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Nationally Appropriate Mitigation Action Study on Sustainable Charcoal in Uganda

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Acronyms

BAU	Business-as-usual
BEST	Biomass Energy Strategy
BTC	Belgium Technical Corporation
BUR	Biennial update report
CCU	Climate Change Unit
CDM	Clean Development Mechanism
CERs	Certified emission reductions
CH_4	Methane
CIM	Centre for International Migration
cm	Centimetres
CME	NAMA coordinating and managing entity
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
COP	Conference of the Parties
CSO	Civil society organization
EAP	Environment Action Plan
EB	Executive Board
EE	Energy efficiency
EPAC	Energy Policy Advice Component
FAOSTAT	Food and Agriculture Organization Corporate Statistical Database
GEF	Global Environment Facility
GHG	Greenhouse gas
GIS	Geographic information system
GIZ	German Agency for International Cooperation (Gesellschaft für Internationale Zusammenarbeit)
hp	Horsepower
hr	Hours
ICA	International consultation and analysis
IRIN	Integrated Regional Information Networks
KfW	Reconstruction Credit Institute (Kreditanstalt für Wiederaufbau)
kg	Kilogram
km	Kilometer
kW	Kilowatt
kWe	Kilowatt equivalents
kWh	kilowatt hour
LDCs	Least developed countries

LPG	Liquefied petroleum gas
LSC	Large scale
MEM	Ministry for Energy and Minerals[1]
MEMD	Ministry of Energy and Mineral Development
MRV	Measurement, Reporting and Verification
MNRT	Tanzanian Ministry of Natural Resources and Tourism
MoFPED	Ministry of Finance, Planning and Economic Development
MW	Megawatt
MWLE	Ministry of Water, Lands and Environment
MWE	Ministry of Water and Environment[2]
NAMA	Nationally Appropriate Mitigation Action
NCV	Net calorific value
NEA	National Environment Act
NEAP	National Environment Action Plan
NEMP	National Environment Management Policy
NFA	National Forestry Authority
NFP	Uganda National Forestry Policy
NGOS	Non-governmental organizations
NPA	National Planning Authority
NTF	National Task Force for Biomass Energy
RE	Renewable energy
SBL	Standardized baseline
SME	Small- and medium-sized enterprises
SSC	Small-scale
t	Metric tonne
tCO_2e	Metric tonnes of CO_2 equivalents
TJ	Terajoule
UGX	Ugandan shilling
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
WB	World Bank
WE	Wood equivalent
X_{NRB}	Non-renewable biomass

[1] Formally Ministry of Energy and Mineral Development (MEMD).

[2] Formally Ministry of Water, Lands and Environment (MWLE).

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Foreword

The objective of this NAMA study is to provide Uganda with an important opportunity to help shape its future low carbon development. Not only would the implementation of an improved charcoal value chain NAMA help Uganda to increase the efficiency and effectiveness of the current value chain, it would enable the country to remove a major driver of deforestation while increasing energy security and sustainability.

The NAMA, once fully developed and approved, would be integrated with other relevant UNDP initiatives in Uganda, in particular the Low Emission Capacity Building Programme, which is part of a larger UNDP low-emission climate programme and addition to the GIZ Biomass Energy Strategy initiative to develop short-, medium- and long-term interventions to achieve sustainable management of biomass energy resources. The NAMA would also be integral to the recently approved UNDP-implemented and Global Environment Facility financed projects in the charcoal sector related to addressing barriers to the adoption of improved production technologies and sustainable land management practices.

UNDP recognizes that the charcoal sector provides some of the most important opportunities to not only prevent emission reductions but also to provide significant and highly relevant sustainable development outcomes for developing countries, and in particular in Least Developed Countries (LDCs). The NAMA modality can provide the essential holistic framework for the improvement of the complete value chain in the charcoal sector.

The understanding of the NAMA concept is still evolving and there is as of to date relatively little on the ground experience with turning the concept into concrete action. UNDP hopes that by funding this study it can contribute to further shaping the concept and translating it into action. The key defining criteria for a NAMA to be comprised of measurable, reportable and verifiable (MRV) emission reduction activities show us the way to the future generation of emission reduction efforts that intend to scale-up their scope and go beyond the project-based approach that has been the main focus of the CDM. UNDP's MDG Carbon program has been providing comprehensive project development services for clients in developing countries. Starting with an exclusive focus on project based CDM, the program has shifted its focus to scaled-up programmatic and sector wide approaches, in particular targeting LDCs. It accompanies these services with targeted capacity development assistance, of which this particular study is a good example.

UNDP is determined to assist developing countries in implementing low-carbon interventions and bringing long-term sustainable development benefits. The sustainable charcoal NAMA in Uganda is an exciting mitigation programme that can achieve both objectives.

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Executive Summary

The charcoal sector currently provides one of the greatest opportunities to help to prevent emissions in least developed countries (LDCs) while fostering significant sustainable development benefits. However, despite recent improvements in the production sector, there have until now been few activities in CDM or general climate financing. However, the recent approval of a small-scale (SSC) methodology for charcoal and the on-going approval of a charcoal standardized baseline (SB) should provide a strong basis for the future development of climate financed charcoal projects.

First developed at the 2007 United Nations Framework Convention on Climate Change (UNFCCC) Conference of the Parties, the concept of a nationally appropriate mitigation action (NAMA) has continually evolved although few have been designed and implemented. NAMAs are well suited to holistic programmes since success depends on considering all components of the value chain – forest management, production, transportation, retail and consumption.

This study focuses on the middle three components of the value chain – production, transportation and retail – and provides information about the Ugandan context of the value chain, the stakeholders involved, the relevant policies and the institutional framework. The core part of the study is the design of an improved value chain for Uganda, including, at the production level, the introduction of improved kilns. A major component of the NAMA would be the creation and institutionalization of a charcoal unit at the district level that is charged with, among other activities, purchasing from producers, categorizing the type produced so producers can be paid a differentiated value based on whether or not the product is sustainable, and arranging transport from the districts to Government-created warehouses located outside urban areas. At the warehouses, the charcoal will be sold by retail associations.

A crucial component in the NAMA design is the incorporation of measuring, reporting and long-term verification. For this reason, the study includes a system that permits robust monitoring that is implementable in the Ugandan context in addition to parameters and recording and reporting procedures. It also presents the necessary next steps in the NAMA process that include two stages of development of a NAMA design document, which must be developed in close co-operation with stakeholders, and, eventually, implementation. Finally, the study includes a list of possible donors to fund both stages.

1. Introduction

1.1. BACKGROUND

One of the largest opportunities to prevent emissions and trigger significant sustainable development benefits in least developed countries (LDCs) is improving the charcoal sector. Yet until recently, there has been very little CDM or general climate activity within the charcoal production sector.[3] Only two approved CDM charcoal methodologies exist with a newly approved third methodology discussed below. The first is a SSC methodology, the AMS-III.K, which comprises the avoidance of methane release from charcoal production. Only one charcoal project[4] has applied this methodology and after it was registered, the first issuance of certified emissions reductions (CERs) from the project was only 12 percent of the expected volume (UNEP Risoe 2012a). The second methodology is a large scale methodology, the ACM0021 relating to the reduction of emissions from charcoal production by improved kiln design and/or abatement of methane. Two projects have been registered under this methodology but no CERs have yet been issued.

To date, there is no methodology to acquire CERs from the improvement of the efficiency of the charcoal production process or from the reduction in the use of non-renewable biomass (X_{NRB}). The lack of a relevant methodology is a missed opportunity to tap into the significant potential to reduce charcoal production emissions.

In addition, the lack of incentives to switch to renewable biomass or of interventions in improving charcoal production efficiency has been fueled by a number of factors, including its low cost, generally under-priced by 20 to 50 percent, and strong cultural barriers to switch to alternative fuels. As a result, use X_{NRB} and of traditional low-efficiency kilns continues alongside conventional charcoal production and the consumption chain, which places a high burden on local forest resources and becoming a major source of deforestation.

At the seventieth CDM Executive Board (EB) meeting held in November 2012, a new charcoal methodology was approved. The SSC methodology, AMS-III.BG: Emission reduction through sustainable charcoal production and consumption, will for the first time provide an opportunity to earn CERs for switching from X_{NRB} to renewable biomass in improved kilns. In addition, the first SB submitted to the UNFCCC is for charcoal production in Uganda. This SB was submitted in May 2012; an initial assessment by the UNFCCC was successfully completed and a more detailed assessment has been ongoing since November 2012.

The new SSC methodology and SB pave the way for further carbon market activity for improved charcoal production by providing a strong basis for Measuring, Reporting and Verification (MRV). In particular, the SB provides strong and conservative assumptions with regard to the yield and carbon flows in the baseline production. It is in that light that this study was commissioned. The goal of the study is to undertake a basic assessment of how the charcoal SB in Uganda could be further built upon and expanded on a policy level, in the form of a NAMA.

3 Refer to Section 1.2 for further information about the scope of this study.

4 Coconut shell charcoaling and power generation at Badalgama, Sri Lanka.

UNDP financed this study with the goal that the development of the NAMA concept would provide an important opportunity for Uganda to help to shape its future low carbon development. The implementation of an improved charcoal value chain NAMA will help Uganda to increase the efficiency and effectiveness of its current value chain and will enable Uganda to remove a major driver of deforestation while increasing energy security and sustainability.

Establishing an adequate NAMA for the charcoal problem would ideally entail the following steps:

i. **Assessment:** Knowing the scale of the problem in order to provide a solution at a sufficient or at least meaningful scale

ii. **Analysis:** Presenting the functional chain that links the consumption of charcoal as cooking energy to deforestation

iii. **Formulation of response:** On the basis of the functional chain, identifying and selecting the most appropriate scope of intervention to address the problem (e.g. deployment of improved production technologies; switch to alternative sources of biomass, etc.)

iv. **Monitoring of results (first part of the MRV):** Computing the results achieved by the NAMA intervention for the selected measures

v. **Evaluation of the cost-effectiveness of the results (second part of the MRV):** Economic indicators on the cost effectiveness of the problem should be included in order to check the cost of avoided emissions against initial assumptions

vi. **Evaluation of the impacts (third part of MRV):** The MRV of the results should enable an evaluation of the impacts

This report provides a strong basis for steps (i) through (iii) and touches upon (iv) through (vi). Following the completion of this NAMA study, the next step would be a further elaboration of all steps.

1.2. SCOPE

As will be seen in Section 3.2, the charcoal value chain is comprised of five components: forest management, production, transportation, retail and consumption.

The first component of the value chain that could be improved is forest management. This component will be touched upon in this study but will not be elaborated since the issue is being addressed by other initiatives, such as the Uganda Forest Working Group Sustainable Forest Management, and should be addressed by forestry experts.

The components of production, transportation and, to a lesser extent, retail will be addressed in this study.

The final crucial component of the value chain is consumer demand. This component, which is often examined in relation to carbon finance, consists of reduction in consumption through the use of improved cook stoves. Indeed the energy efficiency of unimproved charcoal cook stoves is quite low, with an efficiency of only 17 percent, while modern cook stoves can reach an efficiency of above 40 percent (Berkeley Air Monitoring Group 2012). This indicates that switching to more efficient cook stoves could significantly slash the demand for charcoal while providing the same cooking energy.

Although there is a great potential for charcoal savings from improved charcoal cook stoves, the present study will not focus on the user side of the charcoal chain for the following reasons:

1. Programmes and projects aimed at improving the energy efficiency of charcoal cook stoves are already underway in several countries, including Uganda, where related projects include Improved Cook stoves for East Africa, Efficient Cook stove Programme: Uganda and Up Energy Improved Cook stoves (UNEP Risoe 2012b).

2. Pressure on countries where charcoal is used as a cooking fuel is often doubled, with growing populations and charcoal demands alongside the decreasing availability of wood. For example, charcoal demand in Uganda is growing at yearly rate of +6 percent and without intervention forecasts show that a total depletion of forestry resources would occur by 2050 (NEMA 2008). With this in mind, solely improving the mid- to long-term efficiency of charcoal stoves might not be sufficient.

It should be noted that when the full NAMA design document is developed, improved cook stoves need to be taken into consideration. The inclusion of improved cook stoves is particularly important regarding charcoal price elasticity. If the use of improved cook stoves significantly increases, the demand for charcoal will in turn significantly decrease, leading to lower charcoal prices. A price decrease will change the profit made by actors throughout the value chain and must be considered as it could significantly affect stakeholders' willingness to engage in an improved value chain.

UNDP strongly supports the integration of this NAMA study with other relevant initiatives in Uganda, for instance, a Global Environment Facility (GEF) supported project that has a highly relevant goal of securing multiple environmental benefits. Addressing the twin challenges of unsustainable utilization of biomass for charcoal and poor land management practices common in Uganda's woodlands, the project uses technology transfer and fuel switch, improved data collection and carbon monitoring and promotion of sustainable land and forest management practices.

This study serves to provide information that can be used to concretely develop the necessary documentation needed for the successful implementation of an efficient charcoal production NAMA in Uganda.

1.3. STRUCTURE

The study will first introduce NAMAs and report on the current progress at the international level. A general introduction provides the reader with background knowledge, including examples of charcoal policies implemented in sub-Saharan Africa. The study will then narrow its focus to Uganda, providing background information about the value chain, policies, institutional framework and, briefly, other on-going initiatives. Next, technology options for improved production will be provided. The most relevant of these technologies will then be included, amongst other activities, policies and the governance structure, in the proposal for the NAMA. The grounds for the NAMA measuring, reporting and verification will then be set. Finally, a discussion covers where support for the NAMA is needed and who could provide it.

2. Nationally Appropriate Mitigation Action

The NAMA concept was created at the 2007 thirteenth Conference of the Parties (COP) to the UNFCCC. Since then progress at the international level on the design of NAMAs has been slow but steady although the exact definition of the concept remains vague. The key defining criteria for a NAMA are that the concept is comprised of measurable, reportable and verifiable (MRV) emissions reductions activities by developing countries in the context of sustainable development (UNFCCC 2007). Two types of NAMAs have been defined – domestically or internationally supported with support coming in the form of finance, capacity or technology transfer.

A number of developments at the fifteenth COP to the UNFCCC (COP15) in 2009 in Copenhagen included developing countries' requests to submit information about NAMAs and decisions to create a UNFCCC NAMA registry and to conduct international consultations and analyses of biennial reports (UNFCCC 2009). In 2010, at COP16 in Cancun, a decision permitted developing countries to apply NAMAs to reach a deviation from business-as-usual (BAU) emissions in 2020. In 2010 and 2011, developing countries submitted an extensive list of NAMAs to the UNFCCC and COP17 in Durban saw the mandate to develop and finalize the NAMA registry prior to COP18.

In 2011 and 2012, NAMA progress was made on the ground. Capacity building activities for developing countries began, initial NAMA documents were written and requests for support for NAMA designs were uploaded onto the registry. The concept of NAMAs has slowly been turned into concrete actions.

3. Charcoal Sector

3.1. PRODUCTION

Biomass fuels are an essential component of life in Africa, meeting more than 90 percent of energy needs in much of sub-Saharan Africa. In 2000, households in the region were estimated to consume nearly 0.72 tonnes per capita or 470 million tonnes of wood fuels in the form of pure wood and charcoal (Bailis et al. 2005), with this number increasing over time as population does. Since much of the biomass consumed is non-renewable, there is a significant generation of greenhouse gas emissions. The majority of the biomass used in rural areas is wood and, across the region, the use of charcoal is limited to urban households.

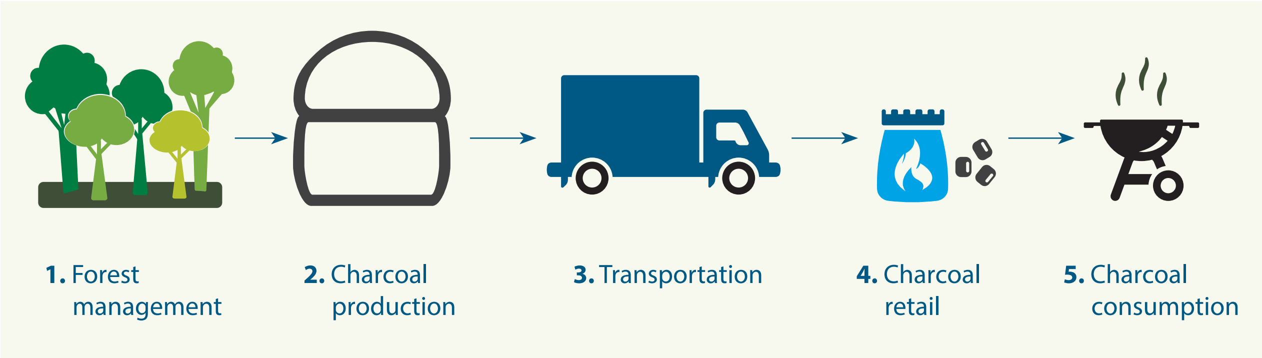
For instance, in Kenya, 80 percent of households rely on charcoal as their primary source of fuel for cooking (Energy for Sustainable Development Africa 2005). Scenarios that anticipate large shifts to charcoal and no improvements in harvesting and production suggest that greenhouse gas emissions associated with charcoal could reach 15 billion tonnes of CO_2 by 2050 (Steenblik 2006).

Charcoal is produced by slow pyrolysis, which is the heating of wood or other substances in the absence of oxygen. Pyrolysis, or carbonization, is initiated by heating a pile of wood under controlled conditions in a closed space, such as a charcoal kiln, with a very limited supply of air triggering endothermic and exothermic reactions. The biomass produces, as a result of the pyrolysis process, a mixture of gas, liquid and charcoal (Energypedia 2012). This process is usually carried out in traditional kilns. Once the charcoal has cooled, it is placed into bags and transported to retail centers, mainly in urban areas. The entire process can take 7 to 12 days (Greenpower 2012a).

Traditional kilns have conversion efficiencies of 10 to 22 percent (calculated on using oven-dry wood with 0 percent water content), resulting in the use of 8 to 12 kilograms (kg) of wood for the production of 1 kg of charcoal. This low efficiency is primarily due to the rudimentary techniques used by producers. Variables, such as pyrolysis temperature and time, and the initial rate of heating have a significant impact on charcoal's physical and chemical properties (Cuña Suárez et al. 2010), therefore affecting the efficiency of the production process. Switching to the use of improved kilns can result in increasing efficiency up to 30 to 42 percent, with the use of just 3 to 4 kg of wood per kg of charcoal produced (Adam 2009).

3.2. VALUE CHAIN

Figure 1: Charcoal value chain

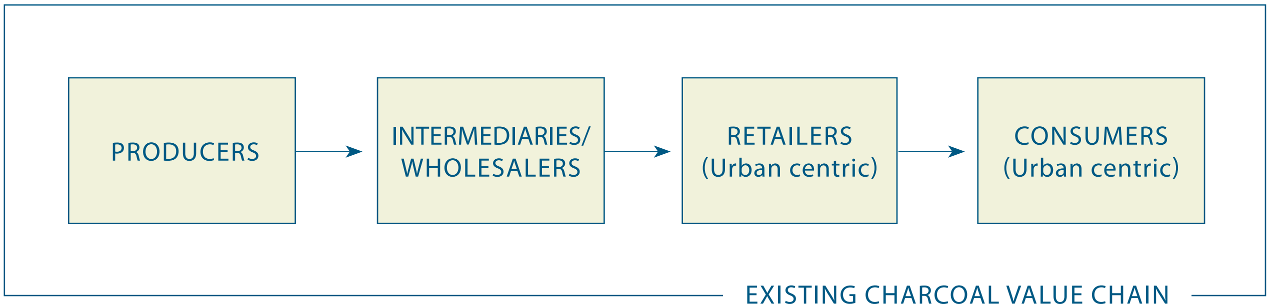


Source: Authors.

