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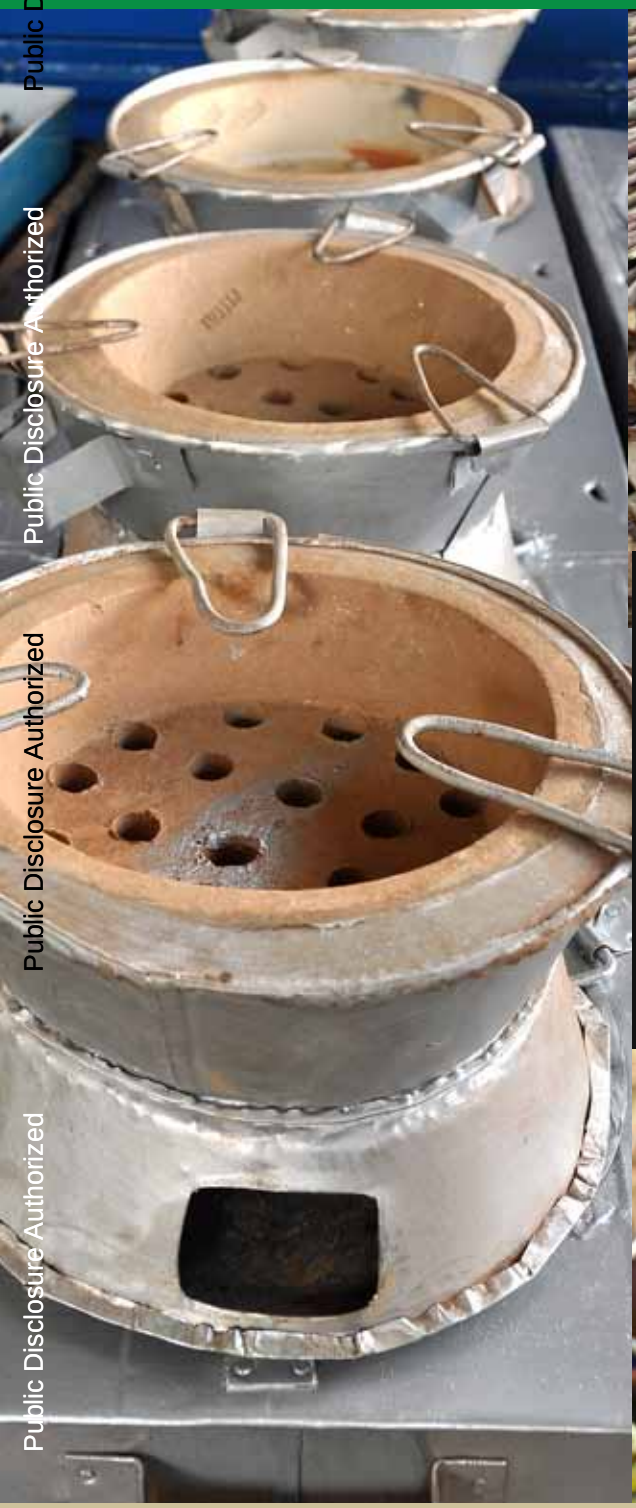
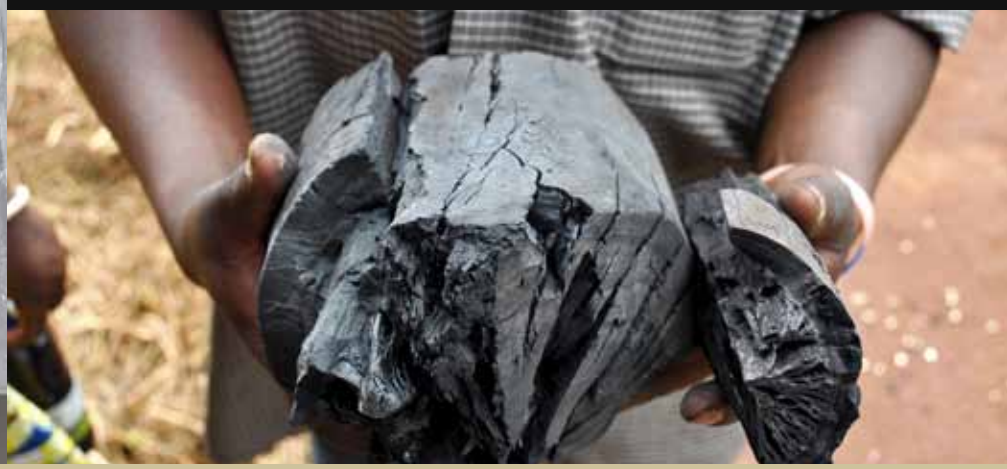


EXECUTIVE SUMMARY

ESTABLISHING A GREEN CHARCOAL VALUE CHAIN IN RWANDA

A Feasibility Study



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FOREWORD

The Government of Rwanda gives high priority to improve access to energy in the country as a driver of economic and social development as well as for improving the wellbeing of its population. Much emphasis is given to accelerating connectivity to the electricity network and improving the quality of supply. The number of households connected to the grid has increased rapidly over the past few years from only 4.3% in 2006 to over 16 % in 2012 and ambitious plans are in place to increase this to 70% by 2017. This will require large investments in generation as well as in transmission and distribution systems.

In contrast to the importance of electricity for economic development, especially for commercial and industrial applications, a recent study indicates that only 4% of the households in Kigali use electricity for cooking. Outside of the capital city this percentage is negligible. Even though it is expected that electricity will become more important as a cooking energy as access increases and incomes rise, it is expected that households will predominantly still rely on wood-based biomass energy for cooking at least for a foreseeable future. For the period 2010/2011 the reliance on wood and charcoal as the primary cooking fuel was still 97% nationwide.

To respond to the need to manage this energy source responsibly and sustainably, The Ministry of Infrastructure (MININFRA) developed the Biomass Energy Strategy (BEST) in 2008/9 to compliment the Energy Policy which was mainly focused on electricity supply and fossil fuel energy. The BEST focuses on 4 key areas: 1) increased and sustainable supply of wood fuels and professionalizing the charcoal value chain , 2) increased efficiencies in the use of wood and charcoal, 3) promotion of alternative cooking fuels (LPG, peat, biogas) and 4) increased capacity of Government agencies dealing with biomass. MININFRA, and since 2011 the Energy, Water, and Sanitation Authority (EWSA), have actively contributed in these areas through facilitating markets for LPG and biogas, promoting more efficient cookstoves for urban and rural areas and supporting the charcoal chain with better technologies and organization. EWSA is grateful for the support it has received from development partners such as the World Bank and Global Environment Facility (GEF) through the Sustainable Energy Development Program which has provided much needed funds for accelerating activities in this sector. However, more efforts are needed to stay ahead of developments with a growing population and increasing incomes resulting in higher demand for biomass and other cooking fuels.

This Green Charcoal Report comes at an opportune time and provides a central overview of the current status of the sector. More importantly it gives ideas about possible wide ranging programs and needed investments to support the development of a well regulated and competitive market for a sustainable supply of charcoal which fits in the Government's energy policy and meets the ambitious environmental sustainability targets of our country.

I wish to express my sincere thanks to all of the institutions and individuals that contributed to the development of this valuable report.

