



Norwegian University of Life Sciences
Faculty of Social Sciences
Department of International Environment and Development Studies, Noragric

2015

ISSN: 1892-8102

Noragric Report No. 77

Energizing Tanzania: Strategic consideration of possible interventions to support sustainable development and use of bioenergy in Tanzania 2015 - 2025

By: Fred H. Johnsen, Mike Bess, Romanus C. Ishengoma and Lars K. Grimsby



Energizing Tanzania

**Strategic consideration of possible interventions to
support sustainable development and use of
bioenergy in Tanzania 2015 – 2025**

By

Fred H. Johnsen
Mike Bess
Romanus C. Ishengoma
Lars K. Grimsby

Noragric Report No. 77

December 2015

**Department of International Environment and Development Studies,
Noragric
Faculty of Social Sciences
Norwegian University of Life Sciences**

The Department of International Environment and Development Studies is part of the Faculty of Social Sciences, Norwegian University of Life Sciences (NMBU). The Department's activities include research, education and assignments.

Noragric Reports present findings from various studies and assignments, including programme appraisals and evaluations.

The findings, interpretations and conclusions expressed in this publication are those of the author and cannot be attributed directly to the Department of International Environment and Development Studies or the Norwegian University of Life Sciences.



Fred H. Johnsen, Mike Bess, Romanus C. Ishengoma, Lars K. Grimsby
Energizing Tanzania: Strategic consideration of possible interventions to support sustainable development and use of bioenergy in Tanzania 2015 – 2025.
Report No. 77 (December 2015)
Department of International Environment and Development Studies, Noragric
Norwegian University of Life Sciences (NMBU)
P.O. Box 5003
N-1432 Aas Norway
<http://www.nmbu.no/en/about-nmbu/faculties/samvit/departments/noragric>

ISSN: 1892-8102

Photo (cover): Charcoal collection point in Kisarawe district, Tanzania. Photo: Lars K. Grimsby, July 2015.
Cover design: Berit Hopland/NMBU

TABLE OF CONTENTS

Acknowledgements	v
Acronyms and abbreviations	vi
Executive summary	viii
1 Introduction	1
1.1 Early interventions in Tanzania's bioenergy sector	2
1.2 Biomass energy strategy (BEST) Tanzania	2
1.3 The present study	3
2 Challenges and opportunities, policy and strategy	4
2.1 Challenges to sustainable use of bioenergy	4
2.2 Opportunities for sustainable use of bioenergy	5
2.3 Ongoing policy and strategy processes in bioenergy	6
3 Ongoing and planned interventions	7
3.1 Supply side	7
3.2 Demand side	8
4 Education and research needs	9
4.1 Training	10
4.2 Research	11
5 Synergies and links with other Norwegian supported programmes	11
5.1 REDD+	12
5.2 SAGCOT	12
5.3 Clean Energy Programme	13
6 Income generation and gender equality	14
6.1 Income generation	14
6.2 Gender equality	14
7 Connection with Norwegian support to research and education	16
7.1 Norad's Programme for Master Studies (NOMA)	16
7.2 Norwegian Programme for Development, Research and Education (NUFU)	16
7.3 Programme for Institutional Transformation, Research and Outreach (PITRO)	17
7.4 Climate Change Impact Adaptation and Mitigation Programme (CCIAM)	17
7.5 Enhancing Pro-poor Innovation in Natural Resources and Agricultural Value-Chains (EPINAV)	18
7.6 Norwegian Programme for Capacity Development in Higher Education and Research for Development (NORHED)	18
7.7 Norwegian Programme for Capacity Development in Higher Education and Research for Development within the Fields of Energy and Petroleum (EnPE)	18
7.8 Drawing from research and education programmes	19

8	Possible interventions for Norwegian support	19
8.1	Relevance to Tanzania's priorities and needs, and value added of Norwegian support	19
8.2	Fit with current priorities for Norway's bilateral cooperation with Tanzania	20
8.3	Lessons learnt and partnerships from current and former Norwegian support	21
8.4	Recommended interventions for Norwegian support	22
8.4.1	A programme to promote improved cookstoves	22
8.4.2	A policy initiative to support the improved cookstoves programme	22
8.4.3	An initiative for applied research on biomass energy issues	23
8.5	Administrative requirements and fit with the ongoing and prospective support programme and portfolio of projects	24
8.5.1	A programme to promote improved cookstoves	24
8.5.2	A policy initiative to support the improved cookstoves programme	25
8.5.3	An initiative for applied research on biomass energy issues	25
9	Theory of change	26
10	Topics for further analytical work and partner institutions for policy dialogue	27
Appendix 1	Reference List	29
Appendix 2	Terms of reference	31
Appendix 3	Itinerary	41
Appendix 4	List of persons consulted	42

ACKNOWLEDGEMENTS

The team members are grateful to representatives of the Government of Tanzania as well as Non-Governmental Organisations and development partners for spending some of their valuable time to discuss with us. We are also grateful to local authorities as well as charcoal burners and transporters in Kisarawe District who shared their experiences with us.

This study was conducted under the Norad – Noragric frame agreement. All the team members have only loose connections to both institutions. We are therefore grateful for being selected to undertake such an inspiring and challenging task.

ACRONYMS AND ABBREVIATIONS

AGRA	Alliance for a Green Revolution in Africa
ANTHEI	Angolan Norwegian Tanzanian Higher Education Initiative
ARTI Energy	Appropriate Rural Technology Institute
BEST	Biomass Energy Strategy Tanzania
CA	Conservation Agriculture
CAMARTEC	Centre for Agricultural Mechanisation and Rural Technology
CCFAT	Clean Cookstoves and Fuels Alliance of Tanzania
CCIAM	Climate Change Impact Adaptation and Mitigation programme
CEP	Government of Norway's Clean Energy Programme (Initiative for Clean Energy in Development Cooperation)
CHP	Combined Heat and Power
COSTECH	Commission for Science and Technology
CTI	Confederation of Tanzania Industries
DANIDA	Denmark's development cooperation under the Ministry of Foreign Affairs
DFID	United Kingdom's Department for International Development
EnPe	Norwegian Programme for Capacity Development in Higher Education and Research for Development within the Fields of Energy and Petroleum
EPINAV	Enhancing Pro-poor Innovations in Natural Resources and Agricultural Value-chains programme
ESEPRIT	Alternative Energy for Sustainable Development, Environmental protection and Poverty Reduction in Tanzania (NUFU project)
ESMAP	Energy Sector Management Assistance Program (World Bank)
EU	European Union
EUEI PDF	European Union Energy Initiative Partnership Dialogue Facility
FINNIDA	Finnish International Development Agency
GEF	Global Environment Facility
GIZ	German Agency for International Cooperation
GoT	Government of Tanzania
GR	Green Resources Ltd.
IAP	Indoor air pollution
ICS	Improved cookstoves
kVA	Kilo-volt-ampère
LPG	Liquefied Petroleum Gas
MEM	Ministry of Energy and Minerals
MFA	Norwegian Ministry of Foreign Affairs
MJUMITA	Mtandao wa Jamii wa Usimamizi wa Misititu Tanzania (Tanzania Community Forest Network)
MNRT	Ministry of Natural Resources and Tourism
NAFORMA	National Forest Resources Monitoring and Assessment of Tanzania
NCMC	National Carbon Monitoring Centre
NEP	National Energy Policy
NGO	Non-Governmental Organisation
NICFI	Norwegian International Climate and Forest Initiative
NMBU	Norwegian University of Life Sciences
NOK	Norwegian krone

NOMA	Norad's Programme for Master Studies
NORAD	Norwegian Agency for Development Cooperation
NORHED	Norwegian Programme for Capacity Development in Higher Education and Research for Development
NTF-PSI	Norwegian Trust Fund for Private Sector & Infrastructure
NTNU	Norwegian University of Science and Technology
NUFU	Norwegian Programme for Development, Research and Education
OfD	Oil for Development programme
PES	Payment for Environmental Services
PFM	Participatory Forest Management
PITRO	Programme for Institutional Transformation, Research and Outreach
ProBEC	Programme for Basic Energy Conservation in Southern Africa
REA	Rural Energy Agency
REDD	Reducing Emissions from Deforestation and forest Degradation
REDD+	REDD plus mitigation actions
REF	Rural Energy Fund
RLDC	Rural Livelihoods Development Company
RNE	Royal Norwegian Embassy in Dar es Salaam
SAGCOT	Southern Agricultural Growth Corridor of Tanzania
SDC	Swiss Agency for Development and Cooperation
SIDA	Swedish International Development Cooperation Agency
SNV	SNV Netherlands Development Organisation (formerly Stichting Nederlandse Vrijwilligers), Dutch NGO
SUA	Sokoine University of Agriculture
TAFORI	Tanzania Forestry Research Institute
TAREA	Tanzania Renewable Energy Association
TaTEDO	Tanzania Traditional Energy Development and Environment Organisation
TDBP	Tanzania Domestic Biogas Programme
TFCG	Tanzania Forest Conservation Group
TFS	Tanzania Forest Service Agency
ToC	Theory of Change
ToR	Terms of Reference
TZS	Tanzanian shilling
UDSM	University of Dar es Salaam
UiO	University of Oslo
UNDP	United Nations Development Programme
UNIDO	United Nations Industrial Development Organization
URT	United Republic of Tanzania
USD	United States dollar
WB	World Bank (International Bank for Reconstruction & Development)
WWF	World Wide Fund for Nature (formerly World Wildlife Fund)

EXECUTIVE SUMMARY

Shortage of biomass for cooking energy has been a concern in Tanzania for several decades and several interventions have been tried out (or: tested) in order to improve the situation. Over time, the concern has become more serious due to population growth, urbanisation and increased deforestation as well as increased knowledge of the socioeconomic impacts in the firewood and charcoal sector. A team of experts formulated a Biomass Energy Strategy (BEST) for Tanzania in 2014, suggesting a wide range of interventions in the sector. In spite of the BEST report being endorsed by a steering committee with all key government ministries represented, the implementation of the BEST recommendations has not yet taken off. This is the background for the present report, which was initiated and funded by the Norwegian Agency for Development Cooperation (Norad) to identify possible interventions for Norwegian funding to support sustainable development and use of bioenergy in Tanzania based on Tanzania's policies and priorities.

The consumption of biomass energy in Tanzania is estimated at 62.3 million m³, while the allowable cut is estimated at 42.8 million m³, leaving a 19.5 million m³ deficit. This fuelwood gap, defined as the negative difference between allowable cut and actual cut, is filled by overharvesting in accessible forests and illegal harvesting in protected forests. Interventions are needed in order to fill the fuelwood gap in a sustainable way. The team therefore asked representatives of government, development partners and the civil society to suggest the most important intervention to promote in this regard. Responses included forest management plans, forest plantations, production of charcoal briquettes, biogas digesters, improved cookstoves, bioethanol production and use of natural gas, while one respondent thought the most important measure was research and education and another respondent thought that many measures should be promoted rather than concentrating on one solution.

A number of interventions are already being implemented within the energy sector in Tanzania. They include electricity production from crop residues, sustainable charcoal production, biogas production from animal wastes, and briquette production from charcoal dust and other biomass. On the demand side, there are ongoing projects focusing on improved cookstoves at the household level as well as in institutions and industries.

Sustainable production and use of biomass energy could be promoted through systematic research and training. Activities within training could include courses, workshops and seminars for researchers, curriculum development within universities and colleges, seminars for policy makers, post-graduate studies, and vocational training for charcoal burners, biogas digester technicians and stove producers. Useful topics for research on the production side include natural regeneration of forests, ecosystem resilience and vulnerability, forest management plans, fast growing tree species for fuelwood plantations, sustainable production patterns including agroforestry, utilization of bio-residues for energy, and efficient charcoal production. On the consumption side, research is needed on assessment of cookstoves produced by various artisans. Also, present and future demand for biomass energy needs to be established, and a cost-benefit analysis is needed for different energy sources and interventions.

Several existing programmes with Norwegian support touch upon bioenergy issues. These include REDD+, which addresses deforestation and forest degradation; SAGCOT, which targets agricultural development, but also promotes biogas energy; and the Clean Energy Programme, which includes a rural energy fund and a support to commercialisation of sustainable energy.

Bioenergy is important for income generation in Tanzania. The charcoal sector generates substantial incomes to charcoal producers, transporters, wholesalers and retailers. Important income generating industries like local beer brewing, baking, brick and tile production, fish

smoking, tobacco curing and tea processing depend on bioenergy resources. Income generation opportunities are also available from sectors like briquette production and biogas. Indoor air pollution from burning firewood and charcoal cause severe health impacts, particularly to women who do most of the cooking. These health impacts could be reduced substantially by using improved stoves. On the other hand, a well-designed improved cookstoves programme could give new income opportunities, particularly to women, in production and marketing of clean and efficient stoves.

Several recent and ongoing programmes supported by Norway within research and education are relevant for bioenergy issues. These include:

- Norad's Programme for Master Studies (NOMA, 2006-2014)
- Norwegian Programme for Development, Research and Education (NUFU, 1991-2012)
- Programme for Institutional Transformation, Research and Outreach (PITRO, 2009-2012)
- Climate Change Impact Adaptation and Mitigation programme (CCIAM, 2009-2014)
- Enhancing Pro-poor Innovations in Natural Resources and Agricultural Value-chains (EPINAV, 2011-2015)
- Norwegian Programme for Capacity Development in Higher Education and Research for Development (NORHED, 2013-2018)
- Norwegian Programme for Capacity Development in Higher Education and Research for Development within the Fields of Energy and Petroleum (EnPe, 2013-2019)

Based on relevance to Tanzania's priorities and needs; value added of Norwegian support; meeting current priorities for Norway's bilateral cooperation with Tanzania; lessons learned and partnerships from current and former Norwegian support; administrative requirements; and fitting into the ongoing and prospective support program and portfolio of projects, the team recommends that the focus is concentrated on three interventions:

- 1) A programme to promote energy efficient cookstoves. Rural Energy Agency (REA) is assumed to be the contract partner but is expected to subcontract Tanzania Renewable Energy Association (TAREA) for practical implementation of the programme
- 2) A policy initiative in the form of formulation and implementation of standards for cookstoves. The Vice President's Office (VPO) is assumed to be the contract partner but is expected to subcontract the Tanzania Bureau of Standards for formulation of standards.
- 3) An initiative for applied research on biomass energy issues. Sokoine University of Agriculture (SUA) is expected to be the contract partner.

A Theory of Change is formulated where the three above-mentioned interventions are expected to contribute to the long-term goal (10-year perspective) to get woody biomass growth and woody biomass consumption in balance to halt deforestation in Tanzania.

Further analytical work should be carried out to fill existing knowledge gaps. Examples of knowledge gaps include precise data on the demand for bioenergy and on the amount of available non-wood biomass. For further policy dialogue, several partners are available within the Government of Tanzania as well as among development partners, NGOs and the commercial sector.

1 INTRODUCTION

1.1 EARLY INTERVENTIONS IN TANZANIA'S BIOENERGY SECTOR

Concerns about availability of fuelwood in terms of firewood and charcoal are not new to Tanzania. The Arusha Declaration (1967) proclaimed village forestry to be a national programme, and the main objective of the efforts was to provide fuelwood (Leach and Mearns 1988).

