Source	2012	2018	2020	2025	2030	% 2030
Wood	339.1	390.1	408.7	458.8	515.0	79.7%
Charc	60.9	70.1	73.4	69.5	60.7	9.4%
Briq	0.8	1.0	1.1	1.3	1.5	0.2%
Biogas	0.2	0.2	0.3	0.3	0.3	0.1%
Kero	5.3	11.6	14.4	34.9	63.3	9.8%
LPG	0.2	0.3	0.3	0.4	0.5	0.1%
Elect	1.4	1.8	2.0	2.4	2.9	0.4%
Other	1.3	1.6	1.7	1.9	2.2	0.3%
Total	409.2	476.8	501.7	569.3	646.4	100.0%

Source: National Statistics Bureau, 2012 Census Data and Projections (NBS. 2009, 2012a&b), World Bank, World Development Indicators (WB. 2013a&b). and BEST Team Projections

Kerosene substitutes primarily for charcoal for household cooking. The effect of this increase, relative to the BAU Scenario, is almost as dramatic as the increase in use of quality ICS.

Figure 19: Alternative Non-Biomass (Kerosene) Scenario



Source: National Statistics Bureau, 2012 Census Data and Projections (NBS. 2009, 2012a&b), World Bank, World Development Indicators (WB. 2013a&b) and BEST Team Projections

As the World Bank showed (Hosier & Kipondya. 1993), Government policy on kerosene importation and prices during the 1980s and early-1990s had a dramatic effect on charcoal consumption. This was seen in many developing countries during the 1980s after the oil price increase of the 1970s. Kerosene is easily transported and stored. It can be sold in very small or very large quantities. Kerosene stoves are relatively inexpensive and accessible to most urban poor.

Kerosene’s primary disadvantages are the costs to the country in foreign exchange and, if non-subsidized, the cost to consumers. As noted in this BEST Tanzania Strategy Report, the dramatic rise in kerosene prices over the past decade has led to a marked shift to charcoal. It is not kerosene’s lack of availability that restricts its use for urban cooking, unlike LPG. It is the high relative cost of kerosene that currently restricts its use for cooking.

However, the effects of any reduction in the kerosene price and increase in availability will have the fastest effect on reducing charcoal demand of any of the scenarios set out herein. The fact that kerosene has so few up-front costs to a consumer (i.e. cost of stove, cost of other equipment, cost of connections, etc.) means that, at the right price, it will have a faster uptake and have a more rapid and significant effect on reducing charcoal demand than by decreased costs of electricity or LPG.

7.2.3 Comparison of Scenarios

Table 27 provides a comparison of all four scenarios: Business as Usual, major acceleration of charcoal ICS, major scaling up of commercial briquetting and biogas, and significant increase in kerosene use for household cooking.

Table 27: Comparison of Scenarios and Potential Impact on Wood Energy Demand

Energy Source	HH Energy in PJ 2012	% Total HH Energy	Household Energy in PJ in 2030				% Total Household Energy in 2030			
			BAU	ICS	Alt Biomass	Alt Non-Biomass	BAU	ICS	Alt Biomass	Alt Non-Biomass
Wood	339.1	82.9%	515.0	515.0	503.8	515.0	79.7%	87.3%	79.1%	79.7%
Charc	60.9	14.9%	113.5	56.7	105.8	60.7	17.6%	9.6%	16.6%	9.4%
Briq	0.8	0.2%	1.5	1.5	8.9	1.5	0.2%	0.3%	1.4%	0.2%
Biogas	0.2	0.1%	0.3	0.3	2.2	0.3	0.1%	0.1%	0.4%	0.1%
Kero	5.3	1.3%	10.6	10.6	10.6	63.3	1.6%	1.8%	1.7%	9.8%
LPG	0.2	0.1%	0.5	0.5	0.5	0.5	0.1%	0.1%	0.1%	0.1%
Elect	1.4	0.3%	2.9	2.9	2.9	2.9	0.4%	0.5%	0.4%	0.4%
Other	1.3	0.3%	2.2	2.2	2.2	2.2	0.3%	0.4%	0.3%	0.3%
Total	409.2	100.0%	646.4	589.7	636.7	646.4	100.0%	100.0%	100.0%	100.0%

Source: National Statistics Bureau, 2012 Census Data and Projections (NBS. 2009, 2012a&b), World Bank, World Development Indicators (WB. 2013a&b) and BEST Team Projections

From a BAU perspective, the scenario that shows the most significant effect on reducing wood energy consumption, specifically charcoal consumption, is the ICS scenario. It would take longer than a rapid increase in kerosene use, but it would not require any major imports or any subsidies.

It will, however, require a major coordinated effort with significant public awareness rising and a dramatically improved commercial perspective – i.e. commercially-led, rather than government, donor or NGO-led as has been the case for most of the past 35 years.

8. Key Elements of BEST

8.1 Introduction

8.1.1 Rationale

The BEST Tanzania Project has demonstrated that biomass energy, namely wood fuels, is the most important source of energy in the country, accounting for some 90% of all energy demand. It is a major source of employment in rural and urban Tanzania and one of the most important sources of household revenue. Charcoal and commercial fuel wood are the least expensive energy sources for cooking and heating, relative to all other commercial energy sources.

However, from a policy point of view, biomass energy is one of the most neglected sectors in Tanzania. It is given relatively little attention in national policy and planning, despite its economic importance. Furthermore, almost all charcoal and commercial fuel wood is produced unsustainably, causing considerable forest degradation and localised deforestation, leading to increasing local and national environmental damage and reducing the country's ability to adapt to climate change.

National and local policies that touch upon the biomass energy sector lack coordination, despite the fact that Tanzania is far ahead of most countries in the world in terms of community-based, participatory forestry. Despite the fact that national forestry policy has supported bottom-up, participatory forestry for nearly 15 years, little concrete attention has been given to mobilising the local interest to address the rapidly growing importance, both positive and negative, of biomass energy, one of the most important drivers in the forestry sector.

There is great potential to put biomass on a sustainable footing. This will require giving biomass energy much more attention at a national and local level, developing and coordinating policy, and building up national and local capacity to manage the sector. Capacity building and training in improved forestry management, harvesting, and fuel wood and charcoal production need to be established, particularly improving the organisation and efficiency of charcoal production.

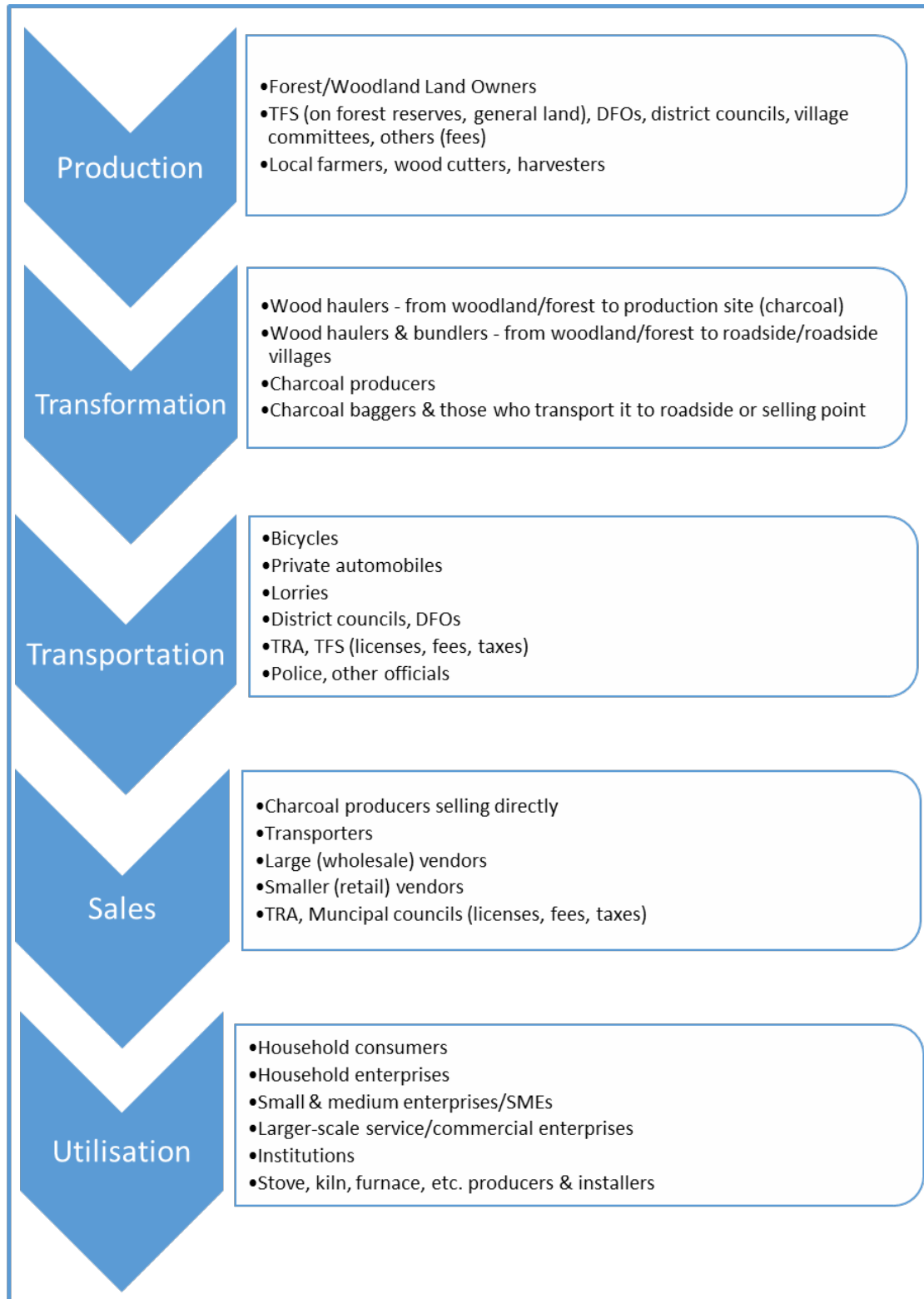
Biomass energy demand must be approached in the same manner in order to clearly identify the stakeholders, what they are doing, or have done, in areas of improving demand-side management, energy efficiency, and the development of alternative fuels. Simultaneously, promotion of and support for energy efficiency on the biomass energy demand side needs to be seriously addressed particularly in the area of improved cook stoves (ICS) in households, household enterprises and in commercial and institutional establishments using wood fuels.

