



**Verified Carbon
Standard**

BETTER COOKING FOR A BETTER HEALTH IN RUSIZI DISTRICT, RWANDA



Document Prepared by Kiasi Energies

Project Title	<i>Better cooking for a better health In Rusizi district, Rwanda</i>
Version	V6
Date of Issue	06 th of June 2025
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1 PROJECT DETAILS

1.1.1 Summary Description of the Project

Kiasi Energies will disseminate fixed Improved Cookstove (ICS) in Rwanda that will drastically increase community access to clean cooking solutions by providing, installing, and maintaining energy efficient and smoke reducing cookstoves.

Summary description of the technologies/measures to be implemented by the project

The project aims at distributing 100,000 fixed improved cookstoves 2023/B045 to all eligible households in the district of Rusizi in Western Rwanda over the next 4 years. Households are eligible as long as they don't already have access to gas (or any other improved cooking method) for cooking and, ideally, have a separate kitchen to install the improved cookstove.

Those single-pot cookstoves will be built in-situ into domestic kitchens to replace the current 3-stone fire method. Cookstove base will be distributed for free and the materials (bricks, clay, ...) needed for construction will be collected by the households themselves. Materials are available locally. When the households are not able to find the materials, it will be financed by Kiasi Energies. To date (2nd of January 2024), approximately 15,000 improved cookstoves have been installed by the team.

This project is developed as a Carbon Emission Reduction for Self-sustainable Environmental Care Project (CCER).

The table below shows the expected distribution timeline:

Year	Number of stoves distributed
Year 1 (15 th of May 2023 to 14 th of May 2024)	25,000
Year 2 (15 th of May 2024 to 14 th of May 2025)	25,000
Year 3 (15 th of May 2025 to 14 th of May 2026)	25,000
Year 4 (15 th of May 2026 to 14 th of May 2027)	25,000
TOTAL	100,000 cookstoves to be distributed

Table 1: Distribution and installation plan

The primary aim of the project is to reduce the emissions of greenhouse gases incurred by high wood consuming cooking practices. Indeed, in the district of Rusizi, a large part of the population is still cooking with a three-stone fire. Education and training programs may also be included to ensure proper usage of the improved cookstoves, which will lead to better health and environmental outcomes for the community,

particularly women and children. By introducing these stoves, the project expects to decrease fuel consumption, save households money, and time on wood purchases, and enhance indoor air quality.

It also benefits the local population with several other socio-economic matters addressed by the Sustainable Development Goals of the United Nations, such as improved health for the households, gender equality, reduced poverty, and others. Those co-benefits will be described in this document.

Location of the project

The project will take place in Rwanda, Rusizi district. The details of the project location are provided in Section 1.11.

Explanation of how the project is expected to generate GHG emission reductions or removals

The project to distribute improved cookstoves in Rwanda is expected to generate GHG emission reductions by replacing the traditional 3-stone fire method with improved cookstoves that are more efficient and emit fewer pollutants.



A brief description of the scenario existing prior to the implementation of the project

Biomass, mainly firewood, is significant in Rwanda, representing 79%¹ of energy consumption. In rural areas, 98% of households depend on firewood, charcoal or other biomass for cooking², but the 3-stone open fire method is inefficient and leads to unsustainable usage of non-renewable biomass. The new fuel-efficient stove can result in annual savings of 51.92% per stove per household when used correctly, as calculated in the ER sheet.

¹ <https://www.mininfra.gov.rw/digital-transformation-1-1>

² Modern Energy Cooking Services (MECS) : Rwanda, eCooking Market Assessment, February 2022.

<https://mecs.org.uk/wp-content/uploads/2022/02/MECS-EnDev-Rwanda-eCooking-Market-Assessment.pdf>

The baseline scenario is the continued use of the baseline technology (3-stone fire) involving placing three stones on the ground and using them to support a cooking pot, with the fire burning in the space between the stones. Non-renewable fuelwood is used by the target population to meet similar thermal energy needs as provided by project cook stoves in absence of project activity.

Additionally, households in the project area, which relied on the traditional 3-stone fire method, spent significant time and money on collecting firewood, which is a labor-intensive and time-consuming task that can limit the ability of women and children to engage in other productive activities.

Overall, prior to the implementation of the project, the predominant method of cooking in the project area was highly inefficient, polluting, and had negative impacts on health, the environment, and livelihoods.



Figure 1: Women cooking with a traditional 3-stones fire

An estimate of annual average and total GHG emission reductions and removals

The average annual GHG emission reduction from the project is expected to be 155,987 tCO_{2eq} per year on average. Overall, the project will avoid the emission of 1,559,878 tCO_{2eq} over a 10-years crediting period.

1.2 Sectoral Scope and Project Type

Sectoral Scope: 03 Project

Type: Type II – Energy Efficiency Improvement Project

This project is not part of a grouped project or any program.

1.3 Project Eligibility

The project aims to replace traditional three-stone fire cooking methods with energy-efficient cookstoves, resulting in a reduction in carbon dioxide (CO₂) emissions, which is one of the seven greenhouse gases listed in the Kyoto Protocol. Additionally, the project is supported by the VCS-approved methodology VMR0006 v1.2, which is called "Methodology for Installation of High Efficiency Firewood Cookstoves", making it eligible under the VCS Program.

1.4 Project Design

- ☐ The project includes a single location or installation only
- ☒ The project includes multiple locations or project activity instances, but is not being developed as a grouped project
- ☐ The project is a grouped project

This project is not part of a grouped project, it has been designed to include multiple installations of improved cookstoves in the district of Rusizi. In the event that the stove broke, another one would be provided to the household.

However, if the need is still present at the end of the certification period, the project could be renewed. Another project would then be created, as the certification period is of 10 years, fixed, thus non-renewable.

Eligibility Criteria

Below are listed all the eligibility criteria required for multiple project activity instances. Those requirements are available from section 3.6.4 to 3.6.9 of the VCS Standard v4.5³.

Requirements	Project
Both grouped and non-grouped projects can have multiple project activity instances.	This project falls under Multiple Project Activity Instances (several cookstove installation) and is a non-grouped project.
Inclusion of further project activity instances subsequent to initial validation of a non-grouped project is not permitted (see Sections 3.6.10 – 3.6.17 for information on grouped projects).	This is not a grouped project. Project activity instances (stoves) will be installed in all households of the Rusizi district that wishes to participate in the project.
The baseline determination and additionality demonstration for all project activity instances in a project shall be combined (e.g., multiple wind turbines shall be assessed in combination rather than individually).	Baseline determination and additionality demonstration are combined for all instances.
Where a project includes multiple project activity instances from multiple project activities, the project activity instances from each project activity	Each instance represents a stove. All instances have the same activity. This section is not applicable.

³ <https://verra.org/wp-content/uploads/2024/01/VCS-Standard-v4.5-watermarked.pdf>

shall be assessed in accordance with Sections 3.6.1 – 3.6.3	
The project proponent shall include in a singular project all project activity instances within ten kilometers of another instance of the same project activity and with the same project proponent (i.e., instances of the same project activity may not be spread across more than one project if they are within ten kilometers of each other).	All instances are in Rusizi district. All instances are part of the same project.
Where a capacity limit applies to a project activity included in the project, no project activity instance shall exceed such limit. Further, no single cluster of project activity instances shall exceed the capacity limit, determined as follows: 1) Each project activity instance that exceeds one percent of the capacity limit shall be identified. 2) Such instances shall be divided into clusters, whereby each cluster is comprised any system of such instances such that each instance is within one kilometer of at least one other instance in the cluster. Instances that are not within one kilometer of any other instance shall not be assigned to clusters. 3) None of the clusters shall exceed the capacity limit and no further project activity instances shall be added to the project that would cause any of the clusters to exceed the capacity limit.	No capacity Limit applies, as per the methodology VMR0006 v1.2.

1.5 Project Proponent

Organization name	Kiasi Energies
Contact person	Guillaume Fouchères (Juliette Cosson)
Title	President (project manager)
Address	102 bis rue de Miromesnil, 75008 Paris
Telephone	+33 6 89 25 71 15

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1.6 Other Entities Involved in the Project

Kiasi Energies is the project proponent of the project. RDIS, whose information are detailed below is the operating partner of the project. This organization, in collaboration with Kiasi, is distributing and constructing stoves locally.

Organization name	Rural Development Inter-diocesan Service (RDIS)
Role in the project	Operating partner
Contact person	Viateur Ntarindwa
Title	Director
Address	P.O.Box 142, Muhanga, Rwanda, Nyamabuye Sector, Gitarama Cell, Muhanga District
Telephone	(+250) 788760910 (WhatsApp Number)
Email	viateur.ntarindwa@rdis.org.rw

1.7 Ownership

The project is owned by Kiasi Energies.

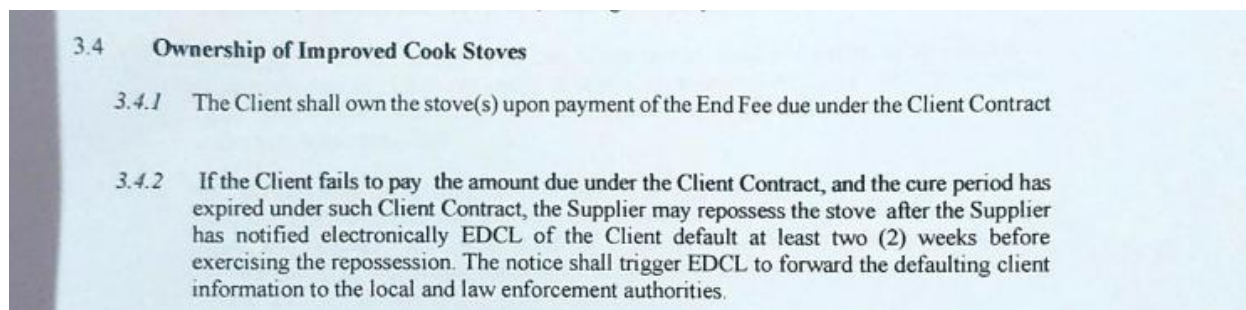
For Kiasi to prove ownership of the project, we need to wonder who the stoves belong to. As per an agreement signed between EDCL⁴ (Energy Development Corporation Limited) and the operator RDIS, the stoves belong to the beneficiaries as soon the “end fee” is paid (see figure 2 below). In our project, there is no end fee, as the stoves is provided for free. Therefore, we consider the stoves to belong to the beneficiaries as soon as it is installed. As the stoves belong to the households, it also owns the reduction emissions provided by the usage of the stove.

After installation of the stoves, each beneficiary will sign a Carbon Transfer Form, transferring the rights over the carbon credits to Kiasi Energies, the Project Proponent (PP), in exchange from the free construction of the stove.

⁴ In Rwanda, REG (Rwanda Energy Group), EDCL (Energy Development Corporation Limited), and REMA (Rwanda Environment Management Authority) are all interrelated entities working towards the country's sustainable energy development and environmental management goals. EDCL and REMA (Rwandan DNA) often collaborate on ensuring that energy projects.

<https://www.reg.rw/about-us/subsidiaries/edcl/>

Figure 2: Extract from the contract signed between RDIS and EDCL, detailing the stoves' ownership



1.8 Project Start Date

The start date is the date of actual usage of the first stove distributed. The first stove distributed and installed as part of the project started being used on 15/05/2023, as shown on the date of the signature of the first Carbon Transfer Form. Therefore, the start date of the project will be the 15th of May 2023.

1.9 Project Crediting Period

The project crediting period is of 10 years, non-renewable: the project will run from 15-05-2023 to 14-05-2033.

1.10 Project Scale and Estimated GHG Emission Reductions or Removals

The estimated annual GHG emission reductions/removals of the project are:

- ☐ <20,000 $tCO_2eq/year$
- ☐ 20,000 – 100,000 $tCO_2eq/year$
- ☒ 100,001 – 1,000,000 $tCO_2eq/year$
- ☐ >1,000,000 $tCO_2eq/year$

Project Scale	
Project	X
Large project	

Table 2: Estimated emission reductions (tCO_2eq)

Year	Estimated GHG emission reductions or removals (tCO ₂ e)
Year 1 (e.g. 15-05-2023 to 14/05/2024)	55,663
Year 2 (e.g. 15-05-2024 to 14-05-2025)	109,912
Year 3 (e.g. 15-05-2025 to 14-05-2026)	162,669
Year 4 (e.g. 15-05-2026 to 14-05-2027)	213,853
Year 5 (e.g. 15-05-2027 to 14-05-2028)	207,711
Year 6 (e.g. 15-05-2028 to 14-05-2029)	201,224
Year 7 (e.g. 15-05-2029 to 14-05-2030)	194,363
Year 8 (e.g. 15-05-2030 to 14-05-2031)	187,094
Year 9 (e.g. 15-05-2031 to 14-05-2032)	137,572
Year 10 (e.g. 15-05-2032 to 14-05-2033)	89,811
Total estimated ERs	1,559,878
Total number of crediting years	10 years
Average annual ERs	155,987

1.11 Description of the Project Activity

The project activity aims to provide households in the Rusizi District of Rwanda with improved cookstoves to replace the highly inefficient and polluting traditional open fires. The households currently rely on traditional open fires for cooking, which results in high levels of CO₂ emissions, deforestation, and indoor air pollution. To replace the traditional open fires, Kiasi Energy will distribute the Stove, a single pot ceramic stove integrated into a mud hearth within the kitchen. This improved cookstove design reduces heat loss and improves heat transfer and combustion efficiency, resulting in decreased fuel use and CO₂ emissions compared to the traditional open fires. The distribution of fuel-efficient cookstoves will also lessen the amount of harmful smoke and indoor air pollution currently associated with traditional open

fires, resulting in a decrease in negative health impacts such as respiratory diseases among rural households. Additionally, by reducing the need to collect firewood, households will have more time for other developmental activities. The project will collaborate with in-country partners to ensure successful implementation.

Beneficiaries will sign a Carbon Transfer Form when receiving the stoves. The CTFs will transfer the carbon rights, and thus the carbon credits to be obtained, to Kiasi Energies, the project proponent. The users also guarantee access to a representative of Kiasi Energies to maintain and monitor the condition of the stove.

Technology/Measure

The 2023/B045 stove, installed by RDIS, is the type of cooking stove that has been designed and developed specifically for use in Rwanda. The stove's liner (Figure 3) is made with locally-sourced materials and the stove body is constructed by RDIS in situ using clay and cement. The stove was assigned codes i.e., 2023/B045. Detailed of the stove physical parameters are described in the table below. The stove 2023/B045 is the only model distributed and constructed for the purpose of the project activities. It has a lifespan of 8 to 10 years, according to the manufacturer's specifications. We will consider a lifespan of 8 years for ER calculation purposes⁵

Table 3: Measurable parameters of the stove

Parameters	Units	Sample 1	
Assigned stove Code		2023/B045	
Length of the entire stove	cm	66.0	
Height of the stove from the ground	cm	44.0	
Combustion chamber height	cm	21.0	
Combustion chamber (inner) diameter	cm	15.0	
Combustion chamber (Outer Diameter)	cm	18.0	
Height of the door	cm	8.5	
Pot rest height	cm	1	
Thermal Efficiency		%	31.2

⁵ Manufacturer's specifications are provided as a supporting document.



Figure 3: RDIS stove before installation (liner)



Figure 4: RDIS stove after installation



Figure 5: Cookstove top Diameter



Figure 6: Cookstove Height from the ground

Stove components

The RDIS improved fixed stove is a type of cooking stove that has been designed and developed by Muhanga Improved Local Technologies company and Best Product Services (BPS) specifically for use in Rwanda. The stove is made from a clay liner and locally sourced materials such as clay and cement. MILT is in the district of Muhanga and is a strategic partner of RDIS (whose headquarters is also based in Muhanga), the operator of the project. MILT and BPS produce clay products, and mainly improved cookstoves and water filters⁶.

⁶ <https://www.rdis.org.rw/milt>

The stove was tested using the WBT 4.2.3 protocol by Clean Cooking Alliance⁷, which provides a standard method for evaluating the performance of the cookstove. The protocol measures several parameters, including thermal efficiency, specific fuel consumption, burning rate, and boiling time.

For our results to be as accurate as possible, 3 WBTs were conducted on six different stoves (all from the same model). The tests were run by two different entities:

- The Rwanda Standard Board (RSB) proceeded to the first batch of WBTs: they tested 3 installed stoves in September 2022 that were not part of our project. Although these results were approved by a governmental entity (RSB), we decided to have the stoves tested on our project site during the pilot phase in March 2023 since the partnership between the Muhanga Improved Local Technologies (MILT) company and Best Product Services (BPS) was new. Plus depending on climate conditions, cooking habits, and construction method, the efficiency can slightly vary.
- The CREEC (Center for Research in Energy and Energy Conservation) is the lab based in a Ugandan university in Kampala, that proceeded to the second batch of tests. One of the CREEC's laboratory technicians came to our project site in Rusizi to run the WBTs locally. The CREEC is working with the latest version of WBT approved by Clean Cooking Alliance and under norm ISO 19867-1 listed by Clean Cooking Alliance.