Each component of the chain has a number of different actors. As mentioned previously, this study will focus on the middle three components – production, transportation and retail. The study will focus on key stakeholders in the existing value chain (See Figure 2).

- Producers have access to private forest lands where they produce charcoal to sell
- The intermediaries connect the producers and transporters who are then involved with transporting the charcoal, either illegally or legally (i.e. after paying the applicable levy) to the urban centres
- Wholesalers are involved with bulk trade and operate from markets located within urban centres
- Retailers purchase from the wholesalers and vary greatly in scale of operation (from large markets to individual shop owners).

Figure 2: Key stakeholders in existing charcoal value chain



Source: Authors.

3.3. POLICIES IN SUB-SAHARAN AFRICA

In order to try and address the problem of deforestation caused by the charcoal sector, a number of countries have implemented a variety of policies and regulations. Relevant regulations range from those related to forestry management, logging, charcoal production, transport and use. Discussion of three examples of regulation is presented below, demonstrating some of the challenges .

Chad

In 2008, the Government of Chad passed a law banning the production of charcoal produced from freshly cut trees. At the same time, the President introduced another initiative of planting a million trees over five years to act as a buffer against the encroaching desert. The tree planting initiative has been welcomed but the charcoal ban has proved highly controversial as the initiative was announced only three weeks prior to coming into force and once the law was enacted, the Government blocked all charcoal, regardless of how it was produced, from coming into the capital, N'djamena (IRIN 2009). The Government introduced a subsidy on natural gas, however, prices have increased three-fold since the ban was implemented, leaving many people without an economically viable fuel option (Hicks 2012).

Kenya

In 1999, the Kenyan Government introduced a partial logging ban in public forests that allowed only four large timber companies to log in state forests and reforest the land. The ban was lifted in 2010 after it had caused increased illegal logging, destroyed timber related jobs and resulted in higher charcoal prices (Migiro 2012). In November 2012, the Kenya Forest Service announced a new charcoal policy to legalize and regulate the charcoal trade fees and charges will be levied on the charcoal and the revenue will then be returned to the charcoal-producing communities (Ndonga 2012).

United Republic of Tanzania

In 2006, the Tanzanian Ministry of Natural Resources and Tourism (MNRT) introduced a ban on charcoal for a period of two weeks to study the impact on the trade. During the two week ban, production, trade and use of charcoal continued almost unchanged, albeit under more difficult conditions. The unsuccessful enforcement of the ban by the MNRT officers, as well as by other Government agencies may have been due to two reasons: the policy measure to ban charcoal was not well coordinated among the different government agencies who are – at least partly – responsible for the subject matter; or the monitoring and enforcement machineries of the other Government agencies were as ineffective as MNRT's bureaucracy to successfully enforce the complete ban on charcoal (World Bank 2010).

As can be seen, many charcoal policies have been ineffective. These failures highlight the need for a fully integrated approach, with significant stakeholder engagement, to tackling the challenges of an inefficient charcoal value chain. It is in this context that a fully integrated NAMA needs to be developed.

4. Current Charcoal Situation in Uganda

4.1. BACKGROUND

The importance of charcoal in Uganda can be gauged by its nickname, "black gold", as it is referred to by some traders in Kampala. Charcoal in Uganda is viewed by urban households as a reliable, convenient and accessible source of cooking fuel available at a stable price. More than 90 percent of the population depends on charcoal and firewood as the primary source of cooking fuel (GIZ 2011). The uncertainties around the availability and high costs of liquefied petroleum gas (LPG) usually results in most rich urban households depending on charcoal cook stoves as backups. Moreover, the socio-economic importance of charcoal is substantial, involving the livelihoods of thousands of people who work in the charcoal value chain.

However, there is a growing concern in Uganda about the deteriorating state of the country's forest cover. The National Forestry Authority (NFA) estimates that 80,000 hectares of private and protected forests are being cleared annually for the unsustainable production of charcoal and timber (IRIN 2012).[5] This is a significant increase from the estimated 50,000 hectares in 2004. For a country where one quarter of the land is covered by forests, the current rate of deforestation translates to almost 1.24 percent of the forest land being lost annually (Knöpfle 2004).

Production

In Uganda, like many other countries in the region, charcoal production is predominantly undertaken by rural populations in unorganized groups or individuals. Following the pyrolysis process and after having cooled, the newly produced charcoal is collected in bags with an average weight of 50 to 60 kg and carried to the nearest road collection point where intermediaries (transporters, traders) pay off the producers at an on-spot price and transport the charcoal to urban centres, predominantly Kampala.

Given the unorganized nature of the business and the complexities involved in the value-chain – from producers to the urban consumers – there is a dearth of verifiable and up-to-date information. In 2004, a survey was undertaken by the then Ministry of Energy and Mineral Development (MEMD) to estimate the annual consumption of charcoal in Kampala and to determine the district of its origin. The data collection was carried out by field agents positioned at ten entry points covering all important arterial roads entering Kampala. Over a one-week period, the agents physically counted and measured the charcoal bags and questioned the source of origin of the charcoal. The data was then extrapolated to determine the annual values of charcoal produced from each region. A summary of the data is provided in Table 1 and Figure 3. While the methodology clearly shows the challenges associated with acquiring accurate data, which is not uncommon in many LDCs, it also provides a practical and proven solution for pursuing similar initiatives in future.

[5] See <www.irinnews.org/Report/94810/UGANDA-Charcoal-boom-a-bust-for-forests> accessed 21 December 2012.

Table 1: Charcoal supply to Kampala and source districts

DISTRICT	CHARCOAL SUPPLIED (IN WOOD EQUIVALENT TONNES/YEAR)	% OF TOTAL
Kamuli	178,165.33	5.91
Kayunga	169,832.85	5.63
Kiboga	442,776.27	14.68
Luwero	810,216.90	26.87
Masindi	199,511.47	6.62
Mpigi	298,408.98	9.89
Mubende	163,965.78	5.44
Mukono	81,514.77	2.70
Nakasongola	450,390.97	14.93
Wakiso	76,802.40	2.55
Others	144,242.45	4.78
Total	**3,015,828.17**	

Source: Knöpfle, 2004 (Mentioned).

Figure 3: Map of Uganda showing urban centres (red) and districts

Source: Ezilon Maps, N.D. (Mentioned).

Value Chain

Most trees used for charcoal production in Uganda are chopped from privately owned forests. The enforcement of laws to prevent random deforestation on private lands has been difficult given the unorganized and distributed nature of the activity. From 1990 to 2005, as seen in the National Biomass Study, there was a 28 percent decrease in forest cover, from 4.9 million hectares to 3.5 million hectares (MEMD 2001, 30). As charcoal consumption is concentrated in urban areas, the deforestation activities have been greatest in central Uganda forest lands, which are near the cities, as can be seen in Figure 4.

Figure 4: The "cone" of major deforestation activities

Source: Authors.

A significant volume (5 to 15 percent at production sites and 5 to 20 percent at retail areas) of charcoal in the form charcoal dust is lost during transportation and improper storage (Knöpfle 2004). The significance of these losses can be gauged by the fact that manufacturers around Kampala buy out the residual charcoal dust and combine it with a binding agent like cassava to form charcoal briquettes. A briquette manufacturer interviewed at the time of the on-site study revealed that he produced over one tonne of briquettes per day with the capacity to scale up to 4 to 5 tonnes/day in the immediate future.

Apart from the income generating potential that charcoal production offers to the rural population, the producing districts stand to earn significant revenue through taxation. Districts charge a levy in the range of 15 to 20 percent of the total value on the charcoal that is "exported" out of the districts. However, traders find means to bypass this taxation resulting in significant economic losses for the districts. Transporters often resort to taking detours through lanes and forest roads to bypass check points located on the major arterial roads.

Transportation of charcoal is often unorganized and frequently involves overloaded trucks of varying capacities. The charcoal is transported to temporary storage sites in and around urban centres from which it is then distributed through a network of local retailers. Transportation also involves a large spectrum of people looking to take advantage of the relatively high price difference between the money paid to the producers and the final price paid by consumers. A market survey indicates that the 2012 retail market price of charcoal in Kampala is in the range of 800 to 1,000 Ugandan shillings (UGX)/kg and producers can expect to be paid in the range of 5 to 10 percent of the retail price. Further information about charcoal prices can be seen in Box 1.

Box 1: Prices in Kampala

For a family of five, the average monthly charcoal consumption in Kampala is approximately two 70kg bags. The price of a 70 kg bag is 55,000 to 70,000 UGX, a significant increase from the price of 20,000 UGX three years ago. The price increase can be attributed to rapidly depleting forests. Locals indicate a reluctance to travel for more than 0.5 km to buy charcoal, which indicates the density of the retail network. Most often charcoal is stored in small neighbourhood shops that maintain a stock of a few bags of varying sizes.

In comparison, prices of briquettes remain competitive. Green Bio Energy, a local manufacturer, sells three package sizes under the brand Briketi™ at the following retail price:

- Small bags 1.1-1.25 kg: 800 UGX
- Medium bags 5.5 kg: 7,000 UGX (branded, packaged in carton with "fire starters")
- Large bags 25 or 50 kg: 18,000 and 35,000 UGX

The average retail price of charcoal briquettes is lower than conventional charcoal, given that the manufacturer incurs no cost of procuring charcoal dust, uses locally improvised technology and maintains a lower overhead for himself (i.e. takes no salary). The cost of setting up a briquetting plant has been low as the investments have been made from personal savings and some grant financing. The current market of briquettes is very limited given the low number of the briquette manufacturers in Kampala, low awareness of the option and that the manufacturers have limited access to the existing charcoal value chain (retailers). Hence, companies such as Green Bio Energy supply briquettes to supermarkets with the target market being educated, upper middle-class customers.

Source: Based on data collected by authors at time of site visit, Oct 2012.

Charcoal Economics

Any charcoal related project in Uganda needs to take into account the entire value chain of production, transportation and distribution. The classic example of a producer is a rural male who undertakes production activity as an additional source of income to supplement his earnings from working on the fields. Operations tend to be unorganized as they are based on the individual producer's constantly changing daily income needs. In Uganda, charcoal producers can also include the entire spectrum of the population including women and children, working in organized groups or as individuals.

The raw material for charcoal production is most often cut from private forest lands, where culturally there is a notion of community and ancestral ownership. In many cases land owners encourage deforestation as it allows them to convert forestland into more productive farming land at a relatively low cost. More organized charcoal producers have some sort of a financial arrangement with the forest land owners based either on the number of bags of charcoal produced or the area of forest land being cleared. Given the producers' limited collective bargaining power, and also their lack of knowledge/incentive to increase production efficiency, the share of the total revenue pie to producers is fairly low, ranging from 5 to 10 percent). Any structure that incentivizes sustainable charcoal production must focus on providing a stable, assured and higher financial return to the producers. Apart from charcoal producers, the owners of private forest lands need to be made aware of the opportunities for comparable or better economic returns by retaining the forests as compared to clearing the forest land for agriculture. The NAMA concept for an improved charcoal value chain takes an inclusive approach and proposes a potential solution that addresses the concerns of all stakeholders.

Industry Findings

The forest lands in Uganda can be classified as either Government-owned forests managed by the National Forestry Authority or private forest lands owned by individuals or clans. The latter constitutes 70 percent of the total forest lands in Uganda with forest ownership being passed down through generations.

Although there are several studies on the impact of charcoal on deforestation in Uganda, the least understood fact is the impact of the existing social system, the various clans and their perception about forest lands and forest ownership. The ownership structure on private forests can be complicated, with several individuals staking a claim on the absolute ownership of a particular forest. The trees in the private forests are deemed to be owned by the individuals/clans and are, therefore, subject to deforestation without any authorization.

In many cases, the private owners allow tenants to reside on the private forest lands and allow them to cut down the trees in return for a pre-determined fee, e.g. based on the number of bags of charcoal produced. There are also instances where tenants are encouraged to cut down trees and profit through charcoal production as the owners are inclined to convert forests into agricultural land, which ensures long term financial returns. The forests continue to provide the rural population the single largest source of income in the form of charcoal, firewood, timber and other forest products, such as medicine, material for crafts etc.

Outside the forest lands, the charcoal industry also provides a significant source of income, both directly and indirectly, for various sections of the society and for the Government. There are parties with significant vested interests in ensuring that the existing charcoal value chain is not disturbed. Any significant exclusion of the various involved parties from the existing value chain without consideration for alternative sources of income can lead to opposition from the parties and social disturbances (e.g. there has been an instance where charcoal transporters set fire to a truck carrying briquettes into Kampala when briquette manufacturing was viewed as competition). Therefore, the approach to introducing sustainable charcoal practices needs to be gradual. The affected parties need to understand the reason for change (e.g. unsustainable forestry would eventually lead to permanent loss of income) and avenues to adapt to the changes would need to be provided (e.g. gradually introduce sustainable charcoal while slowly reducing the demand for unsustainable charcoal through a combination of policy initiatives and market condition). Furthermore, a more inclusive approach needs to be designed (e.g. employ existing transporters of unsustainable charcoal to hassle-free transportation of sustainable charcoal to identified warehouses).

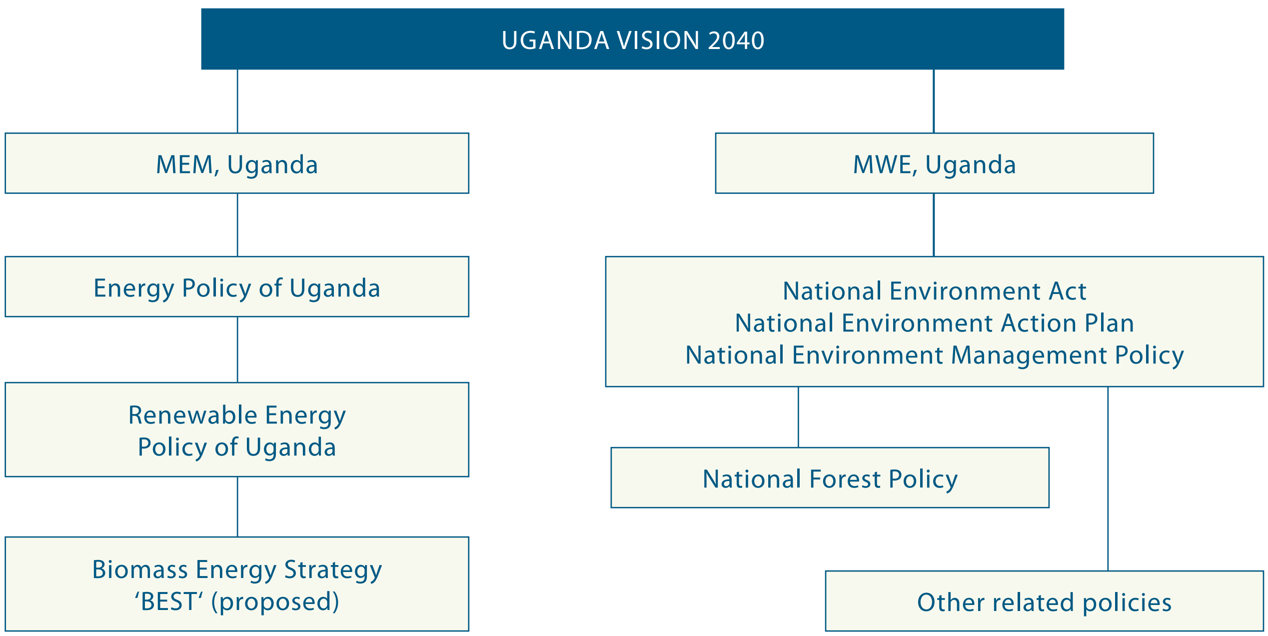
The broad set of issues that need to be tackled is:

- Uganda's energy policy and government regulations
- Charcoal production and supply chain, including producers, transporters and retailers
- Sustainable forest and woodlot management
- Energy efficient cook stoves
- Role and demands of international donor agencies

4.2. POLICIES AND PROGRAMMES

Charcoal in Uganda falls under two ministries (See Figure 5). As a source of energy, the charcoal value chain is subject to rules and regulations under the Ministry of Energy and Minerals (MEM) (also referred to as its former name of Ministry of Energy and Mineral Development). As the raw material is sourced from forest lands, the value chain from the charcoal production perspective is subject to the Ministry of Water and Environment (MWE).

Figure 5: Schematic representation of major policies in Uganda with impact on charcoal



Source: Authors.

Uganda Vision 2040

The National Planning Authority established in 2002 has been entrusted with developing a long-term country strategy for Uganda with the objective of a transformed Ugandan society from a peasant to a modern and prosperous country within 30 years (NPA 2012). The Uganda Vision 2040, a "vision framework" document, provides broad development indicators for 33 categories, with "% of population with access to electricity" slated to increase from the 2010 baseline of 11 percent to 80 percent by 2040. While acknowledging that 95 percent of households use wood and/or charcoal as the primary cooking fuel, the document states that over the vision period, the Government will expand the rural electrification programme to cover the whole country and alternative energy sources such as solar, natural gas and biogas will be promoted (NPA 2012). The long-term development of charcoal value chain, therefore, does not form a critical part of Uganda's long-term energy strategy.

Energy Policy

The Energy Policy of Uganda was formulated by the Ministry of Energy and Mineral Development in 2002 and broadly looks into the energy sector in Uganda via the following categories: power, petroleum, new and renewable sources of energy and atomic energy. The policy has a relatively supportive tone for grid connected power and exploration of oil and gas related sectors. The list below provides the financial resources (required and committed) as per Annex 1 of the document:

- Power generation (hydro power, mini-hydro and bagasse co-gen project): $1.61 million
- Rural electrification and solar PV projects: $357 million
- Improvement of transmission & distribution network: $184 million
- Petroleum exploration and development of supply chain: $179 million
- Environmental impact, energy governance and administration: $30 million
- Promotion of the use of Renewable Energy (RE) and Energy Efficiency (EE): $16 million

Renewable Energy Policy

Approved by the cabinet in 2007, the Renewable Energy Policy of Uganda was an outcome emerging from the need to focus on RE in the Energy Policy of Uganda. The objective of the policy is to increase the use of modern RE from 4 percent to 61 percent by 2017, driven chiefly by a 3.5-fold increase of renewable power generation from 412 MW in 2007 to 1420 MW in 2017 (of which 1285 MW constituted large and mini-hydro). For charcoal-related technologies, the scaling-up is as shown in the Table 2 below:

Table 2: Planned increase of modern energy services

MODERN ENERGY SERVICES FOR HOUSEHOLDS	2007	2012	2017
Improved woodstoves	170,000	500,000	4,000,000
Improved charcoal stoves	30,000	100,000	250,000
Institutional stoves	450	1,500	5,000
Baking ovens	60	250	1,000
Kilns	10	30	100

Source: Rural electrification agency 2007 (Mentioned).

There is no data available on the current status (2012) of the above-mentioned services.

Environmental Policies

The country's three important environment policies are the National Environment Act (1995), the National Environment Action Plan (1994) and National Environment Management Policy (1994). Together they provide strategies to guide and assist decision makers and users to determine national environmental priorities at national, sectoral and individual levels, including the private sector. The policies integrate environmental concerns with socio-economic development and hence form an important guidance for decision making.

More importantly, the policies recognize the importance of sector-specific attention and as a result, sector-specific frameworks have been developed. These include the 1995 Water Policy, the 1996 National Wetlands Management Policy, the 1996 Wildlife Policy, the 2000 Fisheries Policy, the 2001 Forestry Policy and several district environment management policies developed since 2000.