Additionally, attention needs to be paid to alternative sources of energy, including biomass alternatives such as briquettes and biogas. Non-biomass alternatives, such as electricity, LPG and kerosene, need to be revisited with a view of searching for opportunities to support them without direct subsidies in order to reduce forestry biomass energy demand.

Stakeholders must be systematically engaged in all aspects of the biomass energy value chain (Figure 20). This requires review of policies and activities of the Government and other stakeholders to

determine ways to mainstream, organise, commercialise, coordinate and put in place support for actions to make biomass energy sustainable.

Figure 20: Current Commercial Charcoal & Wood Energy Supply & Value Chain



8.2 Objectives

The primary goal of the BEST Tanzania Strategy is to make biomass energy sustainable in Tanzania. There are five groups of actions within the BEST Tanzania Strategy designed to ensure that biomass energy is sustainable in Tanzania along the entire value chain:

- National and local policies;
- Forestry supply side measures that ensure sustainability of biomass energy supplies;
- Improved efficiencies of biomass energy utilisation;
- Commercially viable biomass alternatives to charcoal and commercial wood energy; and
- Commercially viable non-biomass alternatives to charcoal and commercial firewood.

8.3 Guiding Principles

The key principles to guide policy and activities that will make biomass energy sustainable in Tanzania are:

- **Join up and ensure coordination of policies, and policy implementation, at all levels:** Biomass energy touches on many ministries and central agencies, and all village and local governments. Policies should be taking into consideration existing policies that will be touched by biomass energy policy (energy, forestry, poverty alleviation, environment, agriculture, among many others). Policies and regulations should be developed to ensure they are implemented in a manner that complements existing policies.
- **Ensure clarity, simplicity and transparency of biomass energy governance:** At present, not only are there few biomass energy policies, but, those that are in place (e.g., MNRT charges for royalties on charcoal and fuel wood, local government cess for charcoal and fuel wood, etc.) are uncoordinated, lack clarity and transparency, are inefficient in achieving the objectives they were designed for, lead to poor collection of official revenues for district and central government, and lead to considerable unofficial collection of fees. Improving existing policies and developing new policies should seek to improve coordination, efficiency and collection of revenues that go to the intended parties, namely villages, municipalities, local authorities (districts), central governments and the private sector.
- **Engage Stakeholders to Help Develop and Implement Activities in the Sector:** Biomass energy affects nearly everyone, from nearly all households, many commercial and institutional establishments, to local communities and national authorities. Activities along the value chain are multi-disciplinary, ranging from forestry and agriculture to transport, trade and finance. There are many commercial, administrative and non-governmental players. It is key that stakeholders engaged in the biomass energy value chain are engaged in defining new policies, regulations and actions that will affect the value chain.
- **Utilise a Bottom-Up Approach:** Biomass energy supply starts, in almost all instances, at a rural, village and district level. Biomass energy transport involves many small players. Most biomass energy consumers are rural and urban households. Therefore, it is crucial to take as much of a bottom-up approach in designing and implementing policies, in designing and carrying out programmes on the supply, demand and alternative fuels policies and activities.

- **Encourage a commercial and mainstream approach as much as possible:** Biomass policy should be simple, easily understood and address the key driver in the sector – money. Whether it is cutting wood, making charcoal, transporting charcoal and commercial firewood, collecting fees, producing the stoves and equipment that utilise the biomass energy, or buying it for cooking, heating or producing other products, biomass energy is commercial. Therefore, policies that seek to make the business more sustainable, should harness this commercial driver when seeking to address each and every aspect along the value chain.

9. BEST Tanzania Action Plan

9.1 Introduction

Five groups of actions are proposed by the BEST Team:

- Policies and Measures;
- Biomass energy supply;
- Biomass energy demand;
- Commercially viable biomass energy substitutes; and
- Commercially viable non-biomass energy substitutes.

Each has a set of proposed actions that contribute towards achieving the BEST goal of making biomass energy sustainable in Tanzania. Table 28 summarises the five groups and the actions proposed within each. The proposed time frame for the BEST Tanzania Action Plan is meant to comprise 24 months, meaning that the mentioned actions should be initiated within this 24 months period.

9.2 Policies and Measures

Biomass energy is of major importance to the national economy, to rural and urban development, to rural and urban livelihoods, to consumers at most levels, to the national and local environment, and to national and local revenues. However, there is little attention paid to biomass in policies.

Therefore, the first of the BEST Strategy objectives must focus on policy if the other objectives of sustainable supply, improved energy efficiency and commercially viable forestry biomass alternative energy sources are to be successfully addressed.

Policy and regulation have short-term, medium-term and long-term elements. Short- and medium-term elements involve policy changes and, potentially, new legislation. Longer-term policy and regulatory action require institutional support and institutional capacity building. Short-term actions taken in the sector need to be developed from the onset with long-term instructional building in mind.

9.2.1 BEST Steering Committee

The BEST Steering Committee needs to be reconstituted into a standing committee to guide the BEST Strategy and the BEST Tanzania Action Plan during the next two years. The current composition of the BSC is good; it is large enough to represent almost all stakeholders, but, small enough to be workable. It is proposed to add a representative from the President's Office Planning Commission to the BSC.

BSC - BEST Tanzania Action Plan Objective: The BSC's primary functions will be to:

- Review, approve and improve the BEST Strategy and Action Plan;
- Provide guidance, particularly to the MEM, the MNRT and the VPO-DOE, on biomass energy policy formulation in the energy, forestry and environmental sectors;

- Provide the MNRT with support and guidance on expanding the Tanzania Forest Service (TFS) mandate to provide capacity building, training, technical and management assistance to village and local (district) governments, the private sector and NGOs/CBOs in addressing forestry biomass energy supply issues;
- Work with the Tanzania Forest Fund (TFF) to help prioritise activities under the BEST Tanzania Action Plan that can be funded by the TFF;
- Provide guidance, support and review of the MEM's activities with the private sector, NGOs/CBOs, other central and government agencies, and development partners to promote commercially-viable and sustainable biomass energy efficiency in households, commercial and institutional enterprises, and other energy demand efficiency improvement activities;
- Provide guidance, support and review of the MEM's activities with the REA, TANESCO, the private sector, NGO/CBOs, other central and government agencies, and development partners to promote commercially-viable and sustainable forestry biomass energy alternatives;
- Agree to, and set targets for, each of the other three objective areas of BEST (supply, demand and alternative sources); and,
- Review and monitor the implementation of activities to ensure they meet the targets agreed and set out, and update those as may be required.