The Government of Tanzania (GoT), assisted by its development partners and NGOs, took several steps to try to improve the fuelwood situation during the last quarter of the 20th century. These steps included promotion of tree planting, promotion of Improved Cookstoves (ICS) that would consume less wood and promotion of other energy sources that could potentially replace fuelwood.

A national tree planting campaign was launched in 1980, mainly emphasising village woodlots (Dykstra 1983). In spite of considerable resources being allocated to the campaign, tree planting did not reach a level where it could have a major positive impact on Tanzania's fuelwood supply. A survey conducted in 1983 indicated that 10,000 ha were planted annually, which was only 5% of the 200,000 ha needed to be established annually in order to achieve a sustained supply of fuelwood (Kaale 1984). In an even more pessimistic article, Mpinga (1982) claimed that 'few of the village woodlots are lasting long enough to produce usable wood'.

The potential of ICS in reducing fuelwood demand has been known for a long time. As an example, traditional open fire cooking has only 5-7 per cent efficiency, while the Indian Junagarh¹ has 30 per cent efficiency (Ishengoma 1987). In other words, the traditional technology uses about 5 times more firewood to cook the same amount of food compared to the best available technology. In spite that, rural improved stove programmes implemented in the 1980s proved mostly unsuccessful. Important lessons were however learnt, as illustrated by a stove production project in the Morogoro region. There proved to be no or very little demand for an improved firewood stove for rural areas, while, however, there was a demand for improved charcoal stoves among urban households (Sefu 1989). It is not surprising that the interest in energy saving technologies is higher among urban than among rural households when we know that fewer than 10% of rural households pay for their fuelwood, while urban households pay for the charcoal, which over 90% of all urban households use (NBS 2013).

Several *alternative energy sources* to fuelwood are possible but few of them are widely used for cooking in Tanzania. Electricity has become available to an increasing number of Tanzanians but is considered too expensive to be used for cooking. Kerosene started to compete seriously with charcoal as a cooking fuel in urban areas while it was subsidised, but its share of the fuel market dropped dramatically when the GoT gave up its kerosene subsidies. Biogas digesters have been introduced in Tanzania since the 1970s, and in the late 1990s. Kassenga (1997:259) estimated the number of biogas digesters at "more than 1,000", which is still modest in a country with several million households. Other energy sources that were discussed as early as in the 1970s and 1980s include natural gas, coal briquettes and solar power, but none of these came to a level where they had any impact on the fuelwood market in the last quarter of the 20th century.

In a review of 20th century interventions in the Tanzanian fuelwood market, Johnsen (1999:108) concludes: "Many measures against fuelwood scarcity have been suggested and implemented with

¹ A self-built, baked clay/mud two-pot household stove with chimney made with galvanized sheet metal. It was designed in India by the National Building Organization in collaboration with the Planning Research and Action Institute, Lucknow, India in 1967.

great enthusiasm. The discussion in this paper shows that most such measures have not had any significant impact on environmental degradation or availability of energy.”

Very limited success of interventions in the bioenergy sector in the last quarter of the 20th century may have discouraged the GoT and its development partners as well as NGOs and the private sector from serious attempts to address the fuelwood market in the early 21st century. However, there are at least three reasons why the time has come for renewed interest in interventions into the bioenergy sector:

Firstly, due to population growth and urbanisation, deforestation caused by unsustainable fuelwood use is more visible and more acute than it was twenty or thirty years ago. The population in Tanzania is estimated at 44.9 million according to the 2012 national census and it grows at 2.7% per year, a rate that makes the population double in 26 years (TFS 2015:1). That means, if no technical improvements or switch to other sources of cooking energy takes place, we have to expect that the demand for fuelwood also doubles every 26 years. Urbanisation means that the urban population grows at an even higher rate, and the annual growth of the population in Dar es Salaam is estimated at 5.6% (TFS 2015:1), a rate that makes the Dar es Salaam population double every 13 years. Fuelwood use is mainly in the form of charcoal in urban areas, while in rural areas it is mainly in the form of firewood. It has long been acknowledged that rural use of firewood is not as harmful to forests as charcoal burning (e.g. Bhagavan 1984). Thus, urbanisation leads to a switch from the less destructive firewood use towards the more destructive consumption of charcoal and thereby increased deforestation.

Secondly, knowledge of socioeconomic impacts of firewood and charcoal, particularly on health, has increased over the past decades. Low thermal efficiency is linked with incomplete combustion of fuel, which gives high particulate matter emissions. Chimneys are not common. There are major health impacts from indoor air pollution and burns from the three- stone fire, particularly to children. In Tanzania, indoor air pollution from cooking accounted for an estimated 18,900 deaths in 2011 (GVEP 2012). These health impacts mainly affect children and women who do the cooking. They also mainly affect poor people who cannot afford buying improved stoves, basing the cooking on alternative energy sources, or separating the cooking well away from the living rooms.

Thirdly, new approaches to development, particularly emphasising the private sector, give hope of more successful implementation of interventions. The initiatives for household energy in Tanzania in the 20th century mainly focused on the role of government institutions and to some extent the NGOs. All experience shows, however, that successful spread of technologies takes place mainly through the private sector. The mobile phone is a recent and very good example. Thus, the approach in the present report is to emphasise the role of the private sector while at the same time acknowledge the very important roles of Government and NGOs.

1.2 BIOMASS ENERGY STRATEGY (BEST) TANZANIA

In order to assist the GoT in developing a national biomass energy strategy, a team of experts with a steering committee comprising representatives from 8 GoT ministries and agencies, and five private sector and NGO groups, was organised with a mandate to identify means of (EUEI PDF 2014:88):

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.

The team of experts submitted their final report in April 2014, suggesting an action plan with five groups of actions proposed to be implemented within two years (EUEI PDF 2014:73-86):

Proposed actions within **policies and measures** included reconstituting the Biomass Energy Strategy (BEST) steering committee for the two-year action plan period, broadening the mandate, capacity and funding of the Tanzania Forest Service Agency (TFS) to enable it to support sustainable wood energy, and conducting an inventory of policies that affect biomass energy in order to mainstream biomass energy policy in all important national and local policy.

The expert group's suggested actions within **biomass energy supply** included developing and registering village forest management plans, private forest management plans, local authorities forest management plans and management plans for joint forest management areas, comprising local authorities, villages and the private sector. The proposed BEST strategy envisages that TFS will have the leading role in developing all four kinds of forest management plans. Moreover, the BEST document suggests organisation and registration of charcoal producers in order to provide training and technical assistance that will enable them to produce more efficiently and sustainably. Other actions include development of a plan and a standard for sustainable charcoal production, improvement in the collection of wood energy fees, making district authorities the only issuing body for transport licenses, and expansion of payment for environmental services.

Within **biomass energy demand**, the proposed BEST has promotion of ICS as the most important action because it is the action that is expected to achieve the fastest reduction of pressure on wood energy supplies. The private sector is expected to take the main role in production and sales, while development partners and NGOs will take a main role in awareness raising, capacity building, training, facilitating access to finance, quality assurance and promotion. The BEST document also suggests that the tobacco sector should be given particular attention by ensuring that tobacco growers plant enough trees to compensate for the use of fuelwood for tobacco curing and by assessing the potential for saving firewood by improving the tobacco curing technology.

Biomass energy alternatives addressed by BEST include biomass briquettes, biogas and forest residues. For all these three alternatives, the recommendation for the two-year action plan period is to determine whether they can be commercially viable at a sufficient scale to make a significant impact in terms of reducing the need for wood fuel production.

Five **non-biomass energy alternatives** for cooking are discussed in the proposed BEST action plan; these are kerosene, liquefied petroleum gas (LPG), electricity, coal and natural gas. For all these alternatives, the BEST action plan recommends to assess their possible contribution to reducing the pressure on wood energy supplies, rather than trying to promote any of these within the two-year action plan period.

1.3 THE PRESENT STUDY

The present study was requested by the Royal Norwegian Embassy in Dar es Salaam (RNE) and the Norwegian Agency for Development Cooperation (Norad). The complete Terms of Reference (ToR) with annexes can be found as Appendix 2 of this report. According to the ToR, the objective of the study was 'to supplement the focal country and clean energy strategies for Tanzania, by considering and providing recommendations for possible operative interventions by Norway to support sustainable development and use of bioenergy that can be included in these strategies'.

A team of four consultants, who are all authors of this report, were contracted to accomplish the study. The methodologies employed by the team included study of the secondary sources listed in Appendix 1, and a one week field work in Tanzania (see itinerary in Appendix 3). The field work comprised informal interviews with the persons listed in Appendix 4, and direct observations during a visit to a charcoal burning area as well as to a briquetting plant. The team also formulated a simple Theory of Change (ToC) which is presented in Chapter 9.

The remaining nine chapters of this report comprise one chapter for each of the nine main bullet points listed as the scope of work in the ToR (see Appendix 2 p. IV-V), but the sequencing has been slightly altered to improve the flow of the arguments. Chapter 2 identifies and summarises key challenges and opportunities for sustainable development and use of bioenergy in Tanzania. Chapter 3 describes ongoing and planned interventions in the bioenergy sector. Chapter 4 identifies education and research needs within bioenergy. Chapter 5 considers potential synergies and links with other planned and ongoing interventions in the Norwegian development cooperation with Tanzania. Chapter 6 is devoted to income generation and gender issues related to bioenergy. Chapter 7 describes the connection to Norwegian support to research and education. Chapter 8 is the most essential chapter, identifying possible interventions for Norwegian support based on the whole assessment done in Chapters 1-7. Chapter 9 offers a simple theory of change, while Chapter 10 concludes the report by suggesting topics for further analytical work and partner institutions for policy dialogue.

The team has adopted the definition of bioenergy used by the European Commission (2015): 'Bioenergy is the conversion of biomass resources such as agricultural and forest residues, organic municipal waste and energy crops into useful energy carriers including heat, electricity and transport fuels.' The team also acknowledges the distinction that bioenergy is energy contained in living or recently living biological organisms, a distinction which specifically excludes fossil fuels.

The focus in this report is on energy for household use within Tanzania, primarily for cooking. The report therefore does not go into the issue of biofuels for transport. Also, the report does not discuss any aspect of bioenergy as a possible export commodity.

2 CHALLENGES AND OPPORTUNITIES, POLICY AND STRATEGY

2.1 CHALLENGES TO SUSTAINABLE USE OF BIOENERGY

The wood deficit, defined as the negative balance between annual allowable cut of wood on the one hand, and the actual annual cut on the other hand, is assumed to be the overriding challenge in Tanzania's bioenergy sector. TFS (2015) has made the most updated estimates of allowable cut and actual cut (loss) for Tanzania in its National Forest Resources Monitoring and Assessment of Tanzania (NAFORMA). The NAFORMA assessments are based on measurements of 30,773 field plots, as well as 3,483 household interviews and 1,118 key informant interviews (TFS 2015:13-20). NAFORMA is by far the largest exercise of its kind done in Tanzania and the first inventory of woody biomass that covers the whole Tanzania mainland.

The wood balance analysis of TFS (2015:45-47), estimates the 'legally available wood', comprising annual allowable cut plus recoverable deadwood, at 42.8 million m³. The gross annual increment of all trees on the Tanzania mainland, however, is estimated to be as much as 83.7 million m³. That means about half of the woody biomass growth takes place in protected areas and is therefore not legally available for harvesting.

The annual cut of wood (total loss) is estimated at 62.3 million m³, of which 43.0 million m³ is used for satisfying household demand, 2.3 million m³ for industrial use, 14.9 million m³ is lost due to land use changes, and 2.1 million m³ is estimated to be exported, mainly illegally as charcoal. There appears to be a risk that some loss of wood has been double-counted in this estimate, since much of the wood lost by land use changes (mainly conversion to crop production) can be expected to be used for satisfying some of the household demand.

The estimated 42.8 million m³ allowable cut and the estimated 62.3 million m³ actually cut give a wood deficit of 19.5 million m³. According to TFS (2015:viii) 'this annual deficit is currently met by overharvesting in the accessible forests and illegal harvesting in protected forests', thus the conclusion that 'the current supply of wood is therefore unable to meet current demands sustainably'.

While NAFORMA gives a very thorough assessment of wood supply, the estimates on the demand side are not based on a similar amount of research. As mentioned above, there seems to be a risk that some wood loss may be double-counted. Moreover, TFS (2015:viii) admits that '... data from various sources used to estimate wood consumption were very variable. There is therefore, a need to undertake a thorough nationwide wood consumption study.'

2.2 OPPORTUNITIES FOR SUSTAINABLE USE OF BIOENERGY

Sustainable use of bioenergy will be achieved when the reduction in woody biomass is halted, both at national and at local level. For this to happen the wood deficit has to be eliminated by increasing wood supply and by reducing per capita wood demand.

BEST offers an extensive discussion of many possible measures that could contribute towards reduction of the wood deficit, as summarised in Section 1.2. While promotion of ICS is singled out as the measure that can most rapidly give a substantial reduction of the wood deficit, several supply side measures like forest management plans, improved efficiency in charcoal production, organisation and registration of charcoal producers, and improvements in the collection of wood energy fees are suggested for immediate implementation. All options for switching to other sources of cooking energy are only suggested for further research on their possible contribution to reduced woody biomass demand.

During informal interviews with representatives of government, development partners and civil society in July 2015, the team of consultants solicited opinions on what would be the most important action to take in order to reduce the wood deficit and thereby move towards sustainability in the solid biomass energy sector. Table 1 summarizes the answers that the team received.

It seems clear from Table 1 that there is a rich variety of opinions on what is most important to make the bioenergy sector more sustainable. Opinions also differ across types of organisations, but there appears to be a tendency that government organisations believe more than others in switching from solid biomass to other sources of cooking energy while development partners tend to emphasise the supply side in terms of forest management and plantations. It can also be seen from Table 1 that biogas and forest management are mentioned by three stakeholders, while ICS and forest plantations received two 'votes'. Each of the other interventions were mentioned as most important by only one stakeholder.

Table 1 Response from various stakeholders on what will be the most important intervention to promote in order to reduce the wood deficit and thereby move towards sustainability in the utilisation of solid bioenergy. (The answers range from official views on behalf of the organisation in question to personal views of the individual respondents. Therefore, the organisations are not mentioned but only categorised as government and parastatal organisations, development partners and civil society organisations.)

Type of respondent	Suggested most important intervention
Government and parastatal organisations 1	Biogas digesters
Government and parastatal organisations 2	Improved cookstoves
Government and parastatal organisations 3	Bioethanol
Government and parastatal organisations 4	Biogas for rural areas, natural gas for towns
Government and parastatal organisations 5	Proposals within several measures should be considered rather than concentrating on one solution
Development partners 1	Forest management plans
Development partners 2	Increased sustainable wood supply in terms of forest plantations and forest management
Development partners 3	Research and education on sustainable use
Development partners 4	Forest plantations
Civil society organisation 1	Improved cookstoves
Civil society organisation 2	Biogas digesters
Civil society organisation 3	Management of miombo woodland
Civil society organisation 4	Briquettes from charcoal powder and other solid biomass

2.3 ONGOING POLICY AND STRATEGY PROCESSES IN BIOENERGY

The BEST document (EUEI PDF 2014) is the most updated and extensive strategy document on bioenergy in Tanzania. The document was endorsed by the BEST steering committee, which was chaired by the Ministry of Energy and Minerals (MEM) and comprised the most relevant ministries and other government and non-government institutions. In spite of that, the team responsible for the present report could not find any serious efforts to mainstream the BEST recommendations into Tanzanian policies during its meetings with the most important Government institutions in July 2015, about 15 months after the final version of BEST was published.