The results show that it has a thermal efficiency of 31.2% and a specific fuel consumption of 0.0316 MJ/(min-L) according to WBT v.4.2.3 approved by Clean Cooking Alliance. Specific fuel consumption is a measure of the amount of fuel required to boil (or simmer) 1 liter of water. The thermal efficiency of the stove refers to the percentage of heat generated by burning the fuel that is transferred to the cooking pot. A thermal efficiency of 31.2% means that 31.2% of the heat produced by burning the fuel is transferred to the cooking pot, while the rest is lost to the environment. Additionally, the table below shows the results of efficiency for the 3 stoves tested by the CREEC. As precision analysis shows that all requirements are fulfilled (i.e. all 3 values are located within a 10% prevision of the average). Additionally, we do not have the decomposition of the RSB tests, as they are not provided by the standard. However, the average value of 30.6% is also in the proper interval.

Tests from the CREEC	
Efficiency Stove 1	31.20%
Efficiency Stove 2	30.50%
Efficiency Stove 3	32.10%
Average	31.27%
Average + 10%	34.39%
Average - 10%	28.14%

The RDIS-improved cook stove uses a total of six mudbricks that will be made by households as their in-kind contribution. The average size of the brick would be 25cm x 11cm x 8cm. During the installation

⁷ <https://cleancooking.org/binary-data/DOCUMENT/file/000/000/399-1.pdf>

process, the bricks are joined together using a mixture of mudbricks, cement, cow dung, grounded stones, and water. Insulation is settled around the stove to increase the stove's thermal efficiency, ensuring a reduction in heat loss. The stove has a top that allows the pot to sit higher, improving the flow of air into the combustion chamber and out through the top of the stove. It also has three valves at its upper part that support the pan or pot and, more importantly, permit the air to flow inside the stove while feeding the fuel into the combustion chamber, resulting in complete combustion of wood.

As per the water boiling test's results by the Centre for Research in Energy and Energy Conservation (CREEC), an ISO certified laboratory based in Makerere University, its thermal efficiency is 31.2% (initially).

The locally made stove is a sustainable and cost-effective choice for households and communities in Rwanda. Its use of locally sourced and low-cost materials supports local industries and economies, while its efficient and reliable performance can help to reduce fuel costs and improve the quality of life for users. It's simple and easy-to-maintain design ensures that it can be easily repaired and maintained locally, minimizing the need for expensive replacements or repairs.

If a stove were to break before the end of the crediting period, it would be replaced.

Distribution Plan

As stated in the introduction section, the project aims to cover the whole district of Rusizi. Each village and cell of the district will be visited during the first 4 years of the project. Every HHs that does not have access to a clean cooking solution will be offered the opportunity to participate in the project activities. The project aims to distribute 100,000 improved cookstoves within the district of Rusizi. The number of HHs in the district is slightly above 100,000 HHs. The distribution schedule is as followed:

Year	Number of stoves distributed
Year 1 (15 th of May 2023 to 14 th of May 2024)	25,000
Year 2 (15 th of May 2024 to 14 th of May 2025)	25,000
Year 3 (15 th of May 2025 to 14 th of May 2026)	25,000
Year 4 (15 th of May 2026 to 14 th of May 2027)	25,000
TOTAL	100,000 cookstoves to be distributed

Our local team distributes and installs approximately 2,100 stoves per month. The exact number of stoves distributed per month can be extracted at any point from the distribution record. The RDIS' team visits the targeted cells or villages to evaluate the interest of the inhabitants. After storing the appropriate number of stoves in the cell/village offices, the liners are distributed to participants, and the installers then visit HHs to help them install the stoves with the appropriate materials. After a few months, the local team will re-visit each cell or village to ensure every HHs that wished to participate was covered, and that all installed stoves are still used and in good shape. Households that were hesitant during the first visit

are usually convinced by their participating neighbors and decide to join the project during the follow up visit. Kiasi and RDIS have exclusivity of operations in 13 of the 18 sectors of Rusizi district⁸. These 13 sectors will be dealt with in priority, although overall, all sectors are covered at the same time.

Distribution Record

A comprehensive Distribution Record will be stored electronically. The information will be collected by means of a Carbon Transfer Form (CTF) which will be signed by the stove user, stating that the rights to the carbon credits generated by the improved stove will lie with Kiasi Energies.

The following data will be collected:

- Name, Address, and telephone number of all stove end users
- The date of installation
- The sector and cell location of the stove beneficiaries
- Unique Stove ID
- Whether the stove will be used for commercial or domestic purposes
- GPS coordinates of the HH

The central database will serve as a project database for project monitoring and sampling purposes.

Repair, maintenance and replacement plan

During installation of the stoves, the HHs are taught how to carry small repairs with clay and water by themselves. They can then repair small holes or weaknesses on their own.

All beneficiaries are given a phone number to call in case of problem with the stove or to provide their opinion. In case of a more important breakage, the beneficiaries are told to reach out to the team, who would then come to the households to help in the reparation or to replace the stove if the breakage is too important to be repaired. Once again, this replacement is free of charge for the beneficiaries.

All stoves are meant to be replaced when they break and are not repairable.

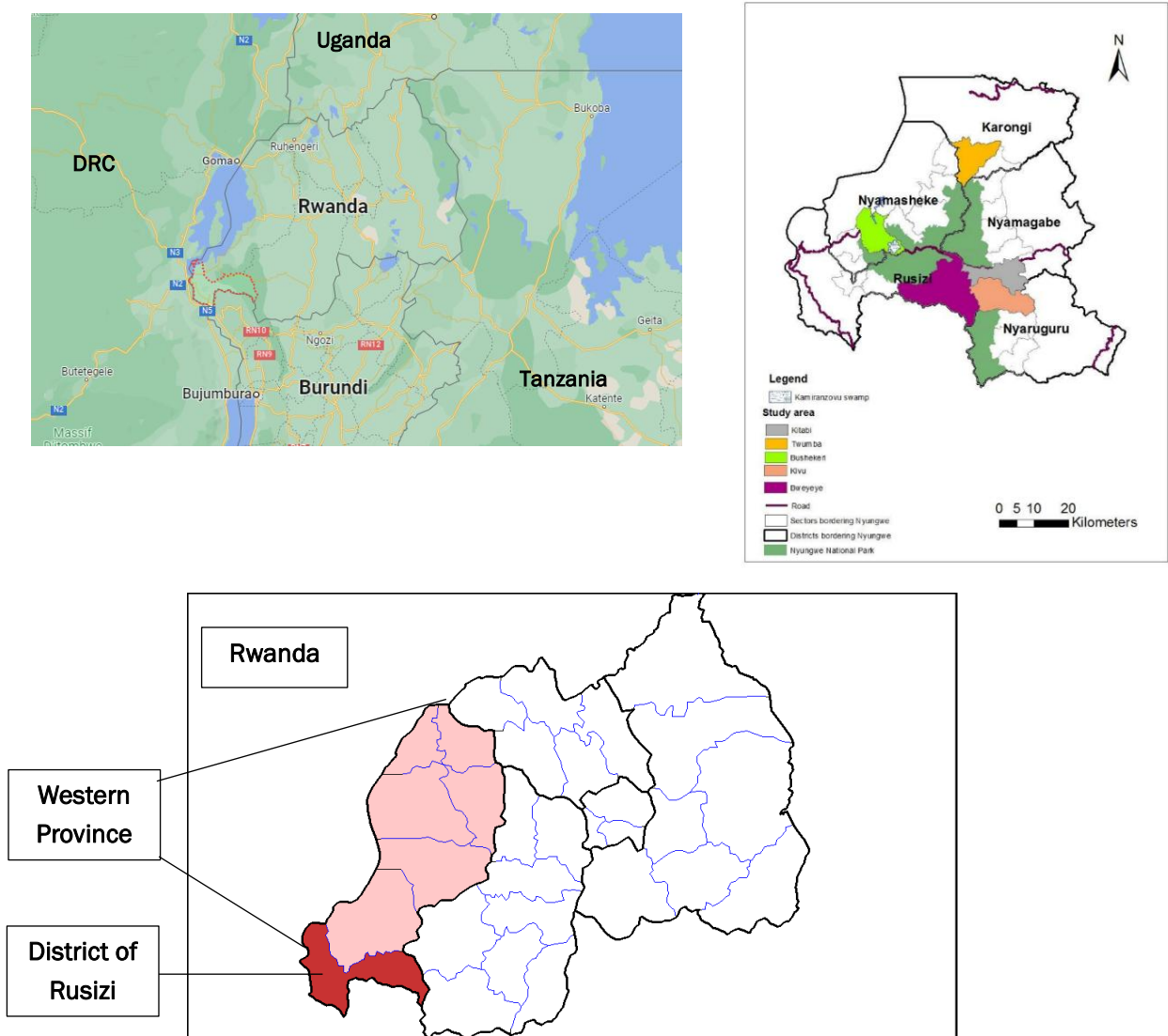
1.12 Project Location

The project aims to distribute improved cookstoves in Rusizi District, circled in red on the map below. The Rusizi district is located in the Western Province of Rwanda.

⁸ The district of Rusizi counts 18 sectors, 89 cells, and 595 villages, all of which will be offered the opportunity to participate.

<https://africaahead.org/countries/rwanda/rwanda-rusizi-district/#:~:text=Rusizi%20District%20is%20one%20of,89%20cells%20and%20595%20villages.>

Figures 7: Location of the project



Rusizi is a district located in the Western Province of Rwanda. The district is located at GPS coordinates 2.4750° S, 28.8414° E. It is bordered by the Democratic Republic of Congo to the west, the district of Nyamasheke to the north, the district of Kamonyi to the east, and the district of Nyaruguru to the south. Rusizi is in the Great Lakes region of Africa, and its landscape is characterized by hills, valleys, and forests. Rusizi is also home to the Kamembe International Airport, which serves the region and provides an important link to other parts of Rwanda and neighboring countries.

1.13 Conditions Prior to Project Initiation

Before the implementation of the project, most of the households⁹ of the Rusizi district cook with traditional open fire. Those “3 stones fires”, as they are called, are very consuming in terms of firewood, and thus they emit large amount of greenhouse gases. They also generate smokes in the kitchen of the households, which causes various respiratory diseases or eye problems, especially for kids and women. The large quantity of wood needed requires a lot of time to collect and is sometimes a financial pit for the households.

1.14 Compliance with Laws, Statutes and Other Regulatory Frameworks

The Project Activity does not violate any of the Host Country’s relevant local, regional, and national laws, statutes, and regulatory frameworks. There are no laws and regulations governing the use of improved cookstoves in Rwanda for households. The project is a voluntary effort by the project proponent.

The following relevant documents have been reviewed:

- Rwanda’s Energy Sector Strategy Plan¹⁰ : clean cooking and woodfuel usage is addressed all along the document. As stated in p.63, most of the investment is expected to come from private sector.
- Rwanda Energy Policy¹¹ (1.3.3, p16 “5) Promoting private sector participation”, p23 “2.8 BIOMASS ENERGY”, but overall, the whole document is relevant)
- Rwanda’s Biomass Energy Strategy¹², whole document.
- 7-Years Government Programme: National Strategy for Transformation (NST1) 2017 – 2024

1.15 Participation under Other GHG Programs

1.15.1 Projects Registered (or seeking registration) under Other GHG Program(s)

The project has not been, and will not be, registered under any other GHG program.

1.15.2 Projects Rejected by Other GHG Programs

The project has not been rejected by any other GHG program.

⁹ There are always some households using gas or other improved technologies. The HH are eligible to be part of the project only if they don’t already have access to improved cooking methods.

¹⁰ https://www.reg.rw/fileadmin/user_upload/Final_ESSP.pdf

¹¹ https://www.reg.rw/fileadmin/user_upload/Rwanda_energy_policy-21612.pdf

¹² <https://cleancooking.org/wp-content/uploads/2021/07/35-1.pdf>

1.16 Other Forms of Credit

1.16.1 Emissions Trading Programs and Other Binding Limits

The project is not involved in any emission trading program or any other mechanism that includes GHG allowance trading.

1.16.2 Other Forms of Environmental Credit

The project has not sought or received another form of GHG-related environmental credit, including renewable energy certificates.

Supply Chain (Scope 3) Emissions

On November 11th, 2023, a letter was signed between the stove manufacturer (BPS – Best Products and Services) and the project proponent (Kiasi Energies), to ensure he was aware and agreed that the GHG emission reductions associated with the project stoves belong to Kiasi Energies, as per say on the CTFs signed by the Households. The manufacturer won't claim these ER.

Have the owner(s) or retailer(s) of the impacted goods and services posted a public statement saying, "VCUs may be issued for the greenhouse gas emission reductions and removals associated with RBS' cookstoves" since the project's start date?

☐ Yes ☒ No

Has the project proponent posted a public statement saying, "VCUs may be issued for the greenhouse gas emission reductions and removals associated with the project."

☒ Yes ☐ No

Have the producer(s) or retailer(s) of the impacted good or service been notified of the project and the potential risk of Scope 3 emissions double claiming via email?

☒ Yes ☐ No

1.17 Sustainable Development Contributions

This project has the potential to make significant sustainable development contributions environmentally, socially, and economically. Improved cookstove projects contribute to sustainable development by promoting the use of cleaner, more efficient cooking technologies, supporting sustainable forest management practices, and creating employment opportunities for local communities. The stoves used in these projects are made from locally available materials, such as clay or metal, and are affordable for most households in the target communities. By doing so, these projects can improve health outcomes, reduce pressure on the forests, mitigate greenhouse gas emissions, and enhance economic development in the target communities.

The Project is expected to contribute positively to the following Sustainable Development Goals (SDGs).

SDG 1: No poverty

This project aims to distribute the stoves for free to try and equip populations who would not have the resources to buy the technology themselves. The stoves are fully financed and should reduce the amount of money needed by HH to buy fuelwood.

SDG 3: Good Health and Well-being

By reducing smoke emissions from traditional stoves, the project can improve the health outcomes of those who use them, particularly women and children.

SDG 5: Gender equality

Women and Children are particularly vulnerable to health issues due to Households Air Pollution (HAP), as they spend more time cooking. By reducing the HAP, women are less likely to develop conditions such as itchy eyes or pulmonary deficiency.

They are usually in charge of collecting firewood, another time-consuming task that prevent them from having other activities. By sparing time on fuel collection, they are more likely to have other activities, such as going to schools for young girls.

In addition to this, the stove manufacturer chosen for this project hires a majority of women, to ensure improved gender equality. 60% of its full-time workers are women.

SDG 7: Affordable and Clean Energy

The project promotes the use of cleaner and more efficient cooking technologies that require less fuel, leading to increased energy access and affordability.

SDG 8: Decent Work and Economic Growth

The project creates employment opportunities for local communities through the production and distribution of improved cookstoves.

SDG 13: Climate Action

The project can mitigate greenhouse gas emissions by reducing the use of traditional stoves and reducing the demand for firewood.

Overall, the project's positive impact on health, energy access, economic growth, climate action, and land conservation aligns with several SDGs and contributes to the achievement of the United Nations' sustainable development agenda. Through the SD Vista program, we will have these impacts certified.

1.18 Additional Information Relevant to the Project

Leakage Management

Not applicable as the project adopts a net gross adjustment factor of 95% to account for leakage, as proposed by the methodology.

Commercially Sensitive Information

Further Information

2 SAFEGUARDS

2.1 No Net Harm

No potential negative environmental or socio-economic impacts have been identified for the project.

2.2 Local Stakeholder Consultation



Figure 8: Group photo of the LSC participants



Figure 9: LSC participants filling the feedback forms.

The local stakeholder consultation was conducted on 20/12/2022 from 9 a.m. to 12 p.m at the Rusizi District Conference room and brought together participants from Local Government, Public Institutions, Church Leaders, and local leaders. All stakeholders were invited to the LSC, including:

- The Mayor of Rusizi District
- National Women Council / Rusizi district
- The Secretary of National Youth Council/ Rusizi District,
- Delegate of Rwanda Energy Group/Rusizi District
- Anglican Diocese staff
- 9 Executive Secretaries of Nine Sectors in Rusizi districts
- Rwanda Environment Management Authority (REMA)

The most common and suitable method of ensuring that invitees receive invitations in Rwanda is through sending them via letter and phone. This approach is widely used by many institutions in the country.

The invitations were written in Kinyarwanda, which is a common language spoken by all Rwandan people.