9.2.2 Broaden TFS's Mandate, Capacity and Funding to Support Sustainable Wood Energy

Expanding TFS's mandate is essential in order to work closely with villages, local authorities and the private sector to improve supply, efficiency of supply and revenue collection (for villages, local governments and the central government).

This will require supporting the MNRT to work with the TFS in these efforts, to obtain financing, to expand staff and capabilities, and to ensure TFS has the other resources necessary to carry out this expanded mandate. TFS currently remits half its revenues to Treasury (Ministry of Finance).

To achieve the sustainable forestry objectives set out in this BEST Tanzania Strategy and Action Plan, Starting in the upcoming financial year, TFS should be allowed to keep 75% of the revenues it collects to finance its expanded mandate and activities. The BEST Tanzania Team recommends that, in the early years of this transition, TFS should keep even more of those revenues to finance the actions set out herein. In line with this, TFS must be able to recruit qualified personnel in a competitive labour marketplace to carry out this mandate. For this to be possible, TFS needs to be upgraded from an Agency to an Authority.

TFS must be able to improve its skill levels to provide training, capacity building and technical assistance to local authorities, villages and the private sector. This will help these stakeholders improve current forest management, expand forested lands through reforestation and afforestation, improve forest harvesting to improve regeneration, and to overall increase the supply of sustainably-produced wood energy. TFS's collaboration with TAFORI needs to be reinforced, better-funded and expanded to cover more local authorities and more intensive training.

TFS - BEST Tanzania Action Plan Objective: The key objective of expanding TFS's mandate, providing TFS with the financial, personnel and technical resources to work with villages, the private sector and local government is to improve forestry management, sustainable forest harvesting, and wood energy production to ensure that Tanzania's forest resources are sufficient to meet the country's wood energy demand.

9.2.3 Inventory of Policies that Affect Biomass Energy

While biomass energy is accorded very little importance in national and local policy, it is touched upon by a number of acts, policies and regulations. A number of those have been highlighted through the BEST Project. However, the BSC should provide support and oversight to the MEM as lead agency, with extensive MNRT participation, to develop a national inventory of those acts, policies and regulations that affect biomass energy, and to make recommendations:

- on how those acts, policies and regulations could be better-coordinated;
- on how those acts, policies and regulations should be changed to ensure forestry biomass energy is more sustainably produced and utilised;
- on new policy and regulations that should be drawn up to improve biomass energy sustainability;
- to improve inter-ministerial, inter-governmental coordination to reduce overlap and improved efficiency in support and governance;
- to explore the options for placing energy officers with local authorities to provide the technical guidance and assistance to deal with biomass energy issues; and,
- to examine options for policies to support wood and other biomass energy research and development to support industry, particularly the biomass industry.

Biomass Energy Policy Inventory - BEST Tanzania Action Plan Objective: Recommendations should be made with the perspective of seeking to mainstream and imbed biomass energy policy in all essential national and local policy (national energy policy, MKUKUTA, Five Year Development Plan, climate change and other environment policy, etc.). This should be done to ensure that all essential policy and administrative support is in place to ensure biomass energy sustainability.

9.3 Biomass Energy Supply Side

A key element of the BEST Tanzania Action Plan is to work closely with villages, the private sector and local governments (primarily district councils), to ensure the long-term sustainability of Tanzania's wood energy supplies. Participatory forest management (PFM) and Community-Based Forestry Management (CBFM) has made significant strides over the past 20 years, particularly the past 10 years, in Tanzania.

Institutional support for local sustainable forestry has been weak due to lack of mandate, lack of financial and personnel resources, and lack of extension resources (e.g. transport, etc.). Efforts have been made by TFS since the 2011 Framework was established, using the MNRT-funded Wood Fuel Action Plan (WFAP).

However, TFS's mandate does not cover the level of support to village forest, private forest and local authority forest (three of the four types of forest defined under the Forest Act, 2002) required to meet the BEST goal. Even with a broadening of the TFS mandate, TFS will have to recruit or contract more qualified personnel to undertake the support to the villages, associations, individuals and councils who manage these forests.

The following sets out a step-by-step process to be reviewed by the BSC during the Action Plan period.

9.3.1 Village Forest Management Plans (VFMP)

Mapping of areas for village resource use is a process undertaken by the National Land Use Planning Commission (NLUPC), with village participation and with support from various governmental and non-governmental agencies. A village land use map, showing land for farming, for grazing, for forests, for wildlife, for watershed management, and other uses, is drawn up prior to a village being certified (i.e. given legal rights).

However, mapping village forest areas is only a first step towards village forest management. A number of villages have developed forest management plans working with NGOs and, in some cases, with the Forest and Beekeeping Department and with TFS. However, development of full village forest management plans (VFMPs) and having those plans registered has been very slow.

This needs to be accelerated with the support of the MNRT for TFS, with the NLUPC, the PMO-RALG and the VPO-DoE, with development partner and NGO support. Section 3.1.7 sets out how the NLUPC, working with FINNIDA and MNRT and with support from development partners and NGOs, has helped establish over 100 Tree Growers Associations.

VFMP - BEST Tanzania Action Plan Objective: Developing and registering these plans is a crucial step in ensuring sustainable forest management. It is a pre-requisite to sustainable wood energy production. For this to occur, TFS's mandate needs to be expanded to enable it to take the lead national role to coordinate this activity. There is no other national agency that has the coverage and technical capability to work with other partners, particularly local government authorities (LGAs), with the NLUPC, with PMO-RALG and VPO-DoE support, to ramp up development and registration of these plans.

TFS, with NLUPC support, should set out a plan for working with villages to develop and register VFMPs up to the year 2030. There are several development partners potentially interested in supporting this, including the SDC (Switzerland), the Finnish Government and the European Union.

With NLUPC support, and working with NGOs such as the Tanzania Forest Conservation Group (TFCG), MJUMITA (national network of participatory forest management groups), TFS should prioritise villages to work with on an annual basis, with indicative five year plans to work with villages to register VFMPs. The objective is eventually to ensure that every village in Tanzania has a VFMP such that all village forests are under sustainable forest management, thereby ensuring that wood energy is harvested in a sustainable way from village forests. This will go far towards meeting the BEST goal of ensuring that wood energy is produced on a sustainable basis.

9.3.2 Private Forest Management Plans

As with villages, private forests have increased in numbers over the past decade. This has accelerated with the development of Tree Growing Associations (TGAs) whose objectives are to produce trees sustainably for commercial use. Both TGAs and other private and NGO-supported initiatives should be encouraged and supported to increase the number of trees managed for commercial fuel wood production.

Private Forest Management Plan - BEST Tanzania Action Plan Objective: As with village management plans, private forest management plans should be developed with TFS support, working with NGOs and others (including development partners). TFS should draw up an annual plan for working with private forest owners to develop and register private forest management plans with the objective of not only ensuring the production of sustainable energy from private forests, but to also accelerate the expansion of private forests (woodlots, plantations, etc.) for purposes of sustainable wood energy production.

9.3.3 Local Authority Forest Management Plans

A crucial area for improved forest management is the relation with local authorities (primarily district councils) and their Local Authority Forests. Forests that fall under local authority management comprise the third largest forestry stock in the country. Most local authorities lack the financial and technical resources to manage their forests. Developing local forest management plans would enable local authorities to define their forestry resource base, and put in place management plans that would enable them to sustainably manage areas for biomass energy production and sales.

This would provide them with much-needed revenues on a long-term, sustainable basis. TFS has a crucial role to play in this process. They already work with district councils and their district forest officers (DFOs) to try to manage both local authority forests and natural forests (under TFS management), and collect royalties from forest production on natural forest land.

However, because both TFS's and local authorities' capacities to manage are over-stretched, few local authorities are able to develop the management plans to set the framework for proper management, and to benefit from improved management. This has generated a vicious circle which most local authorities want to break.

While a forest management plan alone will not break that circle, it will provide a key tool to help break it. Having such a plan will enable local authorities to enter into ventures with private individuals and companies to manage forests and to harvest them sustainably. A local authority management plan will also enable them to set up joint forest management areas with TFS to benefit from a larger pool of management and technical skills.

Local Authority Forest Management Plans – BEST Tanzania Action Plan Objective: Local authority forest management plans should be developed with TFS as a key step towards improved and eventually sustainable forestry management. It will strengthen cooperation between TFS and local authorities, which, in turn, help strengthen governance of local authority forests as well as other forests (natural forest, village forests and private forests) that are within the district's boundaries. Improving governance is one of the most critical elements in the BEST Strategy.

TFS should identify districts it wishes to assist in developing local authority management plans on an annual basis, and set out indicative plans for such on a three year forward basis. Developing these local authority forest management plans is key to ensuring that Tanzania's forest resources are sufficient to meet the country's wood energy demand.