National Forestry Policy

The Uganda National Forestry Policy (NFP) was set forth by the Ministry of Water, Lands and Environment (MWLE) in 2001 with the view to "sustainably manage forests, woodlands and trees, providing ecological and social services, producing economic goods for present and future generations of Ugandans, and making a contribution to the global community". The key issues tackled in the policy which have a direct impact on charcoal production are:

- Sustainable management and protection of "permanent forest estate under government trusteeship"
- Promote the development and sustainable management of natural forests on private land
- Promote profitable and productive forestry plantation businesses
- Promote a modern, competitive, efficient and well-regulated forest products processing industry
- Develop collaborative partnerships with rural communities for the sustainable management of forests
- Develop and promote tree-growing on farms in all farming systems, and innovative mechanisms for the delivery of forestry advisory services
- Promote urban forestry
- Support sustainable forest sector development through appropriate education, training and research
- Develop innovative mechanisms for the supply of high quality tree seed and improved planting stock

However, the policy does not elaborate on how the key issues will be tackled and overcome. This lack of elaboration about implementation remains an important set-back to most of the above-mentioned policies. There is a clear need to propose a well-defined roadmap and specific agenda for the promotion of sustainable forestry and environmental management in the country.

Programmes on Biomass and Related Sectors

The Promotion of Renewable Energy and Energy Efficiency Programme (PREEEP) is being implemented by the MEM with the support of the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), the German Financial Cooperation (KfW) and the Centre for International Migration (CIM). The programme offers support in developing skills, resources and capacities in the fields of energy policy, disseminating modern biomass energy technologies, promoting energy efficiency and rural electrification.

The EU Energy Initiative's Partnership Dialogue Facility and GIZ are funding the Biomass Energy Strategy (BEST) initiative to develop short-, medium- and long-term interventions to achieve sustainable management of biomass energy resources and provide better energy services to the people.

The UNDP Country Programme Action Plan (CPAP) (2010-2014) for Uganda is focused on strengthening the efforts and capacities of local governments, civil society organizations (CSOs) and communities to help them to sustainably manage and utilize natural resources, integrate climate change adaptation and mitigation in their activities and build climate change resilient societies. This is expected to be achieved through developing, piloting and implementing initiatives in biodiversity and ecosystem management, sustainable land management, efficient energy technologies and reduction in GHG emissions, as well as building climate change resilient communities.

The Low Emission Capacity Building (LECB) Programme is part of a larger UNDP low emission climate programme that builds on initiatives already developed by the UNDP and the EU. The five-year programme focuses on the development of NAMAs, greenhouse gas inventory systems and MRV in 24 countries. Uganda has been shortlisted for the LECB programme with an emphasis on three areas, namely the energy, transport and waste sectors.

Uganda has also been chosen as a potential pilot country for the CleanStart programme, a new UNDP and United Nations Capital Development Fund (UNCDF) joint initiative, which aims to support 2.5 million poor people in gaining access clean energy through microfinance across Africa and Asia. An assessment for Uganda has already been undertaken and the Government shall be provided with a strategy and a business plan to implement activities for off-grid energy access under a future potential NAMA on energy use.

The GEF is the largest public funding agency for projects related to improving the global environment. In partnership with 182 countries, institutions and the private sector, the GEF provides grants for projects related to biodiversity, climate change, international waters, land degradation, the ozone layer and persistent organic pollutants. In Uganda, the GEF has approved 25 projects in the areas of climate change, biodiversity, land degradation and others, with a total grant of $73 million and co-financing of up to $585 million. One of the recently approved projects in the charcoal sector relates to addressing barriers to the adoption of improved charcoal production technologies and sustainable land management practices through an integrated approach.

4.3. INSTITUTIONAL FRAMEWORK

The Ministry of Energy and Minerals and the Ministry of Water and Environment are the two governmental institutions in charge of policies related to charcoal. The institutions involved with charcoal- and forestry-related issues are complex at present. While the trees are standing, the charcoal value chain is under purview of the National Forestry Authority, which falls under the MWE. After the trees are cut for charcoal production, jurisdiction of the charcoal value chain shifts to the MEM. As charcoal pertains to energy use, the MEM is in a better position to strengthen the charcoal value chain.

The ability to sustain itself financially is crucial when proposing any institution as the coordinating and managing entity for any potential NAMA. Although the MEM is focused on promoting grid connected power and a greater role of fossil fuels in the country's energy balance, it employs individuals who have an understanding of charcoal-related issues and, more importantly, understand the need to include sustainable charcoal production in the country's short- and medium-term energy strategy planning. The discovery of oil and gas reserves may cause MEM to re-examine their priorities; however, it will still take some time before Uganda organizes its fossil fuel sector given the relatively limited experience it has had until now.

The MWE on the other hand has a wide reach, ranging from forestry (through the National Forestry Authority), climate change (through the Climate Change Unit and the Designated National Authority) to energy (through district energy officers). The MWE has also recently set up "environment police" mandated to prevent illegal deforestation. The National Forestry Authority has undertaken studies based on a geographic information system (GIS) in order to understand the impact of deforestation from timber production. Thus, it is fully aware, through the use of GIS, of the country's deforestation activities. Similarly the Climate Change Unit (CCU) was a decision-maker in developing the country's environment programmes, including the development of a national NAMA strategy to identify the most suitable NAMAs for future development and government support.

Any potential NAMA on sustainable charcoal, therefore, needs to consider both ministries when setting up an institutional structure to benefit from the expertise and resources that each of them bring in (See Section 6 for discussions on a proposal for the most appropriate institutional framework.).

5. Technology Options for Improved Production

The overarching objective of a charcoal NAMA should be to balance the demand for wood for charcoal production with the quantity of wood that can be sustainably harvested for that purpose. In most countries, the demand for wood exceeds the amount of wood that can be sustainably harvested. As a consequence, the collection of wood for charcoal production is often a key driver of deforestation.

This section will look at technology options that can be used to improve charcoal production and, therefore, reduce the demand for wood.

5.1. BASELINE PRODUCTION

In the absence of intervention, virtually all of the charcoal consumed in low-income countries and LDCs is produced by the informal sector from wood on the basis of unimproved technologies. The informal sector is characterized by the use of traditional kilns that require no investment besides labour. The individuals or group of individuals involved in charcoal production are not formally registered or regulated by the authorities for the production and supply of charcoal products or related services.

The unimproved technologies, also referred to as traditional technologies, used by the informal charcoal makers are earth mound kilns, pit kilns or equivalent open-end technologies solely made of branches and soil. They do not incorporate parts made of metal and/or masonry.

The main problem with the baseline charcoal production is the low conversion efficiency of the wood used as both fuel and feedstock for the pyrolysis process. The ratio between the mass of charcoal obtained and the mass of biomass used for its production (ideally expressed on an oven-dry basis) is called the charcoal yield. As mentioned previously, the efficiency of traditional kilns is 10 to 22 percent while efficiency can be increased to as high as 30 to 42 percent.

A second although more minor problem associated with the production of charcoal is the production of methane during the pyrolysis gases. Depending on the source, between 0.027 and 0.045 tonnes of methane are emitted per tonne of charcoal in the pyrolysis gases (Müller and Michaelowa 2011).

5.2. TYPES OF TECHNOLOGY INTERVENTIONS

The following types of technology improvements can reduce the specific consumption of wood per tonne of charcoal consumed:

i. **Fuel switch:** While virtually all of the charcoal is produced on the basis of wood logs, charcoal can also be produced from other sources of biomass. For example, biomass waste, such as agricultural waste, can be used instead of wood. An estimated 1.7 Mt of agricultural waste was found to be available in Uganda (MEMD 2001). While this amount is certainly not sufficient to replace all the 4.0 Mt of wood consumed for the production of charcoal in 2006, the switch to biomass waste can substantially reduce the pressure on the country´s wood resources. One tonne of charcoal produced from alternative sources of biomass can fully avoid the harvest of wood, which in the baseline would have been needed to produce this tonne of charcoal (estimated at 5 tonnes of wood per tonne of charcoal).

ii. **Agglomeration (for switch):** Only a few biomass types, such as wood logs, coconut husks and bamboo in the form of large chunks, can directly form large pieces of charcoal. Most other sources of biomass consist only of small particles. In order to produce useful pieces of charcoal, such as briquettes, an agglomeration process is needed. An agglomeration process can either be deployed before the carbonization (to form biomass briquettes to be carbonized) or after the carbonization (to agglomerate charcoal particles into briquettes).

iii. **Increase in yield:** More advanced charcoal kilns enable higher yields in the wood to charcoal conversion. Under optimal conditions, surprisingly high yields in the magnitude of 30 percent can be achieved from traditional technologies. In practice, however, yields from charcoal made from unimproved technologies are about 20 percent. In the case of Uganda, the yield of traditional technologies has been found to be around 15.6 percent (Nturanabo et al. 2010). Improved technologies not only achieve higher yields but also are much more constant in the yields achieved.

iv. **Reduction in specific methane emissions:** The methane emissions resulting from the pyrolysis process can either be reduced or combusted with or without energy recovery.

   a. **Methane formation avoidance:** As methane emissions are negatively correlated with the efficiency of the wood to charcoal yield (Kammen and Lew 2005), opting for a more efficient technology will result in lower methane emissions. So far, specific methane emissions per tonne of charcoal have only been measured for a limited number of kilns. As such, there are still large uncertainties about the scale of methane emissions reductions from various technologies. Determining the methane formation avoidance requires determining, on a basis of sampling, the specific CH_4 emissions per tonne of charcoal in the project.

   b. **Methane destruction with or without energy recovery:** When pyrolysis gases are fully captured and combusted, methane emissions, which would otherwise have occurred as the result of the pyrolysis process, can be fully avoided. As the pyrolysis gas stream has a substantial energy content, it can be combusted to produce heat either as process energy for the pyrolysis reaction or for other uses, such as power generation. In the case of methane destruction, the methane can be assumed to be completely destroyed if pyrolysis gases are fully combusted.

5.3. SELECTED TECHNOLOGIES

Although many technologies for the improved production of charcoal exist, it was decided not to list all options but instead to emphasize the most adequate and prominent technologies for the local context. Technologies can be divided in three broad categories:

i. Carbonization technologies

ii. Briquetting technologies

iii. Integrated (carbonization and briquetting) solutions

Carbonization technologies:

Many carbonization technologies exist, but their efficiency varies (For the most cost-efficient, see Table 3). For example, brick kilns can commonly achieve efficiencies of 30 percent. Compared to the Adam kiln regular, brick kilns are suboptimal as the cost, scale and difficulty of adoption is similar while achievements are lower (lower yield and much lower reduction in methane emissions). Also, many third-generation retort kilns exist.

Table 3: Carbonization technologies

NAME	ADAM RETORT KILN
Type	Retort kiln - Brick kiln (advanced 2nd generation kilns)
Capacity per kiln	47 tonnes per year
Cost per unit	$1,200+ (license cost of $2,000 + $40 per kiln)
Yield	35-40% (Adam 2009)
Specific cost	USD 25/t
Power consumption	None (to be confirmed)
CH_4 emission factor	0.0036 kg/t charcoal (based on an estimated 88% reduction rate) (Adams n.d.)
Strengths	➚ Small scale: easier adoption at the level of communities ➚ Can be built with locally sourced material and labour ➚ High yields can be achieved ➚ Very low specific cost per tonne produced
Weaknesses	➘ Large range of yields: sampling required to determine the real achieved yield ➘ Need for trained operators ➘ Not transportable

NAME	EURO KILN (GREENPOWER)
Type	Twin Retort (3rd generation kilns)
Capacity per kiln	500 tonnes per year
Cost per unit	$39,000
Yield	35-40%
Specific cost	$78/t
Power consumption	up to 0.55 kW/hr (Greenpower 2012b)
CH_4 emission factor	0 kg/t charcoal (assuming full flaring)
Strengths	Automated operations High and steady yields Moderate to low specific cost per tonne produced High quality of products (over 90% carbon content with wood charcoal)
Weaknesses	Import of equipment Large scale which cannot be easily integrated to communities Sedentary large scale: need to transport wood to the kiln Need for source of power
NAME	**EURO KILN (GREENPOWER)**
Type	Improved traditional kilns (advanced 1st generation kilns)
Capacity per kiln	50 tonnes per year
Cost per unit	$200 per portable chimney (+ training cost)
Yield	Up to 30% (Energypedia 2012)
Specific cost	$4/t
Power consumption	None
CH_4 emission factor	Unknown
Strengths	Micro scale: easy adoption at the level of communities Simple equipment which can be produced locally Good yields Very low specific capital cost per tonne produced Portable: also adequate for hilly and mountainous areas
Weaknesses	Unknown specific methane emissions Need for operator training Additional effort to cut and pile logs in specific stacked 50 cm length pieces Limited technical lifetime

Source: Authors.

When considering the cost of kilns, its expected lifetime and the operation and maintenance costs need to be considered. For instance, the chimneys used in the Casamance kiln may only last for 3 to 5 uses, if low cost locally produced chimneys are used. Adam and Euro kilns, on the other hand, may have lifetimes spanning a number of years.

Briquetting technologies:

A large selection of briquetting technologies exist (For a sample of the briquetting technologies, see Table 4). From a short review of briquetting technologies, the following facts can be highlighted:

i. The observed cost for briquetting equipment ranges from $4.4 to $20 per tonne of charcoal, depending on whether briquetting takes place before or after carbonization

ii. The cost of briquetting is small when compared to the final charcoal price. For example, charcoal briquettes in Kampala cost around $380/tonne (converted from UGX 1,000/kg charcoal) while briquetting equipment solely cost $10/tonne

iii. A major barrier to the deployment of briquetting technologies remains the lack of an available electricity grid. In countries with very low levels of rural electrification, such as Uganda, charcoal briquette projects will either need to generate their own electricity or be sited where a connection to grid electricity is possible

iv. The biggest challenge remains how the technology can be either imported or developed/replicated and maintained locally

Table 4: Briquetting technologies

NAME	–
Type	Charcoal particles briquetting Self-made briquetting machine (meat mincer + 1 horsepower electric motor)
Capacity unit	30 tonnes of charcoal powder briquetting per year (from 10 kg per hour) (Shri AMM 2010)
Cost per unit	$363 per unit
Specific cost	$12.1 per tonne of charcoal particles turned into briquettes (per year)
Power consumption	0.75 kW (from 1hp)
Strengths	➶ Simple technology ➶ Low cost per unit of output ➶ Use of charcoal dust possible
Weaknesses	➘ Consumption of power (limited availability) ➘ Important need of labor

NAME	JUMBO 90
Type	Biomass briquetting Large automated briquetting press
Capacity unit	Max. 10,500 tonnes biomass per year (from 1.5 t per hour) (Radhe, n.d.)
Cost per unit	n.a.
Specific cost	7.2/t biomass per year Equivalent to $/20 tonne of charcoal per year (assuming a 35% yield)
Power consumption	68 kilowatt equivalent (converted from 91 horsepower)
Strengths	Automated No need for binding material Can use a variety of particle sizes
Weaknesses	Consumption of power (limited availability) Important need of labor

NAME	PYRO 7
Type	Retort kiln (advanced 3rd generation kiln)
Capacity per kiln	1,850 tonnes charcoal per year
Cost per unit	$317,000 (excluding labour) (Reinaud 2008)
Yield	33%
Specific cost	$169/t capacity per year
Power consumption	Self-generation of power from pyrolysis gases Possibly additional power free for local supply
CH_4 emission factor	0 kg/t charcoal (assuming full flaring)
Strengths	Self-generation of power consumed Full abatement of methane emissions Good yields Automated production Integrated flexible production from any biomass wastes Enables limited electrification
Weaknesses	Cost per unit Advanced technology (expertise and maintenance) Import of equipment Sedentary large scale: need to transport the biomass to the kiln

Source: Authors.

Integrated solutions: Briquetting and carbonization

Integrated solutions allow the production of charcoal briquettes from a wide range of biomass. As pyrolysis gases can be used for the generation of electricity, such autonomous facilities could be established even where access to power is not available.

6. The NAMA Concept

The concept of a NAMA framework is new and, therefore, designing a NAMA framework provides both challenges and opportunities. The design is challenging as there is still no specific definition of what constitutes a NAMA framework, and also offers a degree of flexibility since the lack of a concrete definition provides potential "NAMA project developers" with the opportunity to define the constituents. The type of actions that are proposed to be undertaken under a NAMA can greatly vary and may include different types of targets – national emissions reduction targets in tonnes of carbon dioxide equivalent, national intensity-based targets, deviations from business–as-usual emissions – and a wide variety of actions – national policies and strategies, sector-focused policy approaches and specific programmes or projects.

Given the multiple layers of complexities involved in developing a programme for sustainable charcoal in Uganda, the NAMA framework provides an ideal platform to account for and unlock the huge potential for greenhouse gas (GHG) mitigation. This section provides a conceptual idea for setting up a NAMA on sustainable charcoal production in Uganda. The NAMA concept focuses on the following issues:

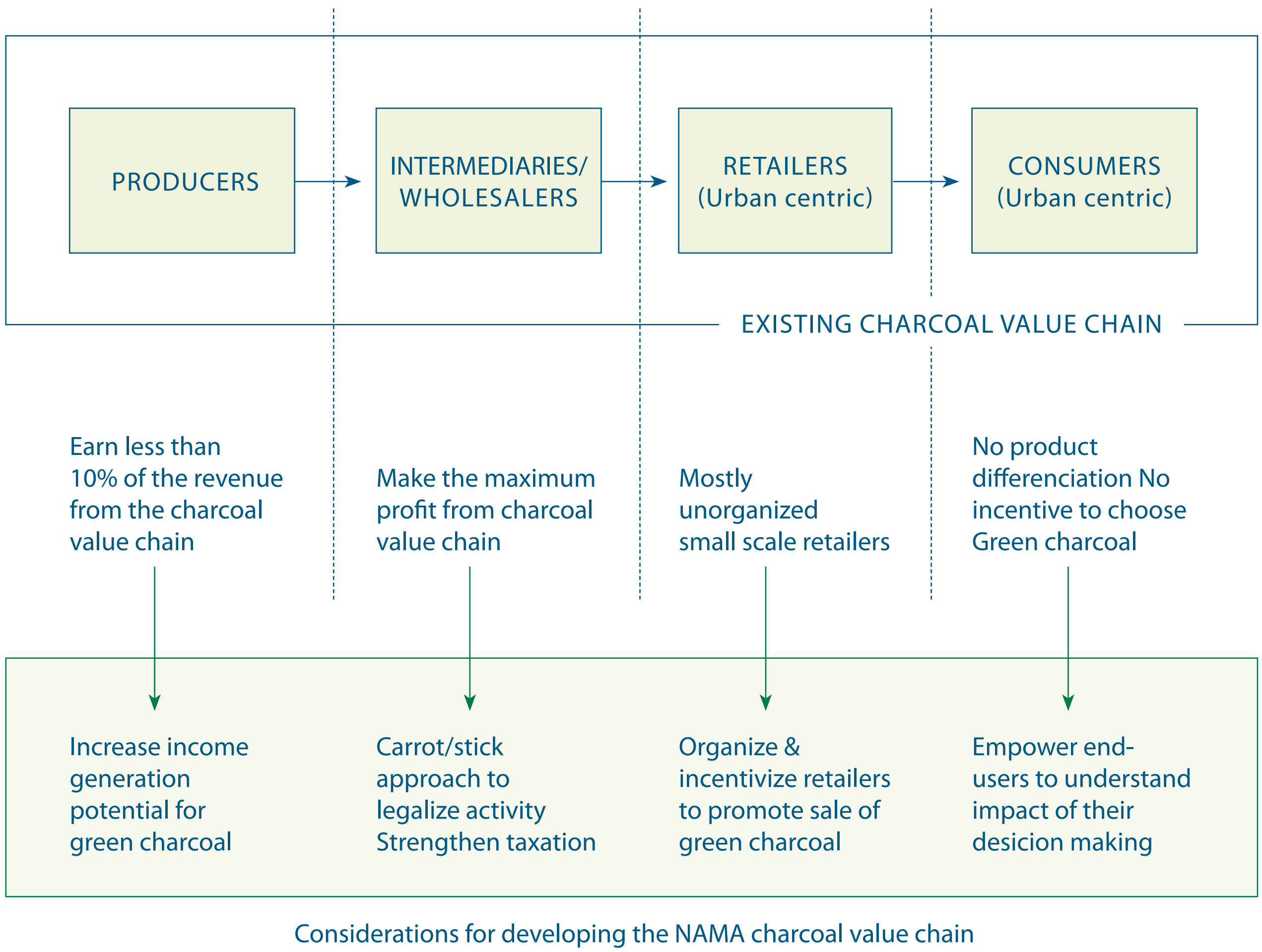
- Charcoal value chain stakeholders – producers, middle-men and consumers
- Sustainable woodlot/forest management
- Sustainable charcoal production/selection of kiln
- Institutional framework
- Creation of an enabling environment: charcoal policies

Given the issues discussed in Section 1.2 and the ongoing efficient cook stove projects in Uganda and other countries in Africa, there is a large knowledge base regarding applicable technology, project implementation and monitoring, which has been excluded from further discussion.