During the local stakeholder consultations, discussions were held on the potential risks, costs, and benefits associated with the project. Project representatives emphasized the importance of ongoing communication between stakeholders and project representatives, allowing for continuous feedback and grievance reporting. The meeting included a question-and-answer session, and stakeholders were asked to fill out feedback forms at the end.

The local stakeholder consultations were highly successful, with active participation and lively discussions on the project's potential risks, costs, and benefits. Stakeholders were enthusiastic about the project, appreciating the positive impacts on their health, workload, and the environment.

Following the local stakeholder consultations, stakeholders were invited to provide feedback on the project via email or letter.

Below are the feedback and questions raised by the stakeholders:

QUESTIONS	ANSWERS
1. How is the reduction of CO ₂ consumption calculated?	1. The RDIS Executive Secretary replied that project partners use technical steps, such as kitchen surveys and water boiling tests, to calculate the reduction of CO ₂ emissions.
2. What contribution beneficiaries can make to generate more CO ₂ and support more carbon projects in Rwanda.	2. Community ownership is key to this project, so training and awareness campaigns will be conducted to help beneficiaries understand that increased usage of the stoves generates more carbon credits. This, in turn, will enable the project developer to implement additional projects.

Ongoing communication with Stakeholders

Community awareness (local leaders included) is carried on yearly. It keeps the population posted on how the project is moving forward, and it reminds them the benefits and impacts of the project. During stoves distribution, we work in collaboration with local leaders and district officials. Local leaders are the link between the population and our implementation team.

After each monitoring, we host a meeting with the district officials to provide information on how the project is moving forward. Every Tuesday there is a community meeting at village level (where enumerators teach village leaders and HHs about proper stoves usage and impacts). Every year, we are required to report to REMA, the Rwandan DNA. Every other stakeholder will be provided with the latest monitoring report on demand in the district office.

Households' representation

In Rwanda, the organization of the society is very vertical. Sector leaders, district officials, youth representatives, women representatives, religion representatives from the project area were invited to the LSC. They represent the local populations. Village and cell leaders then provide information to local inhabitants. From this information, village leaders report to our team to coordinate activities within their area for the households that wish to be part of the project. These leaders are themselves inhabitants from the villages.

2.3 Environmental Impact

The main goal of this project is to reduce the emission of greenhouse gases due to cooking with traditional stoves in Rwanda. The wood consumption of the beneficiaries should drop by at least 50%, thus limiting the amount of wood needed by the population. Hopefully, this project will help reduce deforestation in this district.

No negative environmental impacts have been identified.

Note: several stakeholders noted that the number of cookstoves to be distributed was not high enough to equip the whole district. After the LSC, we then decided to double the number of ICS to be distributed (from 50,000 to 100,000 stoves) to align with the stakeholders' comments.

2.4 Public Comments

Two public comments periods were closed:

- The first one happened from 22nd of August 2023 to 21st of September 2023: on VERRA website, as required by the standard.
- A second public comment period happened in Rwanda, to make sure local communities could have a say. An announcement was published in a notorious Rwandan newspaper (igihe.com). The article asking for feedback was published on the 8th of August 2023.

No feedback was received from any of these 2 channels.

2.5 AFOLU-Specific Safeguards

This section is not applicable as the project is not an AFOLU project.

3 APPLICATION OF METHODOLOGY

3.1 Title and Reference of Methodology

Methodology: VMR0006 v1.2 – Methodology for Installation of High Efficiency Firewood Cookstoves ¹³

Version: 1.2 issued on 28th March, 2023 and approved on July 6th, 2023.

The project also used:

- Water Boiling Test Protocol 4.2.3

¹³ VMR0006: Methodology for Installation of High Efficiency Firewood Cookstoves, Version 1.2

- CDM Guidelines: Sampling and surveys of CDM project activities and programmes of activities v4.0
- CDM Standard “Sampling and surveys of CDM project activities and programmes of activities”, version 9.0
- TOOL 30 version 4.0: Calculation of the Fraction of Non-Renewable Biomass
- TOOL 33 version 2.0: Default values for common parameters

Overall, a large variety of tools proposed by VCS and CDM were used to develop the projects in accordance with all the requirements.

3.2 Applicability of Methodology

Source	Applicability conditions	Projects
VMR0006 v1.2	This methodology applies to project activities that introduce energy efficiency and fuel switch measures in thermal applications (including cookstoves, ovens, and dryers) that: 1) Increase thermal efficiency to reduce the consumption of non-renewable biomass; or 2) Switch from fossil fuel (coal or kerosene) to renewable biomass in new or existing improved thermal energy generation units.	The project involves distribution of domestic fuel-efficient cookstoves to households, thus increasing thermal efficiency of cooking devices. The project does not expect switch from fossil fuel. (further conditions do not apply)
VMR0006 v1.2	This methodology is applicable to both ‘Projects’ and ‘Large Projects’ under the following conditions: 1) All applicability conditions of the latest version of AMS II.G. must be met. 2) The project activities must be implemented in households, community-based kitchens, institutions (e.g., schools), or small and medium-sized enterprises (SMEs).	1) See below in this table for eligibility conditions of AMS II.G. 2) The project activities are implemented in households.
VMR0006 v1.2	For fuel switch activities, the following additional conditions must be met: 3) Projects must exclusively use renewable biomass and meet the following additional conditions: (a) If biomass residues are used, they have been left for decay or burned without energy recovery before the implementation of the project activity. (b) If biomass residues from a production process are used, the implementation of the project does not	The project does not involve any fuel switch activities. This condition is therefore not applicable.

	result in an increase of the processing capacity of raw input or any other substantial changes (e.g., product change) in this process. (c) If biomass from dedicated plantations is used, the applicability conditions of TOOL16 “Project and leakage emissions from biomass” must be satisfied. 2 Refer to EB 23 Annex 18 for definition of renewable biomass VMR0006, v1.2 6 4) The renewable biomass sources must be documented in the project description and monitoring periods, including origin, quantities, and pre-project conditions. If the biomass is sourced from a third-party, proof of purchase must be provided (e.g., contractual agreements or purchase receipts). 5) More than one type of biomass may be used (e.g., briquettes and wood chips).	
AMS-II.G_v13.0 (2.2 Applicability 3.)	The methodology is applicable to the introduction of single pot or multi pot portable or in-situ cookstoves with rated efficiency of at least 25 per cent.	According to the manufacturer’s specifications, the stoves of the project: - Are Single pot - Are Fixed (in-situ) cookstoves - Exclusively use woody biomass - Have an initial thermal efficiency of 31.2 % the first year
AMS-II.G_v13.0 (2.2 Applicability 5.)	Non-renewable biomass has been used in the project region since 31 December 1989, using survey methods or referring to published literature, official reports or statistics.	In Rwanda, there is a significant reliance on non-renewable biomass, primarily firewood, which accounts for a minimum of 86% of the country's energy consumption ¹⁴ . Wood fuel is particularly essential in rural areas, where 98% of households depend on it as their primary cooking fuel ¹⁵ . However, this high demand for biomass has resulted in the loss of approximately 64% of forests between 1960 and 2007, according to the Forest department's statistics ¹⁶ . Moreover, Global Forest Watch reported a 7.6% reduction in tree cover, equivalent to 37.7kha lost between

¹⁴ Rwanda Ministry of Infrastructure (MININFRA), 2011:
http://mininfra.gov.rw/index.php?option=com_content&task=view&id=115&Itemid=143

¹⁵ <https://www.mdpi.com/1996-1073/14/15/4582/htm>

¹⁶ <https://www.rema.gov.rw/soe/chap6.php>

		2001 and 2020 ¹⁷ . Further information are available below this table and in Appendix 1.
AMS-II.G_v13.0(2.2 Applicability 7.)	The PDD shall explain the proposed method for distribution of project devices including the method to avoid double counting of emission reductions such as unique identifications of product and end-user locations (e.g. programme logo)	Each of the 100,000 improved cookstoves to be distributed will be identified through a unique ID. This ID, engraved on a metallic plate, will be fixed next to the stoves in the beneficiaries' kitchen. A Project database will list the stoves installed, their ID, precise location (coordinates), the beneficiary's name, address, contact and the distribution date. This will ensure that no double-counting occurs, and the project's environmental impact is accurately assessed
AMS-II.G_v13.0 (2.2 Applicability 8.)	The PDD shall also explain how the proposed procedures prevent double counting of emission reductions, for example to avoid that project stove manufacturers, wholesale providers or others claim credit for emission reductions from the project devices	Kiasi Energies will ask each beneficiary to sign a Carbon Transfer Form, to ensure that the carbon rights are the property of Kiasi Energies. Furthermore, it has been made clear to the manufacturer that he would not be able to claim to carbon rights. The stoves' manufacturer committed, in a signed letter, not to claim the environmental benefices of the stoves.
AMS-II.G_v13.0 (2.2 Applicability 4.)	The aggregate energy savings of a single project activity shall not exceed the equivalent of 60 GWh per year or 180 GWh thermal per year in fuel input.	Specific fuel consumption of 0.032 MJ/(min.L) ¹⁸ Baseline Energy consumption (MJ) = 100,000 (cookstoves) * 120 min (daily usage) * 365 (days) * 0.032 MJ/(min.L) = 1.4016 * 10 ⁸ MJ / (3.6 * 10 ⁶) < 40 GWh Plus, 40GWh over 10 years = 4,000 MWh/year during 10 years, on average. Therefore, Energy savings are far below 60GWh/year To conclude: Energy savings can't exceed baseline consumption, which is far below 180 GWh thermal per year.
AMS-II.G_v13.0 (2.2 Applicability 6.)	For the cases where the biomass is sourced from renewable sources, the project should use a corresponding Type I methodology.	Biomass is not sourced from renewable biomass sources. Calculation of f_{NRB} , below, confirms this.
TOOL 30 v4.0 2.2.3 Applicability	This tool may be used by: (a) DNAs to submit region- or country-specific default f_{NRB} values, following the procedures for development, revision, clarification, and update of standardized baselines (SB procedures); or (b) project participants	We, as project developers, have used this tool to calculate the f_{NRB} for area of the project.

¹⁷ <https://www.globalforestwatch.org/dashboards/country/RWA/>
¹⁸ From the results of the WBT led by the CREEC.

	to calculate project- or PoA-specific f_{NRR} values.	
TOOL 33 v2.0 2.2 Applicability	This tool shall be applied in conjunction with the methodologies which refer to this tool to source the default values to estimate the baseline emissions (e.g. from the use of diesel for off-grid power generation, from the use of kerosene for lighting, from the use of woody biomass for cooking).	The methodology VMR0006 v1.2, used for this project, stated CDM TOOL 33 as a source in section “1. Sources” p4.
TOOL 33 v2.0 2.2 Applicability	The default values as contained in section 5 of this tool are valid up to 10 March 2025. Notwithstanding the provisions on the validity of new, revised, and previous versions of methodologies and methodological tools in the “Procedure: Development, revision and clarification of baseline and monitoring methodologies and methodological tools”, there will be no grace period for the application of this tool and the validity of the default values after this date, including in cases where further default values are added to this tool through revisions of this tool before this date.	This project started in May 2023, therefore during the period of validity of this TOOL33. The latest values will be used to estimate default parameters for monitoring.
Standard: Sampling and surveys for CDM project activities and programmes of activities Version 09.0	This standard is applicable to CDM project participants, coordinating/managing entities and designated operational entities (DOEs).	Kiasi Energies is a project participant and a managing entity. We will use this standard during surveys sampling.
Standard: Sampling and surveys for CDM project activities and programmes of activities Version 09.0	This document specifies the reliability requirements and describes appropriate sampling methods and what is expected to be provided in a sampling plan. The general requirements shall be applicable to both small-scale and large-scale CDM project activities and PoAs, with any requirements specified in the applied methodologies taking precedence. This document also provides sampling-related requirements pertaining to validation and verification, including the sampling approach to be undertaken by the validating/verifying DOEs. A definition of essential sampling terminology is contained in section 3 below.	This project is large scale. We will provide a sampling plan in the monitoring section.

Evidence that the non-renewable biomass has been in use since 1989

The FAO country report on the extent, characteristics, and changes in Rwanda's forests in 2020 provides a list of 13 key natural forests in Rwanda and their change over time from 1984 to 2015. The report highlights a steady decrease in natural forests and parks during this period¹⁹. When considering this information alongside the data in the table above, it can be concluded that non-renewable biomass has been utilized in Rwanda since December 31, 1989.

Table 4: Decrease of Rwandan Natural Forests from 1984 to 2015

Name of the forest	Area (ha) 1984	Area (ha) 2015	% Loss
Buhanda Natural Forest	1116	18	98.4%
Gishwati Natural Forest	21213	93.2%	93.2%
Mashyuza Natural Forest	85	6	92.7%
Ibanda-Makera Natural Forest	1425	169	88.1%
Karama Natural Forest	3235	1061	67.2%
Dutake Natural Forest	31	11	65.7%
Karehe-Gatuntu Natural Forest Complex	48	19	60.3%
Nyagasenyi Natural Forest	45	19	58.2%
Akagera National Park	267,741	112,185	58.1%
Mukura Natural Forest	4376	1988	54.6%
Sanza Natural Forest	49	24	51.0%
Mashoza Natural Forest	36	18	51.0%
Muvumba Natural Forest	1286	688	46.5%
Ndoha Natural Forest	39	29	26.0%
Kibirizi-Muyira Natural Forest	454	352	22.4%
Busaga Natural Forest	191	159	16.9%
Nyungwe National Park	112,230	101,005	10%
Volcanoes National Park	16,128	16,004	0.8%
Total	429,728.47	235,192.27	45.27%

3.3 Project Boundary

Source		Gas	Included?	Justification/Explanation
Baseline	Emission from use of non-	CO ₂	Yes	Major Source
		CH ₄	Yes	Major Source

¹⁹ <https://www.fao.org/3/ca9878fr/ca9878fr.pdf>

Source	Gas	Included?	Justification/Explanation
renewable biomass	N ₂ O	Yes	Major Source
	Other	No	No other source identified
Project Emission from use of non-renewable biomass	CO ₂	Yes	Major Source
	CH ₄	Yes	Major Source
	N ₂ O	Yes	Major Source
	Other	No	No other source identified

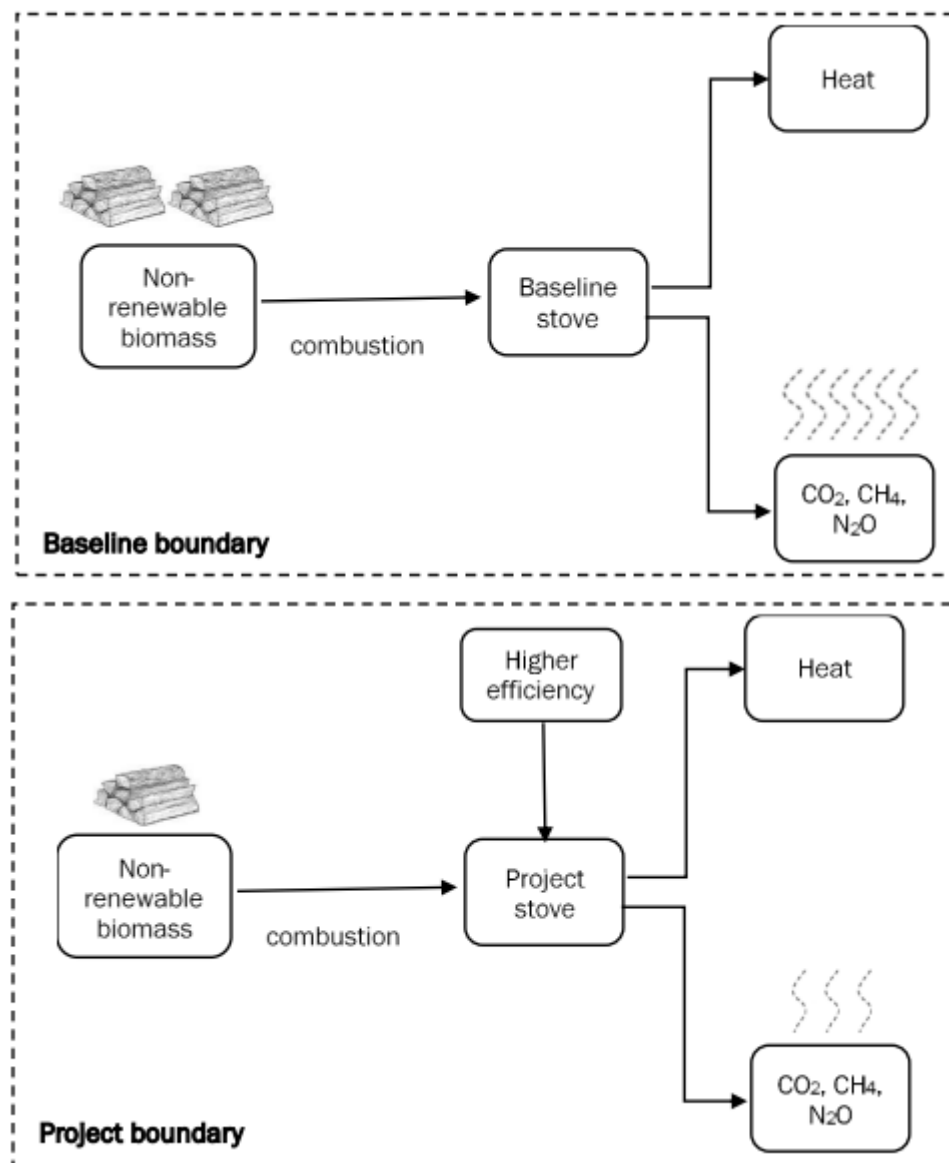


Figure 9: Project boundary and Baseline boundary

3.4 Baseline Scenario

The baseline scenario is the scenario that would most likely have happened in the absence of the project. For this project, it corresponds to the continued use of non-renewable wood fuel (firewood) by the target population to meet similar thermal energy needs as provided by project cookstoves, in absence of project activity.