9.3.4 Joint Forest Management Areas (JFMA)

As noted, TFS is empowered under the Forest Act (2002) to set up joint management areas, with joint management plans with local authorities, villages and the private sector. Given the large and growing pool of villages, NGOs and private groups practicing participatory forest management and CBFM, developing JFMAs will help accelerate sustainable forestry management.

Joint Forestry Management and Management Plans – BEST Tanzania Action Plan Objective: As TFS gains capacity and resources, it should set up joint forest management with villages, local authorities and the private sector. This will help strengthen management capabilities, communications, and cooperation on sustainable forest management as a means of meeting the BEST goal: to ensure that Tanzania's forest resources are sufficient to meet wood energy demand.

9.3.5 Organisation and Registration of Charcoal Producers

Charcoal production, with the exception of several pilot activities, is unorganised and unsustainable. Most charcoal is produced by individual farmers and their families. Few charcoal producers cooperate with one another on an organised basis. This makes it difficult for producers to add value to their production and to introduce measures to make charcoal production sustainable.

As villages develop village forest management plans, and as local authorities and private forest individuals and groups do the same, they will take control and manage forests better. As that happens, the current situation of unmanaged, uncontrolled forest harvesting for charcoal production will become more difficult. Charcoal producers will be forced to enter into agreements with villages, local authorities and the private sector.

As this happens, they will start paying for the forest resources that they currently harvest for free to produce charcoal. Organisation will make production at scale easier. Furthermore, it will provide incentives to produce charcoal more efficiently through improved techniques.

Organisation and Registration of Charcoal Producers – BEST Tanzania Action Plan Objective: This scenario of organising, training and registering charcoal producers is essential if Tanzania's forest resources are to become sustainable. TFS, with the MEM, with NGOs and the private sector, will provide training, technical assistance and, in some cases, small-scale finance, to promote improved charcoal production.

TFS, with district level participation, organises and registers all charcoal producer groups within an agreed time frame (to be set with the BEST Steering Committee). It should start with an annual target for organising, training and registering groups, with a three-year forward plan for expanding that organised base. The BEST Tanzania Action Plan envisages that, once there is sufficient capacity to organise and train all charcoal producer groups, it will become a national law that charcoal can only be produced and sold by registered, licensed groups. It is an important BEST objective to build the

capacity to register (and monitor) all charcoal producer groups in order to ensure that the BEST goal is achieved.

9.3.6 Sustainable Charcoal Production and Certification

As more forest land is brought under management plans and management, and as charcoal producers are organised and registered, charcoal production will become more sustainable. Local authorities (supported by the PMO-RALG), TFS, MEM and NGOs, perhaps with the Tanzania Bureau of Standards, should work with producer groups to establish a standard for sustainable charcoal production. Once that standard is set, producer groups should be trained in it, and if they produce under that standard, they should be certified. This will take time and resources. It should be one of the areas the BSC looks at carefully over the next two years.

Sustainable Charcoal Production and Certification – BEST Tanzania Action Plan Objective: TFS, working with the PMO-RALG (and key local authorities), and with MEM, should provide the BSC with a proposed plan for introducing sustainable charcoal certification, with a suggested timeframe. This should draw upon the experience of TFCG, WWF and others who have developed projects for sustainable charcoal.

9.3.7 Improve Collection of Wood Energy Fees

The World Bank and others, including BEST stakeholders in national meetings and in interviews, have pointed out the necessity of improving revenue collection from the production of wood energy products (charcoal and commercial fuel wood). Royalties should be collected on both natural forests and local authority forests.

TFS, working with district forest officers and district councils, should tighten up enforcement of fee collection, including clarifying the roles of TFS and DFOs in royalty collection, as well as improving record keeping and auditing. Improved royalty collection from wood energy production will provide the central government with much needed revenues. Revenue-sharing with local authorities should be explored to incentivise collection and record keeping.

Local authorities should tighten up their procedures and record keeping for collection of cess (local authority fees) as a percentage of royalty payments. Cash-strapped district councils have an incentive to improve these procedures and collections as a way to generate much-needed revenues for their district requirements.

Improve Collection of Wood energy Fees – BEST Tanzania Action Plan Objective: Improving the collection of fees from the harvesting of forests for energy production is essential to putting a price on forestry resources for energy. This is crucial in providing the revenues for supporting forest management, for improving harvesting, for replanting and afforestation and for sustainable wood fuel production (charcoal and firewood). This is a major component required to achieve the BEST goal.

9.3.8 National Charcoal Transport Licensing

One of the important steps in simplifying the business of regulating wood energy supply is to consolidate charcoal transport licensing. Transport licensing should be simplified and made

transparent. Transport licenses should be issued by district authorities. They should collect revenues for the production and transport of charcoal, on behalf of the Tanzania Revenue Authority (TRA).

National Charcoal Transport Licensing – BEST Tanzania Action Plan Objective: District authorities should be the only issuing bodies for transport licenses. They should share a proportion of the license fee with the TRA to provide incentives to district councils to put the resources into properly licensing wood energy product transport. Having one issuing authority, with straightforward transport procedures and fees, will go far towards making charcoal and commercial firewood more sustainable. There should be publicized fines and penalties for improper transport.

9.3.9 Payment for Environmental Services (PES)

Payment for environmental services (PES) takes many forms. TANESCO has paid village councils to protect watersheds that supply hydropower reservoirs for many years. National parks, tourism companies and hunters have paid communities to protect wildlife, wildlife migration routes and habitats for many years. More recently, governments, individuals and some international organisations have paid national and local governments for protecting forests to reduce emissions from deforestation and degradation (REDD). Some individuals and companies pay for charcoal and fuel wood produced sustainably, another form of PES.

Support Expansion of PES – BEST Tanzania Action Plan Objective: PES should be supported to promote sustainable forestry management and the sustainable production of wood energy products. This will contribute towards achieving the BEST goal.

9.4 Biomass Energy Demand

Demand for wood fuels for cooking and heating is one of the most important factors affecting Tanzania's forest sustainability. Increased urbanisation, increased incomes in rural areas, increased industrial and other economic activity, combined with the increase in relative prices for other wood fuel energy alternatives (particularly electricity, kerosene and LPG), have increased demand for charcoal, in particular, as well as for commercial fuel wood.

9.4.1 Improved Cook Stoves (ICS)

Work has been undertaken on improved cook stoves in Tanzania since the 1980s. The greatest efforts have been made on urban household ICS. While several million urban ICS, tens of thousands of rural ICS, and thousands of institutional and commercial ICS have been produced over the past 30 years, little is known about how many are currently being produced and how efficient they are in reducing pressure on wood energy supplies. Efforts at production have been primarily NGO- and development partner-led, as has been Commercialisation-.

There is agreement by almost all parties that ICS, if produced to quality efficiency standards, and cost-effectively and competitively by the private sector, can achieve the fastest reduction of pressure on wood energy supplies.

The criteria for success for all commercial (i.e. non-self-made) stoves, hinges effectively on four key criteria which include:

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- Ensuring significant stove efficiency improvements (i.e. reduced wood fuel consumption) relative to traditional stoves (usually 50% reduction in fuel consumption relative to traditional fuels or less);
- Ensuring quality of stoves to meet consumer requirements and tastes (ease of use and durability being of major importance);
- Achieving commercial production at scale (thus, ensuring costs to consumers that are competitive with traditional stoves and/or where reductions in expenditures on fuels provide a very fast payback); and,
- Having distribution and/or installation networks that make purchasing ICS as easy as traditional stoves.

These are the primary challenges of all the ICS suggested here in the action plan. The BEST Team recommends the focus of the BEST Tanzania Action Plan be on the following in order with these four criteria:

- Urban households;
- Commercial, institutional and industrial stoves;
- Urban household enterprises;
- Rural household enterprises; and,
- Rural households.

A national ICS Task Force was established in 2012. It comprised 12 members, including one private sector member. After a year's activities, the Task Force met in December and handed over their work to the Clean Cook stoves and Fuels Alliance of Tanzania (CCFAT) with ongoing support from SNV. CCFAT is primarily an NGO. The BEST Tanzania Team believes that best practice and experience in other parts of the world show that the more commercial an ICS programme is, the greater the chance that it will meet the four criteria set out above and achieve rapid market penetration.