6.1. CHARCOAL VALUE CHAIN

The NAMA proposal will need to be taken into consideration throughout the value chain. Figure 6 demonstrates the existing value chain and specific items to be considered along the value chain.

Figure 6: Existing charcoal value chain and considerations for developing a charcoal NAMA



Source: Authors.

* Green charcoal denotes improved and sustainable charcoal

None of the actors in the charcoal value chain have any incentive to produce or promote the use of "green" charcoal (See Box 2). The first step for developing the NAMA concept, therefore, involves, understanding the type of incentive structure that can be created to encourage the various actors to gradually shift towards the use of green charcoal.

Box 2: Charcoal types

In this study, charcoal production is classified into three types:

- Sustainable charcoal: Involves both sustainable forest management and use of efficient kilns
- Improved charcoal: Produced using efficient kilns where the efficiency of charcoal production is higher than the baseline of traditional kilns
- BAU charcoal: Conventionally produced using traditional kilns

The term "green" charcoal is used to collective represent sustainable and improved charcoal

Source: Authors.

Incentivizing Stakeholders

As with any new technology or new process, the introduction of green charcoal will involve a period of transition. The first objective of the improvement of the charcoal value chain should be to bring all production, legal or otherwise, into a single scheme. This allows for greater control over the entire value chain, enables putting in place a robust MRV system and makes the chain more accessible for involving, educating and gradually shifting producers from conventional to sustainable charcoal production. In order to design this single scheme, significant coordination with various ministries and stakeholders must first occur. Stakeholder consultations should be held and the scheme design process and design should be made publicly available. Experts in technologies, taxation and all relevant sectors should be involved. This study provides suggestions of activities that could be included in the scheme design.

Producers

Charcoal producers are the ones who benefit the least from the charcoal economy and are the most important actors in shifting production techniques from BAU to green charcoal. The producers can be incentivized to undertake this shift to green charcoal through higher income generation potential. As the charcoal producers constitute the "poorest of the poor", the incentive of a significantly higher, stable and assured source of income is expected to be a key driver to shift towards green charcoal use.

Intermediaries

Intermediaries financially benefit the most and are also responsible for the illegal nature of activities including evading levies and taxes resulting in significant loss of revenue to the state exchequer. The transporters move charcoal in overloaded trucks resulting in higher waste, operate on ad-hoc basis and avoid paying levy on charcoal. Wholesalers receive the charcoal from transporters and deal in bulk purchase of (e.g. 50 and 100 bags per week) from where the individual retailers source the charcoal supply for final sale (e.g. 1 or 2 bags). Any NAMA concept that completely cuts off the income source for the value chain involving intermediaries, transporters and wholesalers would result in a backlash for local governments as they are often influential politically, economically and socially. The incentive structure should involve a combination of incentives with sufficient opportunities to adapt to the new market scenario. The following actions should be considered:

- Bring stakeholders into the mainstream charcoal value chain by encouraging them to secure license/permits for their activities and pay taxes
- Provide hassle-free conditions for green charcoal and levy higher taxes for illegal charcoal
- Encourage them to participate in green charcoal production, as they have the financial resources and manpower to invest in modern kilns
- Ensure stricter border controls between districts (e.g. police forest roads, minor roads which are often used by transporters to evade taxation)

Retailers/Wholesalers

Retailers are often unorganized and dependent on daily changing conditions (e.g. supply of charcoal entering Kampala, local demand, presence of small/large charcoal retailers in the vicinity) hence charcoal retailing is not often their primary business. Most retailers are small shop owners, who purchase a couple of bags of charcoal from wholesalers from charcoal markets in the city. Retailers then resell the charcoal in smaller bags of 1 to 5 kg, making them affordable to local consumers. Increasing the profile of green charcoal retailers through a system of Government-supported co-branding schemes would raise the visibility of the new product. Some cost differentiation for the different types of charcoal will need to occur in order to encourage consumer purchase of green charcoal. Generating additional business through sales is expected to be the key incentive for retailers to promote green charcoal, given that all other conditions remain the same.

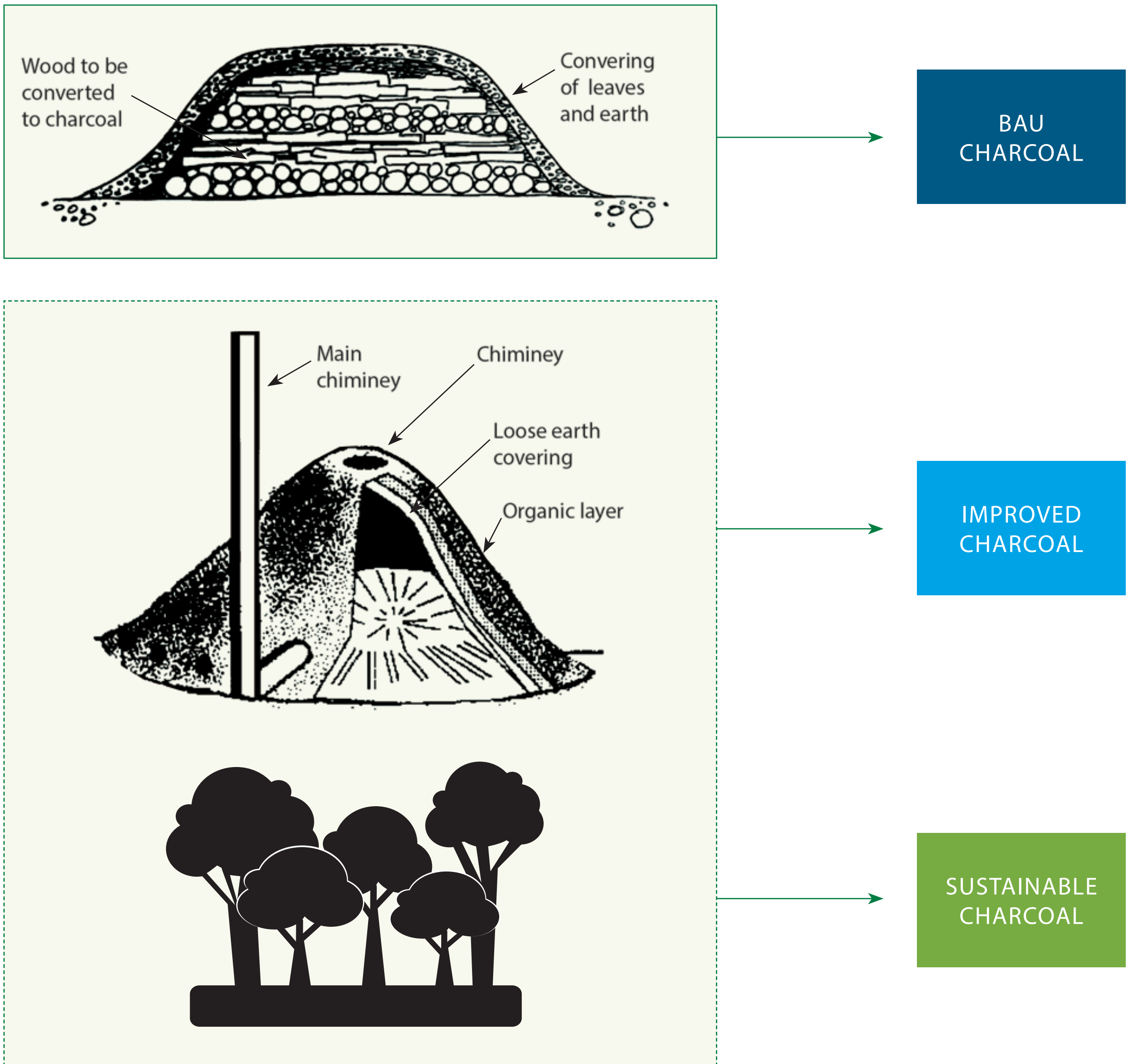
6.2. SUSTAINABLE CHARCOAL PRODUCTION

The Government of Uganda realizes the importance of charcoal in the country's energy planning and the need for a comprehensive strategy to promote sustainable charcoal production, as seen in efforts by the Ministry of Energy and Mineral Development to initiate the development of a BEST and the proposed National Task Force for biomass energy. However, given the socio-economic importance of charcoal production, the shift from conventional charcoal production to sustainable production needs to be gradually introduced to avoid disturbing the existing social fabric.

Charcoal Classification

As discussed in Section 6.1, charcoal has been broadly classified into three types (See Figure 7). The BAU charcoal currently produced using traditional kilns constitutes almost 100 percent of charcoal production in Uganda. With low efficiencies ranging from 10 to 15 percent, and a growing demand, the rate of deforestation has also seen a significant upward trend.

Figure 7: Charcoal types and the type of intervention



Source: Authors.

Use of the improved charcoal will act as a first step in reducing deforestation by introducing improved kilns with higher efficiencies (between 25 to 35 percent) that produce more charcoal per tonne of wood. For rural populations, the introduction of efficient and portable kilns will enable them to continue their current lifestyles, namely using private forest lands for wood to be burned into charcoal. Higher charcoal volumes combined with an improved pricing structure will allow producers to see a direct benefit to adopting new technologies, making it easier for NAMA promoters to get a "buy-in" when introducing the concept of sustainable forestry. However, it should be recognized that producers' increased time and labour capacity as a result of the new technologies could potentially lead to increased deforestation (See Section 8.2 for further discussion). The choice of technology, the cost of efficient kilns and the ease of adaptation will thereby be crucial to determine the success of the NAMA.

Sustainable charcoal production involves sustainable forest and woodlot management, and also the use of efficient kilns. Implementing sustainable forestry will involve a larger financial outlay, significant planning and stakeholder interaction. In addition, it will be a longer time horizon before forests are sustainably producing wood. (See Section 6.3 for an example of sustainable forestry and charcoal production).

Kiln Selection

When selecting technology interventions to be deployed, the following criteria should be considered:

i. **Scale:** The informal charcoal sector is extremely fragmented and consists of thousands of small-scale producers, most of whom make a living by producing less than 50 tonnes of charcoal per year. Improved small-scale production technologies can replace previously employed technologies at the level of charcoal makers and/or communities, thereby keeping most of the same informal charcoal makers employed in the sector. Large-scale charcoal production units, however, have a high productivity and are more complex. As such, informal charcoal makers are unlikely to either get involved with large-scale units or give up their source of income. The potential outcome of this would be an increased competition for wood between informal charcoal makers continuing their small-scale activity parallel to wood being harvested for newly established large-scale charcoal facilities. Nevertheless large-scale facilities are interesting on different accounts: (i) the product quality is high and stable, (ii) yields are very high and steady and (iii) the advanced technology allows the processing of many types of biomass. One disadvantage associated with large-scale facilities is the need to transport wood over increased distances to the sedentary kiln/processing unit.

   Small-scale facilities should be preferred when community participation is important. Large-scale facilities can be the preferred choices where charcoal production does not compete with local communities for wood harvests, such as: (i) in the use of alternative sources of biomass, (ii) in the production of charcoal from newly established plantation or (iii) in areas where local communities have previously not produced charcoal.

ii. **Quality of the charcoal produced:** Most improved kilns have been observed to produce high quality charcoal from wood. Attention should nevertheless be paid to charcoal production from alternative sources of biomass such as agricultural wastes. Indeed, high ash contents of the inputs might reduce the overall quality of the product, which is mostly determined by the fixed carbon content in the charcoal. It is, therefore, important to establish minimum quality standards and ensure that production complies with those standard, for example, by operating with mix of biomass wastes whose expected charcoal quality is predictable.

iii. **Complexity:** More advanced kilns require trained staff for their operation and maintenance. In some cases, trained staff proves problematic to find. Large-scale kilns or briquetting units also often require a source of electricity to be operated. This can be problematic in countries with low rates of rural electrification like Uganda.

iv. **Local vs. global technology:** Technologies which need to be imported might face administrative hurdles related to their import. Ideally, technologies which can be:

   a. produced locally, or
   b. sourced locally, or
   c. maintained locally or even
   d. produced and maintained locally should be preferred

v. **Yield:** This criteria is one of the most important as the wood savings per tonne of charcoal are directly proportional to the difference in yields (savings = quantity charcoal/(baseline yield – project yield)). Ideally, yields obtained should be not only high but also steady providing a high degree of confidence for the subsequent calculation of wood savings. Theoretical yields are roughly known for specific technologies. Real yields might need to be measured by sampling, especially in cases where a broad possible range of yields was achieved.

   Even for alternative sources of biomass, a high yield is important as the quantity of available wastes is limited and it is therefore essential to use the waste in the most efficient manner to displace a maximum of the baseline charcoal which is produced from wood.

vi. **Portability:** In most areas, installing small-scale sedentary kilns is possible. In mountainous or highly hilly landscapes however, transporting the wood to a sedentary kiln instead of building a traditional kiln on-site might prove challenging. For this reason, only very light portable kilns such as the Casamance kiln, see Box 3, are likely to be successful in such contexts.

vii. **Cost:** The cost is one of the most important selection criteria for charcoal making equipment. With limited budget available, the cost should be kept as low as possible in relation to the achievements. In turn, the cost indicator should for example be expressed in USD per tonne of wood avoided:

   a. for fuel switch projects, the wood consumption avoided is the quantity of wood which would have been consumed for the same production of charcoal on the basis of the unimproved baseline technologies (applying for example the proposed SBL PSB0001).

   b. for projects which improve yields without fuel/feedstock switch, the wood consumption avoided is the quantity of wood which would have been consumed for the incremental quantity of charcoal produced thanks to the higher achieved yield (applying for example the proposed SBL PSB0001).

If an objective is also to avoid CH_4 emissions associated with the pyrolysis process, an apportioning of the cost between the avoided wood consumption and avoided CH_4 emissions is required. For this purpose, both terms should be expressed in a common unit such as tCO_2e. For the sake of initial simplicity, the incremental charcoal produced without wood will in this case be accounted for on the basis of the future avoided fossil fuel emissions taking into account a factor of 82 percent X_{NRB} as would be the case for the application of the approved SSC CDM methodology in Uganda.

Box 3: The role of the Casamance kiln

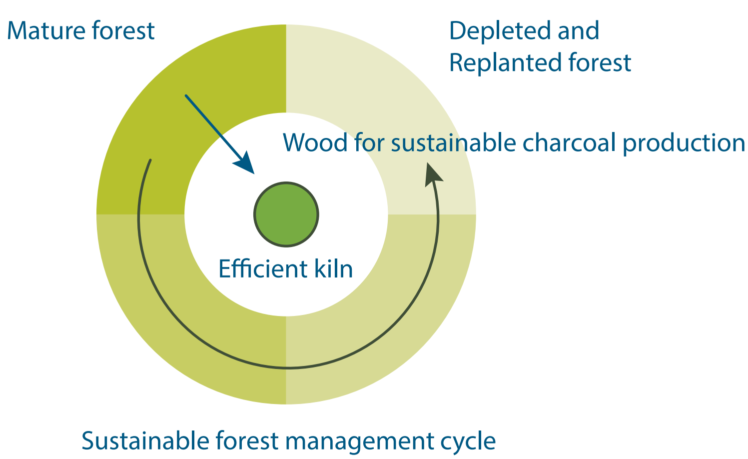
The Casamance kiln is one of the simplest kiln technologies that improves the control of the carbonization process and thus achieves better recoveries of charcoal (therefore higher efficiency). The kiln can be constructed using local materials and there is very little cost incurred with the construction of the needed chimneys. The kiln however may not be appropriate for large-scale charcoal production. The Casamance kiln can be expected to play a pivotal role in the initial stages of the NAMA to kick-start the production of "improved charcoal". As charcoal producers continue to scavenge forests for firewood, the portability and ease of implementation of the kiln is expected to significantly increase the charcoal output (and thereby reduce the rate of deforestation) while providing the charcoal producers with a tangible impact – in the form of increased earnings, making it easier to implement the subsequent objectives of the NAMA, i.e. production of sustainable charcoal.

Source: Authors.

6.3. SUSTAINABLE WOODLOT/FOREST MANAGEMENT

Given the inter-relationship of charcoal production and forest depletion, any potential NAMA needs to account for sustainable forestry in order to ensure a balance between Uganda's growing demands for charcoal and the preservation of the country's forest health and diversity. This balance and sustainable forest management cycle is critical for the survival of forests and for the long-term sustainability of the NAMA.

Figure 8: Schematic representation of sustainable forestry and efficient kilns



Source: Authors.

To ensure that rural communities see long-term economic benefits in the production of sustainable charcoal, the final type of energy efficient kiln utilized is not portable kilns, such as the Casamance type, but rather the "fixed" type of kiln such as the Adam model (See Box 4). This kiln should be located in proximity of the neighbourhood forests and community to ensure a sense of ownership. A fixed kiln also has other benefits including larger production capacity and a forced need for sustainable forest management as there will be dependency on local forest resources (See Figure 8). A patch of forest can be segregated into sections proportional to the annual volume of wood required, the capacity of the kiln and the time required for a sapling to grow into a full tree ready for harvesting. Considering an Adam kiln, which has a capacity to produce about 50 tonnes of charcoal annually and an efficiency of 30 to 40 percent, this translates to approximately 125 to 165 tonnes of wood used per year. Hence the forest land needs to be divided into sections such that each section generates 165 tonnes of wood annually. If the period required for a sapling to grow into a tree that can be harvested is four years, then four such forest sections need to be created. When one section is cleared for charcoal production, the area can be replanted and harvested back in four years' time. This will allow for a sustainable harvesting of trees while preventing unorganized and unsustainable deforestation. Importantly, it will provide the local population an assured supply of raw materials and, therefore, income generation for the future.

Box 4: The Adam kiln

The Adam kiln is a fixed type kiln and known to be one of the most efficient charcoal producing ones. The kiln operates by recycling the gases generated from the burning of wood back to the carbonization chamber. Efficiencies are known to be in the range of 35 to 40 percent and the process can be completed over a one-day cycle. This would result in higher turnaround time for charcoal production and also larger batch sizes. Although the kilns are expensive and require skilled operators, the Adam kiln provides many advantages that outweigh the disadvantages.

Source: Authors.