The project was designed to specifically equip households that cook with 3-stone fire (firewood). As explained in part design of the project, Rwanda classifies households as of their equipment level. Level 4, for instance, represent HHs that already have access to a gas or electric cooking method. These HHs are not offered the possibility to be part of the project (they represent a very tiny proportion of the population), as it would not be useful to them. HHs which usually use charcoal have an improved stove to cook with charcoal. HHs with any improved cookstoves solutions are not included in the project activities. Our KPT focused on firewood for 2 reasons:

- It is by far the most common fuel used in Rusizi district, a rural district in Western Rwanda (~95%).
- Our stoves are meant to replace 3 stone fires exclusively, and HHs participating were all using 3 stones fires (therefore wood fuel) before RDIS provided an ICS. The baseline is the continuous used of 3-stones fire as the HHs are offered the possibility to participate specifically over that criterion.

Additionally, this question is part of the kitchen and usage surveys that will be carried out annually. We will ask HHs the different type of fuel they use on a daily basis.

In rural areas in Rwanda, a very large part of the population uses firewood as main fuel for cooking. The document *Policy and market review for modern energy cooking in Rwanda*, dated from June 2021, mentions: “Firewood accounts for 93% of the cooking fuel used in rural areas, while charcoal is predominant in urban areas.” Rusizi district is almost exclusively rural.²⁰ Another chapter in this document explains that “Charcoal is substantially more expensive than firewood, which can be often collected for free”. In addition to this, a CASE Project ran a study²¹ mentioning that the households that were not exclusively using firewood were usually using a combination of charcoal and firewood for cooking.

In addition to this, Kiasi and RDIS run 120 Kitchen Performance Tests in Rusizi district prior to the project start date, from 22nd to 25th of November 2022. Results from this KPT are available on demand. This allowed the determination of an important value: the consumption of wood per households in the project region with baseline device. On average, households from Rusizi district use 3.6 tons of wood fuel per year for cooking purposes.

²⁰ <https://mecs.org.uk/wp-content/uploads/2021/10/Policy-and-market-review-for-modern-energy-cooking-in-Rwanda.pdf>

²¹ <https://cleancooking.org/binary-data/RESOURCE/file/000/000/60-1.pdf>

3.5 Additionality

The methodology uses activity method for the demonstration of additionality.

Step 1: Regulatory Surplus

The project to distribute domestic fuel efficient cookstoves in the host country is voluntary, as there is no mandated government program or policy requiring it. However, the project is aligned with Rwanda's Energy Sector Strategy Plan²², which aims to promote efficient technologies and reduce the reliance on firewood. The project's approach to market development is also in line with the plan's principles, seeking to establish an enabling environment for private sector engagement and investment. The targeted households in the project area will receive a stove on a voluntary basis to help achieve a sustainable balance between the supply and demand of biomass. Overall, the project represents a proactive effort to promote sustainable development in the country.

Step 2: Positive List

Projects are on the positive list if they meet all applicability conditions plus the following criteria:

1. The project activity installs or distributes the project devices at zero cost to the end-user and has no other source of revenue other than carbon credits.
2. The project activity is not implemented as part of a government scheme or supported by multilateral funds.

The project meets the applicability conditions of the methodology which represent the positive list. The project installs the ICS at zero cost to the household and has no other source of revenue other than the sale of GHG credits. The project is not implemented as part of government schemes or supported by multilateral funds.

Conclusion

The project fulfils both conditions above, it is therefore additional.

3.6 Methodology Deviations

The project did not apply any methodology deviations.

²² https://www.reg.rw/fileadmin/user_upload/Final_ESSP.pdf

4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

The methodology does not account for baseline emissions separately, but instead quantifies net emission reductions achieved by the project. Please refer to Section 4.4.

4.2 Project Emissions

The methodology does not account for project emissions separately, but instead quantifies net emission reductions achieved by the project. Please refer to Section 4.4.

4.3 Leakage

Leakage is already accounted in calculation of emission reduction by adjusting with default value of 0.95, as set in the methodology.

4.4 Net GHG Emission Reductions and Removals

The improved cookstove is introduced as energy efficiency measure in the project, therefore equation 1 of the methodology will be applied to calculate the net GHG emission reductions:

$$ER_y = \sum_i \sum_j B_{y,savings,i,j} * N_{0,i,j} * n_{y,i,j} * \mu_y * f_{NRB,y} * NCV_{biomass} * (EF_{wf,CO2} + EF_{wf,non\ CO2}) * Adj_{LE} * (1 - u_d)$$

Equation (1)

Where:

Variable	Meaning	Project value
i	Indices for the situation where more than one type/model of improved cookstove is introduced to replace three-stone fire	i=1 There is only one model of stoves
j	Indices for the situation where there is more than one batch of improved cookstove of type i	1 batch = 1 stove
ER _y	Emission reductions during year y in tCO ₂ eq	Calculated
B _{y,savings,i,j}	Quantity of woody biomass that is saved in tons per improved cook stove of type i and batch j during year y	Calculated See equation 2 and 3 below

$NCV_{biomass}$	Net calorific value of the non-renewable woody biomass that is substituted or reduced	0.0156 TJ/tonne (IPCC default for wood fuel)
$f_{NRB,y}$	Fraction of woody biomass that can be established as non-renewable biomass	0.917 (calculated with TOOL 30)
EF_{wf,CO_2}	CO ₂ emission factor for non-renewable woody biomass	112 tCO ₂ /TJ (IPCC default for wood fuel)
$EF_{wf,nonCO_2}$	Non-CO ₂ emission factor for non-renewable woody biomass	9.46 tCO _{2eq} /TJ (IPCC default for wood fuel)
$N_{0,i,j}$	Number of project devices of type i and batch j commissioned (number)	The project aims at distributing 25 000 stoves per year for 4 years (see table 5 below for estimated active ICS)
Adj_{LE}	Adjustment factor to account for leakage related to the non-renewable woody biomass saved by the project activity	0.95 (as per described in version AMS-II.G v13.0 chapter 5.4)
u_d	Uncertainty deduction for $f_{NRB,y}$	26% (as required by TOOL 30 v4.0 and AMS-II.G v13.0 for uncertainty regarding $f_{NRB,y}$ calculation)
$n_{y,i,j}$	Proportion of commissioned project devices of type i and batch j that remain operating in year y	To be estimated during monitoring. Broken stoves will be replaced; therefore, we assume a value of 1
μ_y	Adjustment to account for any continued use of pre-project devices during the year y	1 Previous devices are decommissioned.

Number of Improved cookstoves $N_{0,i,j}$

Each batch is represented by 1 stove. Table 5 is the evolution of the number of stoves distributed as part of the project over time:

Table 5: Evolution of the number of operating cookstoves

Year	Stoves distributed in year 1	Stoves distributed in year 2	Stoves distributed in year 3	Stoves distributed in year 4	Active ICS
Year 1	25000				25000
Year 2	25000	25000			50000
Year 3	25000	25000	25000		75000
Year 4	25000	25000	25000	25000	100000
Year 5	25000	25000	25000	25000	100000
Year 6	25000	25000	25000	25000	100000
Year 7	25000	25000	25000	25000	100000
Year 8	25000	25000	25000	25000	100000
Year 9		25000	25000	25000	75000
Year 10			25000	25000	50000

Each broken stove will be replaced. Therefore, we assumed that the loss rate is of 1, giving us the results presented in Table 5. However, the proportion of commissioned project devices of type i and batch j that remain operating in year y will be monitored yearly to have an accurate estimate of the operating stoves.

Quantify of woody biomass saved $B_{y,savings,i,j}$

The quantify of woody biomass saved $B_{y,savings,i,j}$ due to implementation of improved cook stoves will be estimated using Equation 2 and 3 of methodology AMS-II.G v13.0 (option 3: WBT):

$$B_{y,savings,i,j} = B_{old,i,j} * (1 - \frac{\eta_{old,i,j}}{\eta_{new,i,j}})$$

Equation (2)

$$B_{old,i,j} = \frac{B_{old,HH}}{N_{d,HH}}$$

Equation (3)

Variable	Meaning	Project value
$B_{old,i,j}$	Annual quantity of woody biomass that would have been used in the absence of the project activity to generate thermal energy equivalent to that provided by the project device type i and batch j (tons/year)	Calculated with equation 3 right above. As $N_{d,HH} = 1$, $B_{old,i,j} = B_{old,HH}$

$B_{old,HH}$	Annual quantity of woody biomass that would have been used in the household in the absence of the project activity to generate thermal energy equivalent to that provided by the project devices (tons/household/year)	Determined with KPT Baseline survey (KPT v4.0 from 2018 ²³): 3.6t/HH/year
$N_{d,HH}$	Number of project devices per household (number)	Only 1 stove is distributed per household
$\eta_{old,i,j}$	Efficiency of the old devices being replaced by project devices of type i and batch j (fraction)	0.15 (default value for 3 stones fire in the new version of the TOOL33 v2.0)
$\eta_{new,i,j}$	Efficiency of the improved cookstove type i and batch j. It can be determined through the water boiling test (WBT). Alternatively, efficiency may be determined by applying a default schedule of linear decrease in efficiency from 31.2% (initial efficiency) up to the terminal efficiency assumed as 25 % through the span of the life span of the project device. (Box 6, p13 of the AMS-II.G v13.0)	Calculated ex-ante (or on-site measure). Results of calculations are shown in table 6 below. Initial efficiency of 31.2 determined through Water Boiling Tests (WBT) carried out within Rusizi HHs. Appendix 3 explains how the values for efficiency were selected to be extra conservative.

To be even more conservative and take into account the efficiency decay throughout the year, we will be using the end-of-the-year values, as per explained in Appendix 3 and displayed in Table right below. Which gives us this set of values for $\eta_{new,i,y}$, over the stoves life time:

Table 6: Initial efficiency of the stove and evolution over the stove's lifetime

	Initial efficiency (day 1 of the year)	Final efficiency (day 365 of the year)
Year 1	31.20%	30.43%
Year 2	30.42%	29.65%
Year 3	29.65%	28.88%
Year 4	28.87%	28.10%
Year 5	28.10%	27.33%
Year 6	27.32%	26.55%
Year 7	26.55%	25.78%

²³ <https://cleancooking.org/binary-data/DOCUMENT/file/000/000/604-1.pdf>

$B_{old,HH}$ was determined with a baseline KPT survey run by our team in 2022 before the beginning of the project and following the guidelines of Clean Cooking Alliance and the KPT v4.0 from 2018²³ methodology on 120 households in Rusizi district.

Year 8	25.77%	25.00%
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This estimates the following results for $B_{y,savings,i,j}$.

Table 7: Quantify of woody biomass saved $B_{y,savings,i,j}$ and Emission Reductions (ERs) over a stove lifetime

Year (y)	$B_{y=1,new,i,survey}$ (t/stove/year)	$\eta_{new,y,i,j}$	η_{old}	$B_{y,savings,i,j}$ (t/stove/year)	ER (tCO ₂ /stove/year)
1	3.59525	30.43%	15%	1.82	2.23
2	3.59525	29.65%	15%	1.78	2.17
3	3.59525	28.88%	15%	1.73	2.11
4	3.59525	28.10%	15%	1.68	2.05
5	3.59525	27.33%	15%	1.62	1.98
6	3.59525	26.55%	15%	1.56	1.91
7	3.59525	25.78%	15%	1.50	1.84
8	3.59525	25.00%	15%	1.44	1.76

During monitoring, option 2 (KPT) of the AMS-II.G. v13.0 will be considered (as running KPT on fixed improved cookstove in remote area might become easier than WBT). Below is the equation to be used in this case:

$$B_{y,savings,i,j} = B_{old,i,j} - B_{new,KPT,i,j}$$

Equation (4)

Emission Reductions

Those equations 1, 2 and 3 give us the estimated net GHG emission reductions in tCO_2eq , available in the table 8 below and in table 9 for the whole project.

Table 8: estimated net GHG emission reductions (tCO₂eq) per year

Year	ER from Year 1 stoves	ER from Year 2 stoves	ER from Year 3 stoves	ER from Year 4 stoves	Total Estimated ER (tCO ₂ e/year)
Year 1	55 663	-	-	-	55 663
Year 2	54 248	55 663	-	-	109 912
Year 3	52 757	54 248	55 663	-	162 669
Year 4	51 184	52 757	54 248	55 663	213 853
Year 5	49 521	51 184	52 757	54 248	207 711
Year 6	47 761	49 521	51 184	52 757	201 224
Year 7	45 896	47 761	49 521	51 184	194 363
Year 8	43 914	45 896	47 761	49 521	187 094
Year 9	-	43 914	45 896	47 761	137 572
Year 10	-	-	43 914	45 896	89 811
Total					1 559 878
Annual estimated average					155 987

Table 9: estimated net GHG emission reductions (tCO₂eq) over the certification period

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Yearly expected ERs (tCO ₂ e/year)	55 663	109 912	162 669	213 853	207 711	201 224	194 363	187 094	137 572	89 811
Annual ER average (tCO ₂ e/year)	155 987 over a 10-year crediting period									

Stoves' maintenance and calculation method

These calculations have been made with maintenance of the stoves but without replacement after 8 years. However, we hope to replace every broken stove to keep the number of stoves to 100 000 up until the end of the crediting period. This calculation will be adjusted with the actual number of operational stoves at each monitoring.

At the end of the lifespan (8 years) or in case of breakage, the stoves will either be replaced by a new stove with exact same properties (reinitializing efficiency decrease) or will be repaired (prior efficiency decrease remains active). In other words, if the stove is repaired, the efficiency decrease continues as it was projected. In case of a replacement, efficiency is reinitialized. Kiasi's project comply with paragraph 39 of the methodology AMS II.G. v13.0.

As per the national standard RSB (Rwanda Standard Board), our stove is Tier 5 ("Best") in terms of durability. RSB test was carried out in accordance with norm ISO 19867-1 (2018). Additionally, the staff repairing a stove is required to keep trace by filling a form including date, reparation carried out, personnel name. Therefore, Kiasi's project comply with paragraph 40 of the methodology AMS II.G. v13.0.

5 MONITORING

5.1 Data and Parameters Available at Validation

Data / Parameter	NCV_{biomass}
Data unit	TJ/ton
Description	Net calorific value of the non-renewable woody biomass that is substituted or reduced
Source of data	Default value from IPCC
Value applied	0.0156 TJ/t
Justification of choice of data or description of measurement methods and procedures applied	Default value from IPCC is used in methodology VMR0006 v1.2 and AMS-II.G v13.0.
Purpose of Data	Calculation of Emission Reductions
Comments	The value is fixed ex-ante

Data / Parameter	$EF_{\text{wf},\text{CO}_2}$
Data unit	tCO ₂ /TJ
Description	CO ₂ emission factor for non-renewable woody biomass
Source of data	2006 IPCC Guidelines for National Greenhouse Gas Inventories; Volume 2 Energy, Chapter 2 Stationary Combustion
Value applied	112 tCO ₂ /TJ
Justification of choice of data or description of measurement methods and procedures applied	Default as per applied approved methodology VMR0006, v1.2
Purpose of Data	Calculation of emissions reductions
Comments	The value is fixed ex-ante

Data / Parameter	$EF_{\text{wf},\text{nonCO}_2}$
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Data unit	tCO ₂ /TJ
Description	Non-CO2 emission factor for non-renewable woody biomass
Source of data	IPCC Default emissions factor
Value applied	9.46 tCO ₂ /TJ
Justification of choice of data or description of measurement methods and procedures applied	Default from IPCC
Purpose of Data	Calculation of emissions reductions
Comments	The value is fixed ex-ante

Data / Parameter	$f_{NRB,y}$
Data unit	Fraction
Description	Fraction of woody biomass that can be established as non-renewable biomass
Source of data	Calculated with CDM TOOL 30 v 4.0. Calculation sheet will be provided on demand.
Value applied	91.7%
Justification of choice of data or description of measurement methods and procedures applied	Calculated with CDM TOOL 30 v 4.0. Calculation sheet will be provided on demand. Appendix 1 provides comparison and analysis of calculated value as required by TOOL30 v4.0.
Purpose of Data	Calculation of emission reductions
Comments	The value is fixed ex ante.