ICS – BEST Tanzania Action Plan Objective: Thus, a key objective of the BEST Tanzania Action Plan for all ICS is to promote commercial approaches that generally involve training up local producers, or setting up local production facilities, having a market-based, competitive approach, and utilising development partner and NGO support to facilitate commercialisation, where the development partners and NGOs play a minimal role in actual production and sales, and a large role in:

- Public and consumer awareness raising;
- Technical capacity building of producers and businesses;
- Training of producers and businesses in marketing and promotion in the private sector;
- Providing access to finance (usually micro-finance) where necessary and appropriate;
- Quality assurance; and,
- Promotion.

The BEST Team suggests that the BEST Tanzania Action Plan uses this as the framework for promoting ICS. It is recommended that the BEST Steering Committee and the Minister of Energy and Minerals work with the Secretariat, SNV and TAREA to develop a major ICS programme, setting quantitative targets to be achieved over particular time frames (e.g., x urban ICS sold, that reduce charcoal consumption by y%, by 2020, 2025, 2030, etc.). Reducing wood fuel consumption in

households, household enterprises, commercial establishments and institutions will help meet the BEST Tanzania goal of ensuring the sustainability of Tanzania's wood fuel supplies.

9.4.2 Improved Fuel Wood Use for Tobacco Production

Tobacco production in Tanzania has been increasing by over 10% per year since 2001. It has a major effect on Tanzania's woodlands. First, significant amounts of land are cleared each year for tobacco planting. Second, curing the tobacco consumes large quantities of firewood.

Almost all tobacco curing in Tanzania is carried out in simple, homemade barns using firewood placed in a small excavated pit in the ground at one end of the barn. When the firewood is lit, heat is simply and inefficiently drawn up through the barn to dry tobacco hanging from poles that are stacked from the bottom to the top of the barn. This is referred to as flue-curing tobacco.

Efficiencies of traditional flue-curing were tested in Tanzania by the World Bank in the 1980s under an extensive programme that showed that wood fuel consumption could be easily reduced by 50% simply by improving the wood fuel efficiency, both through installation of simple furnaces (stoves) and by better management of the amount of the furnace.

Virtually all farmers are organised in cooperatives, which are members of the Tanzania Federation of Cooperatives (TFC). Tobacco farmers are also required to be registered (through their cooperatives) with the Tanzania Tobacco Board (TTB). Registration is required in order to sell tobacco to the two major buyers in the country. Under the Tobacco Industry Act of 2001, the TTB is required to ensure that trees are planted for every tree cut for curing tobacco. The TTB is required to report those numbers annually. Likewise, the TTB should provide tree seedlings for every tree cut for firewood.

i.Tree-Planting for Tobacco Drying - BEST Tanzania Action Plan Objective: During the Action Plan period, the TTB should be engaged to determine how farmers are supported for tree planting to ensure that tobacco-production, on the fuel supply side, is sustainable. Key issues to be examined include:

- Whether or not tree seedlings are made available to farmers?
- Who makes seedlings available to farmers?
- Do farmers pay for them and how (e.g. through deductions in tobacco payments)?
- Are farmers trained in tree planting?
- Who trains farmers?
- How does TTB measure the planting rates of farmers?
- How does TTB measure the survival rates of trees?
- How are statistics collected?

The objective of this is to determine how extensive and successful tree planting for tobacco curing is. Based upon these findings, recommendations should be made, if determined as necessary (the criterion being whether enough trees are being planted to maturity for trees harvested for curing) on how to improve the wood fuel sustainability rate. The Action Plan objective is to ensure sustainable supply of forest wood energy for tobacco curing, thereby ensuring sustainability of Tanzania wood energy.

ii. **Improve Efficiency of Tobacco Curing – BEST Tanzania Action Plan Objective:** A study should be undertaken, through the MEM, the TFC, the TTB and the tobacco cooperatives, to determine the wood fuel savings potential for tobacco curing. This should build upon the World Bank/ESMAP work of 1988-89 and any other work in the sector in Tanzania. The objective is to quantify the potential wood fuel savings from improving tobacco barn flue-curing and thereby make recommendations on how to improve the sustainability of Tanzania wood energy.

9.5 Commercially-Viable Biomass Energy Alternatives

9.5.1 Introduction

Forestry biomass energy alternatives are a key element in achieving the goal of making biomass energy sustainable in Tanzania. Alternatives fall into two categories: Biomass alternatives and non-biomass alternatives. Both have particular roles to play in reducing the pressure on biomass energy supplies.

9.5.2 Biomass Energy Alternatives

Additional to forestry biomass, Tanzania has abundant resources of other biomass that can potentially play a role in substituting for forestry biomass. Most of these resources fall into the categories of residues or wastes. They include agricultural crop residues, such as coffee husks, rice husks, coconut husks, and sisal, cashewnut, cotton, wheat and other crop residues that result from agro-processing; animal wastes are another source of biomass energy. Forestry wastes, including sawdust, shavings, thinnings and other residues that come from harvesting, cutting and processing forest resources primarily for timber, pulp and paper, are potentially extensive alternative biomass resources.

9.5.2.1 Biomass Briquettes

Biomass briquettes have been produced for over 30 years in Tanzania. All briquettes are densified, in order to make them more compact and to increase their energy value by weight. Most are pyrolised, as wood is for charcoal, to further increase their energy value per unit of weight. Some producers mix wood charcoal dust (chardust), collected primarily at sites where charcoal is sold wholesale.

All briquetting activities started with government, NGO and/or development partner support. Several briquetting activities have become commercial over the past several years. However, none have achieved large scale. The ones being commercial target niche markets, including high-end households and institutions (schools, prisons, military) or small-scale rural.

The key challenge for briquettes in Tanzania, as in many countries in the world, is to **make them commercially viable at sufficient scale to make a significant contribution to reducing pressure on wood fuels production**. This is the **primary objective** for targeting biomass briquettes in the BEST Tanzania Action Plan.

Biomass Briquettes - BEST Tanzania Action Plan Objective: Issues such as cost and economies of aggregating source materials (husks, sawdust, chardust, etc.), costs of production, and not least, consumer demand and markets are the key issues that need to be addressed. These are summarised

as making biomass briquettes commercially viable and a mainstream energy resource. Whether destined for households, institutions, commercial or industrial establishments, successfully mainstreaming and commercializing briquettes could reduce pressures on wood biomass energy supplies, particularly charcoal, to make wood energy more sustainable. The potential for biomass briquettes to make a significant difference in substituting for wood energy, and the above factors are the elements that should be focused on in developing a full BEST Tanzania Action Plan. If briquettes are found to be a strategic and cost-effective wood energy substitute, then, as the Alternative Biomass Energy Supply Scenario sets out (Section 7), an ambitious target of, say, a 10-fold increase in commercial supply could be set.

9.5.2.2 Biogas

As with briquettes, biogas has been piloted in Tanzania for over 30 years, and started with government, NGO and/or development partner support. Like briquettes, there are few commercially viable activities, and these are on a very small scale. The main stock for biogas is animal waste, although sisal waste has been piloted to generate biogas for combined heat and electricity (cogeneration).

Many of the same issues that face briquettes also face biogas. However, the investment requirement for a biogas digester, in terms of materials, labour and the consequent cost, are much higher.

Biogas - BEST Tanzania Action Plan Objective: As with briquettes, the objective of including biogas in the BEST Tanzania Action Plan's two-year period is to determine if biogas can be commercially viable at sufficient scale to make a significant contribution to reducing pressure on wood fuels production. If such a determination is made, the BEST Tanzania Project Team recommends a 2030 target of 120,000 biogas units, as laid out in the Alternative Biomass Energy Supply Scenario (Section 7).

9.5.2.3 Forest Residues

Forest residues are being utilised for direct combustion in forest industries for timber drying and curing, for generating combined heat and power (CHP) (with some electricity exported), and for producing charcoal on a sustainable basis. CHP has been shown to be commercially viable when the producer receives a sufficient price to make the investment. Charcoal production from wood industry residues has been less commercially successful.

Forest Residues - BEST Tanzania Action Plan Objective: Both wood residues CHP and charcoal need to be reviewed with the same objective as biomass briquettes and biogas. As with those, wood residue electricity, and charcoal need to be reviewed during the two-year BEST Tanzania Action Plan period to determine if they can be scaled up sufficiently to make a significant contribution to reducing pressure on wood energy supplies and make them more sustainable.

9.6 Commercially-Viable Non-Biomass Energy Alternatives

Non-biomass wood energy substitutes have been utilised in Tanzania since electricity was first generated and when fossil fuels (namely kerosene and liquefied petroleum gas (LPG)) were first imported into Tanzania.