A new National Energy Policy (NEP) has been drafted by MEM (2015), and two drafts have been sent to stakeholders for comments. The new NEP is still to be finalised, thus the authors of this report can only base their impressions on available drafts and information obtained through consultations with stakeholders in July 2015. When it comes to bioenergy, it is clear that biogas will be emphasised in the strategy and that the successful promotion of biogas digesters that has already been experienced through the Tanzania Domestic Biogas Programme (TDBP) will be taken further and new targets will be set. Solid biomass energy, however, is almost ignored in the draft NEP. This is surprising, since solid biomass is currently the most important energy source for the majority of Tanzanians. The lack of focus on biomass energy is also apparent from the fact that wood, which is Tanzania's most important energy source, is not even visible in the country's official statistics on energy consumption.

A new National Forest Programme for Tanzania is underway. Since that programme is not yet finalised, there is still a possibility to emphasise bioenergy from the forest as one of the main aspects. If that opportunity is also missed, solid biomass as an energy source will remain a gap in the policy and strategy efforts of the GoT.

3 ONGOING AND PLANNED INTERVENTIONS

3.1 SUPPLY SIDE

Biomass electricity from crop residues has been generated in Tanzania since the 1920s, in both the timber and sugar sectors through Combined Heat and Power (CHP) plants. Electricity from sisal wastes has been piloted since 2009 by Katani Ltd (near Tanga) through a project supported by the United Nations Development Programme (UNDP) since 2009. Norad funded a detailed 'prospectus' for the Rural Energy Agency (REA) for long-term electricity sector planning and investment (URT 2014). A major recommendation in the prospectus is to electrify 139 settlements with a combined population of nearly 450,000 inhabitants with off-grid electricity from bioenergy.

The rural electrification prospectus calls for the participation of Tanzanian and international project developers to invest in, and supply electricity to rural areas for productive use, and for households, institutions and social services for hundreds of thousands of rural Tanzanians (URT 2014). It envisages biomass gasification from crop residues and electricity generation from biogas from sisal waste. However, the biomass electricity recommendations were based upon very scant and highly aggregated biomass resource and supply information.

Currently, biomass electricity (from crop residues) is being generated in off-grid rural areas, or is in the pipeline, from several private developers, including Husk Power Systems and Ruaha Power. Additionally, four sugar companies, one pulp and paper mill and one timber company are generating electricity by utilising their own crop and wood wastes.

Sustainable charcoal has been an area of focus in Tanzania since the 'Energy 1' project of the World Bank (WB) (1988 to 1992). Charcoal from black wattle (*Acacia mearnsii*) at Tanganyika Wattle Company was pilot-produced in Njombe in the early 1990s. Sao Hills Industries, a subsidiary of Green Resources Ltd (GR), currently produces charcoal from wood wastes with the support of the European Commission's Economic Development Fund in Mufindi. This follows upon a pilot charcoal and charcoal briquette (carbonised) pilot undertaken with Norwegian Government funding in 2009 and 2010.

The Swiss Agency for Development and Cooperation (SDC) supported the Rural Livelihoods Development Company (RLDC) in efforts to produce sustainable charcoal in the Morogoro Region from 2005 to 2009. SDC now supports the second phase of a sustainable charcoal programme in Kilosa (Morogoro Region) under the programme Transforming Tanzania's Charcoal Sector with Tanzania Forest Conservation Group (TFCG). The World Wide Fund for Nature (WWF), with support from a number of sources, piloted sustainable charcoal in Rufiji between 2011 and 2013, with the intent to expand it to villages in Kisarawe, near Dar es Salaam.

Biogas from animal wastes has been a focus of NGOs and GoT since the early-1980s. The primary, and continued, focal agency is CAMARTEC (Centre for Agricultural Mechanization and Rural Technology), a Government-supported technology agency based in Arusha. CAMARTEC received support from the German International Cooperation Agency (GIZ, formerly GTZ) under two programmes, one from 1988 to 1994 and the other, ProBEC (Program for Biomass Energy Conservation) from mid-2000 to 2011.

SNV Netherlands Development Organisation (SNV) picked up where ProBEC left the TDBP. TDBP succeeded in supporting the commercial production of over 10,000 domestic biogas digesters in Tanzania by mid-2015. The TDBP supports and mobilises the private sector and NGOs throughout Tanzania, particularly in the northern and north-western parts of the country. TDBP Phase II aims to achieve a target of 10,000 additional digesters by 2017 through a NOK 15 million sub-project under the Norwegian Government (Ministry of Foreign Affairs - MFA) grant to the Rural Energy Fund (REF), administered through the REA and implemented by SNV (SNV 2015).

A Dutch company, Simgas, produces and sells **commercial biogas digesters** using household wastes in urban areas of Tanzania. They are active in Dar es Salaam, Arusha and Mwanza and state that they have sold nearly 1,000 units on a commercial basis. As noted, Katani Ltd, Tanga, has operated a 150 kVA electricity generation facility supported by the UNDP since 2011 using biogas generated from sisal wastes.

Biomass briquettes were piloted in Tanzania by TaTEDO (Tanzania Traditional Energy Development and Environment Organisation) in the late-1980s. Private producers began producing carbonised briquettes in the early 2000s, with at least two still in production, primarily targeting high-income consumers. A broader-based development approach to production and consumers has been adopted by ARTI Energy, an NGO which has been active in Tanzania for several years. Biomass briquette production is relatively limited. Several other small NGOs have been producing briquettes over the past decade.

The forestry company GR, with support from the Dutch Private Sector Investment programme has recently invested USD 1.9 million in a wood (from wood wastes) briquette production facility with a capacity of 15,000 tonnes per year. The total output of wood briquettes is currently sold to a textile mill, which is using them as a coal substitute. GR claims there is significant interest in wood briquettes from other potential buyers. Within the next 2-3 years, they expect a slump in supply of timber from the government plantations. Small-holder farmers growing timber represent an important source of raw material. The estimates of planted areas belonging to small growers is in the range of 50,000-200,000 ha.

The Royal Norwegian Society for Development (Norges Vel) in Tanzania implements a number of activities to support the bioenergy sector. Through Tanzania Renewable Energy Incubator they support entrepreneurs who engage in utilization of biomass waste as a source of energy. One of the entrepreneurs has ventured into large-scale production of pellets from sawdust.

3.2 DEMAND SIDE

ICS were first tested in Tanzania in the late 1970s after the first major oil price increases in 1973 and 1979. An urban charcoal stove, called the Jiko Bora ('best stove'), was introduced during the WB Energy I Project (1988 to 1992). This was based upon the successful hybrid South East Asian ceramic stove as the inner liner for a modified traditional East African metal stove. This was successfully introduced and widely commercialised in Kenya during the mid-1980s (and subsequently in Ethiopia and a number of other African countries).

The Jiko Bora stove was produced by Energy I project-contracted artisan metalsmiths and ceramic liner producers through the Energy I Project. Versions of the stove are still widely produced in all major urban areas in Tanzania. However, there has been little follow-up to determine how efficient and robust the stove is – i.e. how 'improved' it is. ProBEC and other NGO and donor projects have promoted this and a range of other stoves. There are currently dozens of ICS models in Tanzania, but little tangible, credible evidence exists on how improved they are relative to traditional all-metal charcoal stoves.

A number of efforts have also been made to introduce and disseminate **improved rural cook stoves**. These have ranged from self-built fixed stoves, to portable versions of wood stoves based upon the Jiko Bora. As with urban charcoal stoves, rural wood stove activities have been largely NGO- and donor-based, with little follow-up and monitoring of their impacts or long-term quality. There has been little long-term commercialisation of rural improved cook stoves.

Improved institutional stoves were first introduced by the late Prince Sadruddin Aga Khan's Bellerive Foundation in the late 1980s. These started out as stoves for commercial use, produced on a commercial basis. However, a Danida project subsidised the production and installation of hundreds of institutional stoves for schools during the 1980s and early-1990s. Commercial production of improved institutional stoves, which is very successful in Rwanda, Uganda and Kenya, has virtually ceased in Tanzania.

In an effort to address these ICS issues, SNV followed up the ProBEC project with several timely activities under a programme for “**enhancing the value chain (producers, retailers and users)**” of ICS in 2013 and 2014. They helped set up a national ICS Task Force comprising ten key stakeholder agencies and groups, including MEM, TFS, the Tanzania Commission for Science and Technology (COSTECH), TaTEDO and others. The ICS Task Force elected the Tanzania Renewable Energy Association (TAREA) as chair and established the Clean Cookstoves and Fuels Alliance of Tanzania (CCFAT).

A number of studies were commissioned by the ICS Task Force, including studies on quality control, improved marketing and commercialisation, and technical assessment on stoves found in the market place. These were intended to lay out the framework for a set of focused, commercially-oriented, private sector-led activities, supported by a programme of quality assurance and monitoring, public awareness, and producer training.

The BEST and draft national strategy recommended a major ICS programme, based upon expert review and the ICS Task Force recommendations in December 2013. BEST analyses showed that a national urban charcoal ICS programme that achieved 50% urban household penetration by 2030 (a target achieved in less time in Rwanda, Ethiopia and Kenya), could result in no net increase in total urban charcoal demand between 2015 and 2030 at a fraction of the cost of using kerosene or LPG to achieve the same, or by increasing the household use of biogas and biomass briquettes by a factor of 20 during the same period.

Industrial demand for biomass extends beyond the sugar and wood industries. Tanga Cement (Holcim) uses biomass residues to meet about 30% of their industrial heat demand, while Mbeya Cement (Lafarge) is in the process of converting some of its heat production from biomass wastes replacing coal currently used. Most tobacco processing (drying and curing) is carried out using wood for energy. Almost all tea in Tanzania is processed using wood, either purpose-grown by the tea companies or purchased from local suppliers and outgrowers.

A number of industries, including textiles, drinks, and agro-processing use wood and/or biomass residues. Wood, rice husks and other agricultural residues are used in the brick and tile small-scale industries, in beer brewing, in honey processing and in many other rural and urban small and medium enterprise uses, as well as in restaurants and hotels. Demand for fuelwood in the industrial and commercial sectors is rapidly increasing.

4 EDUCATION AND RESEARCH NEEDS

The bioenergy sector is characterized by many challenges including weak governance, weak law enforcement, illegal and unsustainable harvesting leading to deforestation and forest degradation,

licenses and levies largely evaded, inefficient production and utilization technologies, but also a perception that it is a poor man's business, considered 'dirty' and economically unattractive. The sector has remained informal, almost totally unregulated, therefore significant changes need to be introduced to regularize and legalize this sector.

Charcoal and firewood are wrongly viewed as "traditional", "inferior", as retrogressive and environmentally destructive, tolerated rather than encouraged energy sources that will grow less important, as economic development occurs and "modern" energy sources become more widely available (Grimsby 2013). Tanzania's National Strategy for Growth and Reduction of Poverty II of July 2010 holds the same vision of Tanzania transitioning from wood fuels to "modern fuels". Unfortunately there is nothing that will change that quickly. On the other hand, Tanzania has a unique opportunity to convert its large biomass resource potential into a sustainable and renewable energy asset (Ishengoma 2014).

Significant changes need to be introduced to make biomass energy more modern, more efficient, more sustainable and cleaner, both in production and use, but also to continue as an important source of livelihoods to thousands of Tanzanians. If traditional biomass energy was modernized, it could generate far reaching benefits including raising households' living standard. However, much of what is understood about biomass energy is surrounded by misinformation, scarcity in knowledge and inadequate skills.

The United Nations Industrial Development Organization (UNIDO), in collaboration with REA, Global Environment Facility (GEF), Tanzania Investment Bank, National Ranching Company, Mohammed Enterprises, and Masasi Food Industries Co Ltd, has recently launched the Waste to Energy Project for agro-industries of Tanzania to process residues from sugar cane (bagasse), sisal, rice husks, sawdust, cow dung, etc. to electricity. Through this project, Tanzania will create a learning center at Dar es Salaam Institute of Technology for agro waste conversion to energy.

On the overall, interventions to support bioenergy research and training are limited. However, the status and sustainable production and use of biomass energy could be enhanced through systematic research and training in their production and use. Enhancing Tanzania's capacity to generate and disseminate new knowledge on biomass is key in the promotion of green growth.

4.1 TRAINING

The Higher Education Policy of 1999 requires that research and training target the development and promotion of a strong indigenous base of science and technology to enable Tanzanians to solve their development problems (URT 1999). Sustainable and efficient production and use of biomass energy is among the most immediate challenges facing Tanzania.

Naturally, the training institutions are expected to provide a level of instruction necessary to develop core competences, producing suitably trained graduates with adequate knowledge base who are socially aware, and technically skilled to handle these challenges. Professional training is provided by universities and technical training by colleges/institutes, but currently there is a limited coverage of biomass energy topics among the syllabi of courses taught by institutions.

In Tanzania there are petroleum engineers and electrical engineers, but very few biomass experts, yet 90% of energy is biomass based. Consequently, biomass energy training programmes designed to develop a critical mass of trained human resources with required competence are urgently needed. Many of the courses that are currently taught at universities and colleges in Tanzania simply provide little exposure to biomass energy issues.

A comprehensive training project for biomass could be designed to ensure that existing capacity is enhanced and fully utilized, while new and forward looking capacity is generated to address future challenges and needs. Such a project could intervene at several levels:

- Re-tooling serving scientists with additional knowledge, skills and attitudes (upgrading and updating serving scientists and technicians, on bioenergy issues through approaches such as short courses, workshops, seminars) that will enable them to do a better job.
- Effecting changes in the curricula of existing colleges and universities to significantly increase the supply of skilled human resources knowledgeable on bioenergy issues.
- Conducting policy maker's seminars on biomass energy to enable better understanding. These could be 2 to 3 days (maximum one week) highly interactive sessions where policy makers, development partners, investors, and NGOs work with scientists and resource persons to gain better understanding of biomass energy issues.
- At a post-graduate level, Sokoine University of Agriculture (SUA) and the Norwegian University of Life Sciences (NMBU) could co-develop a joint programme for bioenergy, with studies/ courses established and mainly based at SUA, Morogoro, Tanzania, but using academic staff from both sides.
- Vocational training for charcoal burners, biogas digester technicians, wood and charcoal stove producers. The approach could mainly be Training of Trainers.

4.2 RESEARCH

The institutional basis for research to handle biomass issues is reasonably well developed in Tanzania, both with respect to Faculty/Departments of Forestry at SUA and the Tanzania Forestry Research Institute (TAFORI). What is often lacking, however, is enough resources to adapt research programmes and priorities to changing needs and opportunities, and to renew staff competences in emerging areas or challenges and in sufficient numbers to effectively tackle research needs (Lundgren et al. 2011). This particularly applies to challenges that require broader and more interdisciplinary research approaches, such as biomass energy. It is prudent to look upon biomass energy as an enormous economic potential for rural people, and efforts ought to concentrate on producing it (mainly fuelwood and charcoal) in sustainable ways.