Eng. Yussuf UWAMAHORO
Deputy Director General for Energy
Energy, Water and Sanitation Authority – EWSA

BACKGROUND

As is the case for most Sub-Saharan African countries, biomass is the most important source of energy in Rwanda, especially for domestic cooking. It is likely that this will continue for some time in the future. Today approximately 86% of primary energy comes from biomass, mainly in the form of wood that is either used directly as a fuel (57%) or converted into charcoal (23%) together with smaller amounts of crop residues and peat (6%). Biomass is also an important source of income and employment. The value of firewood and charcoal in 2007 was in the order of 122 million USD or 5% of GDP. Some 50% of this value remains in rural areas where it is distributed among woodlot owners and charcoal burners.

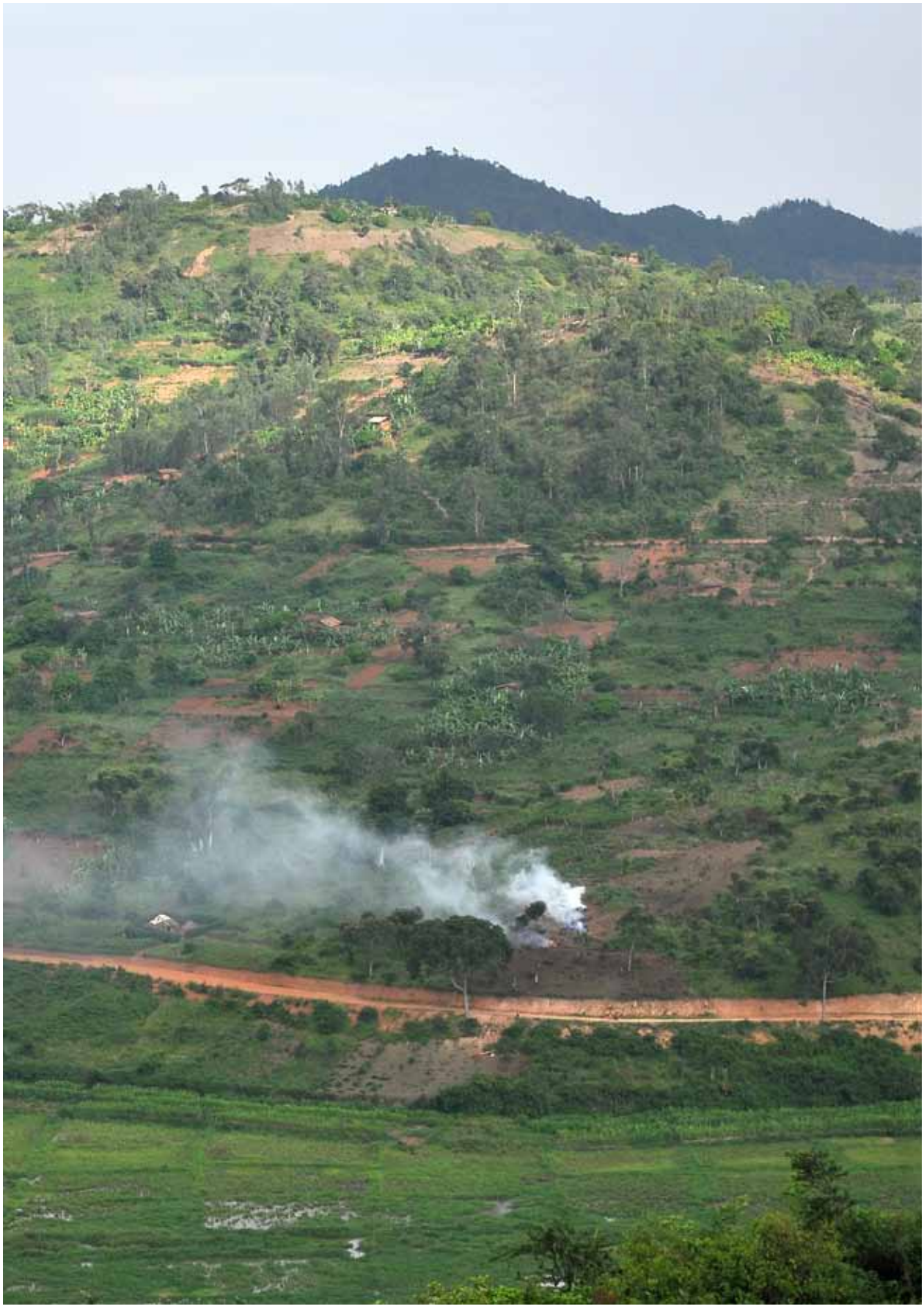
In the past, the production of charcoal in Rwanda was one of the factors that contributed to deforestation. Nowadays, due to massive reforestation in the country, Rwanda may well be among the few African countries where the relation between charcoal and deforestation no longer exists.

However, even with charcoal featuring as an important economic and ecological potential, the sector is generally not considered as a possible means to achieve long-term sustainable development, for example as a low-carbon growth option contributing to energy security and poverty alleviation. Modernizing the charcoal sector and bringing it out of its largely "informal" status carries important benefits: Revenue collection could be significantly enhanced to leverage much needed resources for investments in sustainable natural resource management and other aspects of economic development. In this context, the feasibility study focuses on the elaboration of a road map to develop a modern and efficient charcoal value chain.

Rwanda has elaborated a number of planning documents to guide national development over different time horizons. The nation's current socio-economic goals form the basis of the Economic Development and Poverty Reduction Strategy (EDPRS), which covers the period 2008–2012. The EDPRS is the medium term programmatic framework for achieving the country's long term development aspirations as embodied in Rwanda Vision 2020, as well as the intermediate targets in the 2015 Millennium Development Goals (MDGs). The Vision projects that by 2020, at least 35% of the population will be connected to electricity and the share of the consumption of wood will decrease to 50% of national energy consumption. The EDPRS further proposes to increase forest and agro-forestry cover from 16 to 23.5% of the country's total surface area (equivalent to 89,583 ha). More recently Government targets have been raised substantially and forest cover is now planned to be 30% and electrification 70% by 2017.

Rwanda's energy policy is mainly based on three documents: (1) the National Energy Policy, (2) the National Energy Strategy (2008–2012) and (3) the Biomass Energy Strategy (BEST) from 2008. The following institutions play a role in the biomass energy sector: Ministry of Infrastructure (MININFRA), Ministry of Natural Resources (MINIRENA), Ministry of Agriculture and Livestock (MINAGRI), Ministry of Environment and Lands (MINELA), Ministry of Local Government, Good Governance, Community Development and Social Affairs (MINALOC) and Ministry of Finance and Economic Planning (MINECOFIN).

[1] Recent estimates indicate that the relative share of wood energy may have fallen to about 3.5%.
[2] These are indicative targets formulated in the draft EDPRS for the 2012–17 period that still has to undergo formal approval processes.



STATUS OF THE CHARCOAL SECTOR IN RWANDA[3]

The value chain approach has been applied to describe the elements of the charcoal sector in Rwanda.