9.6.1 Kerosene for Cooking

Kerosene was the major urban cooking fuel until the 1970s when international oil prices increased dramatically. Kerosene was still a major urban cooking fuel until Government liberalised fossil fuel supplies during the past decade. Demand for kerosene has been influenced primarily by price, but also by availability. It is clear that the decreased use of kerosene for cooking has reduced its impact on the supply of wood energy, both in urban and rural areas.

Kerosene - BEST Tanzania Action Plan Objective: The key objective to be addressed during the two-year BEST Tanzania Action Plan is what actions would need to be taken to increase the use of kerosene for cooking in order to reduce the pressure on wood energy supplies and make them sustainable.

Issues to be addressed include interest by commercial fuel companies to increase imports of kerosene for cooking (thus affecting prices in Tanzania's liberalised market), availability and cost of cooking appliances, distribution networks and costs, in particular. The impact on making wood fuel supplies more sustainable needs to be quantified in order to make any recommendations on proposed policy.

9.6.2 LPG for cooking

LPG has been influenced more by availability of both cylinders and quantity of imports than by price. LPG imports have always been used by industries for process heat, and by the institutional, commercial and household sectors primarily for cooking and some heating. Over the past five years, use of LPG has shifted increasingly to large commercial, institutional and small and medium enterprises, driven perhaps as much by the costs and availability of electricity as by anything else.

As such, it is not clear how much increased imports of LPG (which have increased seven-fold since 2007) have reduced pressure on wood energy supplies. These are key issues that need to be examined during the two-year BEST Tanzania Action Plan period.

LPG - BEST Tanzania Action Plan Objective: As with kerosene, issues to be addressed include interest by fuel companies to increase imports of LPG and to increase the number of smaller-size cylinders (thus affecting price and availability in Tanzania's liberalised market), availability and cost of cooking appliances and other equipment required for LPG use for cooking, and distribution costs and networks, in particular. The impact on making wood fuel supplies more sustainable needs to be quantified in order to make any recommendations on proposed policy.

9.6.3 Electricity for Cooking

Like kerosene, electricity was very important prior to the 1970s' oil price increases. As increasing amounts of hydroelectricity were made available in the 1980s and 1990s, electricity for cooking became more common.

However, TANESCO's domestic electricity prices have increased four-fold over the past three years. Therefore, the use of electricity has decreased and the pressure on wood fuels for cooking has increased.

Electricity - BEST Tanzania Action Plan Objective: Given the fairly extensive distribution of electricity in Dar es Salaam and other urban areas, the key issues to be addressed include availability and cost of cooking appliances and other equipment required for electricity use for cooking, various fees and rates charged by TANESCO to consumers, in particular. The impact of any effective reduction of both electricity feeds and prices for cooking, as well as the availability of electricity for cooking, making wood fuel supplies more sustainable, need to be quantified in order to make any recommendations on proposed policy.

9.6.4 Coal for Cooking

While Tanzania has extensive quantities of coal, only a limited amount has been used, primarily in institutions (prisons, schools) to substitute for wood fuels.

Coal - BEST Tanzania Action Plan Objective: The primary issues to be examined during the BEST Tanzania Action Plan period will be to what extent coal distribution networks can be developed and the cost of coal, a charcoal and fuel wood alternative, can be reduced to make coal competitive with wood fuel energy in order to reduce pressure on Tanzania's forestry resources, making wood fuel supply more sustainable.

9.6.5 Natural Gas for Cooking

Significant deposits of natural gas have also been discovered in Tanzania. The new Natural Gas Policy mentions natural gas for cooking. No natural gas has been used in Tanzania, thus far, as a substitute for wood fuel energy.

Natural Gas – BEST Tanzania Action Plan Objective: The primary issue to be examined during the BEST Tanzania Action Plan period will be to determine to what extent natural gas will be available, when and in what quantities to make it a wood energy alternative to reduce pressure on forestry resources to make Tanzania wood energy supplies sustainable.

Biomass Energy Strategy (BEST) Tanzania

Table 28: Proposed BEST Tanzania Action Plan

Action	Responsibilities					Develop Partners	Timeframe											
	Central Govt	Local Govt	Villages	Private	NGOs		2014				2015							
							Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4				
1. Policies and Measures																		
1.1 Extend BSC for 2 Years to Support & Monitor BEST Action Plan																		
1.2 Broaden TFS Mandate & Increase Capabilities																		
1.3 Biomass Policy Inventory																		
2. Biomass Energy Supply																		
2.1 Village Forest Management Plans																		
2.2 Private Forest Management Plans																		
2.3 Local Authority Forest Management Plans																		
2.4 Joint Forest Management Plans																		
2.5 Organisation & Registration of Charcoal Producers																		
2.6 Sustainable Charcoal Production & Certification																		
2.7 Improve Collection of Forest Energy Fees																		
2.8 National Charcoal Transport Licensing																		
2.9. Payment for Environmental Services (PES)																		
3. Biomass Energy Demand																		
3.1 Improved Cook Stoves																		
• Urban households:																		
• Commercial, institutional and industrial stoves:																		
• Urban household enterprises:																		
• Rural household enterprises; and,																		
• Rural households.																		
3.2 Improved Fuelwood Use for Tobacco																		
3.2.i Tree Planting for Tobacco Curing																		
3.2.ii Improved Tobacco Curing																		
4. Commercially-Viable Biomass Energy Substitutes																		
4.1 Biomass Briquettes																		
4.2 Biogas																		
4.3 Forest Residues																		
5. Commercially-Viable Non-Biomass Energy Alternatives																		
5.1 Kerosene for Cooking																		
5.2 LPG																		
5.3 Electricity for Cooking																		
5.4 Coal for Cooking																		
5.5 Natural Gas for Cooking																		

Appendices

A.1 BEST Terms of Reference

1. Country context and background

Biomass accounts for over 90% of Tanzania's primary energy supply and is mainly used in the form of firewood and charcoal. Although the National Energy Policy (NEP) and the National Strategy for Growth and Reduction of Poverty (known by its Kiswahili acronym MKUKUTA) aim to move Tanzania away from biomass to other energy sources, the proportion of households cooking with biomass fuels rose from 93% to 96% between 2001 and 2007, and even in Dar es Salaam the percentage of households cooking with electricity halved during the same period. So the dominance of the sector is increasing. The poorly managed use of biomass contributes to the unsustainable exploitation of natural forests and woodland, particularly in the districts around Dar, and inefficient combustion contributes to wastefulness and health problems among users resulting from indoor air pollution. The importance of the sector for the economy, the environment and energy self-sufficiency justifies the development of a forward-looking and effective national strategy that addresses supply, demand, substitution and sector governance.

At the request of the Ministry of Energy and Minerals (MEM), the European Union Energy Initiative Partnership Dialogue Facility (EUEI PDF) has agreed to support the development of a Biomass Energy Strategy (BEST) in Tanzania. This will be in accordance with a Memorandum of Understanding that was signed between the two parties in February 2010.

Although the strategy development process will be led by MEM, its success will depend upon the close cooperation of other government agencies in particular the Forestry and Beekeeping Division of the Ministry of Natural Resources and Tourism, as well as the Vice President's Office (Division of Environment), the Prime Minister's Office – Regional Administration and Local Government, the Ministry of Finance and Economic Affairs, and the Ministry of Lands and Human Settlements Development. A range of other non-governmental actors will also need to be involved including the private sector, civil society, and research and academia. Consultants will provide technical support. The process is expected to draw on existing studies and data to the extent possible.

2. Objective

The objective of the assignment is to assist the Government of Tanzania (GoT) in developing a national Biomass Energy Strategy that will identify means of:

1. ensuring a more sustainable supply of biomass energy;
2. raising the efficiency with which biomass energy is utilised and used;
3. promoting access to alternative energy sources where appropriate and affordable; and
4. Ensuring an enabling institutional environment for implementation.

In working towards these objectives, BEST will aim to identify and work with institutional drivers for change and reform, in recognition of the fact that previous efforts at policy change in the field of biomass energy have had limited success. It will be particularly important to work with MFEA to raise awareness of the magnitude of lost income due to gross under-collection of non-tax revenues from wood fuels, and potential measures to increase the efficiency of collection. Working with civil society to build public awareness around governance constraints within the biomass energy sector will provide additional incentives for change.

3. Coordination

A team of consultants will act in an advisory and supporting role, while GoT will be expected to direct the BEST development process. The 2nd edition of the [EUEI PDF BEST Guide for Policy-makers and Energy Planners](#) outlines the recommended steps to be followed, but may be adapted as required to fit the Tanzanian context. In developing a methodology and carrying out the assignment, close reference should also be made to the BEST Tanzania Scoping Study (August 2010), which provides background information on sector stakeholders, the policy, legal and regulatory environment governing biomass energy, existing research and studies, and a number of key gaps and issues that the BEST process will be expected to address.