In addition to cross-cutting issues such as gender, governance, climate change, population growth, urbanization, formalization of the biomass sector, and private sector participation, there are several other research issues such as:

- On the production side, natural regeneration, ecosystem resilience and vulnerability, changes in natural vegetation, biodiversity loss, land degradation, management plans for community based forest management, fast growing tree species, establishment of wood fuel plantations, small woodlots, sustainable production patterns (including agroforestry), utilization of bio-residues for energy (e.g. co-generation, briquettes,), efficient charcoal production.
- On the consumption side, assessment of "efficient" stoves produced by various artisans, health concerns, demand for various biomass energy, cost/ benefit analysis for different energy sources.

5 SYNERGIES AND LINKS WITH OTHER NORWEGIAN SUPPORTED PROGRAMMES

Tanzania is a focus country for Norwegian bilateral development cooperation and a main partner country for the Government of Norway's Clean Energy Programme (Initiative for Clean Energy in Development Cooperation, CEP). This chapter explores potential synergies and links between an initiative on bioenergy in Tanzania and on-going programmes supported through the Norwegian

embassy in Dar es Salaam (RNE). These include REDD+, the Southern Agricultural Growth Corridor of Tanzania (SAGCOT), and activities under CEP.

5.1 REDD+

REDD+ addresses deforestation and forest degradation and includes the role of conservation, sustainable management of forests and enhancement of forest carbon stocks. In 2009, Norway engaged in a programme to support Tanzanian readiness for participating in REDD+. Support for REDD+ between 2009 and 2015 was NOK 500 million, and activities included:

- Support to 9 NGOs conducting pilot projects in community based carbon monitoring and benefit sharing.
- Climate Change Impact Adaptation and Mitigation (CCIAM) programme on research and capacity building involving Tanzanian and Norwegian research institutions, coordinated by SUA.
- Zanzibar Woody Biomass Inventory.

Support from 2015 to 2018 will continue to be mainly for building capacity and strengthening institutions. Planned activities are:

- REDD+ Coordination Unit at the Vice Presidents Office.
- National Carbon Monitoring Centre (NMC) based at SUA.

The process of building capacity and strengthening the NMC and the REDD+ Coordination Unit offers opportunities for linking an initiative on bioenergy to national institutions overseeing climate mitigation and adaptation. Mechanisms and techniques for monitoring the rate of deforestation developed under REDD+ could be applied to measure the impact of an initiative on bioenergy in Tanzania. However, NMC and the REDD+ Coordination Unit will be concerned with the national REDD+ policy and coordination and reporting, and there is limited leeway for expanding their mandate to include practical interventions on bioenergy.

Links between REDD+ and an initiative on bioenergy: An initiative on bioenergy in Tanzania may be supplementary to REDD+ objectives, particularly bioenergy supply-side interventions such as those suggested in BEST (EUEI PDF 2014:75-80). Capacity built and projects established during the first phase of REDD+ may be central to implementation of an initiative on bioenergy. Several NGOs have successfully managed pilot projects on village forest management, and these can be scaled up and linked directly with supply-side activities under an initiative on bioenergy in Tanzania.

5.2 SAGCOT

The Southern Agricultural Growth Corridor of Tanzania (SAGCOT) is designed to harness the potential of smallholder farmers in the Southern Highlands through developing consortia for selected agricultural value chains. Smallholders will collaborate with large commercial enterprises. This will provide access to agricultural inputs, credit and markets for smallholders. Key investment opportunities include community forestry enterprises and bioenergy (SAGCOT 2012).

MFA has recently entered into a Private Public Partnership with the Alliance for a Green Revolution in Africa (AGRA) for support of smallholder agriculture in SAGCOT (RNE project code: TAN-12/0053). The project will run from 2015 to 2020. Details in the partnership will be decided during the one-year inception phase.

SAGCOT (2012) acknowledges that “energy supply presents a major challenge and opportunity for the future of the Southern Corridor” and identifies biogas as a technology which unlocks

synergies between the energy, agriculture, and forestry with the benefit of reducing carbon emissions. Improved household energy use with ICS is mentioned as an investment opportunity.

SAGCOT's objective is agricultural development based on integrating energy, agriculture, and forestry. Scope and target group within SAGCOT may be aligned with those of an initiative on bioenergy in Tanzania. SAGCOT's network of collaborating enterprises could be engaged to tap into the bioenergy potential in by-products from agro-processing and forestry for bioenergy.

Possible interventions to link an initiative on bioenergy with SAGCOT:

- Scaling up access to biogas through TDBP Phase II in the SAGCOT area.
- Stimulate CHP electricity generation in SAGCOT area.
- Smallholder woodlot forestry in SAGCOT for CHP in industry and charcoal briquette production.

5.3 CLEAN ENERGY PROGRAMME (CEP)

Through CEP, Norway has supported hydropower, grid extension and projects on bioenergy in Tanzania. The goal of CEP has been to improve access to clean energy at affordable prices, based on long-term management of natural resources and efficient energy consumption. Below are some activities with relevance to an initiative on bioenergy in Tanzania, supported by the RNE.

Rural Energy Fund (REF)

Norway has committed financial support of NOK 700 million from 2013 to 2018 to improve supply of energy to rural areas in Tanzania through REF (RNE project code: TAN-12/0017). Activities in the workplan have entailed developing, preparing and establishing the necessary framework and capacity to be able to reach the goal of 30 % of the population having access to electricity by 2015. The agreement for Norwegian support of REF also covers bioenergy (MFA 2013).

TDBP Phase II has recently been approved for Norwegian funding, with 1.85 million USD through REF. Biogas digester infrastructure will be co-financed as an investment discount to households, to be channelled through the private enterprises that construct the digesters.

Link between REF and an initiative on bioenergy in Tanzania: REF offers a mechanism for financing bioenergy projects in Tanzania.

Commercializing sustainable energy through TaTEDO

TaTEDO is a central actor in promoting sustainable production and use of bioenergy in Tanzania. The NGO has expertise in ICS, efficient kilns, biogas, gasification and more. TaTEDO has been implementing rural energy projects with Norwegian support over many years (Norad 2007b). The recently concluded project (2011-2015) aimed at scaling up and commercializing sustainable modern energy technologies (RNE project code: TAN-10/0032), with a budget of NOK 13.2 million. TaTEDO is a partner organisation in the TDBP and has implemented a REDD pilot project in Shinyanga. TaTEDO exemplifies the active Tanzanian NGO sector working with bioenergy.

Potential synergies between TaTEDO's capacity and an initiative on bioenergy in Tanzania:

- TaTEDO is an implementing partner in the TDBP.
- Together with other NGOs, TaTEDO could participate in a concerted action to address bioenergy.

6 INCOME GENERATION AND GENDER EQUALITY

6.1 INCOME GENERATION

In 2009, the World Bank estimated that USD 650 million were generated along the charcoal sector value chain, from wood harvesting for charcoal production to transport, wholesaling and retailing. BEST Tanzania estimated that the charcoal value chain was worth more than USD 1 billion in 2013, and that fuel wood production and sales (primarily to urban consumers, institutions, rural and urban small and medium enterprises, commercial establishments and industries) accounted for at least USD 100 million in 2013.

Traditional beer-brewing, baking, brick and tile production, fish smoking, tobacco curing, tea processing, other agro-processing using bioenergy resources (primarily wood, but, also coffee husks, rice husks, cashew wastes, cotton wastes, sisal wastes, sugar bagasse, among others) supports income generation for hundreds of thousands of rural and urban Tanzanians.

Studies carried out in Tanzania show that improved charcoal production (i.e. sustainable charcoal production, as opposed to traditional charcoal production), can double returns per kilogramme of charcoal produced, relative to traditional methods. Improving charcoal production through training, introduction of improved techniques and technologies, and organisation of producers (i.e. formalising the sector), could provide major income generation and livelihood improvement opportunities for tens of thousands of rural families (RLDC 2007; ESD/Camco 2009; SDC 2013). This does not count the environmental benefits of improved forestry management, reduction of unsustainable forestry utilisation with its negative effects of land use, watershed management and agriculture.

Briquette production from biomass, particularly from biomass residues and wastes, provides another set of opportunities for rural and urban income generation. While biomass briquetting activities have tended to be led and operated by NGOs, there are several successful commercial briquetting operations in Tanzania.

Biogas offers both opportunities for income generation and improved health in households and institutions through substituting clean biogas for often smoky, unhealthy wood and charcoal use for cooking (see below). TDBP has become a commercial success, which MFA will assist as it moves to large-scale commercialisation. Over 200 artisans are currently employed, primarily in rural areas, in producing and installing household and commercial biogas digesters (SNV 2015). BEST recommends a major acceleration of this programme to achieve utilisation in more than 100,000 households by 2020. This would have a major positive effect on income generation.

In Section 8.4.1 the team suggests that support should be availed to an ICS programme. Such a programme will give new opportunities, mainly to artisans who will produce the stoves, but also in transport and sales.

6.2 GENDER EQUALITY

MFA (2015:26) makes it clear that the Norwegian government ‘will ensure that women’s rights and the gender perspective are integrated into its work to advance private sector development. Norway will also support targeted efforts to reduce political, economic, legal and other structural obstacles to women’s participation in the private sector.’

Norad’s Clean Energy for Development Policy Platform (Norad 2007a:2) states: ‘It is often women and children who bear the largest burden of fuel collection and who are most exposed to pollution from traditional energy sources. Development cooperation on clean energy is intended to play a

part in improving the situation of women, and their energy needs and assessments of their own situation should be taken into account in planning.’ The policy platform aims at “Giving priority to projects that will reduce adverse effects on health of household use of biomass and to sustainable production of biomass” (p. 4). It will take measures ‘to reduce the negative health effects, particularly for women and children, of household use of biomass’ (p. 7).

CEP emphasises gender: ‘Through the Norwegian Trust Fund for Private Sector & Infrastructure (NTF-PSI) in the World Bank, Norway will continue to support the Energy Sector Management Assistance Program (ESMAP), with the primary goal of alleviating poverty through better access to electricity in a financially and environmentally defensible manner. Energy and women will be given special emphasis. ESMAP has been one of the few energy/infrastructure programmes that has encompassed this area’ (Norad 2009:11).

The largest area in which bioenergy has an impact on women in Tanzania is in household cooking and heating. Women and children collect the majority of firewood for rural and peri-urban (rural areas near major urban areas) household cooking and heating. Cooking in rural areas is done almost entirely on the traditional “three stone fire”, which is very inefficient relative to enclosed stoves. Further, traditional three stone fires have major health impacts, namely indoor air pollution (IAP) and burns (particularly to children). In Tanzania, IAP from cooking accounted for an estimated 18,900 deaths in 2011 (GVEP 2012).

Improved cooking practices and cooking stoves could reduce health problems from IAP, both from firewood combustion and from charcoal combustion. BEST proposes a major ICS approach that would lead to over 2 million improved charcoal stoves being in use by 2020, 4 million by 2025. This would have a significant effect of reducing IAP in urban, peri-urban and an increasing number of rural households. The Tanzania Bureau of Statistics 2012 Census (NBS 2013) shows a doubling of rural household use of charcoal from 2003 to 2012, a trend implying that 20% of rural households, or 3 million households, will use charcoal by 2022.

Tens of thousands of women cook foods, bake bread and brew beer using firewood and charcoal on a commercial, small scale basis in urban and rural areas. Beer brewing, using large quantities of firewood, is one of the largest income-generating activities for women in Tanzania and most of Sub-Saharan Africa (Kaale 1990; McCall 2001).

Women cook food and bake bread for sale using traditional three stone fires for wood and traditional, highly inefficient metal stoves from their homes, from small kiosks, restaurants and hotels throughout Tanzania. Commercial women bakers use highly inefficient ovens to bake bread, pastries and other dishes.

The vast majority of these women entrepreneurs pay for their fuel. They could benefit substantially, on both a health and an increased income-generation way, from using improved household and institutional cook stoves. Improved institutional stoves and ovens offer a cost-effective means to reduce expenditures and improve incomes, as demonstrated in Kenya, Uganda, Ethiopia and a number of other developing countries.

Production of ICS, whether for households, or for commercial and institutional uses, is another proven means to generate urban employment and incomes. Work carried out by DFID on improved stove producers in Ethiopia, Kenya and Uganda showed considerable improvements in livelihoods and income-generation over a ten-year monitoring period in those three countries (ESD 2000).

In Section 8.4.1 the team suggests that support should be availed to an ICS programme. The most certain gender effect from such a programme is that women, who most often do all the cooking in the household, will improve their health due to reduced indoor air pollution. Gender awareness

in the project design will in addition give new opportunities to women, e.g. by training women in production and marketing of ICS.

7 CONNECTION WITH NORWEGIAN SUPPORT TO RESEARCH AND EDUCATION

Research and education are important areas of development cooperation for Norway, and is 'to create synergies between higher education and technical or vocational training and other development efforts by taking an integrated approach' (MFA 2014:38). Research and education are integral parts of initiatives such as Oil for Development (OfD), CEP, and the Norwegian International Climate and Forest Initiative (NICFI).

The currently running Norwegian Programme for Capacity Development in Higher Education and Research for Development (NORHED) aims at strengthening capacity of higher education institutions 'to educate more and better qualified candidates, and to increase quality and quantity of research conducted by the countries' own researchers" (Norad 2015b). NORHED is supplemented by The Norwegian Programme for Capacity Development in Higher Education and Research for Development within the Fields of Energy and Petroleum (EnPe). EnPe is an element of OfD.

The University of Dar es Salaam (UDSM) and SUA have been main partners in research and education collaboration in Tanzania with the University of Oslo (UiO), the Norwegian University of Science and Technology (NTNU) and the Norwegian University of Life Sciences (NMBU) as main partners in Norway.

This chapter addresses 1) activities related to bioenergy in recently closed programmes and their potential synergies with an initiative on bioenergy, and 2) potential for bioenergy-related activity under NORHED and EnPe.

7.1 NORAD'S PROGRAMME FOR MASTER STUDIES (NOMA)

NOMA (2006-2014) was a programme for educational cooperation based on partnerships between higher education institutions in Norway and the Global South. NOMA contributed to education of staff in public and private sectors as well as civil society through capacity building at the Master's level in higher education institutions. NOMA had 9 projects with Tanzanian involvement, of which one is relevant to an initiative on bioenergy supported by RNE.

Project: Master Programme in Renewable Energy Systems

This NOMA project established master programmes in sustainable energy systems in East African institutions, including UDSM. NTNU was the Norwegian partner and the budget was NOK 12 million. Focus was on sustainable energy production, civil, mechanical and electrical engineering, operating of small isolated electric grids, as well as project planning and implementation and entrepreneurship. It included specialization in one of three fields, hydropower, solar energy or bioenergy. The project educated 38 MSc students. UDSM now offers the 'Master of Science in Renewable Energy' (UDSM 2015).