Data / Parameter	$\eta_{old,i,j}$
Data unit	Fraction
Description	Efficiency of the old devices being replaced by project devices of type i and batch j (fraction)
Source of data	Methodology default value from CDM TOOL 33 v2.0, p5

Value applied	0.15
Justification of choice of data or description of measurement methods and procedures applied	A default value of 0.15 shall be used if baseline device is a three stone fire using firewood, or a conventional device with no improved combustion air supply or flue gas ventilation, that is without a grate or a chimney.
Purpose of Data	Calculation of emission reductions
Comments	The value is fixed ex ante

Data / Parameter	$B_{old,i,j}$
Data unit	Tons/year
Description	Annual quantity of woody biomass that would have been used in the absence of the project activity to generate thermal energy equivalent to that provided by the project device type i and batch j
Source of data	Calculated with equation 3 from $B_{old,HH}$ and $N_{d,HH}$
Value applied	3.6 t/HH/year
Justification of choice of data or description of measurement methods and procedures applied	Calculated
Purpose of Data	Calculation of emission reductions
Comments	The value is fixed ex ante for the entire crediting period.

Data / Parameter	$B_{old,HH}$
Data unit	Tons/HH/year
Description	Annual quantity of woody biomass that would have been used in the household in the absence of the project activity to generate thermal energy equivalent to that provided by the project devices (tons/household/year)
Source of data	Baseline Survey of Local Usage as per option b. in section 8.4 of VMR0006 v1.2.

Value applied	3.6 t/HH/year
Justification of choice of data or description of measurement methods and procedures applied	This value was determined during the baseline survey through a Kitchen Performance Test²⁴ (KPT v4.0 as defined by Clean Cooking Alliance) carried on 120 households of the Rusizi district. Data can be provided on demand. For 3 days, HHs wood consumption was carefully assessed (by weighing a predefined pile of wood) to estimate an average of the daily and yearly HHs fuelwood consumption. To be conservative, we removed outliers and HHs with too many beneficiaries. These tests were carried out in accordance with the requirements from the latest version of “sampling and surveys for CDM project activities and programme of activities”: The conditions for cooking are homogeneous, as the method used by all HHs that will integrate the project are the 3 stones fire method. Therefore, only 1 sampling group is needed. For methodology purposes, the minimal number of surveys to be carried out was 100. To be conservative, we decided to survey 120 HHs. These surveys were carried out in various locations to be as representative as possible. Additionally, the monitoring period being longer than 1 year, the result may be extrapolated for the monitoring period, as stated in methodology AMS-II.G v 13.0. However, the value estimated through our KPTs does not meet the 90/10 confidence criteria because of the discrepancies within HHs (size, financial means, cooking habits). However, AMS-II.G. methodology also states that: “Values used in other schemes (e.g. registered Gold Standard carbon offset projects) from the same region are acceptable when it is demonstrated to be suitable for use as per the procedures indicated in the above general guidelines” (p17 of 35) We decided to refer to POA GS5047 African Improved Cookstoves and Clean Water Program. This Project is located in Nyungwe district, which is one of Rusizi’s neighboring district. Both districts are part of the western region of Rwanda. The close location and similar type of Project made it appropriate. In this project, KPTs were carried out to evaluate Pby, the specific fuel consumption for an individual technology in baseline scenario b during year y. Pby is therefore the GS equivalent for Bold,HH. KPTs were audited by a VVb and the Project is certified. The value used in the PD is of 0.011 t/day of fuelwood for 1 HH. The value has been reviewed every 2 years for good practices. The latest value used and referred to in monitoring report is of 0.01031 t/day (from a 2019 survey). However, $0.01031 \times 365 = 3.76$ t of fuelwood/HH/year. We kept the most conservative of both values, therefore 3.6 t/HHs/year.
Purpose of Data	Calculation of emission reductions
Comments	The value is fixed ex ante for the entire crediting period.

²⁴ <https://cleancooking.org/binary-data/DOCUMENT/file/000/000/604-1.pdf>

Data / Parameter	u_d
Data unit	%
Description	Uncertainty deduction for $f_{NRB,y}$
Source of data	Estimated based on uncertainty requirements : The following uncertainty deduction must be applied, depending on the procedure for $f_{NRB,y}$ used from AMS-II.G v13.0.: 1) If the default value for $f_{NRB,y}$ from TOOL33 is applied: ud = 0 2) If $f_{NRB,y}$ is calculated as per TOOL30: ud = 26% 3) If $f_{NRB,y}$ from an approved standardized baseline is applied: ud = 26%
Value applied	26%
Justification of choice of data or description of measurement methods and procedures applied	$f_{NRB,y}$ was calculated with TOOL 30, therefore this uncertainty shall be applied.
Purpose of Data	Calculation of ERs
Comments	-

Data / Parameter	Adj_{LE}
Data unit	-
Description	Discount factor to account for leakage related to the non-renewable woody biomass saved by the project activity
Source of data	as per described in version AMS-II. G v13.0 chapter 5.4
Value applied	0.95
Justification of choice of data or description of measurement methods and procedures applied	Default value
Purpose of Data	Calculation of emission reductions
Comments	The value is fixed ex ante for the entire crediting period.

5.2 Data and Parameters Monitored

Data / Parameter	$No_{i,j}$
Data unit	Number

Description	Number of project devices of type I and batch j commissioned
Source of data	TDR: carbon transfer form will give the date of commissioning for each stove
Description of measurement methods and procedures to be applied	CTFs are dated from the date of installation of the ICS. Kiasi and RDIS hold a database that includes: - Each device distributed. - Indication to identify the stove: unique ID number, GPS coordinates. - The information of the beneficiaries: name, address, phone number when available This database will be referred to for evaluation of the precise number of devices commissioned. Additionally, please note CTFs are signed only when the stove is commissioned (1 week after installation)
Frequency of monitoring/recording	Every year
Value applied	For ex-ante emission reduction calculation, it is assumed that the project will distribute: 25,000 stoves in year 1 25,000 stoves in year 2 (50,000 applied) 25,000 stoves in year 3 (75,000 applied) 25,000 stoves in year 4 (100,000 applied)
Monitoring equipment	Database of the project
QA/QC procedures to be applied	
Purpose of data	Calculation of emission reductions
Calculation method	1 stove = 1 batch. CTFs will give the exact number of stoves distributed per year.
Comments	-

Data / Parameter	Lifespan
Data unit	Number
Description	Expected life duration of the stoves.

Source of data	Manufacturer's specifications
Description of measurement methods and procedures to be applied	Manufacturer provided documents certifying the expected life duration of the stoves liner they offer. Additionally, the Rwandan Board of Standards certified that this stoves model has a high durability (best score).
Frequency of monitoring/recording	Fixed ex-ante We have a monthly visit of the stove manufacture to evaluate proper manufacturing conditions.
Value applied	8 years
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of data	Emission Reduction calculation (specifically, the calculation of the efficiency of the stoves and the yearly decrease in stove efficiency)
Calculation method	-
Comments	-

Data / Parameter	$N_{d,HH}$
Data unit	Number
Description	Number of project devices per household
Source of data	Kitchen Performance Test and Usage surveys.
Description of measurement methods and procedures to be applied	Kiasi Energy will only distribute 1 stove per household. If a large family requires a second stove, Kiasi might add another identical cooking device, but only 1 unique ID number will be given to the HHs for the 2 stoves, to avoid double counting or false ERs accounting.
Frequency of monitoring/recording	Fixed ex ante Yearly KPTs and usage surveys will confirm this result.
Value applied	1

Monitoring equipment	Surveys
QA/QC procedures to be applied	-
Purpose of data	Emission Reduction calculation
Calculation method	-
Comments	-

Data / Parameter	Date of commissioning of batch j
Data unit	Date
Description	Date on which each stove distributed and installed in a batch. Each individual stoves distributed are considered as separate batches.
Source of data	- TDR: carbon transfer form will give the date of commissioning for each stove, along with unique ID number, GPS coordinates, and beneficiary information - Internal Records
Description of measurement methods and procedures to be applied	CTFs are dated from the date of installation of the ICS. Kiasi and RDIS hold a database that includes: - Each device distributed. - Indication to identify the stove: unique ID number, GPS coordinates. - The information of the beneficiaries: name, address, phone number when available This database will be referred to for evaluation of the precise number of devices commissioned. Additionally, please note CTFs are signed only when the stove is commissioned (1 week after installation to allow for the material to dry)
Frequency of monitoring/recording	Every year (TDR are updated and monitored weekly, the database will be audited yearly)
Value applied	For calculation, the date of commissioning of the batch will be used to evaluate ER. It will vary from one batch of stove to another.

Monitoring equipment	Database of the project
QA/QC procedures to be applied	-
Purpose of data	Calculation of emission reductions
Calculation method	1 stove = 1 batch. CTFs will give the exact date of commissioning of each stoves distributed.
Comments	-

Data / Parameter	Date of commissioning of project device i
Data unit	Date
Description	Date on which each stove distributed and installed was commissioned.
Source of data	TDR: carbon transfer form will give the date of commissioning for each stove, along with unique ID number, GPS coordinates, and beneficiary information
Description of measurement methods and procedures to be applied	CTFs are dated from the date of installation of the ICS. Kiasi and RDIS hold a database that includes: - Each device distributed. - Indication to identify the stove: unique ID number, GPS coordinates. - The information of the beneficiaries: name, address, phone number when available This database will be referred to for evaluation of the precise number of devices commissioned. Additionally, please note CTFs are signed only when the stove is commissioned (1 week after installation to allow for the material to dry)
Frequency of monitoring/recording	Every year (TDR are updated and monitored weekly, the database will be audited yearly)
Value applied	For calculation, the exact date of commissioning will be used to evaluate ER. It will vary from one stove to another.
Monitoring equipment	Database of the project

QA/QC procedures to be applied	-
Purpose of data	Calculation of emission reductions
Calculation method	1 stove = 1 batch. CTFs will give the exact date of commissioning of each stoves distributed.
Comments	-

Data / Parameter	μ_y
Data unit	Fraction
Description	Adjustment to account for any continued use of pre-project devices during the year y
Source of data	Monitoring surveys
Description of measurement methods and procedures to be applied	If equation 2 under option 3 (WBT) is used combined with direct measurement of Biomass (which has been done during the baseline surveys carried out), then μ_y may be assumed as 1.0. For subsequent years, the value of 1.0 may be applied, only if it can be demonstrated through either measurement campaign or questionnaire survey for a sample of households established according to the sampling standard that pre-project devices are not used in parallel with the project devices during the monitoring period. This is required even in cases where pre-project devices were demonstrated to be decommissioned ex-ante in order to ensure that such devices and alike have not been reintroduced.
Frequency of monitoring/recording	At least once every 2 years
Value applied	1 (baseline stoves will be decommissioned)
Monitoring equipment	Usage survey and Kitchen Survey
QA/QC procedures to be applied	-
Purpose of data	Calculation of emission reductions
Calculation method	Using questionnaire survey to evaluate cooking practices.
Comments	-

Data / Parameter	$\eta_{new,i,j}$																				
Data unit	Fraction																				
Description	Efficiency of the device of each type i and batch j implemented as part of the project activity																				
Source of data	Certification by a national standards body (RSB) or an appropriate certifying agent (CREEC) recognized by that body and calculated using linear decrease as requested by methodology VMR0006 v1.2.																				
Description of measurement methods and procedures to be applied	Efficiency is calculated using linear decrease from the initial value of 31.2%, as requested by methodology AMS-II.G. v13.0 (37.) Independent stove efficiency test performed by the Centre for Research in Energy and Energy Conservation (CREEC) and from Rwanda Board of Standard to determine the initial efficiency of the stoves (31.2%) Calculation for the following years: as per AMS-II.G. v13.0 (37. Option (a)), $\eta_{new,i,j} = \eta_{new,i-1,j} - (\eta_{new,i,j,y=0} - \eta_f) / (8-1)$ η_f is the efficiency required by the standard during the last day of the last year of the stoves' lifetime (25%) This method of calculation was also used to account for intra year decrease of efficiency. To be conservative, we will use the final efficiency of the year rather than an average to calculate emission reductions. Results are presented in Appendix 3.																				
Frequency of monitoring/recording	- Fixed en-ante. On site measurements will be carried out occasionally to back the values below.																				
Value applied	<table border="1"> <tr> <td>$\eta_{new,i,j}$</td><td>31.20%</td></tr> </table> <table border="1"> <tr> <th>Year</th><th>$\eta_{new,i,j}$</th></tr> <tr><td>1</td><td>30.43%</td></tr> <tr><td>2</td><td>29.65%</td></tr> <tr><td>3</td><td>28.88%</td></tr> <tr><td>4</td><td>28.10%</td></tr> <tr><td>5</td><td>27.33%</td></tr> <tr><td>6</td><td>26.55%</td></tr> <tr><td>7</td><td>25.78%</td></tr> <tr><td>8</td><td>25.00%</td></tr> </table>	$\eta_{new,i,j}$	31.20%	Year	$\eta_{new,i,j}$	1	30.43%	2	29.65%	3	28.88%	4	28.10%	5	27.33%	6	26.55%	7	25.78%	8	25.00%
$\eta_{new,i,j}$	31.20%																				
Year	$\eta_{new,i,j}$																				
1	30.43%																				
2	29.65%																				
3	28.88%																				
4	28.10%																				
5	27.33%																				
6	26.55%																				
7	25.78%																				
8	25.00%																				
Monitoring equipment	WBT equipment: thermometer, pot, ...																				

QA/QC procedures to be applied	Latest version of WBT emitted by Clean Cooking Alliance (to date, WTB v4.2.3)
Purpose of data	Calculation of emission reductions
Calculation method	Calculation was made using the Good Practices Box 6 of the AMS-II-G. methodology, as explain below.
Comments	The efficiency is fixed ex ante for the whole duration of the project. However, we might occasionally have the stove's efficiency tested through a WTB. In that case, we commit to use the real value of efficiency rather than the estimated one.