Forest management & wood production: According to official statistics, Rwandan forests cover 330,576 ha, comprising 215,739 ha of natural forests and 114,837 ha of forest plantations (> 0.5 ha). However, available data on forest cover from different sources vary considerably. These data do not include forest plantations of less than 0.5 ha and isolated trees, so called trees outside forests (TOFs). Estimates on surfaces covered by TOFs range from 5,300 to 222,520 ha indicating a high uncertainty for this wood source. Natural forests, in contrast, are well protected and hardly any wood is extracted from them. Today, practically all charcoal in Rwanda is derived from trees that have been planted on government, private or community land. In the recent past, the area of forestry plantations increased by around 2.5% per year. Mono-specific plantations cover 91.3% of the plantation area and mixed stands 8.7%. Eucalyptus camadulensis and Eucalyptus maïdeni are the dominant species.

Most public plantations are over-aged and characterized by decreasing productivity. Traded wood and wood-fuels come mostly from private plantations of less than 2 ha. These family farms contribute substantially to the supply of wood energy. The mean annual increment (MAI) of Eucalyptus species in Rwanda is 5.5 m^3/ha/yr. This is below the productivity levels expected for these regions under adequate forest management practices, which are around 20 m^3/ha/yr. The sustainable wood supply from public and private forest plantation ranges between 1.1 million and 2.0 million tonnes of biomass, i.e. between 40 and 75% of the estimated demand of 2.7 million t/yr.

Exploitation & transformation: In Rwanda there exists a strict disjunction between private plantation owners and charcoal burners. In general, the owner takes charge of plantation management and sells the standing timber stock to charcoal burners or fuelwood wholesalers. Exploitation of the stands and further transformation to charcoal is in more than 90% of cases done by charcoal burners. Farmers experience considerable difficulties and delays in applying for exploitation permits. Overregulation and administrative requirements tend to delay management operations and markedly increase the transaction costs of forestry production. Most charcoal burners use traditional mound kilns or rectangular hillside kilns. In general, such kilns produce between 825 to 1,155 kg of charcoal per kiln. The carbonization efficiency of traditional Rwandan kilns ranges from 12 to 14% of air-dried wood. Traditional kilns are the norm, but there are also some charcoal burners, who employ more efficient kilns such as the Casamance kiln or various types of rectangular kilns with chimney.

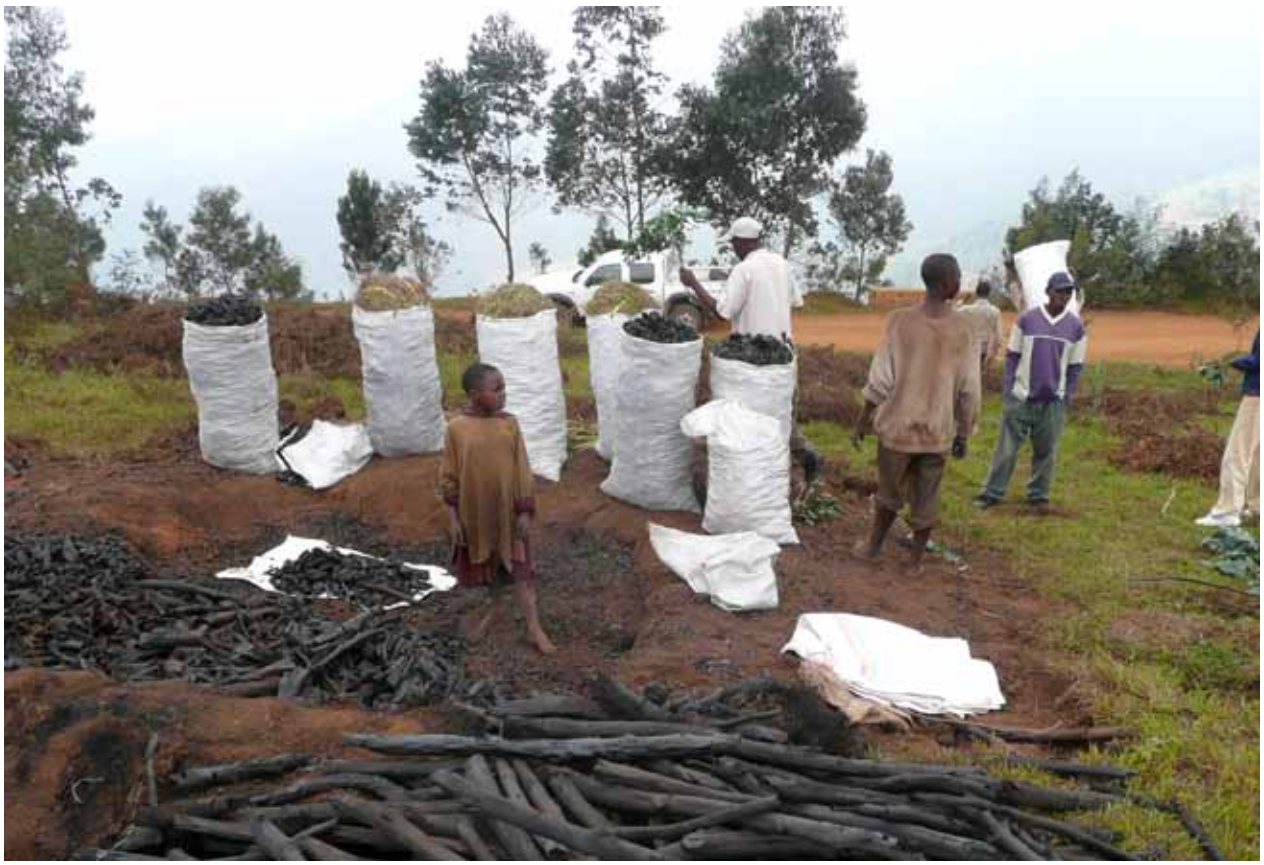
Transport & marketing: "Transport and marketing" of charcoal is characterized by a multitude and diversity of players. In general, stakeholders are involved individually; contracts with other market actors rarely exist. Depending on the charcoal circuit from producer to consumer, actors include charcoal producers, collectors, transporters, wholesalers and retailers. Charcoal channels can be straightforward or more complex: (1) producer to consumer, (2) producer to buyer to consumer and (3) producer to primary buyer to secondary buyer to tertiary buyer to consumer. The cost of wood represents 17% of the consumer price, ranging between 177 to 233 RwF per kilogramme. The cost of charcoaling adds another 29% and the roadside-price equivalents nearly 50% of the final consumer price. Transport and related charges and taxes add around 34% and wholesaling and retailing together add 13% of the final price. In total, some 49% of the retail value in Kigali stays in the rural areas as income for the farmers, charcoal burners and laborers and 51% is used to transport and distribute charcoal in town.

Utilization of charcoal: Fuelwood and agricultural residues are the two dominant energy sources in Rwanda, followed by charcoal.[4] Actual data on wood-fuel consumption give per capita estimates of 314 kg/yr for fuelwood and 134 kg/yr for charcoal. Rwanda is one of a few African countries where improved cooking stoves (ICS), including

[3] The field work for this report was done in 2011. Due to the fast development changes happening in the country more data has been generated and some institutional changes have taken place. However, this does not change the overall findings and recommendations of the report.