7.2 NORWEGIAN PROGRAMME FOR DEVELOPMENT, RESEARCH AND EDUCATION (NUFU)

NUFU (2007-2012) supported researchers and institutions in developing countries, including Tanzania, and their partners in Norway. The focus has been on research, education, capacity building and institutional development. The Tanzania – Norway NUFU Programme focused on

natural resource management. NUFU supported a variety of projects in Tanzania, one of which may be relevant to an initiative on bioenergy.

Project: Alternative Energy for Sustainable Development, Environmental protection and Poverty Reduction in Tanzania (ESEPRIT)

The scope of ESEPRIT (NOK 3.4 million) was to conduct research on processing of biodiesel and bioethanol from biomass. NTNU and UDSM were involved. It included a baseline survey to identify the potential sources of bioenergy, research on methods for production of biofuel, and optimisation of production parameters suitable for Tanzania's environment. Project participants contributed to processes of developing policy on biofuels and bioenergy in Tanzania.

7.3 PROGRAMME FOR INSTITUTIONAL TRANSFORMATION, RESEARCH AND OUTREACH (PITRO)

PITRO III (2009-2012) supported UDSM through a partnership with UiO with a NOK 18.5 million annual budget. The programme supported research projects in the fields of agriculture and resource management, education, economic development and good governance. None of the PITRO projects are directly relevant to an initiative on bioenergy in Tanzania.

7.4 CLIMATE CHANGE IMPACT ADAPTATION AND MITIGATION PROGRAMME (CCIAM)

The CCIAM programme (2009-2015, extended to 2016) focuses on promoting natural forest conservation, afforestation, reforestation and better agricultural practices for improved livelihoods related to REDD. The programme has a NOK 93.9 million budget. CCIAM is coordinated by SUA. UDSM, Ardhi University and the Tanzania Meteorological Agency are partners in Tanzania. NMBU is the main Norwegian partner. Of 15 projects and 11 'strategic interventions', several are relevant to the supply-side of bioenergy use in Tanzania. A few activities are listed below:

Project: 'Development of biomass estimation models and carbon monitoring in selected vegetation types in Tanzania'

The objective of the first project 1) is to develop equations and methods for assessing and monitoring carbon stocks in Tanzania required for implementing REDD at local and national levels. The project aims to cover all major forest vegetation types: miombo woodland, montane forests, lowland forests, *Acacia commiphora* woodland, mangroves, thickets and plantation forests.

Project: 'Economic Valuation of Incremental Biomass under PFM and its Potential to serve as Management Incentives under REDD initiatives in Tanzania'

The project evaluates the REDD model of payment for environmental services in a Tanzanian context. The project has educated MSc and PhD students through collaboration between SUA and NMBU.

Strategic intervention: 'Alternative energy sources and efficient utilization of biomass energy for reduced depletion of carbon sinks and improved livelihoods in rural areas of Tanzania'

This strategic intervention under CCIAM has a component on ICS, and is one of the CCIAM activities that have addressed the demand-side of bioenergy use in Tanzania.

Strategic intervention: 'The prospect of biogas among small-holder dairy goat farmers in the Uluguru Mountains, Tanzania'

The study investigates the potential for biogas generation from new feedstock. TDBP targets smallholder dairy cow producers. This strategic intervention looks at the possibility of also including dairy goat farmers in the target group.

7.5 ENHANCING PRO-POOR INNOVATIONS IN NATURAL RESOURCES AND AGRICULTURAL VALUE-CHAINS (EPINAV)

The EPINAV programme (2011-2016) has a NOK 72 million budget and intends to stimulate innovations for smallholder agriculture and value-chains. The programme involves researchers from SUA, NMBU and Bioforsk/NIBIO. Of 17 projects, two have relevance to an initiative on bioenergy supported by RNE in Tanzania.

Project: 'Application of Value Chain and Innovation Systems Approaches for Up-scaling and Out-scaling Technologies for Enhancing Integrated Dairy Production System in Njombe District'

The project has a component on integration of biogas technology in dairy farming. In collaboration with CAMARTEC and the TDBP the potential for recycling bio-slurry from the biogas process back into crop production is investigated. The collaboration has extended the TDBP biogas technology to more villages in Njombe district.

Project: 'Enhancing adoption of Conservation Agriculture (CA) in selected villages in Njombe District'

The project has a component on integration of biogas technology in conservation agriculture (CA). In collaboration with CAMARTEC and the TDBP the potential for recycling bio-slurry from the biogas process back into crop production is investigated. The collaboration has extended the TDBP biogas technology to more villages in Njombe district.

7.6 NORWEGIAN PROGRAMME FOR CAPACITY DEVELOPMENT IN HIGHER EDUCATION AND RESEARCH FOR DEVELOPMENT (NORHED)

NORHED (2013-2018) aims at strengthening the capacity of higher education institutions within a wide range of areas, including natural resource management, climate change and environment.

One of NORHED's sub-programmes, Natural Resource Management, Climate Change and Environment, opens for strengthening the capacity of higher education institutions on REDD and natural resource management. However, none of the four NORHED projects in Tanzania have relevance to an initiative on bioenergy (Norad 2015b). Instead, NORHED is supplemented by the EnPe programme in the area of energy.

7.7 NORWEGIAN PROGRAMME FOR CAPACITY DEVELOPMENT IN HIGHER EDUCATION AND RESEARCH FOR DEVELOPMENT WITHIN THE FIELDS OF ENERGY AND PETROLEUM (EnPe)

EnPe (2009-2014) is administered by NTNU. It has contributed education of staff in the energy and petroleum sectors in Norway's selected partner countries through building capacity at the Master level in higher education institutions. EnPe is associated with OfD in Tanzania.

Project: 'Angolan Norwegian Tanzanian Higher Education Initiative (ANTHEI)'

This is a multilateral master programme intended to strengthen national capacity in the petroleum sector in Angola and Tanzania. The budget is NOK 6 million during the period 2009-2014, and EnPe's second phase (2013-2019) supports ANTHEI with NOK 9 million. UDSM, NTNU and the Angolan University of Agostinho Netto collaborate to train professionals for petroleum engineering and geosciences at masters level. Twenty-eight Tanzanian students were enrolled in the master's program in 2014, and 10 in 2015 (Gemini 2015). Statoil supports the project financially and with professional staff.

The programme now enters a second phase (2013-2019), and 7 new projects have been approved. Two have activities in Tanzania: 'Capacity building to promote Sustainable Governance of

Petroleum Resources, Biodiversity and Livelihoods in East African Communities’ and ‘MSc in Oil and Gas Technology’. These are not relevant to an initiative on bioenergy in Tanzania.

7.8 DRAWING FROM RESEARCH AND EDUCATION PROGRAMMES

An initiative on bioenergy will have much to gain from drawing on knowledge and capacity built through previous and existing research and education programmes in Tanzania:

- The Master of Science in Renewable Energy at UDSM has an option of specialising in bioenergy, which could be linked up with an initiative on bioenergy in Tanzania.
- The expertise in institutions that have been involved in CCIAM can make significant contributions to bioenergy supply-side interventions. SUA has a Master’s degree in forestry which is relevant to the supply-side of bioenergy.
- Synergies have been made from the collaboration between SUA and CAMARTEC on biogas in EPINAV. This should be continued in TDBP Phase II.
- SUA is building capacity on biogas research through CCIAM and EPINAV. There is a need for improving research facilities for biogas for students and researchers.
- Multilateral Master’s degrees, as exemplified with the ANTHEI project, could be established to support bioenergy activities in Tanzania. Existing partner institutions already have well established modes of collaboration.
- To develop the bioenergy sector in Tanzania, vocational training could contribute on both supply- and demand side. Already existing training in forest management and bioenergy technology could be supported financially, and by stimulating to more interaction with higher education institutions in Tanzania.
- EnPe can be realigned towards bioenergy, but only several years into the future, and in the event of a continuation of the programme. Thus, funding for research and education on bioenergy will have to come from other sources.

8 POSSIBLE INTERVENTIONS FOR NORWEGIAN SUPPORT

A number of possible interventions to support sustainable development and use of bioenergy are listed in Annex II of the ToR. This chapter first elaborates on the criteria that the team is mandated to base its assessment on, and then offers the team’s opinion on which interventions that best meet the criteria.

8.1 RELEVANCE TO TANZANIA’S PRIORITIES AND NEEDS, AND VALUE ADDED OF NORWEGIAN SUPPORT

Tanzania’s current 5-year development plan (URT 2011) is the key document for information on Tanzania’s priorities. The plan acknowledges that the country’s main source of energy is biomass in the form of firewood and charcoal ‘which accounts for 85.5% of total energy consumption’ (p. 29). In spite of that, firewood and charcoal are not given any emphasis when it comes to defining policies and strategies.

At a general level and in a 15 years perspective URT (2011:6) expects that the country ‘will also benefit from its natural resource endowments ... energy sources such as coal, hydro-potentials, natural gas, geothermal, solar and wind.’ Biomass is surprisingly not considered in this context.

At a more specific level, the Tanzanian Government’s 5-year development plan defines the following 5 strategic interventions in the energy sector, expected to cost an estimated TZS 14.6 trillion, or approximately NOK 57 billion (pp. 57-58):

- 1) Increase electricity generation
- 2) Upgrade and construct new electricity transmission and distribution lines

- 3) Improve electricity supply / transmission to rural areas
- 4) Enhance the Natural Gas Development Project
- 5) Fast-track the Bio-Fuels Development Project

In the more detailed descriptions of the five above-mentioned strategic interventions (pp. 143-145), it becomes clear that item 3) above includes both grid and off-grid projects, which gives space for considering electricity from biomass (e.g., from direct combustion, gasification or biogas). Within the Natural Gas Development Project (item 4 above) there is emphasis on natural gas distribution pipelines as well as LPG extraction from natural gas, which is a potential substitute for solid biomass as a cooking fuel. The Bio-Fuels Development Project (item 5 above) is focused on sugar-based ethanol, which is also potentially a cooking fuel.

The 5-year development plan also contains policies and strategies within the forestry sector, but no forest strategy addresses specifically biomass energy. Besides, when it comes to allocation of funds (p. 81) it turns out that the intended allocation of funds to the forestry sector is only 0.16% of the total financing requirement in the plan, indicating that forestry is also not a high priority.

Tanzania's 5-year development plan is also well aligned with its Vision 2025 'Big results now', which was adopted by the GoT in 1999. Within energy, the roadmap to Tanzania's Vision 2025 points out improved transmission lines, construction of power generating projects and connections, as well as power sector reforms as the key initiatives within energy (URT s.a.: 16), while biomass as cooking fuel is not touched.

The 5-year development plan is not the most recent policy document in Tanzania, but it is the Government's overall plan at the top of the policy and strategy hierarchy. Therefore, it provides the framework that all other plans need to operate within. When the 5-year development plan does not emphasize the bioenergy issue, it is not surprising that the drafts of the upcoming NEP (MEM 2015), is almost silent when it comes to solid biomass energy (see section 2.3 in this report). For the same reason it is not surprising that most of the GoT representatives whom the team met tended to emphasise switching to non-biomass alternative fuels rather than suggesting interventions into the woody biomass sector itself.

The discussion above shows that electrification and introduction of 'modern' energy is a much higher priority than bioenergy for cooking from the GoT's point of view. It is therefore not realistic in the near future to assume activities within biomass energy for household use on a similar scale as the activities within electricity, natural gas and biofuels, estimated at TZS 14.6 trillions. Instead, the authors of this report have looked for possible bioenergy initiatives that will have a significant impact in terms of reduced fuelwood gap, reduced fuelwood costs for poor households, and reduced negative health impacts associated with fuelwood use at a modest cost.

8.2 FIT WITH CURRENT PRIORITIES FOR NORWAY'S BILATERAL COOPERATION WITH TANZANIA

Five main areas are identified for Norwegian development cooperation with Tanzania (Norad 2015a):

- Environment, climate and forests
- Management of natural resources
- Energy
- Fiscal issues and illegal capital flight
- Human rights and democracy

It seems clear that interventions in the bioenergy sector can fit into the first three bullet points above.

The actual bilateral assistance from Norway to Tanzania in 2014 included support to economic development and trade (NOK 175 million), environment and energy (NOK 156 million), good governance (NOK 56 million), education (NOK 48 million) and health and social services (NOK 45 million) (Norad 2015a). While the categories of actual grants do not quite match all the stated priority areas above, it is still clear that substantial funding is provided to initiatives within environment and energy, where bioenergy interventions could logically be in the core.

Some further direction can be found in a very recent White Paper that emphasises private sector development in Norway's development cooperation. The White Paper suggests to start the support to private sector development 'in some of the countries with which Norway already has extensive, long term development cooperation' (MFA 2015:14). Moreover the White Paper (p. 15) states that 'in its business-oriented cooperation with development countries, the Government will give special priority to energy, ICT, agriculture, fish / marine resources and maritime sectors.' From these statements, it appears that bioenergy interventions in Tanzania with focus on private sector development will fit perfectly with current priorities in Norwegian development cooperation.

This is much in line with the opening paragraph of our ToR (Appendix 2) which states: 'Currently the support includes energy, climate, agriculture and private sector development.' Bioenergy related activities clearly belong to the energy sector, and to the extent that deforestation can be halted there will also be a climate mitigation effect. Moreover, the team will suggest an intervention where private sector involvement plays a major role.

8.3 LESSONS LEARNT AND PARTNERSHIPS FROM CURRENT AND FORMER NORWEGIAN SUPPORT

It is clear from Chapter 5 that several institutions, programmes and projects supported by the RNE already play a role in bioenergy or adjacent areas, and that this role can potentially be expanded:

- Bioenergy supply-side projects could benefit from experiences made in REDD. Implementing organisations such as TaTEDO and WWF could be engaged in multi-faceted projects on bioenergy production and use, as in REDD. However, the REDD institutions will not have the capacity to continue activities.
- According to SAGCOT strategy documents, it is a potential channel for initiatives on biogas, CHP and woodlots for CHP, and charcoal briquettes. However, focus in SAGCOT is primarily on agricultural intensification. Activities on biomass production for energy among smallholder farmers would be an aspect of integrated farming systems such as agroforestry. On the other hand, agriculture would benefit from better access to electricity for irrigation, food processing (including grain milling, oil processing, etc.), and storage (e.g., refrigeration) to add value to agricultural and livestock production.
- REF offers a mechanism for financing commercial and development-based bioenergy projects. As an example, TDBP Phase II will be supported through REF.
- CCFAT, an outcome of the ICS Task Force, is coordinated by TAREA. TAREA has member organisations across the country. CCFAT may play a role in a concerted action for scaling up dissemination of bioenergy cooking technology such as ICS.
- Industrial-scale production of electricity, briquettes and pellets from biomass can be supported through NORFUND, but could be fast-tracked by making available funds for feasibility studies. The close collaboration between the RNE and GR is an example.

8.4 RECOMMENDED INTERVENTIONS FOR NORWEGIAN SUPPORT

As pointed out in Section 8.1 the team has been looking for interventions that can be expected to have considerable positive impacts at a modest cost.