Similar to efficient cook stove projects, private sector companies and non-governmental organizations (NGOs) can be involved in securing finance, setting up infrastructure, capacity building, and awareness creation as required for sustainable forestry and charcoal production. The projects can be operated as a profit making entity to ensure their long-term sustainability. The main tasks of the private companies/NGOs in relation to sustainable forestry would be:

- Identification of the most appropriate site for setting up a sustainable forestry "cycle"
- Create awareness/capacity building for sustainable forestry
- Secure buy-in with local community leaders (village heads, priests, etc.) and make them an integral part of the community outreach programmes

- Ensure that government-based programmes (e.g. distribution of seedlings, improved forestry techniques) are made available to the locals
- Ensure grants for forestry development (e.g. a forestry fund) are appropriately used
- Prepare a time schedule for the sustainable forest cycle (planting of saplings, growth periods, harvesting for charcoal production)
- Secure license/permits as required for the production of sustainable charcoal

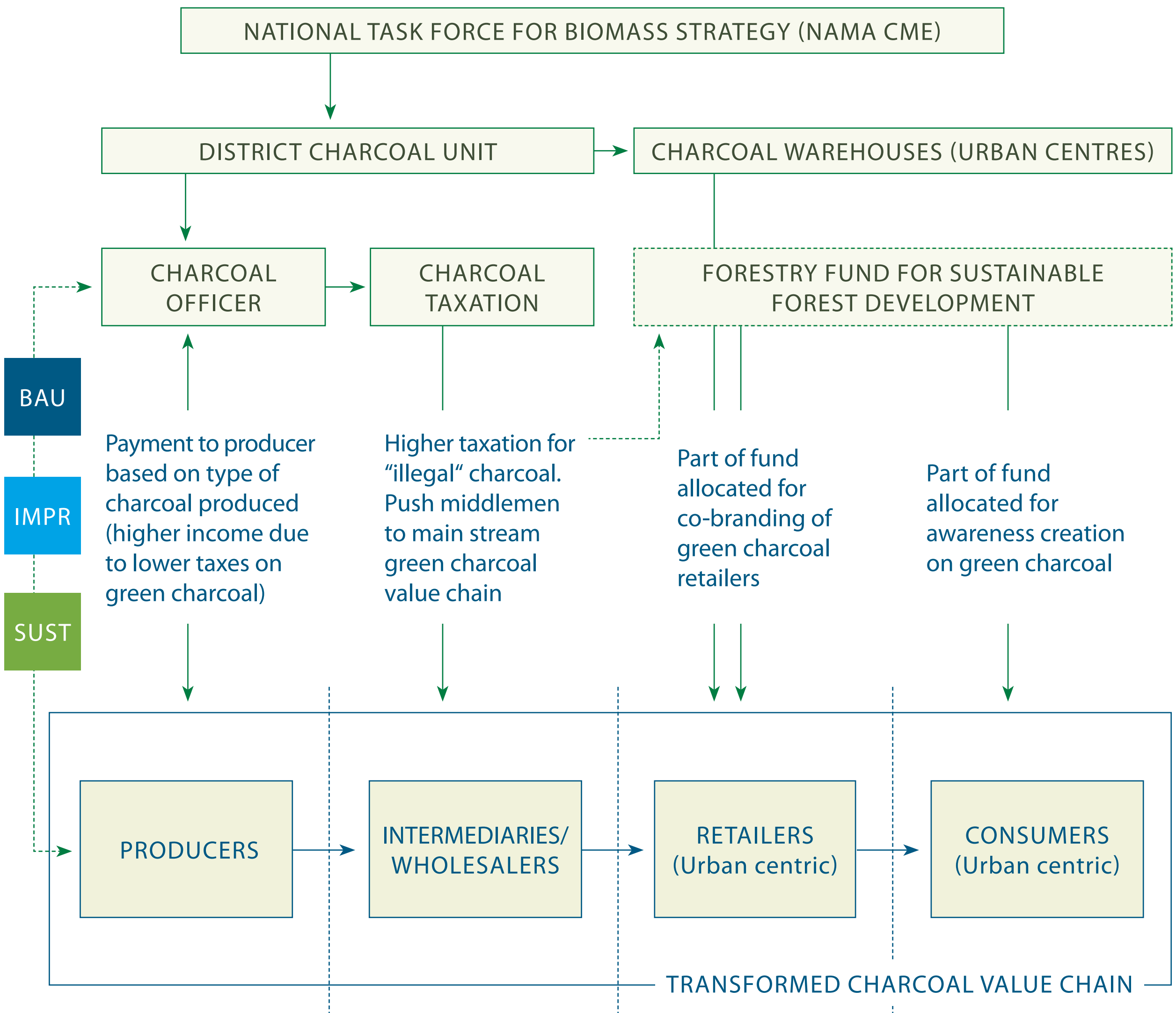
In addition to maintaining the sustainable forestry-related activities, the private sector companies and NGOs will also be involved in operating the sustainable charcoal production as a profit-making business to ensure its long-term sustainability. The tasks in relation to the sustainable charcoal production will include:

- Choosing the appropriate kiln technology
- Securing finance for the construction of the kiln
- Overseeing the implementation, day-to-day operation and maintenance of the kiln
- Preparing a business model around the sustainable forestry and charcoal production cycle
- Securing all necessary license/permits required for operating the business
- Establishing good working relationship with the district charcoal units
- Ensuring that the sustainable charcoal produced are properly packed in labelled bags and transported to the collection points
- Ensuring that all levies are correctly paid and the benefits of charcoal revenues are passed onto the local labourers/charcoal producers
- Maintaining the MRV in accordance with the requirements of the NAMA project

6.4. INSTITUTIONAL FRAMEWORK

Apart from private sector companies/NGOs, whose roles and responsibilities have been described in the previous section, the success of the NAMA will depend on several key stakeholders directly involved in structuring, implementing and operating the NAMA (See Figure 9).

Figure 9: Schematic representation of the proposed NAMA concept



Source: Authors.

* Green charcoal denotes improved and sustainable charcoal

National Task Force: NAMA Coordinating and Managing Entity

One of the difficulties in measuring emission reductions of a project as widespread as that of sustainable charcoal production is the need to set up a robust MRV system and an institutional system that meets domestic and international criteria. As discussed in Section 4, two ministries – the Ministry of Energy and Minerals and the Ministry of Water and Environment – both play key roles in the charcoal value chain.

However, locating the potential NAMA Coordinating and Managing Entity (CME) under one of the ministries would risk the lack of adequate support from the other. The most appropriate entity that incorporates elements from both ministries is the proposed National Task Force for Biomass Energy (NTF) which is currently in the process of being set up to hasten the decision making and implementation process. The composition of NTF is ideal for the organization to be set up as the national focal point for all charcoal related activities.

Entities enlisted for the NTF:

- Ministry of Energy and Minerals (Chair of Task Force)
- Ministry of Water and Environment
- National Forestry Authority
- National Environment Management Authority
- Representatives of BEETA (Biomass Energy Technology Association, an umbrella group of NGOs and biomass producers)
- Uganda Bureau of Statistics

The challenge with appointing NTF as the CME is MEM's desire to have the entire unit funded ideally through the funds raised from the sale of carbon credits. Hence any potential donor agency will need to consider the cost of operating and maintaining (at least a part of) the NTF into the project budget.

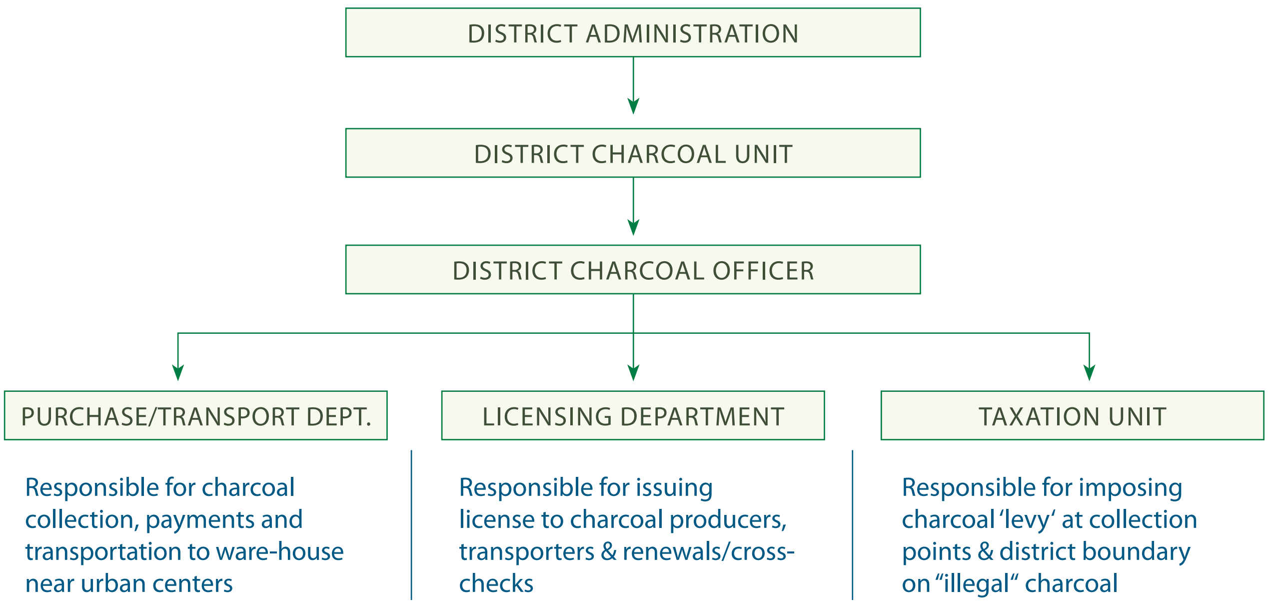
District Charcoal Unit

As explained in Figure 10, the district charcoal unit is an entity under the purview of the National Task Force (NAMA CME) and will be entrusted with the responsibility of reaching out to the entire charcoal value chain at the district level, namely the producers, transporters, wholesalers, and will have jurisdiction over the charcoal until it reaches warehouses located on the outskirts of urban centres.

The charcoal unit will be driven by a district charcoal officer, a Government employee appointed either at the district, county or sub-country level based on the volume of producers. The district charcoal officer will be served by three departments: charcoal purchase and transportation department, the charcoal licensing department and the charcoal taxation unit.

The charcoal purchase and transportation department will be responsible for setting up charcoal collection points in the district, ensuring that charcoal producers are paid a fair price for their goods, and organizing transportation of charcoal to the warehouses located on the outskirts of the urban centres.

Figure 10: Schematic representation of the district charcoal unit



Source: Authors.

Once charcoal producers are registered, the charcoal officers will be responsible for distribution of pre-labelled bags to registered charcoal producers. The bags will be labelled with one of the three types of charcoal: sustainable, improved or BAU. The producers will then be responsible for returning the bags filled with the appropriate charcoal type to the pre-determined drop-off points. The district charcoal unit will then be responsible for transportation to urban centres. Charcoal units can use the existing transportation network, however, transporters must be appropriately licensed into the charcoal value chain and made aware of the truck capacity limitations to prevent overloading and wastage from charcoal dust.

The officers will be responsible for the following set of activities:

- Random sampling of bags to determine if the labelled bags are filled with the appropriate charcoal type
- Weighing of bags to ensure that the bags are accurately filled (e.g. the bags can have a pre-determined capacity of 25 or 50 kg which shall also help in the MRV system)
- Payment to charcoal producers at a pre-determined market rate based on the charcoal type

- Impose applicable charcoal levies at the collection points
- Maintain a detailed record of the number and type of bags provided to individual producers and the number of filled bags returned to the collection points, maintain a record of the actual weight of charcoal collected by the charcoal type (details of the monitoring system can be elaborated at the time of developing an MRV system)

The charcoal licensing department will reach out to various producers and encourage them to register themselves with the district charcoal unit by obtaining an operating license. At the time of registration, the charcoal unit will record the type of kiln used by the producer; this will be verified by means of a physical check and a site visit. The charcoal license would need to be annually renewed thereby allowing the licensing department to annually cross check and verify the technology used. At the time of license renewal, tests can be conducted to determine the net calorific value (NCV) of the charcoal produced. Similarly the licensing unit will also be responsible for providing licenses to transporters. The main incentives for registration and obtaining a license will include:

- Access to the official Government-operated charcoal value chain
- Identification/certification of charcoal type
- Access to market prices
- Access to drop-off points
- Scope for improved income generation through a differentiated pricing and taxation structure
- Access to Government incentives/programmes for sustainable charcoal production
- Hassle-free connection to transporters of charcoal
- Avoidance of the risks associated with operating an illegal activity.

Charcoal Taxation Unit

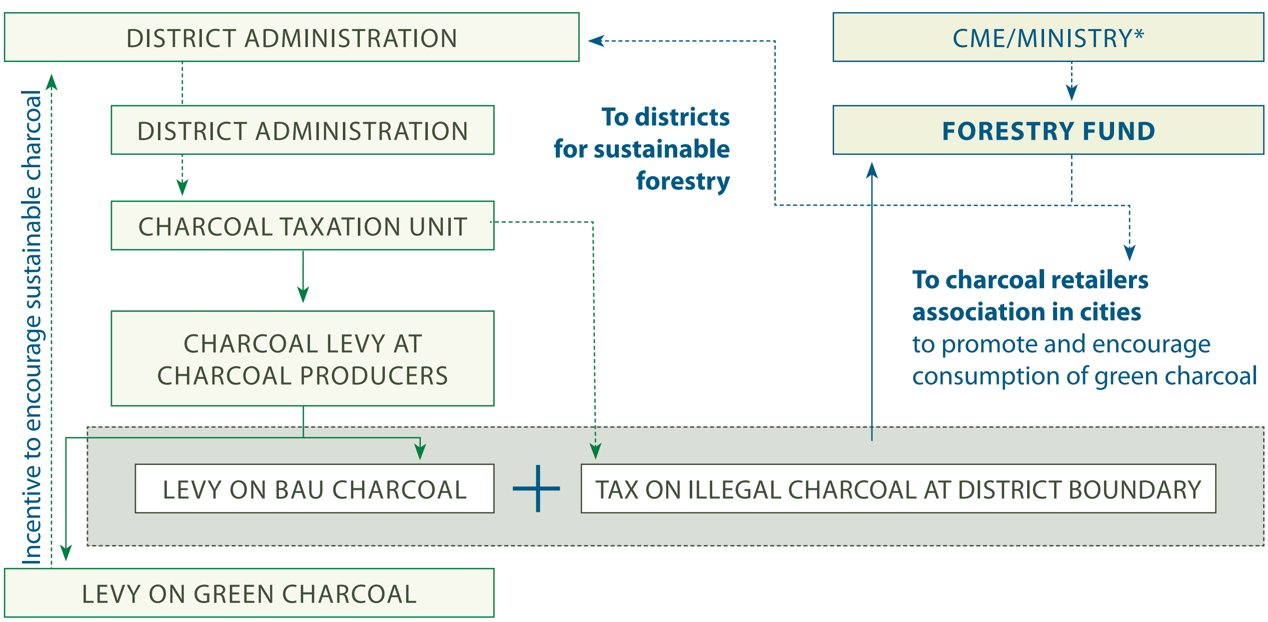
The charcoal taxation unit can be located under the district charcoal unit and will be responsible for all taxation-related activities. The taxation on charcoal (often known as a levy in Uganda) from licensed producers who are part of the proposed NAMA charcoal value chain will happen at the charcoal drop-off points. The levy of charcoal here will be based on a differential taxation system with the lowest tax rates applied to sustainable charcoal and the highest tax rate made applicable to the BAU charcoal. To encourage districts to promote sustainable production, the districts should be allowed to retain the taxes collected from the sustainable charcoal while the taxes from BAU charcoal would need to be put into a central government ministry operated forestry fund.

The existing roadblocks at district boundaries will be strengthened to allow for easy passage of pre-taxed and labelled charcoal, while charcoal from all other sources and transported in unlabelled bags will be levied an additional tax. This taxation system will act as a deterrent for illegal charcoal transportation and provide an incentive to all charcoal transporters/wholesalers to opt for the authorized charcoal value. The charcoal taxation unit will continue to employ the existing personnel responsible for collecting levies at district boundaries and for establishing an easier passage for pre-taxed charcoal, which is expected to free up the capacity of personnel from the existing teams, who can then be empowered to track down illegal charcoal transporters.

Forestry Fund

A forestry fund is designed to be under the ownership of the central Government either through the Ministry of Finance, Planning and Economic Development (MoFPED), MEM or MWE. Establishing a single fund allows for rational redistribution of the taxes collected on BAU charcoal for sustainable forestry practices (e.g. in districts with higher rates of deforestation) and can be used as a means to raise awareness in urban areas for generating and increasing demand for green charcoal. The fund can also be used to assist with sustainable forest management. Considerations could be made about using some of the funds to assist private land owners in improving the management of their forests instead of allowing charcoal producers to clear their land illegally since the clearing helps to convert the forest to agricultural land at a low cost.[6]

Figure 11: Forestry fund use of charcoal taxation revenue to promote sustainable charcoal



Source: Authors.
* Open to discussion

[6] If assistance with improved forest management occurs, linkages with Reducing Emissions from Deforestation and Degradation and sustainable land management (REDD+) should be considered.

As explained in Figure 11, all levies collected from green charcoal will be retained by the respective districts thus acting as an incentive for the district administration to promote green charcoal production through their district charcoal unit. The levy on BAU charcoal and additional taxes on charcoal collected at district boundaries will be transferred to the forestry fund. This is a win-win situation for both charcoal producers and the district administration. Rather than ban or punish BAU charcoal producers, the district charcoal unit will be motivated to seek out BAU charcoal producers to educate and convert them towards green charcoal production.

In regards to the distribution of the levies collected on BAU and improved charcoal, the data on the quantity and type of charcoal bags distributed to charcoal producers will help to determine the revenues for the districts and the forestry fund. All charcoal bags will be stamped with the date of collection and labelled as having paid all necessary levies (pre-taxed charcoal). Increased green charcoal production and decreased BAU charcoal production will lead to a gradual reduction of the forestry fund and as a sustainable charcoal value chain gains greater acceptance, the fund can be phased out.