[4] Estimates indicate that up to 6% of energy is provided through agricultural residues, but there are currently no formally published studies or surveys.

charcoal stoves, have penetrated far. It is estimated that around 50% of Rwandan households own ICS with higher penetration in urban areas than in rural ones. However, it is estimated that a large share of ICS owners never uses their stoves. That said, official surveys or numbers do not exist. Total residential wood-fuel consumption in Rwanda is estimated at 2.7 million tonnes per year. The capital, Kigali, alone accounts for a charcoal consumption of 120,000t, equivalent to 1.2 million m^3 or 850,000t of wood.



GETTING GREEN

The modernization of the charcoal sector requires a consensual vision statement from all relevant government authorities on accepting and promoting sustainable charcoal production and utilization. All activities within the modernization process should address four basic principles: (1) environmental and climate friendliness, (2) security of supply, (3) economic efficiency and compliance, and (4) health and safety requirements. The modernization of the charcoal value chain entails a stepwise approach, which requires a continuous refinement and/or adaptation of respective framework conditions, organizational and procedural aspects, and technological development.

The suggested interventions aim to contribute to a modernization of the wood-energy sector in Rwanda. They focus on the supply and demand of charcoal sourced through management of public and private plantations or harvested from TOF. Other biomass fuels, including novel technologies such as biogas and agro-fuels, are not covered, as they are not expected to grossly impact the urban market for charcoal. Proposed activities and strategies in this document do not aim to replace the existing biomass strategy. They are rather an integral part of it.

GREENING THE CHARCOAL VALUE CHAIN

The recommendations derived from this analysis refer to five basic avenues of intervention: (1) increased production of wood for charcoal burning, (2) introduction of modern conversion technologies for charcoal-production, (3) improvement of the commercial network, (4) improvement of combustion technologies, and (5) introduction of adequate framework conditions. The following figure gives an idea of the proposed activities.

Sustainable wood production

- Elaboration of wood-energy supply plans
- Updating and adaptating district forestry plans
- Guarantee of adequate land tenure/user rights for wood-fuel production
- Rehabilitation and better management of public forest plantations
- Increasing productivity of existing private forest and agro forestry resources
- Increasing private forest area and agro forestry resources
- Testing short rotation coppice

Exploitation and transformation of wood-fuels

- Simplification and harmonization of administrative procedures for cutting permits
- Improvement of carbonization technologies
- Test and introduction of semi-industrial kilns
- Development of concepts for the grading and packaging of charcoal
- Introduction of new technologies allowing the utilization of charcoal dust

Transport and commercialization of charcoal

- Improvement of transport efficiency
- Organization of commercial networks
- Development of a market information system

Utilization of wood-fuels

- Increasing efficiency of cooking devices

Framework conditions

- Introduction of adequate forest taxation procedures and law enforcement
- Implementation of a traceability system
- Promotion of innovative financing mechanisms
- Improvement of governance capacity to reorganize the charcoal production sector
- Setting up a monitoring and evaluation system
- Lobbying and PR measures

(1) PRODUCTION OF WOOD FOR CHARCOAL MAKING

Elaboration of wood-energy supply plans: The elaboration of wood-energy supply plans (WESP) is one of the priorities areas for the modernization of the charcoal sector. A comprehensive and spatially explicit vision of supply and demand is an essential prerequisite for wood-energy planning and strategy formulation at local and national level. In this respect, synergies among institutions for an integrated multi-sectoral approach are absolutely vital.

Updating and adaptation of District forestry plans: In the past years, district forestry plans (DFP) have been developed for several Districts. These DFPs already include simple management plans for public forests, public and private tree plantations, fixing objectives, and exploitation or reconversion goals. DFPs are also a means to boost

decentralization and to stimulate the effective involvement of Districts and Sectors in the rational management of forest and tree resources existing within their territories. Practically speaking, existing DFPs have to be updated after the elaboration of WESPs. In this context, the interventions should focus on: (1) the simplification of DFPs, inter alia through the introduction/elaboration of standardized tools and procedures, (2) the development of simplified management plans for (individual) public forests, (3) the support of Districts and Sectors to implement programmed forestry activities, especially in priority areas, and (4) the assessment of professional and technical capacity building needs and the design of appropriate capacity development plans to improve performance and achieve the objectives fixed in the DFPs.

Guarantee of adequate land tenure rights for wood-fuel production: It is widely recognized that security of land tenure is one of the most significant framework conditions necessary for sustainable forest management. Several actions could be taken to support the security of tenure: (1) identification, documentation and subsequent reconciliation of claims to forest areas, (2) creation of a forest cadastral system, (3) clear assignation of rights, obligations and responsibilities in respect of forest resources, (4) capacity development for community-based institutions in charge of forest resources, and (5) agreed and documented approaches to conflict resolution and enforcement mechanisms.

Rehabilitation and better management of public forest plantations: State and District plantations should be integrated into the wood-energy circuit. These public forests have to be localized and mapped and simple management plans have to be set up. For the management of public forests there are several options: (1) introduction of participatory forest management by newly established local user groups on a contract basis, (2) privatization of the management of the State or District owned plantations through service contracts signed with specialized forest management groups and/or professional charcoal producer groups, and (3) promotion of joint management arrangements and establishment of Forest Management Units (FMUs) sufficiently large to enable sustainable forest management (SFM) through forest associations, cooperative arrangements or Public-Private Partnerships (PPP). Over aged, non-productive public forest plantations should be exploited as fast as possible and reconverted into productive wood-fuel stands.[5]

Increasing productivity of existing private forest and agro-forestry resources: Improving the management of existing tree plantations is one of the key elements for the modernization of the charcoal value chain in Rwanda. Best practices have proved that sustainable yields of 20 to 30 m^3/ha/yr can be obtained with simple and non-expensive management measures: (1) selection of good tree varieties with rapid growth, (2) control of erosion within plantations, (3) reduction of stump height for better coppicing, (4) regular maintenance (thinning), (5) removal of dead and damaged trees, and (6) application of fertilizer (if possible). In applying these "good tree management" practices it is possible to increase profit margins from Eucalyptus plantations by 44%.

Activities to booster the productivity of existing private forest and agro-forestry resources mainly concern: (1) enhancing capacity development for farmers, (2) promoting the creation of farmer "forest associations" or farmer groups, (3) implementation of awareness raising campaigns, (4) establishment of agro-forestry and forest plantation demonstration farms to exhibit "good tree management" for charcoal production, (5) dissemination of best practices in farm forestry, (6) assisting farmer groups to establish and manage tree nurseries for commercial purposes, and (7) supporting investment costs to assist farmers.

Increasing private forest area and agro-forestry resources: Extrapolating the current trends in agricultural productivity, land use and food demand analysis shows that there is no agricultural land available for the expansion of forestry plantations. Only marginal lands are available for wood-energy. The potential for increasing the forest area is estimated at 75,000 ha. These areas have to be mapped within the context of the elaboration and updating of DFP. Farmers have to be involved in the development of specific reforestation and afforestation programs. This implies a demand driven approach where interested farmers and planters must contribute their own means. Contributions in-kind or in money have to be considered for investments in erosion-control measures.

[5] Most recently there have been developments to lease out plantation forests for commercial management.

Test of short rotation plantations: The promotion of short rotation croppice (SRC) will also be an option to increase the supply of wood energy. The goal is to produce the maximum biomass in the shortest possible time with stands being exploited annually or in a 2-year rotation. According to experience, the annual production of the Eucalyptus SRC species ranges between 30–40 m^3/ha.