Some of the relevant interventions are already supported by policies and funding. One example is electrification, which is a top priority in the GoT planning, and which already receives very substantial funding from Norway and other development partners. Another example is forest management and forest plantations, where initiatives are implemented by TFS with long-standing support from Finland.

Within such initiatives co-funding from Norway is likely to be useful. As an example, more resources are needed in order to enable TFS to enforce regulations and also to develop more forest management plans. There seems however not to be a need for Norwegian initiatives to champion these interventions. The highest potential value added of Norwegian support is likely to be seen within initiatives where there is a gap to fill in the sense that useful interventions are not yet funded, and where a modest initiative may be a catalyst for larger efforts to follow, particularly in the private sector.

8.4.1 A programme to promote improved cookstoves

It comes out clearly in the BEST report that promotion of 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' (EUEI PDF 2014:80). The technology is well known and well tested, and sufficient pilot projects have been implemented to know that the technology can be introduced successfully to a significant proportion of the urban population. An efficient ICS reduces the charcoal consumption of the household by at least 50%, thereby reducing household expenditures for charcoal and environmental impact accordingly. At the same time the use of ICS will remove most of the indoor air pollution and therefore improve people's health.

The team therefore suggests that RNE should support a new and upscaled project promoting ICS. The project should focus on improved charcoal stoves, mainly targeting the urban population, and especially Dar es Salaam, being the largest city and thereby the largest consumer market for charcoal.

Production and sale of ICS should be left to local entrepreneurs. The focus of an ICS project should therefore be as suggested by EUEI PDF (2014:81):

- 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.'

8.4.2 A policy initiative to support the improved cookstoves programme

The team considers specific policies to ensure sustainable use of solid biomass to be one of the most important needs in the bioenergy sector. Examples of policy needs within the sector include:

- Development of criteria for sustainable charcoal production. These criteria could be the basis of legislation that clearly distinguishes legal from illegal production of charcoal.
- Improvement of the fee collection practices to ensure that producers, transporters, wholesalers and retailers pay the appropriate fees.
- Development of standards for charcoal stoves. Any charcoal stove on the market should meet a certain standard in terms of energy efficiency, safety and pollution levels.

- Enabling private companies to supply electricity to the national grid at attractive prices. This would give opportunities for industries, such as sawmills and sugar factories, which can use their own biomass residues for electricity production beyond the industry's own energy needs.
- Improvement in law enforcement to avoid illegal cutting of trees.
- Improvement of land use planning practices to halt conversion of forest land to other uses.
- Development of legislation to clarify ownership of trees so that there is no open access to cutting trees.

Substantial resources are needed to seriously work on all the above-mentioned issues. The recommendation is therefore at this stage to concentrate on development of standards for cookstoves because this is the potential policy improvement that would most directly support the ICS programme recommended in section 8.4.1.

8.4.3 An initiative for applied research on biomass energy issues

As pointed out in the BEST report there are several possible activities within the bioenergy sector that may or may not become important in the future. For such interventions there is a need for applied research to find out which technologies and activities that are worthwhile to scale up. The team therefore suggests a focused applied research programme for this purpose.

Apart from ICS, where the team of this report suggests a full-scale programme, and policy issues, where the suggestion is an initiative to develop national standards for charcoal stoves, the following possible interventions are discussed in the BEST Action Plan (EUEI PDF 2014:75-86:

1. Forest management plans of four kinds: Village, private, local authority and joint forest management plans
2. Organisation and registration of charcoal producers
3. Sustainable charcoal production and certification
4. Improved collection of wood energy fees
5. National charcoal transport licensing
6. Payment for environmental services (PES) applied to sustainable forest management and sustainable charcoal production
7. Improved fuelwood use for tobacco production
8. Production of biomass briquettes
9. Biogas production
10. Utilisation of forest residues
11. Kerosene for cooking
12. LPG for cooking
13. Electricity for cooking
14. Coal for cooking
15. Natural gas for cooking

For most of the above-mentioned interventions, pilot projects are already ongoing, and for some of them, the first attempts of implementing them were made in the 1970s and 1980s as discussed in Section 1.1. The proposed research should therefore not focus on developing new technologies, but rather on the impacts of the technologies in a broad sense, such as:

- What is the potential of the technology in terms of increasing sustainable supply or reducing demand of woody biomass for energy?
- What is the cost effectiveness of each technology in terms of costs per unit of increased sustainable production or reduced consumption of woody biomass?
- What are the environmental impacts of the intervention, ranging from the global issue of carbon sequestration and emission of climate gases to local changes in the quality of water and soil?
- What are the social impacts in terms of poverty, gender issues and health?

Such research could be implemented as independent projects by senior researchers as well as support to PhD and Master degree projects. In addition to the topics listed as items 1-15 above, the research should also consider fuelwood plantations and agroforestry systems as technologies that can potentially increase fuelwood supply. From a sustainability viewpoint, items 11, 12, 14 and 15 above, which involve use of fossil fuels, may not be given emphasis.

The suggested research will need to be managed in order to ensure that it gives the answers that are needed for future projects and policy interventions in the bioenergy sector. Typical conventional research funding whereby researchers apply for funds to pursue their own research ideas is therefore not relevant in this case. On the contrary, the research needs funding specifically for the purpose and a steering committee where policy makers within GoT as well as development partners and relevant NGOs and private sector representatives participate to ensure that the research is focused on impacts of relevant interventions and that all relevant issues are covered.

8.5 ADMINISTRATIVE REQUIREMENTS AND FIT WITH THE ONGOING AND PROSPECTIVE SUPPORT PROGRAMME AND PORTFOLIO OF PROJECTS

During the team's meeting with RNE (8 July 2015) as well as during its meeting with Norad (10 August 2015) the team was informed that RNE is constrained on administrative capacity. The team has therefore made an effort to avoid increased administrative burden to RNE. Specifically, the team suggests to integrate the three proposed interventions into existing partnerships and existing or expected programmes rather than establishing new partnerships and programmes.

8.5.1 A programme to promote improved cookstoves

Since several institutions have experience in successful implementation of ICS in Tanzania the team recommends that more than one institution should be actively involved in this effort. The team wants to emphasise the following particularly:

- TaTEDO has recently concluded a project with Norwegian support on 'Scaling Up and Commercialising Sustainable Modern Energy Technologies and Services for Poverty Reduction in Tanzania'.²
- TAREA is elected chair of CCFAT and therefore an obvious local NGO to be involved in any effort on ICS.
- SNV is an NGO that already has an MoU with the RNE. SNV has extensive experience and a high reputation in promoting ICS and therefore appears as an obvious partner to involve in an upscaled ICS project.
- Norges Vel is a Norwegian NGO that is already involved in bioenergy projects in Tanzania and therefore an obvious choice for a Norwegian implementing partner to be involved in the project.
- Other members of CCFAT could also be contributors to an upscaled ICS project.

As a main partner for RNE, however, REA is the most obvious choice for two reasons. Firstly, REA is the Government institution with the overall responsibility for promoting modern energy services in rural Tanzania. Secondly, RNE already has a large agreement with REA. An additional activity on ICS could therefore be added as an addendum to the existing agreement. The administrative arrangement could therefore be:

² Contract between the Norwegian Ministry of Foreign Affairs (MFA) and the Tanzania Traditional Energy and Development Organization (TaTEDO) regarding Scaling Up and Commercializing Sustainable Modern Energy Technologies and Services for Poverty Reduction in Tanzania (SUCOSMETS-PORE). Available at <http://www.norway.go.tz/PageFiles/253880/Scaling%20up%20and%20commercializing%20TaTEDO%20Contract%20TAN100032.pdf>. Accessed on 24 August 2015.

- 1) RNE contracts REA as the main partner on a programme to promote ICS. The contract is formulated as an addendum to the existing contract between RNE and REA.
- 2) REA subcontracts TAREA for the practical implementation of the programme.
- 3) TAREA subcontracts various NGOs, private enterprises, education institutions etc. with relevant experience to ensure sufficient capacity to carry out the programme.

8.5.2 A policy initiative to support the improved cookstoves programme

In the team's meeting with the Director of the Division of Environment at the VPO it came out clearly that the Division of Environment is the right office for formulation of such policies since this division is responsible for the overall formulation, coordination and monitoring of environmental policy within GoT.

RNE is expected to enter into an agreement with VPO on establishing a REDD+ coordination unit. The agenda of REDD+ is so close to the bioenergy agenda that it appears logical to address the suggested need for a standard for cookstoves through the same agreement or as an addendum to the anticipated agreement on REDD+ coordination.

When a contract on a standard for ICS has been formulated between RNE and VPO, the latter will however have to subcontract the Tanzania Bureau of Standards for formulation of the standard, since VPO itself is neither expected to have the capacity nor the mandate to formulate technical standards.

8.5.3 An initiative for applied research on biomass energy issues

SUA is an institution that has implemented programmes with Norwegian support for several decades, and which seems to be in a good position for conducting this kind of research. SUA has two programmes under Norwegian support that are scheduled to be concluded in 2015; CCIAM³ and EPINAV⁴. From the communication that has taken place between RNE and SUA, it is clear that CCIAM will not be followed up with a new phase while EPINAV may or may not be followed by a second phase or a new programme. Assuming that a new programme under Norwegian funding is established at SUA, the team suggests that the initiative for applied research on bioenergy is formulated within this programme.

It would make sense for SUA to implement such a programme in cooperation with other Tanzanian institutions that are active within research on bioenergy, specifically UDSM and CAMARTEC. Also, over several decades SUA cooperates with Norwegian institutions of research and higher learning in its Norwegian-funded programmes. Such cooperation should be considered even within this effort, since there are strong institutions within topics like bioenergy, forestry, agriculture and impact studies in Norway. After some restructuring in the Norwegian university and R&D sector, the most important institutions for research and higher learning within agriculture, forestry and biological resources are:

- Norwegian University of Life Sciences
- Norwegian Institute of Bioeconomy Research
- Hedmark University College
- Nord University (from 1 January 2016)

³ Agreement between the Norwegian Ministry of Foreign Affairs and the Government of the United Republic of Tanzania regarding support to the programme on Climate Change Impacts, Adaptation and Mitigation in Tanzania, 2009-2014. Available at <http://www.norway.go.tz/PageFiles/253880/CCIAM%20Agreement.pdf>. Accessed on 25 August 2015.

⁴ Agreement between the Norwegian Ministry of Foreign Affairs and the Government of the Republic of Tanzania regarding development cooperation concerning 'Enhancing Pro-poor Innovations in Natural Resources and Agricultural Value-chains (EPINAV)'. Available at http://www.norway.go.tz/PageFiles/253880/EPINAV_Agreement.pdf. Accessed on 27 August 2015.

9 THEORY OF CHANGE

Theory of change (ToC) can be seen ‘as a precise planning tool’, ‘as a “way of thinking” about how a project is expected to work’, or ‘as a way of developing a politically informed and reflexive approach to development’ (Stein and Valters 2012:5). However, Stein and Valters (p. 14) also stress that ‘fully pursuing a ToC approach requires significant time and resources’. Given the limitations in time and resources, the present study cannot be very ambitious in its ToC, and therefore adopts the view of ToC as a way of thinking about how a project is going to work.

Conventional project appraisal techniques like cost benefit analysis define various project alternatives or alternative solutions to a problem and then assess the advantages and disadvantages of each alternative. ToC instead starts by defining a desired future outcome and then uses a backward mapping process in order to define the actions that need to be taken in order to get to that outcome or goal. Taplin and Clark (2012:2) define seven stages in ToC. In Table 2, the stages of ToC according to Taplin and Clark are listed in the left hand column while the team’s ToC following the same stages is listed on the right hand side.

Table 2 Theory of Change (ToC) for the solid biomass energy sector in Tanzania

Stages of ToC according to Taplin and Clark (2012)	Stages of ToC for solid biomass energy in Tanzania
Identifying long-term goals and the assumptions behind them	The long-term goal in a 10 years perspective is to have woody biomass growth and woody biomass consumption in balance to halt deforestation in Tanzania. The assumption is that in today’s situation legally available wood is 42.8 million m ³ while actual annual cut is 62.3 million m ³ causing a 19.5 million m ³ fuelwood gap as estimated by TFS (2015).
Backwards mapping from the long term goal by working out the preconditions or requirements necessary to achieve that goal – and explaining why	1) Project to support production and marketing of ICS implemented → Majority of urban populations using ICS → Charcoal demand reduced → Fuelwood gap reduced 2) Standards for improved cookstoves formulated and implemented → Producers encouraged to make higher quality cookstoves → More energy efficient cookstoves used by consumers → Charcoal consumption reduced → Fuelwood gap reduced. 3) Research on impacts of possible interventions in the energy market carried out → The most promising interventions implemented → Increased sustainable energy production and energy use efficiency → Fuelwood gap reduced
Assumptions about what exists in the system without which the theory won’t work, and rationales for why outcomes are necessary conditions to other outcomes	Assumptions: 1) The technology for producing high quality ICS is available and business oriented artisans and manufacturers can be motivated to produce ICS 2) VPO and Tanzania Bureau of Standards are willing to work on standards for cookstoves 3) Interventions can be identified that will contribute to closing the fuelwood gap in a cost effective way. Rationales: 1) Many charcoal stoves presently in the market have a low energy efficiency and therefore contribute to high charcoal demand. 2) Setting standards is necessary in order to ensure that cookstoves that are marketed as improved actually are energy efficient, safe and healthy.

	3) Insufficient knowledge exists on which out of many possible interventions can have a significant and cost-effective impact on the fuelwood gap. Thus, research on this matter is needed.
Weighing and choosing the most strategic interventions to bring about the desired change	1) A project to promote energy efficient cook stoves 2) An initiative to formulate standards for cookstoves 3) An initiative for applied research on biomass energy interventions.
Indicators to measure progress on desired outcomes and assess the performance of the initiative	Indicator on goal level: The gap between sustainable biomass harvesting and actual biomass harvesting is eliminated by 2026. Indicators on intervention level: 1) Majority of urban residents use energy efficient stoves by 2021. 2) Standards for improved cookstoves are formulated, adopted and implemented by 2019. 3) Applied research on biomass energy interventions is concluded by 2021 and the most promising interventions are implemented on a large scale by 2025.
Quality review to answer three basic questions: Is the theory 1) plausible 2) doable (or feasible) and 3) testable	1) The indicated pathways are very simple, but thereby it is easy to confirm that the described action actually will contribute to the overall goal. 2) For all three indicated interventions, institutions that are fully capable of implementing the interventions are identified. 3) All suggested indicators are measurable, making the theory testable.
Writing a narrative to explain the summary logic of the initiative	In today's situation in Tanzania, there is a gap between allowable cut of trees on one hand and firewood and charcoal production on the other hand. The ToC shows how three interventions can contribute to closing this gap. Firstly, a program to support production and marketing of energy efficient charcoal stoves should be implemented. This is considered as the single intervention that can give the fastest reduction in the fuelwood gap. Secondly, standards for cookstoves should be formulated and implemented to ensure that cookstoves marketed as ICS really are energy efficient. Thirdly, a research program should be implemented to identify other interventions that are worthwhile to implement.