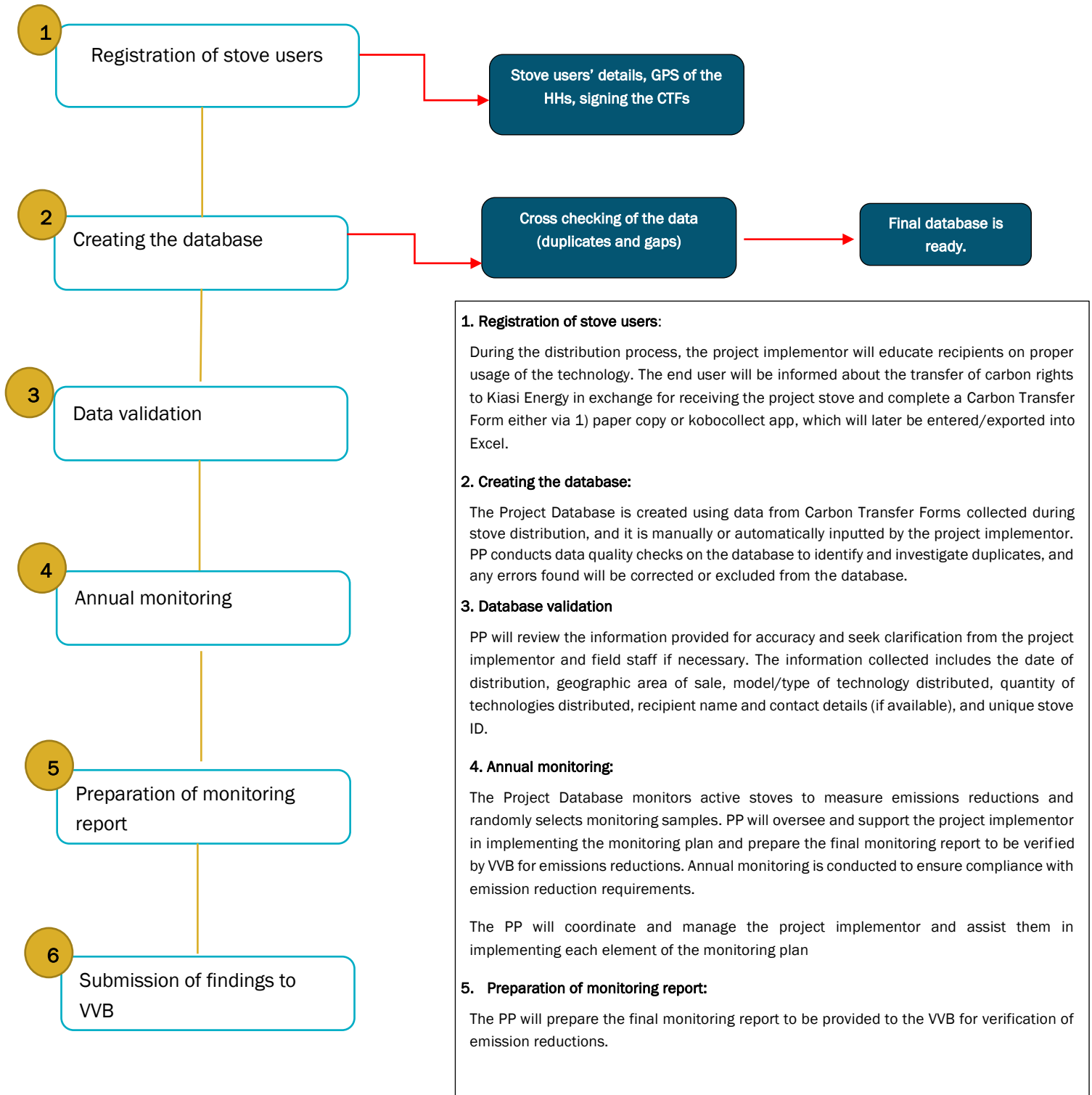
Data / Parameter	$n_{y,i,j}$
Data unit	Number
Description	Proportion of commissioned project devices of type i and batch j ($NO_{i,j}$) that remain operating in year y
Source of data	Monitoring surveys
Description of measurement methods and procedures to be applied	Based on a representative sample. A simplified approach proposed in option (b) under Section 8.4 of the VMR0006 v1.2 methodology will be used for determining the minimum sample size.
Frequency of monitoring/recording	At least once every two years
Value applied	1 (for estimation purpose): because we considered that each of the broken stoves will be repaired to fill its own lifetime. A usage survey will confirm these results at monitoring.
Monitoring equipment	Annual monitoring questionnaire surveys (Kitchen Survey and Usage Survey)
QA/QC procedures to be applied	Regarding the surveys : - VCS requires a minimum of 100HHs sample, we plan to run 120 HHs surveys to ensure conformity. We also plans to ensure that HHs from various locations and different stoves' ages will be part of the sample. - 90/10 precision compared to estimated value.
Purpose of data	Calculation of emission reductions
Calculation method	Proportion of operational stoves obtained from the survey is multiplied by the total commissioned stoves to arrive at this value
Comments	-

5.3 Monitoring Plan

The Monitoring Plan applied in this project involves several key elements that ensure that the PP and/or project implementer have high quality, unbiased, and reliable information regarding the performance of the project in terms of implementation and outcomes, and for the purposes of calculating Verified Carbon Units (VCUs) following methodology VMR0006 version 1.2.

Role and Responsibilities

The below flow chart illustrates the roles and responsibilities of parties during the implementation of the monitoring plan for the project.



Data

The table below provides a summary of the data requirements for field measurements:

Table 9: Parameters to be monitored

Parameter to be Monitored	Description	Method of Data Collection
$N_{0,i,j}$	Number of project devices of type i and batch j commissioned	Project database: our database collects all information on the stoves distributed: date of commissioning, HHs information (name, address, phone number if available), GPS coordinates, ID number, ...
μ_y	Continued use of baseline technologies	Field surveys (Usage Surveys and Kitchen Surveys) of 120 HHs of ICS users randomly selected from the database
$n_{y,i,j}$	Proportion of commissioned project devices of type i and batch j ($N_{0,i,j}$) that remain operating in year y	Field surveys (Usage Surveys and Kitchen Surveys) of 120 HHs of ICS users randomly selected from the database
$\eta_{new, i, j}$	Efficiency of the project device i and batch j (fraction) j	Water Boiling Test or KPT as per the latest version approved by Clean Cooking Alliance to determine actual evolution of efficiency of the stoves over time. ²⁵

Field surveys will include:

1. **Kitchen Survey:** To survey end users currently using project technologies to explore changes in project scenario over time. This will be completed annually, beginning within 1 year after distribution.
2. **Usage Survey:** To gather information on stove usage patterns. This will be completed annually beginning within 1 year after distribution.

²⁵ The efficiency is fixed ex ante for the whole duration of the project. However, we might occasionally have the stove's efficiency tested through a WBT carried on within the district. In that case, we commit to use the real value of efficiency rather than the estimated one.

3. **Water Boiling Test:** *to have actual information on the evolution of the efficiency of the stoves installed, WBT or KPTs (as per the latest versions approved by Clean Cooking Alliance) may be run occasionally.*

Sampling plan:

To avoid the high costs of monitoring every single ICS unit distributed in the project, representative sampling will be used. The sampling plan will be designed to comply with the requirements of the VMR0006 v1.2 methodology. The project will adopt the simple random sampling approach described in section 8.4 of the VMR0006 v1.2 methodology. This approach outlines minimum sample sizes based on the project target population size. For instance, if the project target population is less than 300, a minimum sample size of 30 will be used. If the project target population is between 300 and 1000, the minimum sample size will be 10% of the group size. Finally, if the project target population is greater than 1000, the minimum sample size will be 100. We will run our Kitchen Survey and Usage Surveys on a sample of 120 HHs randomly selected.

The parameters to be monitored include $n_{y,i,j}$, $N_{y,i,j}$ and μ_y , and 2 surveys shall be conducted for all these parameters. Monitoring more than one parameter within the same sample (households) can reduce travel needs and associated costs while ensuring random selection of samples for every parameter. The individual users will be randomly selected from the project database. The geographical locations are assumed to have no influence on the parameters $N_{y,i,j}$ or μ_y , which are expected to be homogeneous regardless of the end user group and distribution/installation location, as the end users are households and the project boundary restricts the geographical location. The random sample will be reselected each monitoring period to ensure it remains random, and trained personnel from the project Implementor or PP team will conduct the surveys within the end date of the project monitoring periods.

Data collection and storage

The sampling plan incorporates various measures to ensure high-quality data. The PP will oversee that the field personnel comprehend the monitoring plan and achieve the minimum sample size during each monitoring session and document any refusals or non-responses. The project implementer and/or field team will be trained appropriately to minimize bias while surveying households. To ensure random selection of replacement households, an additional number of households will be selected in addition to the minimum sampling requirements. The use of well-designed questionnaires and rigorous testing will be employed to minimize interviewer bias. Hard copies of surveys will be stored in-country, while mobile monitoring data collection tool surveys will be backed up online by the PP and project database. All monitored data required for verification and issuance will be kept for two years beyond the end of the crediting period or the final issuance of VCU for the project activity.

Assessment for Leakage:

According to methodology VMR0006, version 1.2, section 8.3: Leakage shall be considered as default 0.95 in accordance with Section 5.4 of AMS II.G. v13.0 therefore default value of leakage as 0.95 will be applied.

Additional monitoring

Although this is not a requirement of the VCS methodology, we commit to having additional parameters monitored during the whole lifetime of the project. Mainly, the efficiency of the stoves will be measured biannually through a Water Boiling Tests on the field to ensure the continuous environmental benefices of the project.

APPENDIX 1: ESTIMATION OF THE FRACTION OF NON-RENEWABLE BIOMASS (f_{NRB}) FOR RWANDA: METHODOLOGY AND RESULTS

I/ Introduction

1. Context

Canopy Energies is an organization specializing in clean energy and sustainable development solutions, with a focus on renewable energy projects, carbon asset development, and energy efficiency interventions. Through its expertise, Canopy Energies supports initiatives aimed at reducing greenhouse gas emissions and promoting sustainable biomass use across various regions.

Kiasi Energy, a subsidiary of Canopy Energies, is specifically dedicated to energy access and the implementation of household-level energy efficiency solutions. One of its flagship initiatives is the **VCS4585 cookstove project**, currently under validation under the **Verified Carbon Standard (VCS)**. This project seeks to distribute improved cookstoves to households in Rwanda, aiming to reduce fuelwood consumption and associated GHG emissions.

As part of the VCS registration requirements, the calculation of the **fraction of non-renewable biomass** (f_{NRB}) is essential. This value is a critical parameter for the quantification of emission reductions (ERs), serving as an input to determine the baseline emissions and the amount of CO₂ avoided using improved cookstoves. The methodology used for this purpose follows the guidelines of UNFCCC's **TOOL 30 version 4.0**²⁶, which provides standardized procedures for estimating the f_{NRB} value.

2. Scope

The project is implemented exclusively in the Rusizi District of Rwanda. However, due to the lack of sufficient district-specific data - particularly on biomass regeneration rates, forest degradation, and woodfuel consumption - it is not currently feasible to determine a reliable subnational f_{NRB} value for Rusizi.

As a result, the analysis in this document adopts a **national level f_{NRB} value for Rwanda**, ensuring methodological consistency and data reliability. This approach is supported by the guidance provided in

²⁶ <https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-30-v4.0.pdf>

Tool 30 v4.0, which allows for the use of national estimates when subnational data is unavailable or unreliable.

As explained in 9.a) of tool 30, f_{NRB} is calculation ex ante: the f_{NRB} value is determined once at the validation stage, thus no monitoring and recalculation of the f_{NRB} value during the crediting period is required.

II/ Calculation

1. Methodological approach

The calculation of the fraction of non-renewable biomass (f_{NRB}) for the VCS4585 cookstove project follows the procedures outlined in the UNFCCC's Methodological Tool 30 (version 4.0). This tool provides standardized guidance for estimating the renewable and non-renewable components of biomass used within a defined project boundary.

The methodology is applied through a four-step process:

- Estimation of total woodfuel consumption (H): this includes both domestic and non-domestic consumption, based on the most recent and reliable national data sources and relevant literature.
- Assessment of renewable biomass (RB): this step involves identifying the portion of biomass considered renewable, based on factors such as biomass regrowth rates and national land-use classifications.
- Calculation of non-renewable biomass (NRB): NRB is defined as the portion of biomass consumption that exceeds the regenerative capacity of local ecosystems.
- Determination of the f_{NRB} value: the fraction of non-renewable biomass is calculated as the ratio of NRB to total woodfuel consumption (H)

These four steps are addressed in detail in Part II of this report, which covers the full set of calculations and assumptions used.

The final step, discussion of results, involves comparing the derived f_{NRB} value with existing national and regional estimates to assess its credibility and methodological robustness. This discussion is presented in Part III of the report.

2. Calculation of wood consumption H

The first step in calculating the fraction of non-renewable biomass (f_{NRB}) is to estimate the total annual consumption of wood in Rwanda, including both domestic (household) and non-domestic (commercial, industrial, institutional, and non-energy) uses.

According to TOOL30 v4.0, the total wood consumption (H) is calculated using the following formula:

$$H = HW * N + CE + NE$$

Where:

- HW = Average woodfuel consumption per household (including fuelwood and charcoal)
- CE = Commercial woodfuel consumption for energy purposes
- NE = Commercial wood consumption for non-energy purposes (e.g., construction, furniture)
- N = Number of households using woodfuel

Alternatively, as per Section 3.1.15 of TOOL30 v4.0, the product HW×N may be replaced by national estimates of total household woodfuel consumption where reliable aggregated statistics exist.

"In Rwanda, wood accounts for 57 % of energy consumption directly and 23 % via charcoal. The per capita demand for firewood (1.93 kg/person/day) significantly surpasses production capacity (0.46 kg/capita/day)" says a scientific article from November 2024 in its introduction²⁷. This value was used for calculating the domestic wood consumption in Rwanda. It includes both consumption of fuelwood and charcoal by households, as stated in the document.

Domestic Wood Consumption

In this analysis, rather than using the number of households and average household consumption, domestic woodfuel consumption is calculated using **per capita consumption** and the total population of Rwanda. This method is based on the following data:

- Per capita firewood consumption: 1.93 kg/person/day, equivalent to 0.70 tonnes/person/year²
- Population of Rwanda (2021): 14,000,000²⁸

Based on these inputs, total domestic wood consumption (including both fuelwood and charcoal) is estimated at 9, 811,200 tonnes/year.

Commercial and non-energy wood consumption

Commercial wood consumption data is sourced from the Rwanda Supply Master Plan for Fuelwood and Charcoal (2020)²⁹. To adopt a conservative approach, the highest available estimates ("worst-case scenario") were used when available.

Table 1 Table showing the expected commercial wood consumption for Rwanda in 2020⁴

Commercial woodfuels ^a	128	38	12	10	7	195
Secondary schools	12	14	15	15	17	74
Prisons	6	9	2	1	6	24
Tea factories	0	6	14	9	0	29
Brick making	5	18	21	33	6	83
Total woodfuels and construction wood - 2020-BAU ^a	1,558	1,350	1,421	943	1,361	6,632

Table 1 below provides values and sources used in this calculation.

²⁷ The challenges associated with firewood supply and analysis of fuel quality parameters of the tree species used as firewood in Rwanda – November 2024

Link: [https://www.sciencedirect.com/science/article/abs/pii/S0961953424003611#:~:text=In%20Rwanda%2C%20wood%20accounts%20for,%2Fday\)%20%5B2%5D](https://www.sciencedirect.com/science/article/abs/pii/S0961953424003611#:~:text=In%20Rwanda%2C%20wood%20accounts%20for,%2Fday)%20%5B2%5D).

²⁸ Worldometer, Statistics on population

²⁹ Rwanda Supply Master Plan for fuelwood and charcoal, Ministry of Natural Resources of Rwanda
Link: Rwanda_Biomass_fuel_supply_baseline.pdf

Table 2 Calculation of total wood consumption of Rwanda

Domestic wood consumption	Data	Unit	Source
HW*N: Fuelwood consumption by for domestic purposes (charcoal is included)	9 811 200,00	T/yr	<i>Calculated</i>
Fuelwood consumption per person household (t/yr)	0,70	T/yr/person	The challenges associated with firewood supply and analysis of fuel quality parameters of the tree species used as firewood in Rwanda, November 2024 ²
Population Rwanda (inhab)	14 000 000	2021	Worldometer ³

commercial wood consumption	Data	Date	Source
Commercial sector consumption	195 000	2020 (worst case scenario)	Rwanda Supply Master Plan for fuelwood and charcoal 2.1.2.1 Commercial sector consumption ⁴
Industrial sector consumption	82 900	2020	Rwanda Supply Master Plan for fuelwood and charcoal 3.1.2.2 Industrial sector consumption ⁴
Public sector consumption	74 000	2020	Rwanda Supply Master Plan for fuelwood and charcoal 2.1.2.3 Public sector consumption ⁴
NE: consumption of construction material	52 000	2020	Rwanda Supply Master Plan for fuelwood and charcoal 2.1.2.4 Consumption of construction material ⁴
CE+NE: consumption by commerce and public services	403 900	t/year (expected in 2023)	<i>Calculated</i>

H: total consumption of woody biomass in Rwanda	10 215 100	t/year	<i>Calculated</i>
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The total consumption of wood for both energy and non-energy sector in Rwanda is of **10 215 100 t/year (H)**.