Box 5: Incentives for district employees

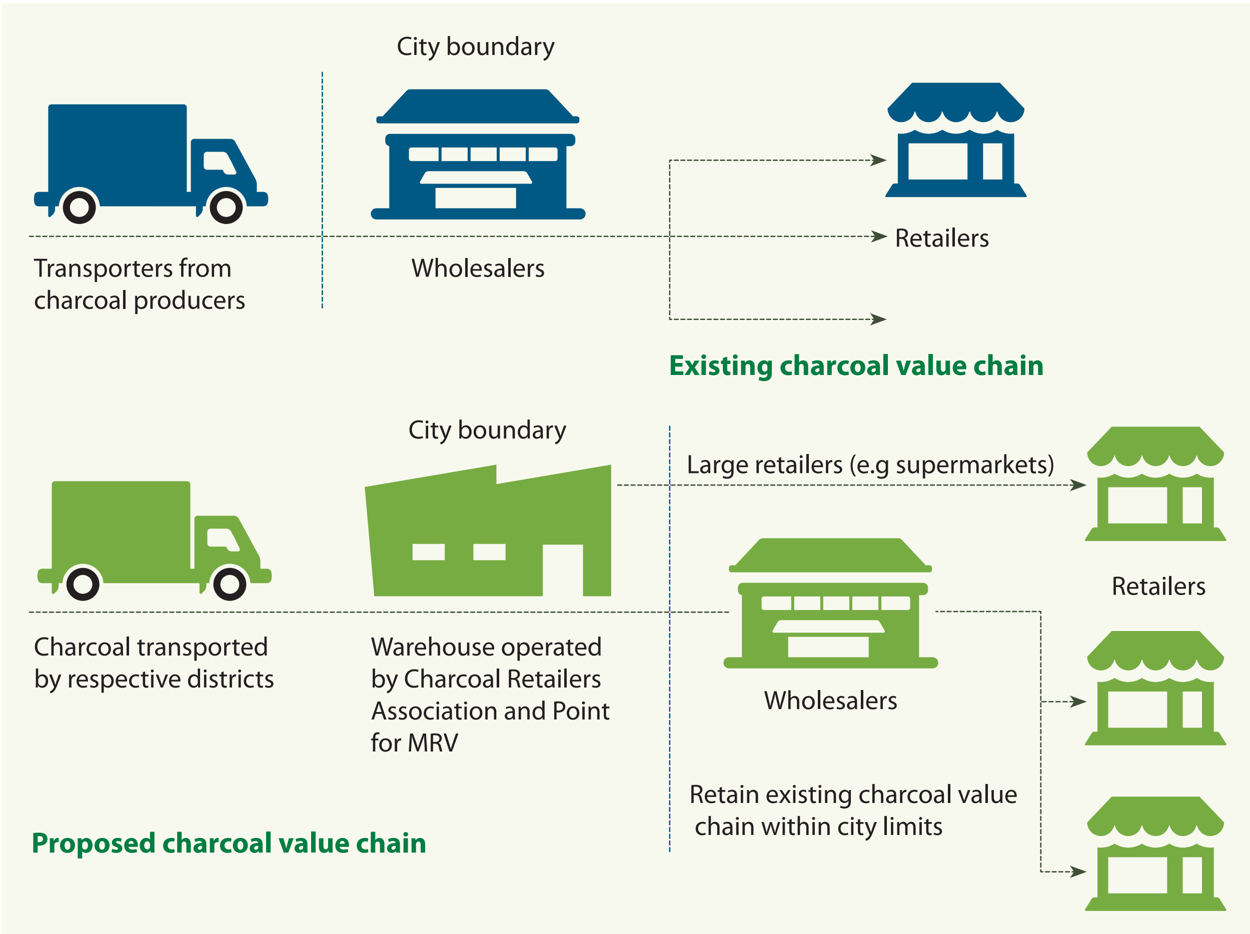
Although a lot of focus is put on incentivizing the various stakeholders of the charcoal value chain, another key group of stakeholder which will emerge under the proposed structure and which will need incentivizing are the members of the district charcoal units themselves. These district charcoal unit members will play the crucial role of enforcement. To encourage healthy competition between district officers to implement sustainable forestry practices and to detect BAU charcoal production (whose producers avoid taxation) or other illegal practices, a financial reward system and a public recognition system can be put into place. These systems can be significant morale boosters and discourage potential corruption among employees. Part of the forestry fund can be earmarked for a national and/or a district-based reward scheme, in a type of results-based financing scheme.

Source: Authors.

Retail

Given the importance of charcoal in the daily lives of urban dwellers, there exists a symbiotic relationship between the trade and the urban society. Any proposed revisions to the charcoal value chain needs to retain the existing relationship so as to avoid damaging the existing social fabric while securing acceptance by the charcoal retailer community.

Figure 12: Restructuring of the charcoal value chain without disturbing the existing relationships



Source: Authors.

As can be seen from Figure 12, the main difference between the existing and the proposed charcoal value chain is the introduction of a warehouse outside the city limits. The warehouse will be operated by the Charcoal Retailers Association, representing wholesalers and retailers who are working for the promotion of the charcoal trade. For services rendered, the warehouse can charge a small surcharge, sufficient to cover expenses, salaries, transportation to wholesalers and maintaining the MRV system. This warehouse results in distinct advantages for all concerned stakeholders:

- Transporters from various districts have a single point of delivery. At present, trucks overloaded with charcoal bags enter directly into the city and drop off the bags at markets where the charcoal wholesalers are located; this system results in congestion and ad hoc distribution.

- Wholesalers will place their orders for charcoal with the retailers association who operate out of the warehouse. This will negate the need for individual charcoal wholesalers to deal with multiple sets of intermediaries and/or charcoal transporters.
- Distribution from the warehouse can take place using smaller trucks operated either by the warehouse or by the wholesalers; this will reduce traffic bottlenecks.
- As the role of green charcoal expands and large charcoal retailers such as supermarkets enter the legal trade, they can directly source their charcoal from the warehouse.
- Small retailers can continue to secure their supply from wholesalers thereby ensuring status quo of the existing charcoal value chain.
- The warehouse is ideally placed to be the point for conducting MRV of all charcoal entering into the city.

Charcoal Retailers Association

The charcoal retailers association will act as an urban counterpart to the district charcoal units for the promotion of green charcoal amongst urban consumers. The role of the association is three-pronged:

- Maintain the charcoal warehouse thereby acting as a bridge between charcoal producers, transporters and the charcoal retailers and eventual consumers
- Support the charcoal trade by marketing and branding of green charcoal retailers and Government co-funded awareness creation activities (e.g. support the creation of an eco-label that would allow consumers to easily identify the retailers dealing with green charcoal)
- Provide charcoal demand and supply data thereby ensuring that information is available and the price for charcoal is market driven

The association will encourage its members, individual charcoal retailers, to purchase green charcoal from the warehouses. The association is also expected to operate a system of eco-labelling with the cooperation of the Government. The Government can help promote the eco-label through awareness programmes and associated media interventions (e.g. billboards, newspaper ads encouraging people to buy green charcoal from participating retailers). Similarly, the association is expected to play a role (e.g. organize road shows, awareness campaigns, etc.) in educating and encouraging consumers to purchase from green charcoal retailers.

Charcoal Data and Pricing

To ensure transparency of the market price based on charcoal type, the association will be entrusted with collecting data on weekly demand from retailers and wholesalers. This data can form the basis for the pricing, similar to the model used in commodities market. This information can be made publicly available and accessed by the district charcoal units to indicate the weekly purchase price. Charcoal producers too can have access to this data either online or using a SMS-based system, to determine whether the price conditions are appropriate for shifting the charcoal bags to drop-off points.

Training and Capacity Building Programme

In addition to awareness raising programmes, specific training programmes will need to be conducted to educate and align the different stakeholders towards a common goal, namely ensuring long-term sustainability of the charcoal supply (and the NAMA).

Table 5: Possible stakeholder trainings

STAKEHOLDER	TYPE OF TRAINING REQUIRED
Producer	• Improved production using portable kilns • Sustainable production using fixed kilns • Packing into appropriately labelled bags to ensure easier MRV, thereby ensuring an increased income generation from the differentiated prices • Pricing and the relevant market information • Government programmes on sustainable charcoal
Forest owners[7]	• *Sustainable forestry practices*
District charcoal unit	• Aligning the actions of purchase, transportation, licensing and tax collection units to ensure smooth operation of the value chain • MRV system
Transporters	• Packaging and transportation to minimize wastage
Intermediaries	• Educating about the benefits of the legal trade and opportunities for intermediaries to integrate or play a more active role in the value chain (e.g. set up energy company to invest in fixed kilns and forestry)
Wholesalers/retailers	• Pricing • Marketing and Government programmes
Retailers Association	• Storage, local transportation, demand and supply • Pricing and information sharing • MRV system

Source: Authors.

[7] The study recognizes forest owners as an important stakeholder in the charcoal value chain, however they have not been considered under the scope of this study.

6.5. POLICIES

The key role of policies is to create an enabling market environment for the promotion of sustainable charcoal in Uganda. As the concept of the NAMA framework evolves, the idea of using a NAMA as a tool to support policy and strategy development for long-term emission reduction is slowly gaining acceptance. A NAMA on sustainable charcoal provides an opportunity to combine Uganda's wider sustainable development goals with emission reductions that can potentially be quantified. The set of policies/Government-supported programmes proposed are designed to gradually change the charcoal value chain, influence consumer behaviour and increasing the demand for sustainable charcoal. As the market gradually transforms, it will provide individuals in the value chain opportunities to adapt to the evolving market scenario. These opportunities include:

- Empower districts to set up a district charcoal units with the authority to license producers, distribute labelled bags, act as collection points, levy taxes and be a legal entity for transportation
- Authorize teams managing road blocks to deter illegal activities while allowing hassle-free transportation of legal charcoal
- Establish a staggered taxation system to encourage sustainable charcoal over improved charcoal and improved charcoal over BAU charcoal
- Ensure that there is a financial incentive for consumers to purchase green charcoal over BAU charcoal
- Initiate a capacity building and awareness campaign to raise the profile of sustainable/improved charcoal. Set up a co-branding system to increase the profile of legal charcoal and providing consumers with a clear choice for their actions

7. Measuring, Reporting and Verification

7.1. MRV OBJECTIVE

The objective of any MRV system is to track the achievements resulting from the NAMA intervention. This requires the following three elements:

i. **A clear goal for the intervention** has to be formulated, regardless of whether the goal is defined in a quantified or qualitative manner before the NAMA. This goal would most likely be to balance the amount of biomass needed to meet the charcoal demand with the available amount of biomass which can be sustainably regrown.

ii. **Impacts should be clearly defined which can be used to measure the bigger picture progress towards the goal.** Such impacts could for example be: to decrease by two-thirds the amount of wood used per unit of cooking energy provided by charcoal.

iii. **Results which enable impacts.** These results could, for example, be: widespread introduction and use of improved charcoal techniques, significant improvement in the tonnes of wood used per tonne of charcoal produced, increased revenue to producers and increased efficiency of the entire value chain. Parameters provide information about the results that need to be achieved in order to enable the results and impacts to occur (and the goal to be met). Ideally such parameters can be quantified using a metric (e.g. quantity of wood removal avoided in tonnes per year).

The goals, impacts and results of the NAMA intervention should, therefore, be well formulated before the indicators can be developed.

7.2 MONITORING RESULTS

This monitoring section, similar to the proposed activities listed in Section 6 of this study, will focus on the production, transport and sale to retailers. However, as the NAMA should include all components of the value chain, it is also crucial to design an elaborated MRV plan incorporating all components of the value chain. This elaborate plan should include forestry management and charcoal consumption by users, two components that were mainly excluded from this study.

Setting the Baseline

One of the first activities of the NAMA development is to establish a baseline. The emission-related component of the baseline should be established by following the relevant establishment procedures in the SB for charcoal projects in Uganda (Perspectives 2011), as seen in Table 6. Additionally, there may be increased efficiency in the value chain in the transport and retail components. However, this efficiency increase will be difficult to quantify, in both the baseline and in the NAMA. Therefore, this increased efficiency will be disregarded but, if it is thought to be significant, the necessary parameters should be included in the monitoring plan.

Table 6: Baseline parameters for charcoal production

TEM	SUB-ITEM	
Sectors	Sectors included	The baseline is applicable to: • the production and consumption chain of charcoal products as a household fuel. • the production chain of charcoal products as a fuel for small- and medium-sized enterprises (SME).
System boundary	–	**Baseline:** Charcoal production site, charcoal transport, charcoal sale to wholesalers and retailers. No "associated upstream emissions" occur
Key performance Indicator	–	tCO_2e per equivalent amount of charcoal produced – corrected for the charcoal NCV
Aggregation level	1) Process	**Baseline emission factor:** **i.** Baseline: the charcoal consumed by households and SME is produced by the "informal sector" on the basis of traditional kilns. **ii.** Other baselines: this current study is not applicable for cases in which other production technologies (e.g. the Casamance kiln) form a substantial share of the baseline charcoal production.
	2) Product	**Baseline inputs:** all inputs whose use lead to a decrease in forest carbon stock as they are partly or totally non-renewable shall take into account the following elements: **i.** the fraction of non-renewable biomass (X_{NRB}) in inputs[8] **ii.** the amount of wood used **iii.** the carbon content in the wood used (expressed on an oven-dry wood basis).
		Baseline outputs: **i.** NCV of the charcoal produced **ii.** The volume of charcoal produced (enabling calculation of the amount of wood needed to produce a unit of charcoal)
	3) Time	Baseline emission factor: No autonomous improvements in the technologies used have been observed. This has two consequences: • The baseline emission factor does not need to be updated over time • Performance test from any point in time can be included in the vintage used to derive values for the baseline emission factor (e.g. a performance test from the 1950´s would still be valid).
Stringency	Specific levels	**Baseline emission factor:** CO_2 emissions: Determined based on the "average" observed on all adequate performance tests. This represents the continuation of the current practice. CH_4 emissions: Weighted average for the region as there is no "most economically attractive course of action" for CH_4 emissions from pyrolysis gases – as there is no economic incentive for charcoal producers to reduce CH_4 emissions. These emissions are the result of both the technology and operating conditions.
	Unaccounted for emission reductions	Estimated to represent around 30% of the baseline emissions. This is an overly conservative default and could be reduced if other emissions are properly accounted for.

Source: Authors.

[8] The UNFCCC Uganda X_{NRB} default value of 82% or a calculated X_{NRB} can be applied.

The net calorific value of the charcoal in both the baseline and in the NAMA should be determined via Option 1, as seen in the CDM SSC methodology, AMS-III.BG: Emission reduction through sustainable charcoal production and consumption (UNFCCC 2012):

Measurement is undertaken in laboratories according to relevant national/international standards. Measure quarterly, taking at least three samples for each measurement. The average value can be used for as long as there is no change in the biomass types used for charcoal production.

In addition to the above-mentioned parameters needed for the emissions baseline, other factors should be included into the baseline in order to have a comprehensive and holistic NAMA.[9] These factors are found in the These factors are found in the monitoring parameters (tables 9 - 20).[10] Knowing information about these parameters will enable all actors to have a clearer picture about the charcoal value chain and who is involved. Knowing as much relevant information as possible enables the proper design of a successful NAMA. Being aware of all involved stakeholders also allows for proper stakeholder consultations and proper involvement of them in the NAMA implementation. This study provides information for the baseline about relevant policies and the relevant institutional framework.

Monitoring

The distinctions between three charcoal types are detailed in Table 7 provided below. The fourth type of charcoal, unimproved unlabelled charcoal, comes into consideration later in this section.

Table 7: Four types of charcoal included in monitoring plan

CASE	TYPE	TECHNOLOGY	FEEDSTOCK	IMPACT ON FOREST CARBON STOCKS
PJ_{sus}	Sustainable charcoal	Improved (preferred option) or traditional	Forests which are now sustainably managed, biomass wastes, newly established forests, etc.	**Zero impact**
PJ_{imp}	Improved charcoal	Only improved carbonization	Common wood mix from local forests	**Reduced impact:** reduced deforestation or forest degradation
BAU_{lab}	Unimproved charcoal which has been put into Government issued labelled bags	Traditional	Common wood mix from local forests	**Strong impact:** strong deforestation or forest degradation
BAU_{unlab}	Unimproved charcoal which has not been labelled or collected at collection points	Traditional	Common wood mix from local forests	**Very strong impact:** strong deforestation or forest degradation (impact is very strong due to value chain inefficiencies)

Source: Authors.

[9] As mentioned previously, forest management is only touched upon in this study and consumer demand is outside the scope of this study.

[10] Some of the parameters may have different entities involved in the baseline.

An overview of the monitoring parameters can be seen in Table 8. Further details about the parameters are provided in the following pages.

Table 8: Monitoring parameters overview

CHARCOAL PRODUCTION	TRANSPORTATION	CHARCOAL RETAIL
Number of producers of each type and affiliated charcoal association	Number of transport licenses granted	Number of registered retailers
Number of labelled charcoal bags provided to producers	Number of bags of each type checked at road blocks	Bags of charcoal brought into the warehouse
Number of labelled bags of each charcoal type purchased by the charcoal unit	Taxes collected from unlabeled BAU charcoal	Bags of charcoal sold to retailers
NCV of different types		
Tax revenue collected from the purchased charcoal		
Tax from charcoal put into forest fund		

Source: Authors.

The first component of the MRV system is the registration of all charcoal producers at the district level. Producer registration periods could be held once every quarter. When registering, the producer will register as a producer of BAU charcoal, improved charcoal or sustainable charcoal. If the producer makes more than one type of charcoal, he/she will be registered according to the majority type of charcoal produced. When registering, the producers will also list the charcoal association that he/she is in (if applicable). At the quarterly registrations, producers are encouraged to change their type of charcoal production if they change to a different type of charcoal produced. See Table 9 for this monitoring parameter.

Table 9: Registration of charcoal producers

MONITORING PARAMETER	DESCRIPTION	UNIT	RECORDING FREQUENCY	RECORDING RESPONSIBILITY	RECORDING FREQUENCY	REPORTED TO
$Prod_{sus}$	Producers of sustainable charcoal and charcoal association	# producers	Quarterly registration periods	Charcoal license unit officer	Quarterly	National Task Force
$Prod_{imp}$	Producers of improved charcoal and charcoal association	# producers	Quarterly registration periods	Charcoal license unit officer	Quarterly	National Task Force
$Prod_{BAU}$	Producers of BAU charcoal and charcoal association	# producers	Quarterly registration periods	Charcoal license unit officer	Quarterly	National Task Force

Source: Authors.

Upon registration, the producer will be given bags marked with each charcoal type, as seen in Table 10 below.

Table 10: Number of labelled charcoal bags provided

MONITORING PARAMETER	DESCRIPTION	UNIT	RECORDING FREQUENCY	RECORDING RESPONSIBILITY	RECORDING FREQUENCY	REPORTED TO
Bag_{PJsus}	Empty labelled sustainable charcoal bags provided	# bags	Quarterly registration periods	Charcoal license unit officer	Quarterly	National Task Force
Bag_{PJimp}	Empty labelled improved charcoal bags provided	# bags	Quarterly registration periods	Charcoal license unit officer	Quarterly	National Task Force
Bag_{BAUlab}	Empty labelled BAU charcoal bags provided	# bags	Quarterly registration periods	Charcoal license unit officer	Quarterly	National Task Force

Source: Authors.

Following the charcoal production process, producers[11] will bring the filled labelled bags to established collection points. These collections can be done on a weekly basis. At each collection point, there will be a charcoal unit officer, who will check a sample of the charcoal. This sample will confirm whether the charcoal is of high quality and produced through efficient processes. There will also be checks conducted where the officer visits the producers to assess the type of kiln used and whether the producers are using renewable[12] or non-renewable wood. The unit will purchase the labelled charcoal from producers, as seen in Table 11.

Table 11: Number of labelled bags of each charcoal type purchased by the district

MONITORING PARAMETER	DESCRIPTION	UNIT	RECORDING FREQUENCY	RECORDING RESPONSIBILITY	RECORDING FREQUENCY	REPORTED TO
Ch_{PJsus}	Sustainable charcoal purchased at the collection point	# bags	Weekly (or as often as collections occur)	Charcoal purchase unit officer	Quarterly	National Task Force
Ch_{PJimp}	Improved charcoal purchased at the collection point	# bags	Weekly (or as often as collections occur)	Charcoal purchase unit officer	Quarterly	National Task Force
Ch_{BAUlab}	BAU charcoal purchased at the collection point	# bags	Weekly (or as often as collections occur)	Charcoal purchase unit officer	Quarterly	National Task Force

Source: Authors.

From each of these bags, a sample of charcoal should be collected on an annual basis, as seen in the NCV details provided in the baseline setting section. This charcoal should be sent to a laboratory for measurements of the NCV. The lab results should be returned to the charcoal unit and recorded by the Unit, as seen in Table 12 on page 62.

[11] Producers can be individuals or associations.

[12] For the wood to be renewable, either the collection happens in a region with very low pressure on forest resources (regions which do not yet produce charcoal) or there is a system for replanting the cut forest.

Table 12: Registration of charcoal producers

MONITORING PARAMETER	DESCRIPTION	UNIT	RECORDING FREQUENCY	RECORDING RESPONSIBILITY	RECORDING FREQUENCY	REPORTED TO
$NCV_{ChPJsus}$	NCV of sustainable charcoal purchased at the collection point	TJ/t	Annually	Charcoal license unit officer	Annually	National Task Force
$NCV_{ChPJimp}$	NCV of improved charcoal purchased at the collection point	TJ/t	Annually	Charcoal license unit officer	Annually	National Task Force
$NCV_{ChBAUlab}$	NCV of BAU charcoal purchased at the collection point	TJ/t	Annually	Charcoal license unit officer	Annually	National Task Force

Source: Authors.