(2) INTRODUCTION OF MODERN CONVERSION TECHNOLOGIES FOR CHARCOAL-PRODUCTION

Simplification and harmonization of administrative procedures: The issuing of mandatory cutting permits is one of the first steps of the exploitation phase. It would be beneficial for all actors if procedures for obtaining permits and paying taxes were clear, simple, and as quick as possible. Most actors currently observe that it is a lengthy, nontransparent and discouraging process.

Improvement of carbonization technologies: Improved charcoaling technologies are probably the key driving force for the modernization of the charcoal value chain. Besides increased productivity, the optimization of carbonization technologies ensures a higher quality of the charcoal produced. It also reduces production times and physical efforts for charcoal burners. Thus, modern carbonization technologies contribute to increased local incomes.

Furthermore, if the entire charcoal chain is reformed in a comprehensive manner, adoption of improved and widely accepted kiln technologies should be part of revised regulatory frameworks in the form of standards for kiln technology.

Different types of improved kilns have been tested and disseminated in Rwanda, and a wealth of experience and lessons learnt are available for practitioners to draw upon. Improved models include non-permanent Casamance kilns, rectangular kilns using one or two chimneys and stationary brick kilns, as well as transportable metal kilns for more flexible and decentralized charcoal production. Selection of the best suited technologies must, in all cases, reflect ecological as well as socio-economic site conditions, including availability of investment capital, transport infrastructure and market access. On average it will be possible to obtain kiln efficiencies between 20–25%.

Various programs in Rwanda have already started to provide training and guidance for value chain development, including the facilitation of association building. Especially on the level of wood and charcoal producers, the establishment of "business development clusters" should be promoted. In this context, capacity development comprises the strengthening of skills required for product and enterprise development, drafting of business plans and linking charcoal burners to financial markets and market information.

Charcoal burners should be assisted with organizing themselves to have a prominent voice. For example, the creation of federations of charcoal producers should be promoted at national and district levels. Via these federations it will be possible to: (1) formalize membership and levy membership fees, (2) provide compulsory training in safety and fire prevention for charcoal workers, (3) lobby amongst its members for compliance with labor legislation and environmental recommendations, (4) set up standardized contracts of employment in accordance with the Labor Act, (5) raise awareness that charcoal producers should provide each laborer with protective clothing, (6) organize exchange study visits among its members to learn from best practices, (7) organize training for members as far as the financial and administrative management of a charcoal business is concerned and (8) collect production and sales data.

Promoting improved kiln technology requires providing financial resources to potential investors. Due to the increased costs of improved kiln technology, seed funding in the form of "one-time" input subsidies may be a policy option. Furthermore, micro-credit schemes could provide cooperatives and enterprises or individual producers with the funding needed.

Test and introduction of semi-industrial kilns: The establishment of semi-industrial or industrial kiln technology targets larger-scale private investors. In these cases the wood-sourcing should preferably come through outgrower schemes or other benefit-sharing arrangements allowing the local population to continue earning a steady income through the charcoal sector. However, the best possibility to test the introduction of

semi-industrial stationary kilns would be on larger public forest plantations. The remaining Eucalyptus plantations form the old World Bank financed program around Kigali would be an ideal source of wood for these kinds of kilns.

Concepts for the grading and packaging of charcoal: The production of charcoal is generally characterized by the uneven quality of the product, especially the uneven sizing of charcoal. This does not facilitate the loading of bags or the utilization by end-users. It is therefore advisable to increase the quality through better calibration of the charcoal produced. High-end buyers – e.g. supermarkets, hotels, up-scale restaurants, tourist camps/lodges – could kick-start the new approach.

Introduction of new technologies allowing the utilization of charcoal dust: In most cases, a large quantity of small pieces of charcoal remain at the production site. Also charcoal dust accumulates downstream of the value chain at wholesale and retail points. Given the large amount of charcoal consumed in Rwanda, the potential annual quantity of charcoal dust in urban trading sites alone ranges probably between 10,000 and 20,000 t. This dust can be easily be transformed into briquettes using simple compaction machines and a binding material. Charcoal briquettes have higher heating value than fuel wood or plain charcoal. They burn almost smokeless and provide intense and steady heat. Briquetting of charcoal dust could be realized directly at the production site and at wood-energy markets in rural and urban areas. In addition, it is recommended to further promote fan-assisted stoves for large households and small restaurants that can effectively use charcoal dust. These stoves are already produced by local workshops in the country.

(3) IMPROVEMENT OF THE COMMERCIAL NETWORK

Improvement of transport efficiency: In Rwanda, national and international transportation is dominated by the road sector. About 75% of all imported petroleum is consumed within the transport sector and transport costs are quite high. In addition, greenhouse gas (GHG) emissions from transport are approximately 13% of Rwanda's total emissions. Transport from districts to urban areas accounts for about 38% of the total charcoal price. Due to poor loading, transport capacities are underutilized. It is estimated that 10–15% of transportation costs of charcoal could be saved through an optimized utilization of the existing loading capacity. Given charcoal's fragility, excessive handling and transporting over long distances can increase the amount of fines to up to 40%, greatly reducing its economic value. In this context there is a strong need to assist charcoal collectors and transporters to optimize transport capacities. The utilization of suitable plastic boxes or bulk transport of charcoal could contribute to increased transport volumes and to reduced losses and costs, and thus deserves to be tested.

Organization of commercial networks: For the modernization of the charcoal value chain, a formalization of the value chain from producer to the consumer is essential. The creation of a network of rural and urban charcoal markets offers excellent opportunities for the organization of the charcoal sector and assists charcoal burners to obtain better prices. These charcoal markets/depots would have to be managed like micro, small or medium enterprises (MSME) and are subject to standard financial rules. Centralized rural charcoal markets could be set up in all Districts that produce charcoal and serve as reloading and wholesaling points, formalizing the interactions between transporters, traders and retailers. Systematically, all charcoal producers could bring their charcoal to these centralized depots instead of waiting along the roadside for transporters to sell their products. The spatial distribution of the rural markets depends on the distribution of production sites/forests. The rural charcoal markets should be organized within a network of several rural markets supplying a network of urban charcoal markets/depots. Urban charcoal markets have to be set up in all district capitals and in Kigali. Urban markets/depots offer the possibility to centralize charcoal flows from different Districts or Sectors.

Rural and urban charcoal markets also offer the opportunity for producers to diversify their product lines to cater for different consumer groups. In the medium run, the charcoal markets/depots could evolve into rural and urban wood-energy markets offering a variety of "green" energy products from charcoal over fuelwood to ICS. In addition, the development of wood-energy markets will greatly facilitate the control of charcoal flows in Rwanda and help enforce modern licensing and fiscal arrangements.