3. Estimation of the available renewable biomass RB

Tool 30 gives us the following equation:

$$RB = \sum_i^n MAI_{forest,i} * (F_{forest,i} - P_{forest,i}) + \sum_i^n MAI_{other,i} * (F_{other,i} - P_{other,i})$$

Where:

- $MAI_{forest,i}$ = Mean Annual Increment of woody biomass growth per hectare in subcategory i of forest areas in the relevant period (tonnes/ha/yr)
 - $MAI_{other,i}$ = Mean Annual Increment of woody biomass growth per hectare in subcategory i of other land areas in the relevant period (tonnes/ha/yr)
 - $F_{forest,i}$ = Extent of forest in sub-category i in the relevant period (ha)
 - $F_{other,i}$ = Extent of other land in sub-category i in the relevant period (ha)
 - $P_{forest,i}$ = Extent of non-accessible area (e.g. protected area where extraction of wood is prohibited, geographically remote area) within forest areas (in subcategory i) in the relevant period (ha)
 - $P_{other,i}$ = Extent of non-accessible area (e.g. protected area where extraction of wood is prohibited, geographically remote area) within other land areas (in sub-category i) in the relevant period (ha)
- i = Sub-category i of forest areas and other land areas

To determine the parameters, we followed several steps.

i) Rwanda's ecological context and land cover

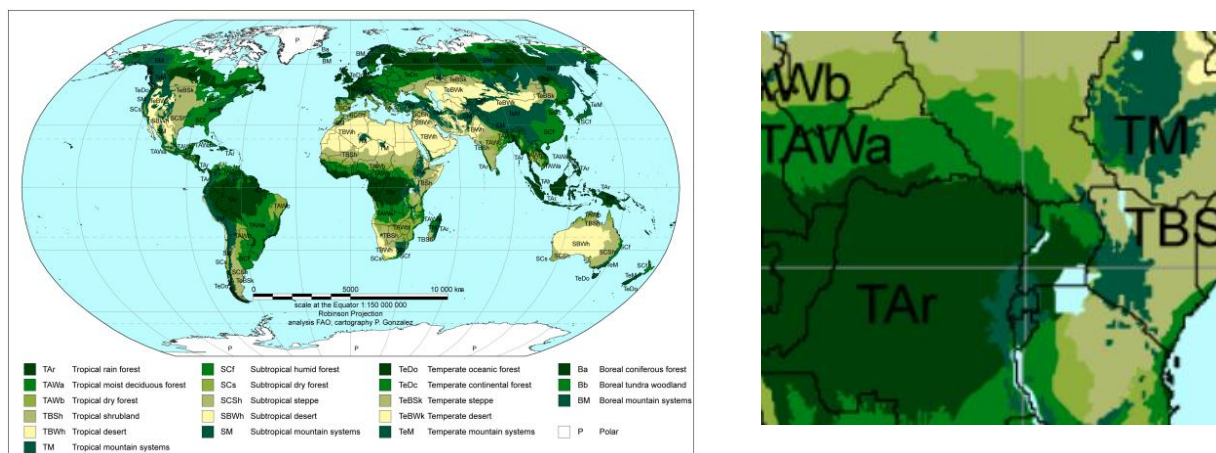


Figure 1 Rwanda's ecological zones³⁰

According to the FAO, and specifically their 2010 report on ecological zones throughout the world, Rwanda is classified as tropical mountains. This data is also backed by Figure 4.1 of the IPCC report on ecological zones³¹.

³⁰ FAO, 2010 : Global Ecological zones for FAO forest reporting

Link: https://www.environment.gov.rw/fileadmin/user_upload/Moe/Publications/Reports/Forest_cover_report_2019.pdf

³¹ IPCC, Chater 4 : Forest Land

Link: https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/4_Volume4/V4_04_Ch4_Forest_Land.pdf

The same report shows the repartition of wooded areas into different types of soil covers. These are described in Table 3. From this classification, we considered that natural forests cover 130 850 ha and other wooded land 593 844 ha. Table 4 presents these repartitions and displays the sources to back them.

Table 3 Summary statistics of forest cover types per category and density⁵

Forest Cover Type	Very low (0 - 10%)	Low (10 - 40%)	Medium (40 - 70%)	High (>70%)	Grand Total (ha)	Percent age (%)
Bamboo stand	15	39	149	410	613	0.1
Forest plantation	11,034	46,077	150,752	179,562	387,425	53.5
Natural forest	466	2,848	207	127,329	130,850	18.1
Shrub	3,184	13,791	24,470	2,518	43,963	6.1
Wooded savannah	11,336	83,466	58,425	8,616	161,843	22.3
Grand Total (ha)	26,035	146,222	234,004	318,434	724,695	100.0

Table 4 Extent of land cover in Rwanda

Extent of land cover	Area covered	Source
Total area Rwanda (ha)	2 377 000 ha	2023 survey on agriculture, national institute of Statistics of Rwanda ³²
Total wooded land (ha)	724 694 ha	Rwanda Forest Cover Mapping November 2019, Ministry of Environment of Rwanda ³³
Area of natural forest (ha)	130 850 ha	Rwanda Forest Cover Mapping November 2019, Ministry of Environment of Rwanda ⁸
Area covered by other wooded land (ha)	593 844 ha	Rwanda Forest Cover Mapping November 2019, Ministry of Environment of Rwanda ⁸
Other non-wooded land (ha)	1 652 306 ha	Rwanda Forest Cover Mapping November 2019, Ministry of Environment of Rwanda ⁸

ii) Forest establishment and accessibility

According to the **Rwanda Supply Master Plan for Fuelwood and Charcoal (2020)** ⁴:

- **47%** of forested areas are classified as “established” (<20 years),
- **53%** are “historical” (>20 years).

To maintain conservative estimates, values corresponding to **established forests** are prioritized, due to their typically lower productivity.

³² National Institute of Statistics of Rwanda, 2023 survey on agriculture

Link: <https://statistics.gov.rw/datasource/seasonal-agriculture-survey-2023>

³³ Rwanda Forest Cover Mapping November 2019, Ministry of Environment of Rwanda

Link: https://www.environment.gov.rw/fileadmin/user_upload/Moe/Publications/Reports/Forest_cover_report_2019.pdf

In terms of accessibility, The Convention on Biological Diversity³⁴, edited in 2020, gives us information on the share of protected areas in Rwanda. Another document from IUCN and UNEP from 2019³⁵ shares information on the protected and conserved areas in Rwanda and their national designations, which allowed us to evaluate the parameters from the table below. Both documents gave comparable results.

Table 5 non-accessible and protected areas in Rwanda

Key factors	Values	Source
Pforest - Extent of non-accessible area (e.g. protected area where extraction of wood is prohibited, geographically remote area) within forest areas (in subcategory i) in the relevant period (ha)	3 400 ha	Convention on Biological Diversity, UNEP & IUCN ⁹
Potherland - Extent of non-accessible area (e.g. protected area where extraction of wood is prohibited, geographically remote area) within other land areas (in subcategory i) in the relevant period (ha)	250 900 ha	Convention on Biological Diversity, UNEP & IUCN ⁹
Total of protected area	254 300 ha	Convention on Biological Diversity, UNEP & IUCN ⁹

iii) MAI consideration

To estimate biomass regrowth, MAI values were derived from the **IPCC 2006 Guidelines for National GHG Inventories (Volume 4, AFOLU)**³⁶:

- MAI for forest: as stated by the FAO, Rwanda is covered by tropical mountains. The remaining of the forest, although it declined in the past decades, are from over 20 years ago therefore:

$$MAI_{forest} = 2.3 \text{ tonnes/ha/year}$$

³⁴ The Convention on Biological Diversity, IUCN 2019

Link:<https://rris.biopama.org/sites/default/files/2021-01/IUCN2020%20ESA%20SoPACA%20Country%20Profile%20-%20Rwanda.pdf>

³⁵ IUCN2020 ESA SoPACA Country Profile - Rwanda

³⁶ IPCC 2006 Guidelines for National GHG Inventories (Volume 4, AFOLU)

Link:<https://www.ipcc-nggip.iges.or.jp/public/2006gl/vol4.html>

- MAI for other wooded land: a weighted average MAI was calculated based on the proportion of soil cover types. To ensure a conservative estimate, the **lower-bound values** were selected across all land types regardless of forest age:

$$MAI_{other} = 1.6 \text{ tonnes/ha/year}$$

iv) Calculation of RB

From the equation presented at the beginning of the section and the data aggregated above, we could calculate the value of each parameter of interest to estimate RB. The following table presents both the values of the parameters and the results for RB in Rwanda, representing **837 721 t/yr**.

Table 6 RB calculation input and result

Variable	Value	Date	Source
Fforest (extent of forest (ha))	130 850 ha	2020	Rwanda Forest Cover Mapping November 2019, Ministry of Environment of Rwanda
Fotherland (ha)	593 844 ha	2020	Rwanda Forest Cover Mapping November 2019, Ministry of Environment of Rwanda
Pforest (ha)	3 400 ha	2020	CBD / UNEP / IUCN (2020)
Pother (ha)	254 300 ha	2020	CBD / UNEP / IUCN (2020)
MAIforest (t/ha/yr)	2,3 t/ha/yr	2023	IPCC 2006, Ecological Zone: Tropical Mountains
MAIother (t/ha/yr)	1,60 t/ha/yr	2023	IPCC 2006, weighted estimate
RB(t/yr)	837 721	t/yr	Calculated

4. Non-renewable biomass: calculation of the share of consumed biomass that is non-renewable

$$NRB = H - RB$$

Where:

- H: total annual wood consumption in Rwanda (tonnes/year)
- RB: total annual renewable biomass supply (tonnes/year)
- NRB: non-renewable biomass consumption (tonnes/year)

From the values obtained in the previous sections, we calculated NRB and obtained a value of **9 377 379 t/year**, as shown in table 7 below.

Table 7 NRB calculation

Parameters	Value	Unit
H	10 215 100	ton/yr
RB	837 721	ton/yr
NRB	9 377 379	ton/yr

5. f_{NRB} calculation: determination of the fraction of non-renewable biomass

The fraction of non-renewable biomass (f_{NRB}) represents the share of total biomass consumption that is non-renewable. According to TOOL30, it is calculated as:

$$f_{NRB} = \frac{NRB}{NRB + RB}$$

Parameters	Value	Unit
H	10 215 100	ton/yr
RB	837 721	ton/yr
NRB	9 377 379	ton/yr
f_{NRB}	91,70%	

Remarks:

- The calculated f_{NRB} of 91.7% indicates that a very large share of woody biomass consumed in Rwanda is derived from non-renewable sources.
- The methodology adopted prioritizes conservativeness, especially regarding the MAI values and protected area exclusions, reinforcing the credibility of the f_{NRB} result.

III/ Results discussion

1. Methodology requirements

i) Paragraph 6

Paragraph 6 of the methodology states :

“Calculate f_{NRB} by determining the share of renewable and non-renewable woody biomass in the total quantity of woody biomass consumption for the country/region or the project area (hereinafter referred as the applicable area) following the procedure and requirements in the paragraphs below. The project participants shall compare and analyse the calculated values against the values for f_{NRB} reported in relevant scientific literature and justify any differences. This analysis shall be included in the appropriate section of the PDD. The relevant scientific literature should include at least: (i) Bailis, R.; Drigo, R.; Ghilardi, A. & Masera, O. (2015). The carbon footprint of traditional woodfuels. Nature Climate Change, 5(3), pp. 266–272.”

Several fNRB values are available for Rwanda in past literature and registered projects:

- Former CDM default values for f_{NRB} in Rwanda: **98%**³⁷
- Revised CDM values under debate for f_{NRB} in Rwanda: **59%**³⁸
- **Enea Consulting (2016)**: 98% (Domestic biogas diffusion in Rwanda) (Source: *Enea Consulting: Domestic biogas diffusion in Rwanda (2016) evaluates*)
- DelAgua VCS Project (Tool 30 v4.0, 2023): 91%
- **This study**: 91.7% (with a 26% deduction applied, as per Tool 30 and VM006 v1.2)

The calculated f_{NRB} of 91.7% is within the range of published values and is very close to the previously validated value (91%) for Rwanda by another VCS project (DelAgua), assessed by C4 EcoSolutions, an independent third-party consultant. Del Agua project was registered 6 months ago, and their calculation was carried out in 2023.

Spatial consideration: the calculated value represents a national average. However, this project is located in Rusizi District, in Rwanda's Western Province, a rural area where dependence on woody biomass for energy is even higher than the national average. According to the Rwanda Forest Cover Mapping (2019), this province is the only one with a net decline in forest area since 2009, which supports the assumption of a higher non-renewable biomass share than other regions.

Uncertainty applied: in addition to this, an uncertainty of 26% is applied to the value we calculated. Overall, $91\% \times (1-26\%) = 66\%$. This value is quite close to the new CDM value under debate at national level for Rwanda. The value we used is the one calculated (91%), with the 26% deduction (imposed by the VM0006 v1.2 methodology and tool 30). f_{NRB} and deduction applied are as stated in section 5 of the PD.

In light of the above, the selected f_{NRB} value of 91.7% (unadjusted) with the adjusted value of 66.9% applied in emission reduction calculations—is both conservative and methodologically sound and complies fully with Paragraph 6 of Tool 30 v4.0.

ii) Paragraph 13

Paragraph 13 says of the methodology states:

"If the f_{NRB} value is estimated at the national level, as a cross check, project proponent shall compare the value of estimated NRB with the product of: i) total average above ground biomass tonnage of the area of forest areas deforested in recent past (tons/ha), and ii) most recent available observed annual rate of deforestation (ha/yr). If the estimated NRB value is more than 10% above the value calculated as per the product of biomass and deforestation rate, justification shall be provided for the higher value for NRB."

We therefore need to calculate 3 values:

³⁷ CDM former default values

³⁸ https://cdm.unfccc.int/sunsetcms/storage/contents/stored-file-20231012184345703/MP92_EA07_Information%20Note_fNRB%20values_collated.pdf

- NRB value for Rwanda (~9MT) ³⁹
- Annual deforestation rate in Rwanda: 3 040 ha/year ⁴⁰
- Total Average above ground biomass tonnage in Rwanda (AGB): 146 t/ha⁴¹

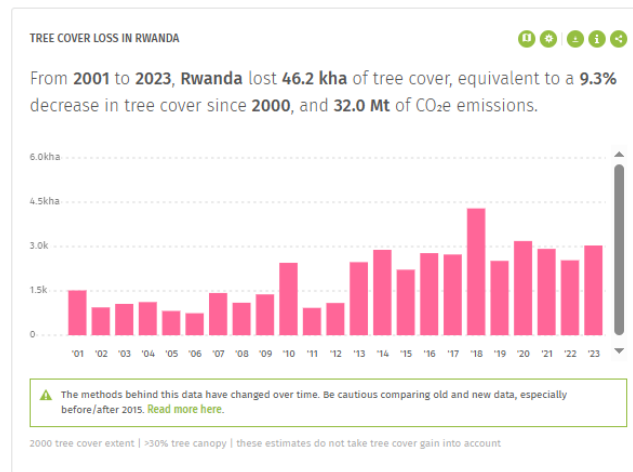


Figure 2 Extract from Global Forest Watch showing the evolution of the deforestation rate in Rwanda

As the NRB calculated is more than 10% above the multiplication of the annual deforestation rate in Rwanda (3 040 ha/year) by the total average above ground biomass tonnage in Rwanda (146 t/ha), further justifications are to be given.

Justification for higher NRB estimate compared to deforestation × AGB benchmark
The estimated NRB for Rwanda exceeds the benchmark value (calculated as the product of average above-ground biomass and annual deforestation rate) by more than 10%, primarily due to the significant impact of forest degradation driven by domestic woodfuel consumption. In Rwanda, the vast majority of biomass is harvested for subsistence energy use (firewood and charcoal), often through selective logging or degradation that does not result in complete forest loss and thus is not captured in deforestation statistics. As a result, actual non-renewable biomass extraction is substantially higher than what is suggested by deforestation rates alone. This explains the discrepancy and justifies the use of a higher NRB value in line with TOOL30 guidance. TOOL30 and related methodologies focus on estimating **total unsustainable biomass extraction**, not just that from deforestation. The formula used for the cross-check is just a rough benchmark—not a full accounting of all biomass loss. According to *Our World in Data*⁴²;

³⁹ NRB value from the calculation of f_{NRB} in Rwanda. See document 20231018_fNRB_CALCULATION_Rwanda

⁴⁰ Global Forest watch. The latest value was used (2023) as shown in Figure 2

⁴¹ FAO, FRA 2020 Étude de bureau, Rwanda, 2020

Link: <https://www.readkong.com/page/slides/rwanda-tude-de-bureau-rome-2020-2782405>

⁴² Our World in Data

Link: <https://ourworldindata.org/grapher/share-deforestation-domestic-consumption?tab=table>

the share of deforestation in Rwanda driven by domestic consumption is over 98% in the country. According to “*The Global Footprint of Traditional Woodfuels*”⁴³, Rwanda indeed stands among the country with the highest rates of NRB utilization, especially in rural areas. Rusizi district is indeed one of the most rural areas of the country.

2. Conservativeness of the f_{NRB} calculated

As previously mentioned, VCS4585 operates in Rusizi district exclusively and aims to cover the whole district with improved cookstoves. However, due to the lack of local information, f_{NRB} for this project was calculated for Rwanda as a whole.

Why should we assume that the f_{NRB} in Rusizi district is higher than the national value for Rwanda?