The Assistant Commissioner for Renewable Energy within MEM will be the GoT counterpart for the BEST development process. The consultants will be contractually responsible to the EUEI PDF management unit in GIZ headquarters, Eschborn, Germany.

4. Approach and Expected Outcomes (Results)

The BEST development process is to be led by GoT and commencement should be contingent on demonstrated commitment and ownership of decision-makers at political level, and the involvement and commitment of relevant sector ministries.

Requirements of MEM therefore include:

- Identify and convene a BEST steering committee, and draw up its Terms of Reference. MNRT will be part of the steering committee given the significant role of the biomass supply side. It is suggested that in order to ensure institutional ownership, the activities of the BEST steering committee should be embedded within an existing and mandated institution. It is proposed that this should be the National Advisory Group (NAG) for ProBEC chaired by the commissioner for energy. It is also proposed to have a member of the REDD committee on energy drivers in the BEST steering committee. If an alternative forum is identified then this should be communicated and agreed with EUEI PDF. The creation of new and temporary structures or steering committees should be avoided, although related groupings may be consulted and involved (such as the steering committee for the Dar Charcoal Project).
- Produce a consensual vision statement on promoting sustainable biomass energy production from the relevant GoT authorities. This should set out a vision for sustainable wood fuel supply and describe the desired situation in the long term, and should include a qualitative

statement on all involved sectors and address economic, social and environmental impacts. Once a vision has been consensually defined by government, a roadmap may be established for realising the vision statement, step by step.

4.1. Specific outcomes to be delivered by consultant

Only when the above outcomes have been realised, will EUEI PDF authorise the BEST advisory consultants to proceed. Their required tasks will be as follows:

- Consult and analyse all documents listed in the BEST Scoping Study.
- Conduct or commission original research to fill data gaps identified by the Scoping Study (non-charcoal biomass consumption, agricultural residue supply and demand, the biogas industry and energy exports), together with any additional data gaps that may be identified; these surveys should be based on rapid sampling rather than exhaustive field-based research.
- Convene one-on-one meetings with key informants and influential persons, including site visits to locations of relevance for gathering data and opinions (e.g. rural agri-businesses, co-generation facilities, charcoal production centres, and briquetting operations).
- Identify sub-groupings representing key stakeholder groups and convene separate meetings with these groups to solicit opinions and specific proposals for sector development (e.g. private sector forums, producer or transporter groups, civil society organisations, NGO networks, donor policy groups, parliamentary standing committees).
- Identify, meet with, brief and solicit information from key decision-makers at departmental or ministerial levels within key government agencies (MEM, VPO DoE, MNRT/FBD, MFEA, TRA, PMO-RALG)
- Engage with specialist agencies or forums with lobbying or policy-making expertise, to design and implement an organised process of awareness-raising among key opinion leaders.
- In collaboration with MEM and MNRT, present progress, findings and analysis at least three times to the steering committee at inception, at the draft reporting stage and at the final reporting stage, to solicit feedback and endorsement from committee members and consensus on the next steps.

5. Deliverables

5.1. Communication Strategy

A communication strategy is required to promote a modern and positive image of biomass energy through civil society and the media. The strategy should be developed and implemented in parallel with BEST development. It should result in (but not be limited to) the following published outputs:

- Three short Policy Briefs developed, targeted and presented to the following interest groups:
 - Parliamentary Standing Committees (on Energy and Minerals, and on Lands, Environment and Natural Resources);
 - MFEA and the Tanzania Revenue Authority;

- Development Partner Groups (such as those dealing with Environment, general budget support, local government reforms and improving the revenue/taxation base).
- Three press releases and media packs covering different aspects of BEST (such as the problem, proposed options and the strategy itself), with evidence of placement.

This communication strategy will be developed in partnership with a Tanzanian PR firm or NGO with experience in public awareness, advocacy and information.

5.2. Biomass Energy Strategy document

The Strategy document should include:

1. An assessment of current biomass energy demand by fuel and by sub-sector, with 20 year forward projections. An assessment of national wood fuel energy supply is *not* expected, given the unavailability of such information until the NAFORMA process is completed, although the supply potential of agro-residues and biogas should be estimated. It is important to stress that original data collection should be limited to targeted sampling rather than large-scale field research.
2. Proposals to:
 - (i) Ensure a more sustainable supply of biomass energy (including an assessment of “green energy” opportunities and Payment for Environmental Services, and the potential of both mechanisms to catalyse a sustainable wood fuels industry; and a practitioner’s guide on how to go about a “green charcoal” project)
 - (ii) Raise the efficiency with which biomass energy is produced and utilised (including among domestic, institutional, commercial and industrial users; with particular consideration of the economic incentives required to bring about efficiency improvement, not only technological interventions).
 - (iii) Promote access to alternative energy sources where appropriate and affordable (based on practical comparisons of costs and benefits from the user perspective).
 - (iv) Ensure an enabling institutional environment for implementation (linked to the communication strategy and including specific suggestions for measures to address current negative perceptions of biomass energy and raise the positive profile of the sector, tackle vested interests and incentivise new approaches). Regulatory gaps should also be identified and addressed, including (a) the conflicting definitions of “general land” between government agencies, working jointly with other players such as the REDD Task Force; and (b) the rules governing export of charcoal to and via Zanzibar, to the extent that this involves exports from the mainland.
3. A two year Action Plan assigning responsibilities for implementation of the interventions, describing institutional arrangements and suggesting funding sources where possible.

A suggested BEST structure is as follows:

1. Introduction

- Background to the Biomass Energy Strategy
- Approach to Strategy Development
- Structure of the Biomass Energy Strategy
- 2. Context for Sector Development
 - National overview
(Administration and Population, Land Use, Economy, Development and Development Assistance, Poverty Reduction Strategy)
- 3. Institutional and Regulatory Context of the Biomass Energy Sector
- 4. Energy Demand
 - Biomass and non-Biomass
 - Household and non-household
 - Commercial and subsistence
 - Employment and revenue generation
 - Future projections of demand
- 5. Biomass Energy Supply
 - Land Cover and productivity
 - Growing stock and yields
 - Supply and demand estimates
- 6. Components of the National Biomass Energy Strategy (which might include)
 - Increasing sustainable supply
 - Increasing efficiency of use and production
 - Promoting appropriate alternatives
 - Ensuring institutional capacity for implementation
- 7. Implementation Plan (complementing ongoing processes)
- 8. Annexes (which might include)
 - BEST Terms of Reference
 - BEST Timeline and implementation plan / budget
 - People consulted
 - Bibliography
 - Summary of raw data

5.3. Strategic Environmental Assessment

A Strategic Environmental Assessment is a GoT requirement for all new Policy or Strategy development and, as such, should be one of the BEST outputs.

6. Experience/ expertise required

The consultancy team supporting Got in BEST development should include both technical expertise (covering biomass energy supply assessment, sourcing, processing and consumption, as well as taxation and revenue generation) and institutional expertise (including consensus-based processes of

policy development). There should also be clear strengths in communications, lobbying and public awareness-raising.

Priority will be given to proposals that demonstrate strong commitment to using Tanzanian consultants, organizations or service providers, with prior evidence of ability to influence government policy. International experts may fill specific technical assistance roles. It is also expected that the team will identify and work with locally based advocacy groups or companies to achieve the awareness-raising outputs that are expected.

- The team coordinator must have at least a Master's degree, 10 years of progressive experience in the energy sector, policy-formulation, dialogue facilitation, strategy development and in the generation of other related tools;
- The other team members must have at least a BSc degree in the areas described in section on the composition of the consultancy team and in other related areas;
- The team members must have relevant experience in the biomass energy sector,
- Knowledge of natural resource management.
- Knowledge about the dynamics of the new and renewable energy subsector, including biomass, and about its stakeholders;
- Ability to interact with stakeholders in the biomass energy value chain and to systematize information.

7. Composition of the consultancy team

The consultancy team must comprise specialists in biomass energy, forestry, natural resource management, and economic and policy analysis or from other related fields.

8. Reporting

- A progress report should be produced after each meeting of the steering committee.
- Steering committee meetings should be held every three months.
- Copies of policy briefs, press releases and other advocacy materials should be shared with and endorsed by MEM, MNRT and EUEI PDF before release.
- A draft Strategy document should be produced on which MEM, MNRT and EUEI PDF will provide feedback before a final document is prepared.
- All other relevant documents prepared in the context of the project should be shared with the EUEI PDF management unit.
- The consultants should also prepare a PowerPoint presentation summarizing the process and content of the BEST Strategy and lessons learned from the process. .