10 TOPICS FOR FURTHER ANALYTIC WORK AND PARTNER INSTITUTIONS FOR POLICY DIALOGUE

Further analytical work is needed to fill remaining knowledge gaps. While NAFORMA is a thorough study of the wood supply, similar precise data on the demand side does not exist. Therefore, NAFORMA points out 'a need to undertake a thorough nationwide wood consumption study' (TFS 2015:viii). Moreover, there is a need for a broad quantitative study on non-wood biomass. Specifically, better data on residues from agricultural products like maize, rice, sugar, cashews, coffee, cotton, coconut, oil palm and sisal would be useful as a basis of assessing the potential of such sources in substituting wood as a cooking fuel. The same applies to wood wastes from sawmilling and other forest product harvesting.

The applied research program suggested in Section 8.4.3 should give plenty of scope for further analytical work. The research should be conducted within a 4-5 years' period. After that, a program should be designed to implement the most promising interventions from the research projects. While SUA and other institutions within research and higher learning will undertake the research, there may be other institutions that will have to be in the forefront when it comes to

large scale implementation of the most promising interventions after the research has been concluded.

Several competent potential **partner institutions for policy dialogue** are available:

- As pointed out in Section 8.4.1, the team suggests the Division of Environment at the VPO as the main partner for a policy initiative. Other obvious GoT institutions for policy dialogue include MEM with its responsibility for energy issues and Ministry of Natural Resources and Tourism (MNRT) with its responsibility for natural resources, and thereby also for forests. Within MNRT, specific attention should be given to the development of TFS.
- Among the development partners, the EU delegation specifically expressed interest to support follow-up of BEST during the team's visit. Both SIDA and FINNIDA have extensive experience in supporting the woody biomass sector on the supply side and are therefore interesting partners for dialogue. In addition, UNIDO implements an ongoing biomass energy program, mainly to assist industries to avoid wasting energy.
- Many NGOs are active in relevant related activities in Tanzania. TATEDO, TAREA and SNV are already emphasised in Section 8.5.1. TFCG has valuable experience with sustainable forest management and charcoal production on a pilot scale. ARTI Energy has tried several briquetting alternatives and gained valuable experience.
- Within the commercial sector, Tanzania Chamber of Commerce, Industry and Agriculture is a very competent representative of the commercial sector in Tanzania with more than 16,000 members nationally. The Confederation of Tanzania Industries is smaller in terms of members, but is very active in the energy sector. Its members include sugar factories, timber, pulp and paper and other wood industries, sisal estates, and tea companies. They have taken policy leads with Government to promote better prices for energy products, improved taxation for enterprises, improved licensing and regulation.
- The Uongozi Institute regularly engages policy makers from Government, the private sector, development partners, and others on key issues, including the biomass sector.

APPENDIX 1 REFERENCE LIST

- Bhagavan, M.R. 1984. The woodfuel crisis in the SADCC countries. *Ambio* 13 (1).
- Dykstra, D.P. 1983. Forestry in Tanzania. *Journal of Forestry* 81 (11).
- ESD 2000. Poverty reduction aspects of successful improved household stoves programmes. UK Department for International Development (Dfid), KAR Grant R7378, Project 7368, Final summary report, London.
- ESD/Camco 2009. Sustainable charcoal business plans: Case study from Kisarawe District. Pwani Region. Tanzania. WWF and Tanzania Forest Conversation Management Programme. Forestry and Beekeeping Division.
- EUEI PDF 2014. Biomass Energy Strategy (BEST) Tanzania. European Union Energy Initiative Partnership Dialogue Facility.
- European Commission (2015): Bioenergy. Webpage: https://ec.europa.eu/research/energy/eu/index_en.cfm?pg=research-bioenergy
- Gemini 2015. Gemini webpage: <http://gemini.no/notiser/2015/05/heder-fra-tanzanias-president/>
- Grimsby L.K. 2013. Bioenergy Back to Basics: Exploring Multiple Technologies across the Divide between Traditional and Modern Energy. Doctoral thesis. Norwegian University of Life sciences. 2013:49
- GVEP 2012. GVEP International and Global Alliance for Clean Cookstoves . GCCA., 2012, "Accelerating Access to Energy: Global Alliance for Clean Cookstoves - Tanzania Market Assessment – Sector Mapping". GVEP International. March 2012,
- Ishengoma, R.C. 1987. The transfer of basic technology to improve the use of woodfuels in the United Republic of Tanzania. In: The transfer of basic technology from the ECE region to other regions. ILO, Geneva.
- Ishengoma R.C. 2014. Demand and challenges of using wood fuels in Tanzania. Presentation to National Forestry Conference, Bahari Beach Hotel 3 – 4 December 2014, Dar es Salaam.
- Johnsen F.H. 1999. Burning with Enthusiasm: Fuelwood scarcity in Tanzania in terms of severity, impacts and remedies. *Forum for Development Studies* 26 (1).
- Kaale B.K. 1984. Wood fuel as a potential renewable energy in SADCC countries. In: Conference on making use of renewable energy. Professional Conferences Zimbabwe Ltd, Harare.
- Kaale B.K. 1990. Women dominate rural industries in the SADCC region. *SADCC Energy [Luanda]* 8 (22) 53–57
- Kassenga G.R. 1997. Promotion of renewable energy technologies in Tanzania. *Resources, Conservation and Recycling* 19 (4).
- Leach G. and Mearns R. 1988. Beyond the fuelwood crisis: People, land and trees in Africa. Earthscan publications Ltd., London.
- Lundgren B., Owino F., Ishengoma R.C. and Gondo P. 2011. Final report on the Planning Phase of the project 'African-Swedish Collaboration Programme on Sustainable Forest Management'. African Forest Forum Nairobi, Kenya.
- McCall M. 2001. Brewing rural beer should be a hotter Issue. *Boiling Point* No 47.
- MEM 2015. National Energy Policy (draft received 10 July 2015). Ministry of Energy and Minerals, United Republic of Tanzania.
- MFA 2013. Agreement between the Norwegian Ministry of Foreign Affairs and The Government of the United Republic of Tanzania Regarding Financial support to the Rural Energy Fund.
- MFA 2014. Education for Development, Meld. St. 25 (2013–2014) Report to the Storting (White paper), Recommendation of 13 June 2014 from the Ministry of Foreign Affairs
- MFA 2015. Working together: Private sector development in Norwegian development cooperation, Meld. St. 35 (2014–2015) Report to the Storting (White paper).
- Mpinga 1982. Tanzania: Firewood as money. *Pakistan Agriculture* 4 (14).
- NBS, 2013. Tanzania 2012. Population and Housing Census: Population Distribution by Administrative Units; Key Findings. Dar es Salaam. Tanzania: NBS and OCGS.
- NORAD 2007a. Clean Energy for Development Policy Platform (approved April 2007)

- NORAD 2007b. Review of TaTEDO. Integrated Sustainable Energy Services for Poverty Reduction and Environmental Conservation Program ISES-PRECP.
- NORAD 2009. Initiative for Clean Energy in Development Cooperation ("Clean Energy Programme"). Action plan 2009-2012
- NORAD 2015a. Tanzania factsheet. Webpage: <http://www.norad.no/en/front/countries/africa/tanzania/>
- NORAD 2015b. NORHED Webpage: <http://www.norad.no/en/front/funding/norhed/>
- RLDC 2007. Eco-charcoal project Phase I: Pilot Demonstration of Best Practice. Maseyu Village Project document for Wami-Mbiki Wildlife Management Area.
- SAGCOT 2012. A Green Growth Investment Framework for SAGCOT - The SAGCOT Greenprint, Draft August 2012.
- SDC 2013. Sustainable Charcoal Project, Proceedings from charcoal marketing survey, 23rd May 2013, supported by the Swiss Development and Cooperation Agency.
- Sefu A. 1989. An aspect of women and stove production in Tanzania – Achievements of a stove project. In: Viklund, E. (ed): Nordic seminar on domestic energy in developing countries. Lund Centre for Habitat Studies, Lund, Sweden.
- SNV 2015. Building on a Solid Foundation for Impact at Scale: Consolidating Biogas Market Development in Tanzania, SNV proposal to the REA and Norad, March, 2015.
- Stein D. and Valters C. 2012. Understanding theory of change in international development. JSRP Paper 1, Justice and Security Research Programme, Asia Foundation, London.
- Taplin D. H. and Clark H. 2012. Theory of change basics. A primer on theory of change. ActKnowledge, New York.
- TFS 2015. NAFORMA. National Forest Resources Monitoring and Assessment of Tanzania. Main results. Tanzania Forest Services Agency.
- UDSM 2015, University of Dar es Salaam Postgraduate Prospectus 2013/2014-2014/2015.
- URT 1999. National Higher Education Policy. Ministry of Science, Technology and Higher Education, Dar es Salaam.
- URT 2011. Five Year Development Plan (FYDP): 2011/12 to 2015/16: Unleashing Tanzania's Latent Growth Potentials. Office of the President, Planning Commission. June 2011,
- URT 2014. National Electrification Program Prospectus, Final Version. URT, supported by Norad, IED.
- URT s.a. Tanzania Development Vision 2025. Big results now. Roadmap. Available at <http://www.pdb.go.tz/documents/Roadmaps/00.%20Tanzania%20BRN%20Roadmap%20-%20Overview.pdf>

APPENDIX 2 TERMS OF REFERENCE

TERMS OF REFERENCE FOR STRATEGIC CONSIDERATION OF POSSIBLE INTERVENTIONS TO SUPPORT SUSTAINABLE DEVELOPMENT AND USE OF BIOENERGY IN TANZANIA 2015-2025

1. Background

Norway has a long history of development cooperation with Tanzania. Currently the support include energy, climate, agriculture, governance and private sector development.

Tanzania is both a focus country for Norwegian bilateral development cooperation as well as a main partner country for the clean energy initiative. In accordance with the Ministry of Foreign Affairs allocation letter, the Embassy will soon embark on the development of a longer-term strategy (ten years) for Tanzania as a focus country including as a main partner country for the clean energy initiative.

A key consideration for the future cooperation will be to avoid further expansion and ideally concentrate and deepen the areas of ongoing cooperation with Tanzania. Recommendations with regard potential support to bioenergy should thus be limited to support within current focal areas and integrated as far as possible with the ongoing and prospective future portfolio of support.

Key features of ongoing (and planned) Norwegian development cooperation with Tanzania within energy, climate, agriculture and private sector development are found in Annex I.

2 Justification - tentative considerations why Norway should engage in bioenergy

Economic importance of bioenergy in Tanzania:

- Bioenergy meets about 90 per cent of the energy needs. About 40% for cooking need in peri-urban areas and 96% of cooking needs of rural population.
- Biomass in the form of charcoal and fuel wood provides incomes and employment for millions of people in the rural areas. Energy poverty leads to economic poverty.
- Reduces reliance on imported petroleum products by promoting biofuels (bioethanol and biodiesel).
- Effective and efficient use of bioenergy would contribute to meeting key Millennium Development goals.

Environmental and health importance of bioenergy:

-
- Energy demand in Tanzania has grown rapidly due to population growth and the increase in economic activities during the last 15 yrs.
- The estimated total energy annual consumption is about 22 million tonnes of oil equivalent (TOE).

- Annual energy deficit is **15.7m³** that is harvested from conserved and village land forests thereby causing deforestation and degradation (over 450,000 ha cleared) at 40m³/ha.

Rate of deforestation and degradation of Tanzania's forest.

- Charcoal key contributor to forest degradation. Tanzania's total annual charcoal consumption is estimated at 1 million tons, with about 500,000 tons used in Dar es Salaam alone. The annual supply of wood needed to meet this demand is about 30 million cubic meters (Chaposa 2002, WB, 2012). Harvesting trees from natural forests to meet daily needs of fuels in the form of charcoal for cooking in urban areas is a big problem that has for many years continued to cause degradation of forests and woodlands in Tanzania.
- Indoor air pollution from burning biomass for cooking is a major health concern. According to WHO, over 4 million people globally die prematurely from illness attributable to the household air pollution from cooking with solid fuels. More than 50% of premature deaths among children under 5 are due to pneumonia caused by particulate matter (soot) inhaled from household air pollution.

3 Objective

The main purpose of this consultancy is to supplement the focal country and clean energy strategies for Tanzania, by considering and providing recommendations for possible operative interventions by Norway to support sustainable development and use of bioenergy that can be included in these strategies.

4 Scope of Work

The assignment includes the following tasks:

- Identify and summarize key challenges and opportunities for sustainable development and use of bioenergy in Tanzania. Provide an update on and assess the ongoing policy and strategy processes in this area.
- Map out and assess the relevance and status of ongoing and planned interventions by the Government of Tanzania, other Development Partners as well as major interventions by civil society organizations.
- Identify and map out education and research needs in bioenergy.
- Consider potential synergies and possibilities to integrate priority areas of support and ongoing (and planned) interventions in the Norwegian development cooperation with Tanzania. Particular emphasis should be on how the clean energy programme could be more relevant for climate and environment priorities.
- Identify and assess opportunities to enhance income generation activities and gender equality.
- Identify and propose interventions for Norwegian support based on the following criteria:
 - Relevance to Tanzania's priorities and needs, and value added of Norwegian support.
 - Fit with current priorities for the bilateral cooperation with Tanzania, including increasing access to affordable and modern energy services, promoting renewable electricity production and access, addressing drivers for forest degradation and deforestation, promoting private sector development, local economic development, employment opportunities and agricultural development.
 - Lessons learnt and partnerships from current/former Norwegian support in relevant/adjacent areas, including the REDD+ pilot projects.

- Administrative requirements and fit (thematically and institutionally) with the ongoing and prospective support program and portfolio of projects.
- Fit with Norwegian application based support schemes to research and education.
- Formulate a clear theory of change (ToC) and provide practical recommendations to operationalize the proposed interventions. This will be discussed with the Embassy during the meeting in June
- Propose topics for further analytical work and recommend partner institutions for policy dialogue.

A non-exhaustive list of possible interventions indicated in annex II for further consideration.

5 Implementation

Team composition

A team of up to three persons, including at least one Swahili speaking consultant hired locally.

The team is required to have in-depth knowledge of and experience in the following areas:

- Bioenergy Supply Side and Demand Side Management
- Private Sector Development (formalisation of value chains)
- Climate policy and environment
- The energy sector (policy, institutional and technical aspects)
- Social issues (poverty, gender and social inclusion)
- Contextual Tanzanian economic and political issues
- Development cooperation, including knowledge of Norwegian development priorities

6 Timeframe

<u>No</u>	<u>Activity</u>		<u>Proposed</u>
<u>1</u>	<u>Formal request to NMBU over frame agreement</u>		<u>26.05.2015</u>
<u>2</u>	<u>Meeting Embassy</u>		<u>08.06-10.06.2015</u>
<u>3</u>	<u>Inception report</u>		<u>17.06.2015</u>
<u>4</u>	<u>Field work Tanzania</u>	<u>7 days in this period</u>	<u>06.07-17.07 2015</u>
<u>5</u>	<u>Final draft report</u>		<u>14.08.2105</u>
<u>6</u>	<u>Comments from Norad/Embassy</u>		<u>14.08.2015</u>
<u>7</u>	<u>Final report</u>		<u>21.09.2015</u>

The review team shall undertake a desk-study of relevant documents, including those mentioned in annex III (and undertake interviews with key informants in Norway).