1. **Forest cover:** Rusizi is home to natural forests, it is the one district in Rwanda totaling the higher area of naturel, non-renewable forest. Over the past 2 decades, the 57% of all tree cover loss occurred in the Western Province of Rwanda (Iburengerazuba), where Rusizi is located. Moreover, most of the remaining forests are located in the Western Province, and specifically in Rusizi (see Figure 3 and 4 below).
2. **Deforestation rate:** deforestation rate is higher in Rusizi than in the rest of the country. Therefore, the f_{NRB} for Rusizi would obviously be higher than the national value. 57% of the deforestation over the past 20 years happened in the Western Province, according to Global Forest Watch (see Figure 3 and 4 below).
3. **IUCN consideration:** Rusizi lake and rivers area is considered by the IUCN (International Union for Conservation of Nature) as a protected area category II. This means the whole area was identified as a place to manage in order to perpetuate, in as natural a state as possible and to maintain viable and ecologically functional populations. This protected area is shared between Rwanda and Burundi. Burundi is the 3rd higher value of f_{NRB} , as explained in the Information note on f_{NRB} values⁴⁴, once again on a national average.
4. **Population growth:** the expected population growth in Rwanda over the lifetime of the project is not considered, although the increasing pressure on the forest shall result from this.

⁴³ (i) Bailis, R.; Drigo, R.; Ghilardi, A. & Masera, O. (2015). *The carbon footprint of traditional woodfuels*. *Nature Climate Change*, 5(3), pp. 266–272.

https://www.researchgate.net/publication/271503594_The_Carbon_Footprint_of_Traditional_Woodfuels

⁴⁴ https://cdm.unfccc.int/sunsetcms/storage/contents/stored-file-20231012184345703/MP92_EA07_Information%20Note_fNRB%20values_collated.pdf

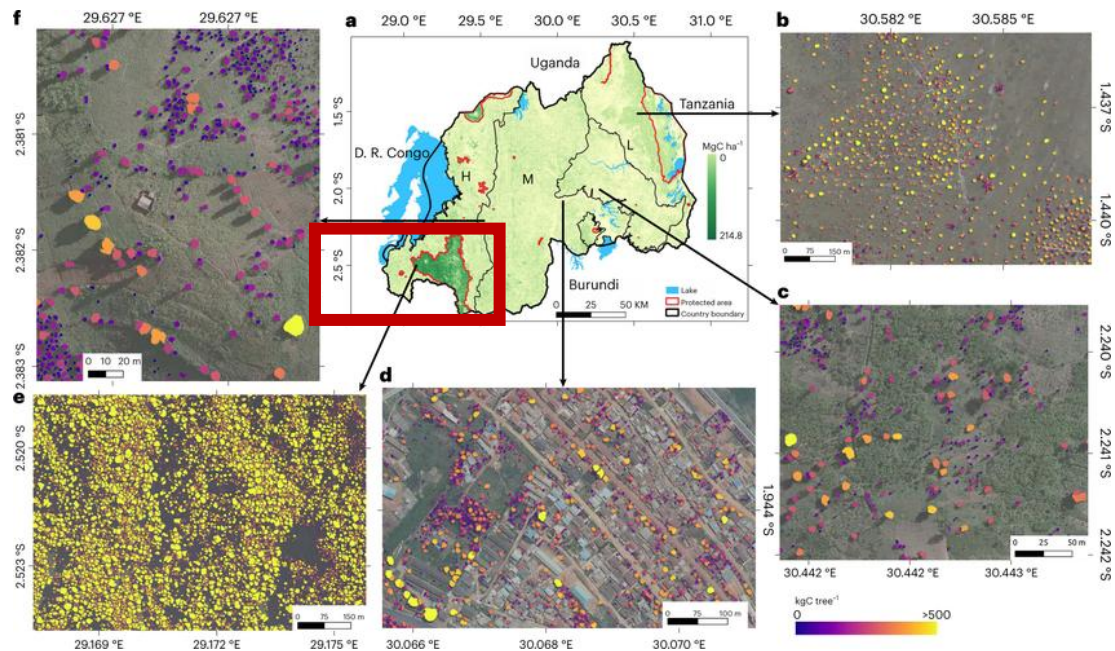


Figure 3: Repartition of forests area in Rwanda (with Rusizi district circled in red)⁴⁵

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<https://www.researchgate.net/publication/366522014/figure/fig3/AS:11431281113658048@1674014051590/Aboveground-carbon-stocks-at-tree-level-in-Rwanda-a-spatial-distribution-of-the.png>

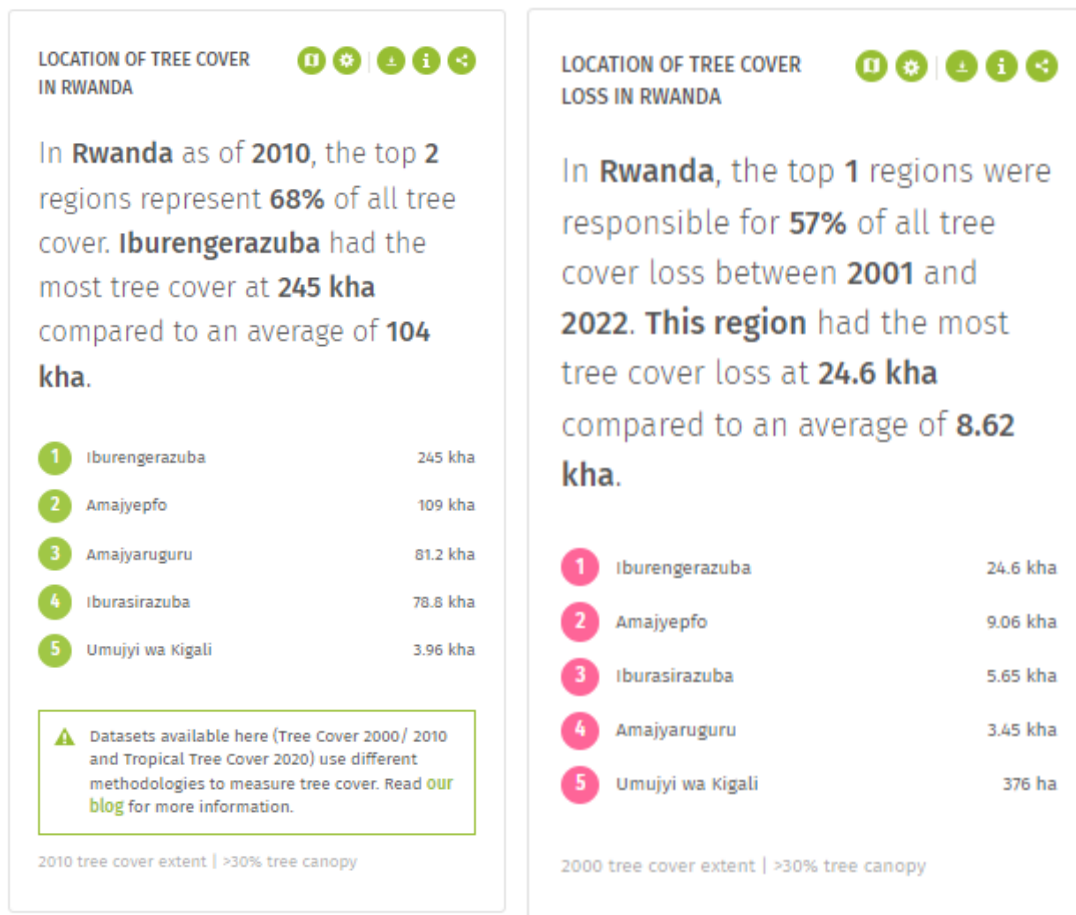


Figure 4: Location of tree cover loss in Rwanda by Region (Rusizi's region is of course on top)⁴⁶

In conclusion, the data reviewed provides strong support for our estimation of the Fraction of Non-Renewable Biomass (f_{NRB}). Applying the national value to a project specifically located in the Rusizi District represents a cautious and conservative approach, ensuring methodological robustness. As such, Project VCS4585 will adopt an f_{NRB} of 91.7%.

⁴⁶ Global Forest Watch

APPENDIX 2: RESULTS OF WBTS RUN BY THE CREEC (FULL REPORT ON DEMAND)

Executive Summary

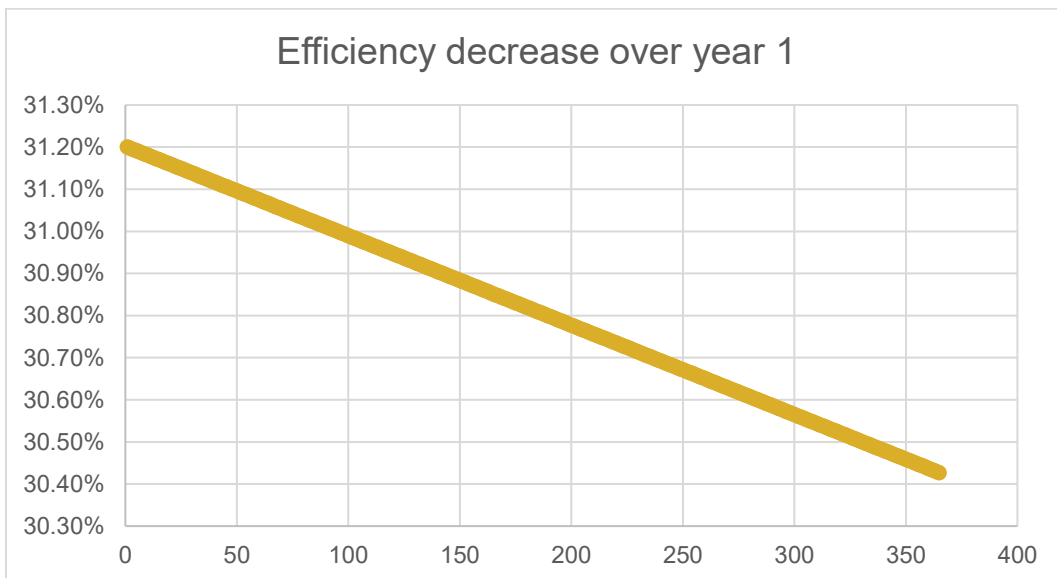
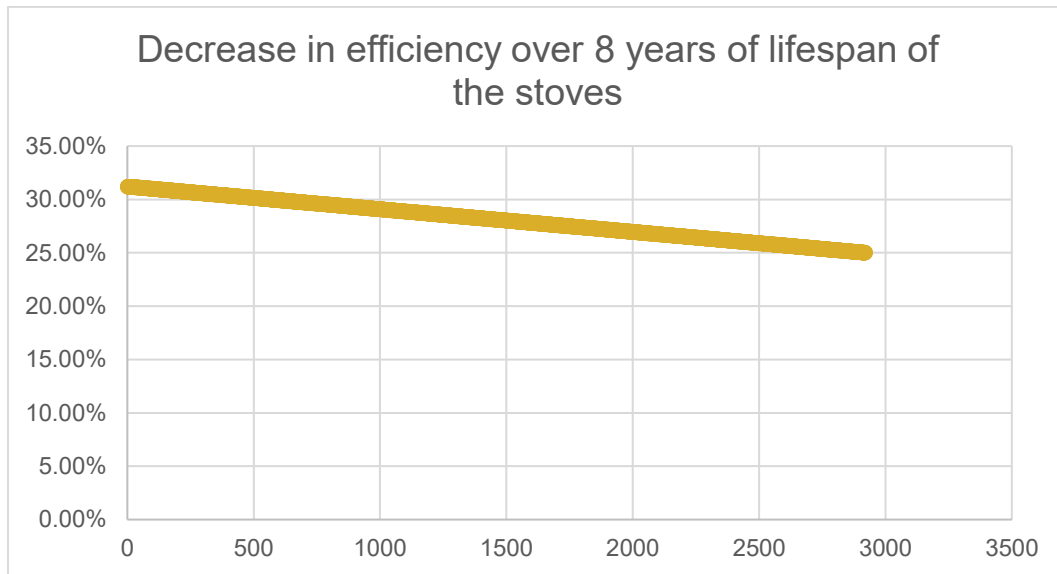
The testing of RDIS wood stoves in Rusizi district, Rwanda, aimed to evaluate the performance of the stove. Three Households with the RDIS stoves were Randomly selected by the RDIS staff for sampling. The results showed that the RDIS has a overall thermal efficiency of 31.2% and specific fuel consumption of 0.032 MJ/(min-L). Details of the stove performance is summarized in the table below.

Table 1. Showing the summary of the RDIS Improved firewood stove

		Sample 1 (2023/B045)			Sample 2 (2023/B046)			Sample 3 (2023/B047)					
BENCHMARK VALUES (for 5L)	units	Test 1	Test 2	Test 3	Test 1	Test 2	Test 3	Test 1	Test 2	Average	STDev	COV	
Fuel Use Benchmark Value	g	851	886	779	928	862	864	844	885	862	42.8	5%	
Energy Use Benchmark Value	kJ	14,417	15,011	13,189	15,707	14,594	14,626	14,286	14,993	14603	724.4	5%	
IWA PERFORMANCE METRICS													
High Power Thermal Efficiency	%	33.5%	30.6%	29.6%	31.4%	29.1%	31.0%	34.7%	29.4%	31.2%	0.020	6%	
Low Power Specific Fuel Consumption	MJ/(min-L)	0.033	0.038	0.026	0.036	0.028	0.032	0.033	0.028	0.032	0.004	13%	
IWA PERFORMANCE TIERS													
High Power Thermal Efficiency	Tier												
Low Power Specific Fuel Consumption	2												
1. HIGH POWER TEST (COLD START)													
Time to boil Pot # 1	min	48	46	42	47	50	42	41	60	47	6.2	13%	
Temp-corrected time to boil Pot # 1	min	53	49	47	52	55	46	46	66	52	6.4	12%	
Burning rate	g/min	9	9	9	10	9	9	10	8	9	0.7	8%	
Thermal efficiency	%	31.1%	28.8%	28.7%	26.8%	27.2%	28.7%	31.7%	28.3%	28.9%	0.0	6%	
Specific fuel consumption	g/liter	80	88	79	97	94	83	81	101	88	8.4	10%	
Temp-corrected specific consumption	g/liter	87	95	89	108	103	91	92	110	97	8.8	9%	
Temp-corrected specific energy cons.	kJ/liter	1,481	1,612	1,510	1,827	1,751	1,543	1,555	1,859	1,642	148.9	9%	
Firepower	watts	2,456	2,653	2,627	2,865	2,550	2,652	2,759	2,218	2,597.56	196.8	8%	
2. HIGH POWER TEST (HOT START)													
Time to boil Pot # 1	min	36	33	30	33	37	38	38	37	35.25	2.9	8%	
Temp-corrected time to boil Pot # 1	min	39	36	34	37	41	41	43	40	37.39	3.1	8%	
Burning rate	g/min	10	11	13	10	10	10	8	11	10	1.3	13%	
Thermal efficiency	%	35.8%	32.3%	30.6%	36.1%	31.0%	33.3%	37.8%	30.5%	33.4%	0.0	8%	
Specific fuel consumption	g/liter	70	75	77	65	82	76	64	88	75	8.2	11%	
Temp-corrected specific consumption	g/liter	77	81	86	73	90	82	72	96	82	8.5	10%	
Temp-corrected specific energy cons.	kJ/liter	1,302	1,368	1,460	1,230	1,524	1,390	1,216	1,632	1,390	144.2	10%	
Firepower	watts	2,871	3,155	3,542	2,691	2,955	2,698	2,337	3,210	2,932	372.1	13%	
3. LOW POWER (SIMMER)													
Burning rate	g/min	8	9	6	8	7	7	7	6	7	1.0	13%	
Thermal efficiency	%	34.3%	30.6%	35.7%	28.6%	32.1%	33.3%	39.3%	35.7%	33.7%	0.0	10%	
Specific fuel consumption	g/liter	88	89	68	95	76	86	87	74	83	9.2	11%	
Temp-corrected specific energy cons.	kJ/liter	1,492	1,512	1,153	1,613	1,281	1,459	1,472	1,253	1,404	156.6	11%	
Firepower	watts	2,319	2,488	1,716	2,378	1,890	2,104	2,056	1,812	2,095	280.9	13%	
Turn down ratio	--	1.06	1.07	1.53	1.21	1.35	1.26	1.34	1.22	1	0.2	12%	



APPENDIX 3: DECOMPOSITION OF DAILY EFFICIENCY DECREASE OVER TIME



Data sheet can be provided on demand as it is too heavy to be added in annex.

In order to be as conservative as possible, we decided to use, every year, the lower efficiency of the year. Therefore, every stove accounted for in year 1 will be accounted for with an efficiency that refers to the latest day of the year.

The table below gives the comparison between start of the year and end of the year efficiency values. The figure right behind compare the values used: **we are using the most conservative ones**, the end of the year-values for every stove.

	Initial efficiency (day 1 of the year)	Final efficiency (day 365 of the year)
Year 1	31.20%	30.43%
Year 2	30.42%	29.65%
Year 3	29.65%	28.88%
Year 4	28.87%	28.10%
Year 5	28.10%	27.33%
Year 6	27.32%	26.55%
Year 7	26.55%	25.78%
Year 8	25.77%	25.00%