Development of a market information system: The modernization of wood-energy value chains goes hand-in-hand with some far-reaching changes. There are concerns that poor small-scale charcoal producers are in a disadvantageous position to adjust to new market conditions and to grasp new opportunities for trade and income requires information as well as communication and commitment from the other value chain partners. Timely and unbiased market information will help charcoal or wood-energy producers to bargain with middlemen for a fair price. In addition, this information is also important for wholesalers, retailers, consumers, researchers and policy makers. Based on the experience of the eRwanda Project, a World Bank funded ICT for Development project, the development of a market information system (MIS) for the wood-energy sector will enable more efficient management of the supply chain by integrating all links of the chain. This includes producers, charcoalers, transporters, wholesalers, retailers and final customers. In a first step, the focus should be on the development of a wood-energy MIS (WE-MIS) centered on flows, quantities and prices of wood-energy and particularly of charcoal. Mobile phones can be a powerful tool for both data collection and dissemination.

The proposed WE-MIS through mobiles will have the following advantages: (1) the bargaining position of farmers with traders can be improved, (2) information reduces transaction costs by reducing risks, (3) it would be of use not only to woodlot owners, charcoal producers, wholesalers and retailers, but also to Government, (4) the system would help to bring the charcoal/wood-energy sector to a more equitable level, and (5) the WE-MIS will boost rural development due to better functioning markets and more empowered charcoal/wood-energy producers.

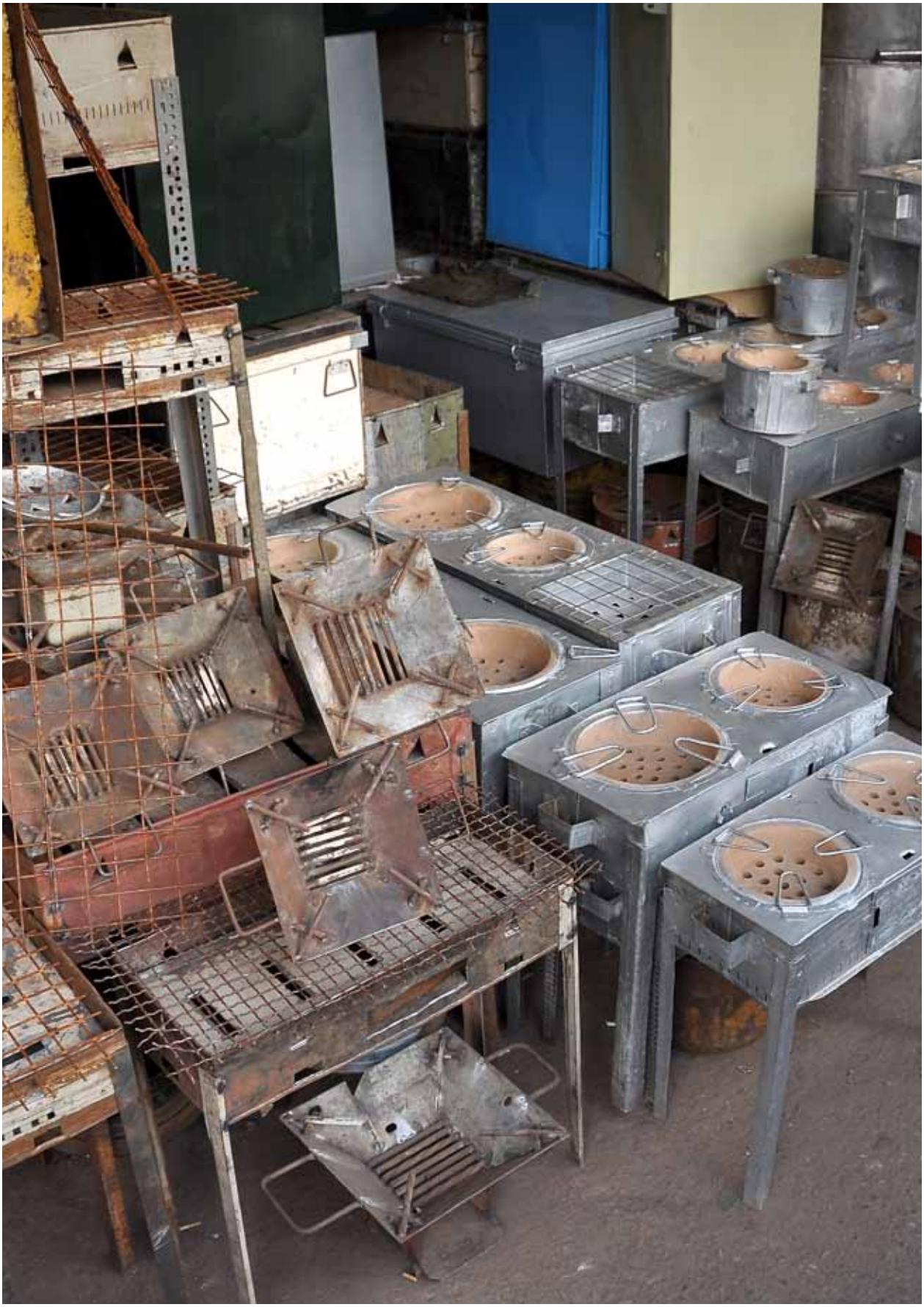
(4) IMPROVEMENT OF COMBUSTION TECHNOLOGIES

ICS are an obvious energy-saving solution for urban and rural households in Rwanda. However, given the high penetration rate of stoves in Rwanda, the incremental impacts of additional stove programs are limited. Nevertheless, the promotion of ICS has a high ranking in the country's policy agenda and given the very high prices for woodfuels in Rwanda there are opportunities to scale up activities. The potential for the adaptation of ICS is estimated at 3 million units.

Besides the promotion of ICS already underway within the country, the strategy should focus on introducing entirely new highly efficient stoves. These stoves can also burn agricultural residues without smoke and could be a good modern solution for some categories of rural households. However, highly efficient stoves are expensive. To reduce the cost of the stoves and create economic incentives to replace old, inefficient cook stove models, the promotion and distribution of ICS should be linked with funding for climate-related projects.

This would require standardization and labeling of stoves to certify the safety and efficiency of stoves. The certification should cover wood and charcoal stoves, but also kerosene and LPG stoves. The Rwanda Bureau of Standards (RBS) could be involved in testing programs, setting of standards and the elaboration of evaluation procedures. Some technical support will be needed to certify or qualify the stoves. Stove manufacturers should be assisted to produce more energy efficient models. They should be involved from the planning stage so they can provide inputs to the program. Capacity development has to follow a step-wise approach so that manufacturers have time to adapt to changing markets. The implementation of a micro-credit policy needs to be treated as a priority to facilitate market development and to assist manufacturers in getting started.

A publicity awareness campaign is needed to inform end-users about the standards, label, and benefits of switching to more efficient equipment. The information campaign should also include the positive environmental, economic and health impacts of using ICS. Specialized trading sites for efficient stoves should be promoted. One additional option to boost the "green" energy market is that Government takes tax exoneration measures specifically for "green" energy merchandizing. Carbon credits may constitute another option for generating additional finance in support of a "green" energy value chain.



ACTIVITIES RELATED TO FRAMEWORK CONDITIONS

Forestry taxation: A modern, competitive and efficient charcoal value chain can only be developed through the effective collaboration of stakeholders and an enabling policy environment that reinforces success factors and removes adverse incentives. Excessive bureaucracy and overstretched administrative requirements (e.g. delays in granting permits, prohibiting the sale of Eucalyptus poles for scaffolding) increase transaction costs and carry the risk of forcing the charcoal business into illegality. In this context, the introduction of a simplified forestry taxation system could be a step forward. However, to guarantee efficient tax collection, the system has to be backed by proficient law enforcement. In exchange for a simplified taxation and permit system, plantation owners and charcoal producers would be bound to enter into a formal agreement with the forest service to manage the woodland sustainably and, as an example, to use improved kiln technologies.