A one-week mission in July 2015 to interview key institutions and stakeholders in Tanzania.

Preparation of an inception report for comments prior to the mission. Based on the inception report and the dialogue with the Embassy/Norad more details regarding the mission will be decided upon.

7 Reporting

The final report shall be written in English and the main report shall not exceed 30 pages. The report shall make concrete recommendations as to possible areas of interventions based

on the outcome of this exercise. The final report shall be submitted in soft copy and five (5) hard copies which shall include the following:

- 1 Executive summary with key recommendations
- 2 Main body of the report in line with ToR (max 30 pages)
- 3 Annex(es) can be used to provide more in depth analysis/information if needed

Dar es Salaam, May 2015

Hanne Marie Kaarstad
Ambassador

Annex I

Development cooperation portfolio

Environment and Climate Change:

In 2009 Tanzania embarked on an ambitious programme in support of Tanzanian readiness to participate in a results based regime for verified Reducing Emissions from Deforestation and Forest Degradation (REDD+)

The sum committed by Norway in support of REDD+ was 500 Mill NOK in 2009. By 2015 this original sum has largely been spent in support of misc. REDD+ readiness initiatives or has been committed.

The main activities supported during the REDD+ readiness support are:

- Climate Change Impact Mitigation and Adaptation – research and capacity building (MSc and PhD) at Sokoine University of Agricultural (SUA).
- Support to National REDD+ task force secretariat under Institute of Resources Assessment at University of Dar es Salaam.
- UNREDD
- Zanzibar Woody Biomass Inventory
- Support to 9 NGOs conducting Pilot Projects in piloting community based carbon monitoring and benefit sharing (7 of these were successfully completed).
- Research project in the application of advanced remote sensing for forest carbon tracking (Collaboration between SUA and Norwegian partner institutions).

The above projects either have been completed or are coming to an end in 2015. The following two are about to start up and will run from 2015 to 2018:

- REDD+ Coordination Unit at Vice presidents Office (overall coordination of REDD+).
- National Carbon Monitoring Centre (NCMC) based at SUA (Monitoring Reporting and Verification of Carbon Emissions)

As the support under Environment and Climate Change mainly relates to building capacity and institutional strengthening. The few projects (NCMC and REDD+ coordination Unit) that will still be active after 2016 offer an opportunity to connect to the formal national institutions while they are being established – but considering they are concerned with national REDD+ policy and coordination and reporting there is likely little scope for practical interventions.

Business and other services

During 2015 MFA is expected to enter into a Private Public Partnership with Alliance for a Green Revolution in Africa (AGRA) for inclusive green growth of smallholder agriculture in SAGCOT. Start up is awaiting political approval. Intention is to engage the potential of smallholder farmers in the Southern Highlands through developing consortia for selected agricultural value chains – thereby providing access to agricultural inputs, credit and a guaranteed market for the increased production for the smallholders. As much of the detail to the program will be added during the initial 10 months inception phase and as the project will extend to ground level – the possibility establishing synergies with this project would appear to be present. In order not to undermine the ownership of the project any proposals for collaborations would have to go through the formal management structures of the project. If political approval to go ahead with the project is

given, it will consist of a 1 year inception phase (9 mill NOK) and a 4 year implementation and upscaling phase. I.e. 2015 – 2020

Clean Energy Portfolio 2015

Rural Energy Agency/Rural Energy Fund (ongoing)

Biofuels Policy Framework (Sweden lead, to be completed 2015)

TaTEDO ICS programme (suspended)

EWURA capacity building (early planning stage)

Annex II

Tentative list of interventions for further consideration

Possible intervention	Partner institution	Source. Status
Mainstream biomass energy in all essential national and local policy (national energy policy, MKUKUTA, Five Year Development Plan, climate change and other environmental policy, etc.)	VPO/Min Env. Other Champion?	BEST recommendation. BEST still to be adopted
DSM: Biogas Market Development in Tanzania. Target: 20,700 digesters by end 2017.	REA, SNV and Cammertech	Proposal to be submitted to the Embassy for no-objection.
DSM: Country Action Plan for Clean Cookstoves and Fuels	REA, SNV and TAREA	Implementation plan to be elaborated. Not considered yet by REA.
DSM: Support for cooking fuels alternatives	EWURA. REA. MEM	Proposal in draft revised Energy Policy
SSM: Electricity production based on biomass. Mapping of potential for off grid and national supply. Facilitation of investments.	REA. EWURA. TANESCO	Rural Electrification Prospectus. Draft revised Energy Policy.
SSM: Electricity production based on biomass (rice husks, bagasse, sisal). Support to agroforestry/energy plantations.	SAGCOT/AGRA	
Biofuels	SAGCOT/AGRA Forestry Development Trust	
Aligning activities with the recommendations of the National Forest Programme (Currently under revision)	MNRT	

DSM: Supporting large scale institutions switch from wood based energy.	Prisons, National Service and Ministry of Education, churches.	
Establish a few urban demonstration sites for best practices diversification of energy supply + recycling etc. Greener and safer urban environment.	A few selected neighbourhoods with committed citizens.	
DSM Incubators for young energy entrepreneurs. Competitions -	COSTECH, MEM, ILO, UNDP	

Annex III

Documentation, key sector institutions and contact persons

- Biomass Energy Strategy (BEST) Tanzania, Final Report, April 2014, Camco/MEM
- National forestry, climate change and environmental policies
- National Energy Policy 2015, draft Jan 2015 (MEM)
- The National Energy Policy 2003. MEM
- Analysing Biquette Markets in Tanzania, Kenya and Uganda. Energy and Environment partnership/ Southern and East Africa. EEP. 2013.
- Tracking Clean Energy Progress 2013. IEA input to the clean energy. International Energy Agency.
- Biomass Energy Potential: Opportunities and Challenges for Tanzania. Ishengoma R. MEM. 2013.
- Value Chain Study on the Renewable Energy and Biofuels Industry in the EAC region. Eastern African Community, Industrial Development Department. MARGE and African Solar Designs 2013
- Status of Renewable Energy and Bio-fuels Development in Tanzania. Paper presented to the National Consultative Forum on Renewable Energy including Biofuels Value Chain 24th January, 2014, Serena Hotel – Dar es Salaam. Ministry of Energy and Minerals – Tanzania.
- National Liquid Bioenergy Policy (final Draft 2). MEM.. 2013
- Tanzania National Forest Resources Monitoring and Assessment (NAFORMA) Brief report. Tanzania Forest Services Agency 2013
- An Overview of The Forestry And Beekeeping Sub Sector: Achievements, Challenges And Priorities For Financial Year 2014/15. MNRT. 2014.
- Status of Energy in Rural Tanzania and Implication to Poverty Reduction. MEM. Mwiha N. C.2006
- Baseline Survey Report for Energy Access and Use in Tanzania Mainland - Rural Energy Agency, Ministry of Energy and Minerals 2011
- Nationally Appropriate Mitigation Action Study on Sustainable Charcoal in Uganda. United Nations Development Programme 2012.
- National Strategy for Growth and Poverty Reduction. President's Office, Ministry of Planning, Economic and Empowerment. Dar es salaam, Tanzania 2005.
- National Climate Change Strategy. Vice President's Office Division of Environment 2012.
- Environmental crisis or sustainable development opportunity: Transforming the charcoal sector in Tanzania. World Bank. 2009.
- Wood Based Biomass Energy Development for Sub-Saharan Africa: Issues and approaches. World Bank. 2011.
- Consolidating Biogas Market Development in Tanzania, Project Proposal, SNV April 2015
- Country Action Plan for Clean Cookstoves and Fuels, TAREA, TaTEDO, SNV July 2014
- REA Programme Agreement
- National Rural Electrification Prospectus, REA/MEM, 2014

Government

Ministry of Energy and Minerals, Paul Kiwele, Asst Commissioner for Renewable Energy,
kiwele@mem.go.tz

MNRT, Forestry and Beekeeping Division, Evarist Nashanda, Principal Forest Officer,
evartist.nashanda@gmail.com

VPO, Division of Environment, Dr. Constantine Shayo, Principal Officer, vpodoe@intafrica.com
cmshayo@yahoo.com

Prime Minister's Office, Regional Administration and Local Government, Francis Sekibaha, Co-ordinator, Environment and Natural Resources, fsekibaha@yahoo.co.uk
NEMC, Eng. James Ngeleja, Principal Environment Management Officer, jlngeleja@gmail.com
Rural Energy Agency, Dr Lutengano Mwakaheysa, Director General, dg@rea.go.tz Gissima Nyamo-Hanga, gnyamo-hanga@rea.go.tz
National Land Use Planning Commission, Gerald Mango, Director general, dg@nlupc.org
Tanzania Commission for Science and Technology, Dr Hassan Mshinda, Director General, dg@costech.or.tz
Small Industries Development Organisation, Emmanuel Saigurani, dtdp@sido.go.tz
Tanzania Industrial research and Development Organisation, Dr Asifa Nanyaro, Director General, info@tirdo.org
Centre for Agricultural Mechanisation and Rural Technology, Elda Kaaya, Extension Officer, camartec@hotmail.com

Research Institutions

National Forestry Resources Monitoring and Assessment (NAFORMA)
Institute of Resource Assessment, UDSM, Prof. P.Z. Yanda, Director
Faculty of Forestry and Nature Conservation, SUA, Prof George Kajembe, Professor Forestry and Forest Economics
Centre for Energy, Environment Science and Technology Foundation, Hubert Meena, Director
Economic and Social Research Foundation, Prof. Bohela Lunogelo, Executive Director

Non-Governmental Organisations

Tanzania Renewable Energy Association (TAREA)
Tanzania Traditional Energy Development and Environmental Organisation (TaTEDO)
Tanzanian Community Forest Conservation Network (MJUMITA)
Tanzania Forest Conservation Group
CARE International in Tanzania
ARTI/Joint Environmental Techniques
Cleaner production Centre of Tanzania
Others?

Private Companies

Tanganyika Wattle Company, Njombe
Sao Hill Sawmill Industries / Green Resources AS
Kilimanjaro Industrial Development Trust, Moshi
Kilombero Sugar Company, Kidatu
Kagera Sugar Limited, Bukoba
Tanganyika Planting Company, Kilimanjaro
Kilombero Rice Farm,
Others?

Development Partners

Finland
Germany/GIZ
Sweden
Switzerland
UNDP and ILO
World Bank
EU Delegation Tanzania
Others?

APPENDIX 3 ITINERARY

Date	Activity
5 July	<ul style="list-style-type: none"> • Team meeting
6 July	<ul style="list-style-type: none"> • Meeting with Ministry of Energy and Minerals (MEM) • Meeting with Ministry of Natural Resources and Tourism (MNRT) • Meeting with Indufor (an international consulting group within forestry) • Meeting with Tanzania Traditional Energy Development and Environment Organisation (TaTEDO)
7 July	<ul style="list-style-type: none"> • Field trip to Kisarawe district, observing degraded forest sites and meeting charcoal burners, charcoal transporters and local authorities
8 July	<ul style="list-style-type: none"> • Meeting with the Royal Norwegian Embassy (RNE) • Meeting with the Rural Energy Agency (REA) • Meeting with the Tanzania Rural Energy Association (TAREA)
9 July	<ul style="list-style-type: none"> • Meeting with Tanzania Forest Conservation Group (TFCG) and Tanzania Community Forest Network (MJUMITA) • Meeting with Appropriate Rural Technologies Institute (ARTI) and visiting ARTI Energy's production unit for charcoal briquettes • Meeting with Swiss Agency for Development and Cooperation (SDC) • Meeting with the European Union (EU) delegation to Tanzania • Meeting with the United Nations Industrial and Development Organisation (UNIDO)
10 July	<ul style="list-style-type: none"> • Meeting with the Vice President's Office (VPO) • Meeting with NIRAS (An international consultancy company) • Meeting with the Commission for Science and Technology (COSTECH)
11 July	<ul style="list-style-type: none"> • Team meeting

APPENDIX 4 PERSONS CONSULTED

Azzoni, Gianluca	First Counsellor, Head of Section for Natural Resources, Delegation of the European Union to Tanzania
Chinjala, Japhari H.	Energy Engineer, Ministry of Energy and Minerals
Dalsgaard, Søren	Consultant, Royal Norwegian Embassy
Daudi, Mbwambo Z.	Directorate of Resources Management, Tanzania Forest Services Agency (TFS)
Doggart, Nike	Senior Technical Advisor, Tanzania Forest Conservation Group (TFCG)
Hermansen, Geir Y.	Counsellor, Energy and Infrastructure, Royal Norwegian Embassy
Kabepele, Ponjoli J.	Programme Officer, Natural Resources, Delegation of the European Union to Tanzania
Kigully, Cosmas L.	Energy Engineer, Ministry of Energy and Minerals
Kiwele, Paul	Acting Assistant Commissioner for Renewable Energy, Ministry of Energy and Minerals
Lelievre, Manon	Projects Manager, ARTIEnergy
Luwuge, Bettie	Communication Officer, Tanzania Forest Conservation Group (TFCG)
Lyimo, Leonard	Coordinator, National Forest and Bee Keeping Programme
Lyimo, Reginald	District Forest Officer, Kisarawe District Council
Mafuru, Paulin M.	Assistant Director, Forest Development section, Forestry and Beekeeping Division
Matimbwi, Matthew	Executive Secretary, Tanzania Renewable Energy Association (TAREA)
Mauderli, Ueli	Head, Rural Development Sector - Economic Officer, Swiss Agency for Development and Cooperation (SDC)
Melchior, Clara	Program Officer, Swiss Agency for Development and Cooperation (SDC)
Meshack, Charles	Executive Director, Tanzania Forest Conservation Group (TFCG)

Michael, Emmanuel	National Energy Projects Coordinator, UNIDO
Mkamba, Gladness A.	Acting Director, Forestry and Beekeeping Division, MNRT
Mkumbwa, Waziri	Assistant District Forest Officer, Kisarawe District Council
Mnzava, Andrew	Senior Research Officer, COSTECH
Morgan-Brown, Theron	Technical Adviser, Mtandao wa Jamii wa Usimamizi wa Misitani Tanzania (MJUMITA)
Msofe, Eng. Bengiel H.	Director, Technical Services, Rural Energy Agency (REA)
Mwakaheya, Lutengano U. A.	Director General, Rural Energy Agency (REA)
Mäkelä, Merja	Senior Consultant, Niras
Ng'atigwa, Charles	Principal Forest Officer, Forestry and Beekeeping Division
Ningu, Dr. Julius	Director of Environment, Vice President's Office
Nkeleke, Cheyo A.	District Land and Natural Resources Officer, Kisarawe District Council
Potnis, Nachiket W.	Executive Director, ARTI Energy
Sawe, Estomih	Executive Director, TaTEDO
Selänniemi, Thomas	Chief Technical Advisor, National Forest and Bee Keeping Programme
Shuma, Jensen C.	Senior Manager, TaTEDO
Simon, Godbert	Forest Officer, TFS checkpoint
Studsørd, Jan Erik	Senior Advisor, Norad
Swai, Mary	Project Manager, TaTEDO
Yonakusimula, Yoab	Forest Officer, TFS checkpoint