At the collection centre, taxes are collected by the charcoal taxation unit officer based on the number of bags of each type sold. There will most likely be a differential tax rate for each type of charcoal. Sustainable charcoal will have the lowest tax rate (which may be zero), BAU charcoal will have the highest tax rate and improved charcoal will have a median tax rate. The Officer will record the amount of taxes collected for each charcoal type, as seen in Table 13 below.

Table 13: Revenue from taxes collected by each district

MONITORING PARAMETER	DESCRIPTION	UNIT	RECORDING FREQUENCY	RECORDING RESPONSIBILITY	RECORDING FREQUENCY	REPORTED TO
Tax_{PJsus}	Tax collected from sustain-able charcoal	UGX	Weekly (or as often as collections occur)	Charcoal unit taxation officer	Annually	National Task Force
Tax_{PJimp}	Tax collected from improved charcoal	UGX	Weekly (or as often as collections occur)	Charcoal unit taxation officer	Annually	National Task Force
Tax_{BAUlab}	Tax collected from BAU charcoal	UGX	Weekly (or as often as collections occur)	Charcoal unit taxation officer	Annually	National Task Force

Source: Authors.

It is acknowledged that the charcoal unit may not be incentivized to encourage producers to produce sustainable charcoal if they receive fewer taxes. Therefore, there should be a differentiation of the percent of taxes that the district needs to put into the forestry fund. The charcoal unit will put a lower percent of taxes from sustainable charcoal into the fund than the percent of taxes from BAU charcoal that will go into the fund. A cross check can be done using the number of bags of each type which are sold and being able to estimate how many bags of each type of charcoal were projected to be produced, as seen in Table 14 below.

Table 14: Tax from charcoal put into forest fund

MONITORING PARAMETER	DESCRIPTION	UNIT	RECORDING FREQUENCY	RECORDING RESPONSIBILITY	RECORDING FREQUENCY	REPORTED TO
$Tax_{PJsusFF}$	Tax from sustainable charcoal put into the forest fund	UGX	Annually, aligned with district taxation schedule	Charcoal unit taxation officer	Annually	MoFPED
$Tax_{PJimpFF}$	Tax from improved charcoal put into the forest fund	UGX	Annually, aligned with district taxation schedule	Charcoal unit taxation officer	Annually	MoFPED
$Tax_{BAUlabFF}$	Tax from BAU charcoal put into the forest fund	UGX	Annually, aligned with district taxation schedule	Charcoal unit taxation officer	Annually	MoFPED

Source: Authors.

The district charcoal unit will then be responsible with transporting the labelled charcoal to a distribution warehouse near urban areas. The number of charcoal specific transport licenses granted should be included in the monitoring system, as seen below in Table 15.

Table 15: Charcoal licenses granted

MONITORING PARAMETER	DESCRIPTION	UNIT	RECORDING FREQUENCY	RECORDING RESPONSIBILITY	RECORDING FREQUENCY	REPORTED TO
Lic_{trans}	Transport licenses granted	# licenses	Continuously	Charcoal unit license officer	Quarterly	National Task Force

Source: Authors.

Along the transport paths, road blocks (on a sampling basis) will be set up by the charcoal purchase and transportation department to check charcoal being. These road blocks will allow district trucks with charcoal in labelled bags to pass through. Furthermore, the number of bags of unlabelled charcoal in non-district trucks can be used to estimate the volume of unlabelled charcoal being produced. At this point, a distinction between BAU charcoal which is labelled (BAUlab) and BAU charcoal which is unlabelled (BAUunlab) must be made, as seen in Table 16 below.

Table 16: Number of bags of each type of charcoal checked during road blocks

MONITORING PARAMETER	DESCRIPTION	UNIT	RECORDING FREQUENCY	RECORDING RESPONSIBILITY	RECORDING FREQUENCY	REPORTED TO
$Chkd_{sus}$	Sustainable charcoal checked during roadblock	# bags	Continuously	Charcoal unit taxation officer	Quarterly	National Task Force
$Chkd_{imp}$	Improved charcoal checked during roadblock	# bags	Continuously	Charcoal unit taxation officer	Quarterly	National Task Force
$Chkd_{BAUlab}$	Labelled BAU charcoal checked during roadblock	# bags	Continuously	Charcoal unit taxation officer	Quarterly	National Task Force
$Chkd_{BAUunlab}$	Unlabelled BAU charcoal checked during roadblock	# bags	Continuously	Charcoal unit taxation officer	Quarterly	National Task Force

Source: Authors.

Trucks with charcoal in unlabelled bags will be fined per bag at a rate higher than the taxation rate plus the value added tax of the BAU charcoal, as seen in Table 17. The fine will then be put into the forestry fund.

Table 17: Taxes collected from unlabelled BAU charcoal passing through road blocks

MONITORING PARAMETER	DESCRIPTION	UNIT	RECORDING FREQUENCY	RECORDING RESPONSIBILITY	RECORDING FREQUENCY	REPORTED TO
$Tax_{BAUunlab}$	Tax revenue collected from unlabelled BAU charcoal checked during roadblock	# bags	Continuously	Charcoal unit taxation officer	Quarterly	National Task Force

Source: Authors.

At the warehouse, trucks will drop off labelled charcoal bags and retailers and retail outlets will come to purchase charcoal. Unlabelled bags cannot be sold at the warehouse. The number of bags dropped off and the number of bags sold will be recorded by the charcoal retailer association, as seen in Table 18 and Table 19.

Table 18: Bags of charcoal brought into the warehouse

MONITORING PARAMETER	DESCRIPTION	UNIT	RECORDING FREQUENCY	RECORDING RESPONSIBILITY	RECORDING FREQUENCY	REPORTED TO
Bag_{insus}	Bags of sustainable charcoal brought into warehouse	# bags	Continuously	Retailer association	Quarterly	National Task Force
Bag_{inimp}	Bags of improved charcoal brought into warehouse	# bags	Continuously	Retailer association	Quarterly	National Task Force
Bag_{inlab}	Bags of BAU charcoal brought into warehouse	# bags	Continuously	Retailer association	Quarterly	National Task Force

Source: Authors.

Table 19: Bags of charcoal sold to retailers

MONITORING PARAMETER	DESCRIPTION	UNIT	RECORDING FREQUENCY	RECORDING RESPONSIBILITY	RECORDING FREQUENCY	REPORTED TO
Bag_{insus}	Bags of sustainable charcoal sold to retailers	# bags	Continuously	Rretailer association	Quarterly	National Task Force
Bag_{inimp}	Bags of improved charcoal sold to retailers	# bags	Continuously	Retailer association	Quarterly	National Task Force
Bag_{inlab}	Bags of BAU charcoal sold to retailers	# bags	Continuously	Retailer association	Quarterly	National Task Force

Source: Authors.

The charcoal retail associations will have a registered list of members, as seen in Table 20.

Table 20: Retailers registered in the charcoal retail association

MONITORING PARAMETER	DESCRIPTION	UNIT	RECORDING FREQUENCY	RECORDING RESPONSIBILITY	RECORDING FREQUENCY	REPORTED TO
$Retail_{ca}$	Retailers registered in the charcoal retail association	# retailers	Continuously	Retailer association	Quarterly	National Task Force

Source: Authors.

As the National Task Force is the CME, all of the data should flow to the NTF. The NTF must compile the information into reports. Smaller quarterly reports should be written in order to check the system, as well as large annual reports.

Verification

There are currently no set verification procedures for NAMAs. The verification procedures should be decided upon by the National Task Force and the donor. However, it is recommended that the NAMA is audited by an independent third party auditor on an annual basis, in order to ensure transparency. This auditor could be a designated operational entity or a specialist in the field of biomass/charcoal.

International guidelines for reporting and verification of developing countries' GHG emissions at the national level have been established at the international level through the system of biennial update reports (BURs) and international consultation and analysis (ICAs).

As decided upon by the UNFCCC COP17, the section on mitigation in the biennial update reports could include the following information (UNFCCC 2011):

- Name and description of the mitigation action, including information on the nature of the action, coverage (i.e. sectors and gases), quantitative goals and progress indicators
- Information on methodologies and assumptions
- Objectives of the action and steps taken or envisaged to achieve that action
- Information on the progress of implementation of the mitigation actions and the underlying steps taken or envisaged, and the results achieved, such as estimated outcomes and estimated emissions reductions, to the extent possible
- Information on international market mechanisms

The NAMA monitoring information should, therefore, be included in the Ugandan BUR. The guidelines provided by the UNFCCC are general. Therefore, the MRV plan for the NAMA should be tailored to the NAMA, as is done above; this information can then be included in the national BUR, along with other mitigation activities.

International consultation and analysis of NAMAs is mandatory although LDCs, such as Uganda, may undergo ICAs at their discretion (UNFCCC 2011). If the ICA is being undertaken at a national level, this verification can replace the annual NAMA verification, in the years that the ICAs are undertaken.

MRV Conclusion

The MRV system is a crucial part of the NAMA and needs to be robust and verifiable. However, the system also needs to be kept as simple as possible so that it is feasible to implement.

In light of this, the proposed MRV system in this study was conceptualized as a system that would provide robust information but also be implementable in the Ugandan context. However, the feasibility and robustness of the scheme should be discussed and agreed upon by all relevant stakeholders in the Uganda charcoal value chain. Actors should also agree upon sufficient cross checks and balances to ensure transparency and efficiency of the system.

7.3. UNDERSTANDING IMPACTS USING THE CORRECT RESULT INDICATORS

The MRV of the above-mentioned parameters can be translated into results achieved. Achieving these results will enable the evaluation of the bigger picture, i.e. the longer-term impacts of the NAMA. These impacts should be regularly assessed and could be:

- Widespread introduction and use of improved charcoal techniques
- Significant improvement in the tonnes of wood used per tonne of charcoal produced
- Increased revenue to producers
- Increased efficiency of the entire value chain

In addition to enabling the longer-term impact evaluation, the MRV of the results also serves to ensure that checks and balances are in place to warrant the successful and long-term impacts of the NAMA. These checks and balances are particularly important in the early stages of implementation, when all of the stakeholders are getting accustomed to the new systems and processes. It is crucial to the success of the NAMA that all of the activities along the value chain are properly implemented; if one step is not effectively improved, there will be a lack of benefits felt along the chain and stakeholders will not want to participate in the changes.

7.4. EMISSIONS REDUCTIONS AND SUSTAINABLE DEVELOPMENT BENEFITS

The two overall objectives of implementing NAMAs are emissions reductions and sustainable development benefits. These two objectives also need to be included in the MRV system, but do not need separate MRV parameters; they can be determined through the MRV of the previously mentioned parameters multiplied by specific sustainable development related factors.

Emissions Reductions

There are two methods for converting the saved wood into emission reductions:

- Avoidance of future fossil fuels (used upon forest depletion - as calculated in CDM SSC methodologies): This approach assumes that carbon stocks from forests are non-permanent and the avoidance of their depletion cannot be adequately quantified and attributed to one single driver. This is currently the approach followed by the CDM in which avoided deforestation is not included as a project type

- Calculation of real change in carbon stocks: This approach requires the determination of the wood carbon extracted[13] and emitted as a result of charcoal making[14] and subsequent combustion. This approach is followed by the proposed charcoal SB PSB0001, which accounts in an accurate and conservative manner only the carbon losses associated with the wood processed into charcoal. It omits conservatively the carbon that is not emitted in the process as well as the associated carbon stocks lost in forest depletion/degradation, such as carbon in roots, small branches and foliage. It should be noted that:
  - The harvest of wood does only lead to carbon emissions when no long-term full regrowth of carbon stock occurs.
  - The application of X_{NRB} determining regrowth through the application of the UNFCCC's default X_{NRB} may not be accurate, as it takes into account all types of drivers to forest stock losses. Instead, perhaps a newly developed indicator of forest regrowth after harvest for charcoal making should be developed and used. Such an approach would more accurately capture the change in land use and carbon stocks.

Sustainable Development Benefits

The sustainable development benefits of the NAMA are expansive. The organization and improved effectiveness and efficiency of the charcoal value chain will result in a significant decrease in deforestation in Uganda. This will result in environmental benefits such as improved soil conditions and improved waterway conditions from decreased runoff. Further benefits are improved forest health, decreased air pollution as improved kilns can significantly reduce air pollution as the smoke produced is partly burned off during the carbonisation process (Adam 2009) and decreased greenhouse gas emissions. From the economic point of view, the NAMA will result in fairer payment for charcoal producers and increased tax revenue for the district and job creation (e.g. in the charcoal unit). From a social point of view,

[13] Further information about this approach can be found in the article by Skutsch & Ba (2010).

[14] Further information about this approach can be found in the article by Bailis (2009).

health conditions will improve due to decreased air pollution and the prevention of deforestation will avoid the eventual lack of biomass fuel availability, which would cause extreme energy poverty. Furthermore, due to shorter cooling times in improved kilns, workers will see a decrease in time spent on production (Adam 2009). Inclusion of improved cook stoves into the NAMA will result in many further sustainable development benefits, such as improved respiratory health due to reduced air pollution, reduction of cost spent on charcoal and reduction of time spent cooking.

In order to estimate sustainable development benefits without added parameters to the MRV system, default factors can be established. This could for instance be: x% reduction in soil erosion per x number of hectares of trees that are now sustainably managed or x amount of disability adjusted life years reduced per x improved kiln used.

7.5. ECONOMIC EVALUATION OF ACTIVITIES

A useful tool for the NAMA would be to undertake a cost benefit analysis.[15] This analysis will enable all of the stakeholders to see the monetary changes that occur and a comparison of the costs versus the benefits of the intervention.

A full list of parameters to include in the cost benefit analysis will not be presented here. However, a sample of parameters is presented below:

- Average charcoal price paid to producers
- Valuation (through the use of a shadow wage) of time saved by various stakeholders (e.g. producers who bring their charcoal directly to a collection point)
- Average purchase price for consumers
- Real valuation of the wood resource (based on real taxes or licenses paid to forestry authorities)
- Total investment per kiln (including technology and training)
- Taxes generated
- "Saved" charcoal (e.g. charcoal dust that was previously not recovered but is now used for briquettes or another purpose)
- Emissions reductions valuation

An example of an economic assessment (cost benefit and cost effectiveness analyses) for an improved cook stove project in Uganda can be seen in the report by Habermehl (2007).[16]

It would be useful to involve the MoFPED in the economic assessment as the Ministry should have the knowledge to undertake the assessment, particularly in the Ugandan context.

[15] Alternatively, if valuation of the benefits is not possible, a cost effectiveness analysis could be undertaken instead of a cost benefit analysis.

[16] Available at: <www.un.org/esa/sustdev/csd/csd15/lc/GTZ_Uganda.pdf> accessed 21 December 2012.

8. Assessment of Support Needs

8.1. FINANCING, TECHNOLOGY AND CAPACITY NEEDS

In order for the NAMA to be successfully implemented, international support will be needed. This support will fall under three categories: financing, technology and capacity.

Activities that would fall under financial support are those that need direct financial flows. These activities include direct project support for institutional set up (e.g. staff, office space, strategy to design new institutional framework), infrastructure (e.g. collection centres, chimneys, training centres, charcoal bags) and indirect costs (e.g. transportation costs for producers to attend trainings).

Support can also be provided directly through the provision of technology. This could include the direct provision of material for kiln construction, material for collection centres, trucks for transport, labelled charcoal bags and purchase of licenses for the retort kiln.

Capacity building support can come from the direct provision of experts to help train staff or implement the NAMA. For instance, this could include supporting international or national kiln experts to provide trainings to staff and producers, economists to work with the MoFPED to help design an efficient taxation system and designers to design the charcoal bags.

8.2. SCALE OF THE PROBLEM

It is strongly recommended to evaluate the scale of the charcoal problem in Uganda prior to evaluating the costs of the solution. Only once the scale is thoroughly understood can the solution (or, if agreed upon, part of the solution) be provided and the costs estimated. The scale of the "charcoal problem" mostly depends on the wood needed to meet the charcoal demand compared with the available wood that can be harvested in a sustainable manner for charcoal production.

Determining the present charcoal demand: The demand for charcoal is mainly due to the demand for cooking fuel in urban areas. In most low-income countries, especially in sub-Saharan Africa, the majority of urban households use charcoal for cooking. Recent data on the charcoal consumption can be directly obtained from reported Food and Agriculture Organization Corporate Statistical Database (FAOSTAT) data.[17] However, although the FAOSTAT data is readily available for all countries, the data obtained may be inaccurate as there have been wide discrepancies with other sources of information.

In 2004, the MEM undertook a survey to establish the volume of charcoal and their respective source (district) entering into Kampala. The future demand of charcoal can be extrapolated, either directly proportional to population growth or at an annual percentage increase of 6 percent as indicated by the MEMD study. With the population of Uganda

[17] Available at: <http://faostat3.fao.org> accessed 21 December 2012.

growing at 3.1 percent annually (Population Reference Bureau 2006) the higher rate of charcoal consumption can be explained due to increasing immigration (from rural areas) into urban centres. However, it is recommended to update the 2004 demand numbers.

Data on the present charcoal consumption can be gathered in two ways:

i. Estimating the number of users and their specific charcoal consumption: The total charcoal consumption in an urban area can be estimated as product of the number (n) of urban dwellings, the specific share (percentage) of charcoal users among urban dwellings and the specific consumption of charcoal per urban dwelling. The values for percentages and specific consumption of charcoal can be obtained by sampling.

ii. Directly sampling the charcoal used per urban centre (as was previously done): It is possible to directly determine the mass of charcoal entering a specific urban area by requiring over a short amount of time all charcoal carrying trucks entering a city to be stopped in order to count the number of bags transported.

Predicting the future charcoal demand: The charcoal consumption in the near future can be extrapolated from the present consumption. The future demand for charcoal as cooking energy will mostly depend on the urban population in the country (in millions of inhabitants). The consumption of cooking energy per capita can, for a rough estimate, be assumed to be constant. Similarly without specific intervention, the efficiency of charcoal stoves can be assumed to remain almost constant. Indeed the demand for charcoal has been observed to increase in line with the growth in urban population (in % per year). Attention should be paid to areas in the process of urbanization which might in the short term constitute new and additional pools of charcoal consumers.

When considering future charcoal demand, the impact of the NAMA on charcoal demand should also be taken into consideration. Improved forest management and improved kiln efficiency will lead to an increased supply of wood and charcoal. In the introduction of this study, reference was made to the fact that the introduction of a significant amount of improved cook stoves leading to a reduced charcoal demand would lead to a depression of charcoal prices. Depression of prices may also occur if a greater supply of wood and more efficient kilns are introduced and the supply of charcoal is increased.

On the other hand, increased kiln efficiency and decreased production time may lead to charcoal producers seeking out an increased supply of firewood. This may occur as charcoal can be produced in a shorter amount of time and producers may use the extra time to produce additional charcoal. If this occurs, it may lead to an increase demand for wood and increased deforestation rates, if the improvements in forest management are not sufficient.

Therefore, when considering the future supply and demand, different scenarios for supply and demand of wood and charcoal should be generated.

8.3. COST ESTIMATION

Urban Population

The urban population of Uganda (2011) is estimated at 2.5 million. Kampala is by far the largest city constituting two-thirds of the urban population. The urban population has grown at an average of 4.5 percent annually (Trading Economics n.d.) and is expected to reach 6 million by 2030 (See Table 21).

Table 21: Uganda's urban population for 2011 (City Population n.d.)

	NAME	POPULATION	%
1	Kampala	1,659,600	65.4%
2	Kira	179,800	7.1%
3	Gulu	154,300	6.1%
4	Lira	108,600	4.3%
5	Mbale	91,800	3.6%
6	Nansana	89,900	3.5%
7	Jinja	89,700	3.5%
8	Mbarara	83,700	3.3%
9	Entebbe	79,700	3.1%
	Total	**2,537,100**	**100.0%**

Source: City Population Website (Mentioned).