By taxing transport of charcoal and fuelwood only, the system is comparatively easy to control and promotes efficient administration as opposed to more extensive and highly decentralized systems based on the granting of wood-fuel cutting permits. Such a transport tax would replace all actually existing individual wood related taxes and permits, including the cutting permit. Transporters pay the tax and every charcoal bag has to be accompanied by a certificate of tax payment. Only accredited transporters are authorized to pick up charcoal. The payment of the transport tax takes place directly at the rural or urban wood-energy markets. Any charcoal transported without a certificate of tax payment is subject to a higher level of tax, which has to be paid at the control post.

According to a formula, tax revenues are distributed between the different actors, e.g. Sector and District administration and National Forest Fund.[6] With reference to the BEST study it is proposed to set the new unique transport tax at 10% of the primary market price. In applying an average charcoal price of 106 RwF/kg (3,500 RwF/ standard sac) and assuming a total annual national charcoal consumption of 120,000 t per year, the total annual transport tax would amount to 2.5 million USD.

Policy formulation and design of regulatory instruments remain ineffective unless backed by strong institutions capable of law enforcement. Approaches such as the wood-energy market scheme depend upon transparent fulfillment of management contracts, protection of tenure rights, and road checks of charcoal transports on the main entry roads to urban areas. Enforcement capacity equally depends on professional skills, equipment and institutional integrity.

Regulation and law enforcement are major driving forces that influence and interact with all other components of a modern wood-fuel supply strategy. Improving forestry taxation and law enforcement should lead to a series of reactions: (1) increased revenue collection and (2) stabilization or even a price increase for charcoal. In return, the price increase should provide incentives for counter action: (1) investments in forest and plantation management, (2) adoption of improved kilns, (3) proliferation of improved stoves, and (4) increased competitiveness of substitute fuels.

Finally, regulation and law enforcement would yield the following benefits: (1) more responsible and efficient resource use, (2) revenue generation that creates leeway for strategic investment, (3) market incentives for tree planting and forest management by a wide range of stakeholders, (4) highlighting the status of tree resources as a renewable resource, (5) rural employment, and (6) foreign exchange savings.

Implementation of a traceability system: On-going concerns about the environmental and socio-economic effects of increased use of charcoal create obstacles to clear commitment from decision makers. To overcome these concerns, third-party certification has become an increasingly accepted tool for proving that forest products originate from sustainably managed forests, although these have not yet been widely applied to charcoal value chains, especially in developing countries. Nevertheless, it is obvious that market based initiatives suffer from a lack

[6] During the preparations of this study there were indications that this fund would be integrated into FONERWA, a climate change fund from REMA.

of opportunities for local and small actors. Actually, certification favors those who are exporting large quantities, running large forest operations and those who can pay the costs.

Given the small-scale wood production systems and a highly aggregated supply chain, it appears difficult to introduce certification schemes without exorbitant administrative cost. And again, it should be noted that the Rwandan "green" revolution is mainly driven by small-scale land owners. Given the small-scale wood production setting and a highly aggregated supply chain, it is likely that introducing certification is associated with high transaction costs, especially administrative costs. In this context, it should be again noted that the Rwandan "green" revolution is mainly driven by small-scale land owners. For these stakeholders, certification would most probably represent a disincentive, especially because a price premium may only be paid by a minority of institutional and upper class clients in Kigali. The broad mass of consumers will revert to the cheapest available products, even if they were derived from unsustainable or even illegal forestry activities.

Instead it is proposed to develop and implement a simple traceability system, allowing for tracking of charcoal from the forest through each stage of distribution to the final consumer. An option may be the introduction of a barcode based system, replacing the currently used "paper permits". Along with appropriately targeted regulations, the introduction of a national barcode based tracking system could be one of the most effective methods of organizing the charcoal sector.

Promotion of innovative financing mechanisms: Whichever means of knowledge and technology transfer are chosen to support the modernization of the charcoal value chain in Rwanda, practical implementation and up-scaling of best practices foremost depends on the availability of funding and adequate management capacities on all levels. Rwanda's capabilities to mobilize domestic budget support for the development of a vibrant biomass energy sector are limited and donor support in most cases cannot maintain development processes past the initiation and demonstration stage. Therefore, innovative funding mechanisms could help to sustain the lasting

transition from an unregulated, non-efficient charcoal value chain towards a modern charcoal sector.

Along a modernized charcoal value chain, there are several potentialities in reducing GHG emissions. Sustainable wood-fuel production, improved sylvicultural treatments or afforestation/reforestation activities will increase the carbon sinks; efficient biomass harvesting helps to reduce wood residues and wastes. The potential for reducing GHG emissions by promoting the application of improved kiln technology is tremendous and cost effective, not only due to higher carbonization efficiencies, but also to the application of GHG reducing technologies. For example, current industrial kilns have only less than 10% of methane emissions as compared to traditional kilns. In addition, the carbon sink potential of forests is preserved by avoiding tree cutting as a smaller amount of wood is required to yield the same amount of charcoal. Globally, road transport is estimated to be responsible for the highest share of emissions. In Rwanda's charcoal sector, it is estimated that 10–15% of transport related emissions could be saved through an optimized utilization of the existing loading capacity. Improved charcoal cookstoves are also vital for reducing GHG emissions. They improve the efficiency of the fuel and reduce GHG emissions by 20–30% through an enhanced combustion process.

Based on the proposed interventions at different links of the charcoal value chain, the total annual emission reduction potential comes to 4.4 million tonnes of CO2. At the voluntary market this is equivalent to a value of 22.3 million USD.

Improvement of governance capacity to reorganize the charcoal production sector: The successful introduction of a supporting governance framework often constitutes the most important challenge for modernizing charcoal sector value chains. Governance must be understood in the broadest possible sense, i.e. definition of frameworks for planning and monitoring, education and training, cross-sectoral coordination and inter-agency collaboration, law enforcement, provision of targeted public support, and encouragement of civil society participation and private entrepreneurship. These aspects reflect an integrated and comprehensive approach, one that would probably overtax the capabilities of a single sector administration.

A possible solution to the currently weak and dispersed governance capacities and mandates may lie in the creation of an Inter-Ministerial Working Group, specifically tasked with cross-cutting wood-fuel planning, strategy development, resource monitoring and evaluation on all levels, and operational support. The latter function would further include a wide range of public relations/awareness building, training and extension activities, lobbying for policy support and high level attention to the goal of sustainable wood-fuel production.

While improved governance is indispensable in promoting sustainable wood-fuel supplies, multi-stakeholder participation and involvement of the private sector is a crucial precondition. Institutions would thus face the task of catering to the various stakeholders' needs, for example, by coordinating their respective contributions and activities, administrating public support schemes and providing information and knowledge management services. Capacity building to these ends must ensure that public institutions are properly prepared to assume their specific relay function and increasingly act as service providers.