8.1. Reporting requirements

The lead consultant closely coordinates with and reports to the EUEI PDF team in this case Ms. Ina de Visser (neeltje.de-visser@euei-pdf.org, +49 61 96 79-7108)

Close coordination is required with the MEM and MNRT focal points as well: Mr Edward Ishengoma, MEM (edwardishengoma@gmail.com ; tel: +255 755 898 679/ +255 22 2117156-9) and Mr Evarist Nashanda, MNRT (evartist.nashanda@gmail.com).

8.2. Reports to be submitted

8.2.1. **Inception report** 1 month after start of activity

8.2.2. **Progress reports** after each meeting of the steering committee (every 3 months)

8.2.3. **Interim report** 6 months after start of activity

8.2.4. **Final report** at the end of the period of execution/ one week before end of contractual period

9. Duration and Input

The strategy should be completed within 12 calendar months from the start date. The process should be linked to key milestones, with Got feedback or action required at suggested points before continuation, which should be sent out in a Gantt chart or similar format. The budget should be staged to correspond to these milestones, providing leeway for termination in the unlikely event that any of the parties fails to deliver on its expected outputs.

9.1. Consultants' input for the assignment;

Assignment of personnel: To achieve the specified objectives, the consultancy firm is expected to second

- One lead consultant (team coordinator) with up to 2 person-months
- One senior consultant with up to 1.5 person-months
- One additional consultant (e. g. junior) with up to 1 person-month
- Local consultants (at least two) for up to 3 person-months.

Expendable goods: The consultancy firm shall assume the operating costs for transportation/logistics and costs for communication and material in the partner country (costs for materials and telephone/fax etc.).

Workshops: The consultancy firm is expected to prepare, organise and finance all one-on-one meetings with key informants and influential persons, meetings with key stakeholder groups and at least three meetings/workshops to present progress, findings and analysis to the BEST steering committee at inception, at the draft reporting stage and at the final reporting stage.

Subcontracting PR firm or NGO: The consultancy firm is expected to develop the communication strategy in partnership with a Tanzanian PR firm or NGO with experience in public awareness, advocacy and information. The PR firm or NGO is to be subcontracted by the consultancy firm and costs are to be included in the financial proposal.

A.2 People Consulted

Name	Position	Organisation	Address
Aloo, Dr. Ismail	Forestry Policy & Law	TFS, MNRT	P.O. Box 9372, Dar es Salaam
Ambrose, Hermegast	Senior Project Manager	Farm Africa	Farm Africa Tanzania, Babati Office, P.O. Box 675, Babati, Manyara Region, Tanzania
Augustino, Dr Suzana	Senior Lecturer, Forestry	SUA	Department of Wood Utilization, Sokoine University of Agriculture, P.O.Box 3014, Chuo Kikuu, Morogoro, Tanzania
Azzoni, Gianluca	Head of Sector, Natural Resources	Delegation of the European Communities to the United Republic of Tanzania	Umoja House, Garden Avenue/Shabaa Robert Street, P.O. Box 9514, Dar es Salaam, Tanzania
Baissac, Robert	CEO	TPC Biomass Co-gen (Arusha)	TPC Ltd., Arusha Chini, Kilimanjaro, P.O. Box 93, Moshi, Tanzania
Banasiak, Magdalena	Climate Change Adviser	DFID East Africa, United Kingdom	Umoja House, Dar es Salaam, Tanzania
Baraki, Kaale		Tanzania Specialist Organisation on Community Natural Resources and Biodiversity Conservation	TASONABI, Sinza Plot 860 Block E, P.O. Box 8550, Dar es Salaam,

Biomass Energy Strategy (BEST) Tanzania

		(TASONABI),	Tanzania
Brown, Abigail	Africa Programme Manager	Gatsby Foundation	Gatsby Foundation, The Peak, 5 Wilton Road, London SW1V 1AP, United Kingdom
Charles, Robert	Deputy General Secretary	Evangelical Lutheran Church of Tanzania (ELCT)	ELCT, P.O. Box 3033, Arusha, Tanzania
Chogo, Gregory	Assistant General Manager	Mufindi Paper Mills Ltd	Post Box 1, Mgololo, Mufindi District, Tanzania
Daniels, Paul	CARE Tanzania		
Doggart, Nike	Senior Technical Advisor	TFCG	TFCG, Plot no. 325, Msasani Village, Old Bagamoyo Road, Dar es salaam, Tanzania
Evangelical Lutheran Church of Tanzania (ELCT)	Executive Director	Evangelical Lutheran Church of Tanzania (ELCT)	ELCT, P.O. Box 3033, Arusha, Tanzania
Faust, Amy	Consultant, Climate Change Planning	Dfid/World Bank	Umoja House, Dar es Salaam, Tanzania
al-Fayadh, Samer	Commercial Attaché	Swedish Embassy, Tanzania	Mirambo Street - Garden Avenue, P.O. Box 9274, Dar es Salaam, Tanzania
Fundi, Elida	Advocacy Officer	MJUMITA (National Community Forest Association Network)	MJUMITA, Plot no. 325, Msasani Village, Old Bagamoyo Road, Dar es salaam, Tanzania

Biomass Energy Strategy (BEST) Tanzania

Gatercole, Peter	Director	Biomass Energy Tanzania & JAAG	PO Box 31748, Dar es Salaam, Tanzania
Glauber, A.J. Ms	Chief Environmental Specialist	World Bank	World Bank, Africa Region, Sustainable Development Department, 50 Mirambo Street, P.O. Box 2054, Dar Es Salaam
Hendriksen, Gerard	Energy Advisor, Consultant, East African Community (EAC)		
Hermansen, Geir Yngve	Counsellor, Energy and Infrastructure	Royal Norwegian Embassy	P.O. Box 2646 Dar es Salaam
Ishengoma, Eng. Edward	Assistant Commissioner for Energy, Renewable Energy; Head of Renewable Energy Section	MEM	754/33 Samora Avenue, P.O. Box 2000, Dar es Salaam, Tanzania
Kaale, Bariki	TASONBI	Tanzania Specialist Organisation on Community Natural Resources and Biodiversity Conservation (TASONABI),	TASONABI, Sinza Plot 860 Block E, P.O. Box 8550, Dar es Salaam, Tanzania
Kalago, Joel	Advisor, Private Sector Development	Swiss Development and Cooperation (SDC)	Embassy of Switzerland, 79 Kinondoni Road, P. O. Box 23371, Dar es Salaam, Tanzania.
Kayanda, Elina	Director Infrastructure Unit	PMO-RALG	P.O.Box 1923 Dodoma

Biomass Energy Strategy (BEST) Tanzania

Kibopile, Anthony	Head of Policy Analysis & Tax	Ministry of Finance, Tax	Ministry of Finance
Kihenzile, Patrick	Commissioned Studies Department (Head of ESRF contract to MEM on National Energy Plan)	Economic & Social Research Foundation (ESRF)	51 Uporoto St (off Ali Hassan Mwinyi Road), Ursino Estates, P.O. Box 31266, Dar es Salaam, Tanzania
Kilahama, Dr. Felician	Consultant	Special Advisor to the FAO, Chair of FAO Committee on Forestry (COFO), former Director of Forestry, MNRT	P.O. Box 9372, Dar es Salaam
Kilewo, Fadhil	Head of Government Communication Unit	MEM	754/33 Samora Avenue, P.O. Box 2000, Dar es Salaam, Tanzania
Kiliba, Mick L.	Director, Management Services	Management Services Division, Office of the President, Public Service Management	Kivukoni Front, P.O. Box 2483, Dar es Salaam, Tanzania
Kiwele, Paul	BFPC, PFO	MEM, Renewable Energy Section	754/33 Samora Avenue, P.O. Box 2000, Dar es Salaam, Tanzania
Landa, Gabriel		Tanzania Private Sector Foundation (TPSF)	Private Sector House, Plot: 1288, Mwaya Road, Masaki, Msasani Peninsula, P. O. Box 11 313, Dar es Salaam, Tanzania
Lelievre, Manon	Marketing Specialist	ARTI (Appropriate Rural Technology Institute)	Plot 334, Kilimani Road, Mbezi Beach, P.O. Box 60055, Dar es Salaam, Tanzania

Biomass Energy Strategy (BEST) Tanzania

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