Demand Scenario

To determine the charcoal demand until 2030 and the cost estimates for implementing efficient kilns, two data sources are considered:

Scenario 1: Analysis on the ground

Charcoal consumption as indicated by various stakeholders at the time of site visit indicates an average consumption of 2 bags of 50 to 70 kg/month for a family of five (household). This works out to approximately 1 kg of charcoal/person/day and matches with the figures observed from a previous on the ground analysis in neighbouring Rwanda at approximately 100 kg/month/household. For this scenario, the charcoal demand is considered directly proportional to the population growth.

Scenario 2: MEMD Charcoal Survey 2004

As explained in Section 8.2, Scenario 2 focuses on the MEMD study. The study was carried over a period of two weeks and the data extrapolated to determine the annual charcoal supply. The total charcoal entering Kampala in 2004 was calculated at 3 million tonnes of wood equivalent (WE). As Kampala constitutes two thirds of the urban population, the annual demand for all of Uganda is estimated to be 4.5 million tonnes of WE. As indicated the MEMD report states that the annual charcoal consumption has grown at a rate of 6 percent (Knöpfle 2004). Applying the annual increase, the charcoal demand for Uganda is projected at 7 million tonnes of WE in 2011 increasing to 20 million tonnes of WE by 2030. The study considers an efficiency of 10 percent; hence 10 tonnes of wood will result in 1 tonne of charcoal (See Table 22).

Table 22: Annual charcoal demand

	POPULATION	DEMAND SCENARIO 1	DEMAND SCENARIO 2
2011	2,537,100	926,042	693,237
2012	2,651,270	967,713	734,831
2013	2,770,577	1,011,260	778,921
2014	2,895,253	1,056,767	825,657
2015	3,025,539	1,104,322	875,196
2016	3,161,688	1,154,016	927,708
2017	3,303,964	1,205,947	983,370
2018	3,452,643	1,260,215	1,042,372
2019	3,608,011	1,316,924	1,104,915
2020	3,770,372	1,376,186	1,171,210
2021	3,940,039	1,438,114	1,241,482
2022	4,117,340	1,502,829	1,315,971
2023	4,302,621	1,570,457	1,394,929
2024	4,496,239	1,641,127	1,478,625
2025	4,698,569	1,714,978	1,567,343
2026	4,910,005	1,792,152	1,661,383
2027	5,130,955	1,872,799	1,761,066
2028	5,361,848	1,957,075	1,866,730
2029	5,603,131	2,045,143	1,978,734
2030	5,855,272	2,137,174	2,097,458

Source: Authors.

Green Charcoal Production of Total Demand

The next criteria considered for the cost estimation is the expected percentage of green charcoal to be produced as part of the total charcoal produced in Uganda. Although the proposed NAMA aims to convert BAU charcoal production to green charcoal, the unorganized nature of existing production would inhibit its rapid deployment over a short period of time. Rather than being a limitation, a gradual deployment of efficient charcoal kilns is a necessity and serves two purposes:

- For project beneficiaries (i.e. stakeholders of the value chain, respective policies, capacity building programmes, infrastructure and other related activities): a phased implementation would provide a learning curve period, opportunity for scaling up and gradual acceptance by the various sections of the society.

- For project financers: A balanced implementation schedule would allow the project finance to be spread over a period of time and allow for fine tuning of the program, technologies, capacity building programmes, etc. based on the learning's that emerge from the field.

Considering an initial gestation period for the development of the NAMA documentation, setting out the policies etc., Table 23 provides an overview of green charcoal in percentage and tonnes/year that can be targeted from 2014 until 2030.

Table 23: Green charcoal supply

	% GREEN CHARCOAL	SCENARIO 1	SCENARIO 2
2011	0%	0	0
2012	0%	0	0
2013	0%	0	0
2014	5%	52,838	41,283
2015	10%	110,432	87,520
2016	15%	173,102	139,156
2017	20%	241,189	196,674
2018	25%	315,054	260,593
2019	30%	395,077	331,474
2020	35%	481,665	409,923
2021	40%	575,246	496,593
2022	45%	676,273	592,187
2023	50%	785,228	697,465
2024	55%	902,620	813,244
2025	60%	1,028,987	940,406
2026	65%	1,164,899	1,079,899
2027	70%	1,310,959	1,232,746
2028	75%*	1,467,806	1,400,048
2029	75%	1,533,857	1,484,050
2030	75%	1,602,881	1,573,093

Source: Authors.

* It is assumed that BAU charcoal production would still be practised by various unorganized groups.

Kilns

The two kilns shortlisted for this estimation are the Casamance and the Adam retort kiln (other portable and fixed kilns may be possibilities and should be decided upon after further exploration of best-fit options for Uganda). Both kilns have a capacity of generating 50 tonnes of charcoal annually with the cost of implementation being $600/year[18] for the Casamance and $1,200 for the Adam kiln. The Casamance kiln can be deployed in a relatively short period of time, thus permitting charcoal producers to experience the benefits of green charcoal. However, due to its portable nature, the Casamance may be a deterrent to sustainable forestry and would require phasing out; it should be replaced with the fixed type such as the Adam retort kiln. The expected time lag between the implementation of the first set of Casamance kilns and the introduction of the Adam retort kiln would allow for certain sustainable forestry practices to be set in motion (e.g. planting of saplings and letting them grow before they are ready to be harvested) (See Table 24).

Table 24: Percentage of green charcoal to be produced by Casamance and Adam retort kilns

Percentage split between Casamance and Adam retort kilns		
	CASAMANCE	ADAM
2011	0%	0%
2012	0%	0%
2013	0%	0%
2014	100%	0%
2015	100%	0%
2016	100%	0%
2017	100%	0%
2018	95%	5%
2019	90%	10%
2020	80%	20%
2021	70%	30%
2022	50%	50%
2023	25%	75%
2024	10%	90%
2025	0%	100%
2026	0%	100%
2027	0%	100%
2028	0%	100%
2029	0%	100%
2030	0%	100%

Source: Authors.

[18] This may be an overly conservative estimate and prices for Uganda need to be thoroughly assessed.

Cumulative Costs

Given the above stated assumptions, we can determine the number of kilns, both Casamance and Adam kiln that needs to be implemented to meet the targeted green charcoal production. A 5 percent inflation rate has been considered for the price of efficient kilns from the base year of 2011. Table 25 provides cumulative costs of achieving the end goal of 75 percent of charcoal production being green for both scenarios.

Table 25: Cumulative kiln costs

Total cumulative cost for both kilns ($/year)		
	SCENARIO 1	SCENARIO 2
2011	0	0
2012	0	0
2013	0	0
2014	734,004	573,480
2015	2,344,776	1,850,048
2016	4,995,905	3,981,277
2017	8,874,507	7,144,021
2018	14,460,240	11,764,197
2019	22,165,199	18,228,747
2020	32,925,175	27,386,076
2021	47,542,602	40,004,876
2022	68,362,421	58,236,008
2023	97,975,722	84,539,480
2024	136,781,880	119,503,107
2025	137,188,237	123,001,779
2026	195,310,015	176,882,558
2027	263,989,837	241,464,890
2028	344,731,553	318,479,321
2029	433,325,402	404,196,382
2030	530,535,002	499,599,471

Source: Authors.

Conclusion

A total cost of $500 million would cover implementing only the technology (efficient kilns) from 2014 to 2030, with the objective of converting 75 percent of the charcoal production into green charcoal. Other costs would include capacity building programmes, sustainable forestry practices and improving the charcoal value chain (e.g. building retail warehouses). In order to do a thorough cost estimate, the full life-cycle cost (e.g. operation and maintenance and capital expenditure) as well as policy implementation and enforcement costs (e.g. roadblocks, charcoal unit staff hired, fines processed) must be considered. Part of these costs is expected to be recovered through the forestry fund. District administrations too will be incentivized to promote sustainable forestry and efficient charcoal production as they will be allowed to retain the levies collected from green charcoal. It is expected that as private companies and investors see long-term income generation potential in the sustainable charcoal trade, more and more companies would be willing to invest in the charcoal value chain and benefit from it.

8.4. POTENTIAL DONORS

There are a number of donors who are looking to fund or who are already funding NAMA related initiatives. These include, but are not limited to:

- Belgium: The Belgium Technical Corporation (BTC) has been very active in supporting the CDM in Uganda. Although BTC has not to date been actively involved in NAMAs, they have recently[19] launched a tender for sustainable charcoal production in Rwanda and Mozambique. In the tender, it was included that the activities may be relevant to CDM or NAMAs.

- France: The Agence Française de Developpement is involved in various NAMA-related activities.

- Germany: Gesellschaft für Internationale Zusammenarbeit (GIZ) has partially funded the Mexican energy efficient housing NAMA, the creation of a NAMA tool and a NAMA technical sourcebook for practitioners. Kreditanstalt für Wiederaufbau (KfW) has also partially funded the Mexican NAMA and is actively pursuing other NAMAs.

- Nordic Ad Hoc Group on Climate Change/Nordic Environment Finance Corporation (established by Denmark, Finland, Iceland, Norway and Sweden) Partnership Initiative: The Initiative is funding NAMA readiness programmes in Peru and Viet Nam and undertaking other NAMA-related initiatives, such as holding an international workshop on NAMA finance.

- United Kingdom: The United Kingdom and Germany are soon launching a NAMA facility to facilitate the implementation of NAMAs.

[19] The tender was launched in January 2013.

- UNDP, with funding from the Global Environment Facility (GEF), supports the government of Peru in the development and implementation of National Appropriate Mitigation Actions in the energy sector to achieve the country GHG emission reduction voluntary target.

Donors that provide support for the NAMA could also be multilateral funds or bilateral funds. Multilateral funds could include (TRANSfer 2012):

- ADB Clean Energy Fund
- Asian Development Bank's Climate Change Fund
- European Union's Global Climate Change Alliance
- Global Environment Facility
- Inter-American Bank's Sustainable Energy and Climate Change Initiative
- Inter-American Bank's Infrastructure Fund (InfraFund)
- UNDP's Low Emission Capacity Building (LECB) Programme (financed by the European Union, Germany and Australia)
- World Bank's (WB) Clean Technology Fund
- WB Public Private Infrastructure Advisory Facility
- WB Carbon Finance Unit

Bi-lateral funds could include:

- German International Climate Initiative
- German Climate Technology Initiative
- Japan's Hatoyama Initiative
- United Kingdom's Department for Energy and Climate Change Capital Markets Climate Initiative

9. Next Steps

The next step in the Uganda sustainable charcoal NAMA process is the development of a full NAMA design document. Providing further details on all of the above mentioned topics, the document must be developed in close conjunction with the Government of Uganda. Stakeholder consultations should be held and the NAMA should gain full Government support. When developing the NAMA design document, the below points about what donors are looking for in NAMAs should be considered.

A presentation from KfW summarized what donors are looking for in NAMAs (Harnisch 2012):

- Significant GHG reduction potential and cost effectiveness of emission reductions
- Potential for transformation (e.g. ease of replicability, potential for sectoral change, use of national systems)
- Initiative for financing from national actors and broad ownership among different ministries; NAMA embedded in an existing climate and development strategy
- Co-benefits
- Financial viability and sustainability
- Financial capacity of implementation partners
- Comprehensiveness and conclusiveness
- Conclusive and cost effective MRV approach, including indicators for actions, baselines, milestones
- Availability of data for MRV-system
- Costs of proposed MRV approach

With proper collaboration and complete support from the Government alongside proper consideration of the Ugandan context and thorough research, it is believed that a NAMA donor can be found to enable the development of a sustainable charcoal value chain in that country.

References

Adam, J.C. (2009). Improved and more environmentally friendly charcoal production system using a low-cost retort–kiln (Eco-charcoal), *Renewable Energy*, Vol. 34, pp. 1923–1925.

Adam, J.C. (unpublished). Pragmatic Calculations to Establish Emissions of an "adam-retort".

Bailis, R., Majid, E., Kammen, D. M. (2005). Mortality and greenhouse gas impacts of biomass and petroleum energy futures in Africa, *Science*, Vol. 308, 1 April, pp. 98–103.

Bailis, R. (2009). Modeling climate change mitigation from alternative methods of charcoal production in Kenya, *Biomass and Bioenergy*, Vol. 33, pp. 1491–1502.

Berkeley Air Monitoring Group. (2012): Stove Performance Inventory Report, Berkeley, California, USA.

City Population. (n.d.). Available at: www.citypopulation.de/Uganda-Cities.html (Accessed 21 December 2012).

Cuña Suárez, A., Tancredi, N., Pinheiro, P., Irene Yoshida, M. (2010). Thermal analysis of the combustion of charcoals from Eucalyptus dunnii obtained at different pyrolysis temperatures, in Journal of Thermal Analysis and Calorimetry. Vol. 100:3, pp. 1051–1054.

Energypedia (2012). Charcoal production. Available at: https://energypedia.info/index.php/Charcoal_Production (Accessed 21 December 2012).

Energy for Sustainable Development Africa (2005). National Charcoal Survey: Exploring the potential for sustainable charcoal industry in Kenya, Kenya.

Ezilon Maps (n.d.). Available at: www.ezilon.com/maps/africa/uganda-maps.html (Accessed 21 December 2012).

Food and Agriculture Organization (FAO) of the United Nations (n.d.). FAOSTAT. Available at: http://faostat3.fao.org (Accessed 21 December 2012).

GIZ (2011). Energy Policy Advice Component, Uganda.

Greenpower. (2012a). Statistics of Charcoal Production. Available at: www.piroliz.org/index.php/component/content/article/6-2009-03-11-16-26-28/96-statistics-of-charcoal-production.html (Accessed 21 November 2012).

Greenpower. (2012b). The Charcoal Kiln "EURO". Available at: www.piroliz.org/index.php/kotly/3-2008-12-22-11-00-58.html (Accessed 21 December 2012).

Habermehl, H. (2007). Economic evaluation of the improved household cooking stove dissemination programme in Uganda, Dissemination of the Rocket Lorena stove in the districts of Bushenyi and Rakai and dissemination of the improved charcoal stove in Kampala in the years 2005 and 2006. GIZ, Germany.

Harnisch, J. (2012). Emerging Channels for International NAMA Implementation Support. Given at the International Workshop on NAMA Finance, Helsinki, 04 October 2012. Available at: www.nefco.org/sites/nefco.viestinta.org/files/HARNISCHpresentationNAMA_WS_4Oct12.pdf (Accessed 21 December 2012).

Hicks, C. (2012). Chad's Charcoal Challenge. Available at: www.guardian.co.uk/journalismcompetition/longlist-chad-s-charcoal-challenge (Accessed 21 December 2012).

IRIN/United Nations Office for the Coordination of Humanitarian Affairs. (2009): Chad: Panic, outcry at Government charcoal ban. Available at: www.irinnews.org/Report/82436/CHAD-Panic-outcry-at-government-charcoal-ban (Accessed 21 December 2012).

Kammen, D., Lew, D. (2005). Review of Technologies for the Production and Use of Charcoal, University of California, Berkeley, California, USA.

Knöpfle, M. (2004). A study on charcoal supply in Kampala: Final report. Kampala, Uganda: Ministry of Energy and Mineral Development.

Migiro, K. (2012). Encourage commercial logging to grow Kenya's forest cover – report, Alertnet. Available at: www.trust.org/alertnet/news/encourage-commercial-logging-to-grow-kenyas-forest-cover-report (Accessed 21 December 2012).

Ministry of Energy and Mineral Development. (2001). National Biomass Energy Demand Strategy strategy 2001–2010. Kampala, Uganda.

Müller, N., Michaelowa, A. (2011). Proposal for a new standardised baseline for charcoal projects in the Clean Development Mechanism, Switzerland.

National Planning Authority. (2012). Uganda Vision 2040, Uganda.

Ndonga, W. (2012). Kenya Seeks to Legalise Charcoal Trade, Available at: http://allafrica.com/stories/201211051760.html?viewall=1 (Accessed 21 December 2012).

National Environment Management Authority. (2008). State of the Environment Report for Uganda 2008, Kampala, Uganda.

Nturanabo, F., Byamuisha, G., Colonna Preti, G. (2010). Performance appraisal of the casamance kiln as replacement to the traditional charcoal kilns in Uganda, Makere University, Kampala, Uganda.

Perspectives. (2011). Proposal for a new standardised baseline for charcoal projects in the Clean Development Mechanism. Zurich, Switzerland.

Population Reference Bureau. (2006). World Population Datasheet, 2006 available at: www.prb.org/pdf06/06WorldDataSheet.pdf (Accessed 21 December 2012).

Radhe Industrial Corporation. Our Model. Available at: www.radheindcorp.com/our-model.html (Accessed 21 December 2012).

Reinaud, G. (2008). Pronatura International Green charcoal. Presentation given at UNIDO Trade Capacity Building Conference, Cairo. Available at: www.unido.org/fileadmin/user_media/Services/Industrial_Competitiveness/Trade_Capacity_Building/Cairo Conference2008/2st_Day_-__3.2__Guy_Reinaud-Pro-Natura-Green_Charcoal___Biochar-France.pdf (Accessed 21 December 2012).

Rural Electrification Agency. (2007). Renewable Energy Policy for Uganda, Uganda.

Shri AMM Murugappa Research Centre. (2010). Booklet on biomass charcoal briquetting. Chennai, India.

Skutsch, M., Ba, L. (2010). Crediting carbon in dry forests: The potential for community forest management in West Africa, *Forest Policy and Economics*, Vol. 12:4, April, pp. 264–270

Steenblik, R. (2006). Liberalisation of Trade in Renewable Energy Products and Associated Goods Environmental and Energy Products: The Benefits of Liberalising Trade. OECD, Paris, France.

Trading Economics. (n.d). Available at: www.tradingeconomics.com/uganda/urban-population-growth-annual- percent-wb-data.html (Accessed 21 December 2012).

TRANSfer. (2012). GIZ/Wuppertal Institut: TRANSfer. Navigating Transport NAMAs (2012). Practical handbook for the design and implementation of NAMAs in the transport sector. Available at: www.mitigationpartnership.net/transfer-2012-navigating-transport-namas-practical-handbook-design-and-implementation-namas-transpor (Accessed 21 December 2012).

UNEP Risoe. (2012a). CDM/JI Pipeline Analysis and Database, 1 November 2012. Available at: www.cdmpipeline.org (Accessed 21 December 2012).

UNEP Risoe. (2012b). CDM Programme of Activities Pipeline Analysis and Database, November 1st 2012. Available at: www.cdmpipeline.org (Accessed 21 December 2012).

United Nations Framework Convention on Climate Change (2007). FCC/CP/2007/6/Add.1/Decision 1/CP.13 Bali Action Plan. UNFCCC. Bonn. Available at: http://unfccc.int/resource/docs/2007/cop13/eng/06a01.pdf#page=3 (Accessed 21 December 2012).

(2009). FCCC/CP/2009/11/Add.1/Decision 2/CP.15 Copenhagen Accord. UNFCCC. Bonn. Available at: http://unfccc.int/resource/docs/2009/cop15/eng/11a01.pdf#page=4 (Accessed 21 December 2012).

(2011). FCC/CP/2011/Decision -/CP.17 Outcome of the work of the Ad Hoc Working Group on Long-term Cooperative Action under the Convention. UNFCCC. Bonn. Available at: http://unfccc.int/files/meetings/durban_nov_2011/decisions/application/pdf/cop17_lcaoutcome.pdf (Accessed 21 December 2012).

(2012). Draft SSC methodology SSC-III.BG: Emission reduction through sustainable charcoal production and consumption, Bonn, Germany.

World Bank (2010). Enabling reforms: A Stakeholder-Based Analysis of the Political Economy of Tanzania's Charcoal Sector and the Poverty and Social Impacts of Proposed Reforms, Washington, D.C., USA.

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