Improvement of the monitoring and evaluation system: Shaping energy policies presupposes reliable baseline information as a precondition for rational decisions. Therefore, precise data on all links of the value chain provide an excellent entry point for shaping sound policy frameworks. They offer an opportunity to the various stakeholders to add knowledge, innovation capital and technology at each step or link in the value chain. On this basis, checks and balances may be introduced to assure a more balanced development within and between the sectors, with a view to achieving the intended overarching goals. Furthermore, evidence-based analyses of the charcoal value chain provide the opportunity to demonstrate the regional added value of charcoal production and thus help to sensitize policy makers for a source of energy hitherto neglected and left to the informal sector.

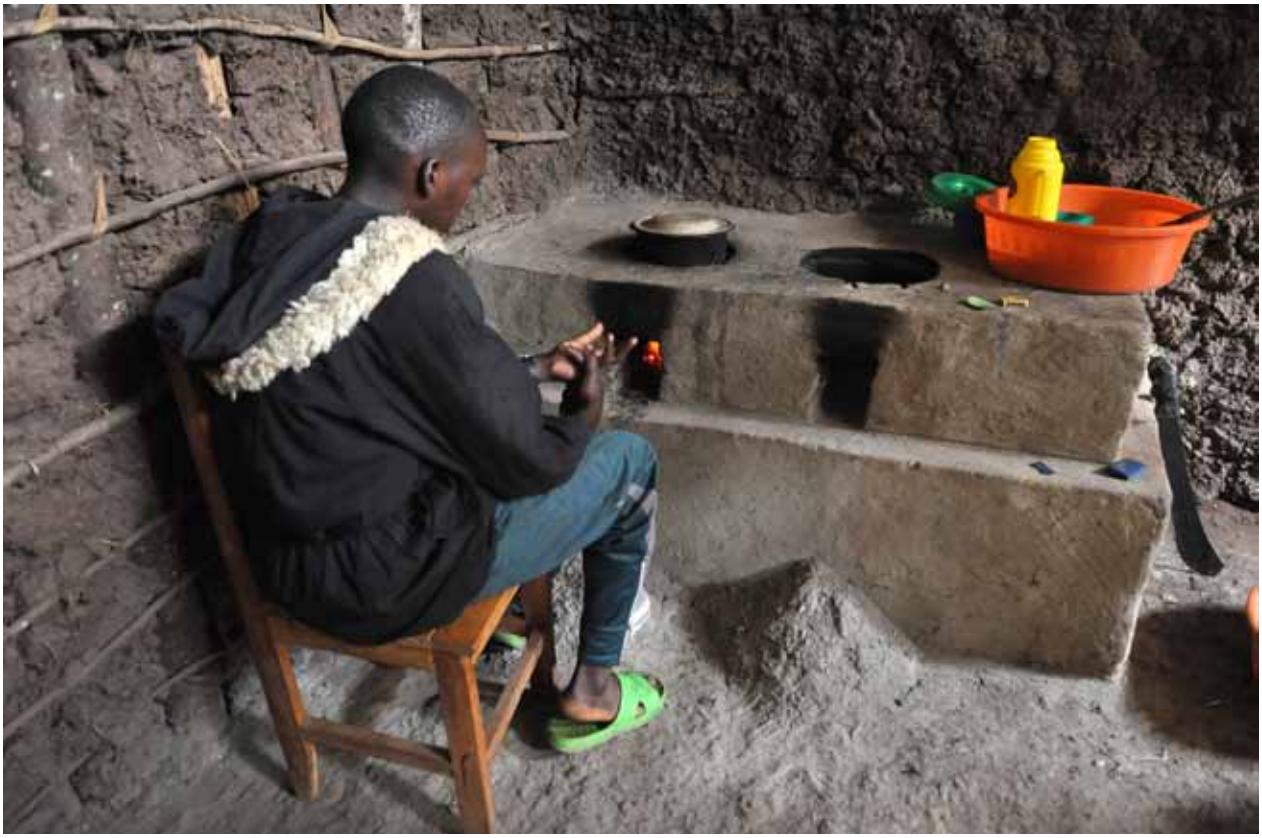
This does not mean that data-collection and subsequent analyses have to commence from scratch. A considerable part of the information required is already available at relevant agencies and institutions. Database formats may vary, though, and statistics may be outdated to some degree. Other aspects may either be missing, or may be worked on by stakeholders outside governmental structures (civil society, the private sector, or donor-supported interventions). The process of collecting and verifying facts and figures is a laborious, costly and time-consuming undertaking that requires a good framework and properly trained and qualified personnel.

Efforts to improve the basis of decision making and subsequent implementation should focus on: (1) identifying information gaps as well as the specific needs and potential contributions of relevant stakeholders, (2) measures to improve information and knowledge management, including harmonization of statistics and management information systems, documentation of lessons learnt, up-scaling of best practices and information sharing among stakeholders, (3) capacity development and pilot-interventions with a view to collecting supplementary data, and (4) targeted supply of novel/advanced methods and technologies.

For data collection, it is important to intensify cooperation with legal actors and organized players in the wood energy sector. This can be achieved by promoting partnerships between the main entities concerned, supporting the dissemination of a wide range of relevant information, combining the efforts of training and capacity building and using the observatory to promote participation and accountability of local communities and decentralized authorities.

Lobbying and PR measures: Wood-fuels – especially charcoal – have an image problem. Awareness building, lobbying and PR measures are indispensable to ensure that support to charcoal production or, more generally, to wood-fuel production are accepted as a green and sustainable source of energy that generates lasting and self-sustaining impact. This seems advisable particularly in the following respects: (1) education programs to sensitize the public to the harmful ecological and socioeconomic consequences of unregulated and wasteful wood fuel consumption, (2) PR programs to inform concerned segments of society about the green potential of biomass, its income generating aspects for the rural economy and ongoing programs and initiatives, and to capacitate them for equitable participation as stakeholders, (3) technical information to disseminate knowledge and innovative approaches, and (4) policy and legal-regulatory information campaigns to educate concerned segments of society about legal-regulatory amendments, incentive schemes and economic policies.

Engaging leaders and policy makers on the benefits of biomass energy needs to be an important component of any initiative to promote renewable energy in Rwanda. In this context, the setting-up of an "Inter-Ministerial Working Group" will strengthen the cross-sectoral collaboration between different sectors such as energy and natural resources, and may facilitate lobbying on behalf of a green charcoal value chain in Rwanda.



INVESTMENT NEEDS TO REALIZE A "GREEN" CHARCOAL CHAIN

It is proposed that the modernization of the charcoal value chain starts with a pilot phase of three years in three conjoined districts and in the capital city of Kigali. As a first recommendation, the activities during the pilot phase should focus on the districts of Nyanza, Huye and Nyaruguru. The total cost of the pilot phase comes to 4.9 million USD. In all, the costs of the subsequent phase(s), totaling 20.6 million USD, cover the interventions in the remaining 27 districts of Rwanda.

Summary of costs related to the different avenues of intervention

Category	Pilot phase (USD)	Total (USD)
Sustainable wood production	2,000,000	11,445,000
Exploitation and transformation of wood-fuels	430,000	2,760,000
Transport and commercialization of charcoal	725,000	2,000,000
Utilization of wood-fuels	220,000	440,000
Framework conditions	1,767,500	4,370,500
Total	**4,922,500**	**20,575,500**

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