IMPROVED COOKSTOVE GROUPED PROJECT IN PAPUA NEW GUINEA

Tasman Environmental Markets Asia Pacific Pte. Ltd.

Project Title	Improved Cookstove Grouped Project in Papua New Guinea
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Prepared By	*Tasman Environmental Markets Asia Pacific Pte. Ltd.*
Contact	*Dr. Gabriel Machovsky-Capuska, Head of Science and Sustainability (TEM)* *15th Floor* *31 Market Street,* *Sydney, NSW 2000, Australia* *Email: gabriel@tem.com.au*

CONTENTS

1 PROJECT DETAILS

1.1 Summary Description of the Project

The Improved Cookstove Grouped Project in Papua New Guinea by Tasman Environmental Markets Asia Pacific Pte. Ltd. ("**TEM**") is a grouped project activity that involves the distribution of fuel efficient improved cookstoves (ICS) within the boundary of Papua New Guinea (PNG). The ICS disseminated through this project will replace traditional cooking methods where open-fired wood-fueled cooking is the primary cooking method in the household.

The project activities included in this grouped project activity will occur in geographically defined regions within the project boundary of PNG, starting first within the Southern Highlands Province (SHP), Western Highlands Province (WHP), Jiwaka Province (JP) and Western, Eastern Highlands Province (EHP).

For more information on exact coordinates, refer to Section 1.12 of this document.

A summary description of the technologies/measures to be implemented by the project:

The technology of the project activity involves the use of Improved Cookstoves (ICS), whereby it is designed as a stainless-steel insulated combustion chamber, with a high thermal combustion efficiency (over 25%). This highly effective stove uses less biomass fuel and emits less smoke than open-fired wood-fueled cooking methods. The implementation of the ICS is estimated to reduce the amount of wood cutting, as well as the amount of time spent by end-users foraging for firewood.

In the baseline scenario prior to the implementation of the project, there would be continued wood cutting practices and use of non-renewable wood fuel by the target population to meet the thermal energy needs for cooking. With ICS technology, woody biomass would be more efficiently combusted, hence emitting lower carbon emission and in turn generating GHG emission reductions.

Presently, a total of 40,000 ICS are planned to be distributed, one to each household, within Phase I of the project, estimated to be on 01/01/2024, and will eventually scale up to 100,000 ICS within the targeted Highlands Provinces in later phases. Given the success of these implementations, TEM may implement more projects and distribute more cookstoves. The ICS number will vary during actual implementation and same will update during registration and verification of project activity. The average annual and total GHG emission reduction from the project is expected to be **242,804 tCO2e** and a total of **2,428,045 tCO2e** for the group project over the entire crediting period.

Audit Type	Period	Program	VVB Name	Number of years

Validation	04-04-2023 - Current	Verified Carbon Standard	Earthood Services Private Limited	-
Total				

1.2 Sectoral Scope and Project Type

The project is a grouped project and is categorized as following:

- Sectoral Scope 03 – Energy demand
- Type II – Energy efficiency improvement projects

1.3 Project Eligibility

The grouped project activity involves energy efficient cookstove distribution which falls under the category of efficiency improvements in thermal applications, therefore it is eligible under the scope of VCS Program.

1.4 Project Design

The project is a grouped project activity (GPA).

This document will also be known as the GPA Design Document (GPA-DD).

Eligibility Criteria

For the inclusion of new project activity instances, the project proponent shall ensure that each Project Instance (PI) included:

S/N	Criterion	Applicability	Evidence
1	Meets the applicability conditions set out in the methodology applied to the project.	New PIs will meet the applicability conditions set out in Section 4 of the methodology	- GPA-DD
2	Uses the technologies or measures specified in the project description.	Only ICS that conforms with the grouped project description are to be distributed in the project. The ICS will be chosen to deliver a level of service	- ICS manufacturer's technology description.

		at least equivalent to the baseline appliance.	
3	Applies the technologies or measures in the same manner as specified in the project description.	ICS distributed in the PIs will adhere to the grouped project description.	- ICS manufacturer's Technical Specifications
4	Are subjected to the baseline scenario determined in the project description for the specified project activity and geographic area.	New PIs will be installed only in regions within the geographic borders of PNG subject to the same baseline scenario determined in Section 3.4 in this Project Description.	- Global Position System (GPS) coordinates captured from each end user will demonstrate the location of the project. - Virtual geographical log of cookstoves in monitoring database.
5	Have characteristics with respect to additionality that are consistent with the initial instances for the specified project activity and geographic area. For example, the new project activity instances have financial, technical and/or other parameters (such as the size/scale of the instances) consistent with the initial instances, or face the same investment, technological and/or other barriers as the initial instances.	All new PIs will use the activity method for demonstration of additionality. **Step 1:** Regulatory Surplus There is no government mandated programme or policy in host country of this project ensuring the distribution of new project activity instances. **Step 2:** Positive List The inclusion of new project activity instances will comply with the positive list as it satisfies	- Analysis on PNG government programs or policies for cookstoves conducted in Section 3.5. - The End User Agreement will confirm that the TEM "installs or distributes stoves at zero cost to the end-user and has no other source of revenue other than the sale of GHG credits".

		criterion 1 where it meets all the applicability conditions of the methodology.	
6	Occur within one of the designated geographic areas specified in the project description.	New PIs will only occur within the boundary of PNG.	- GPS Coordinates of ICS end user.
7	Comply with at least one complete set of eligibility criteria for the inclusion of new project activity instances. Partial compliance with multiple sets of eligibility criteria is insufficient.	New PIs will comply with at least one complete set of eligibility criteria for the inclusion into the GPA.	- GPA-DD
8	Be included in the monitoring report with sufficient technical, financial, geographic, and other relevant information to demonstrate compliance with the applicable set of eligibility criteria and enable sampling by the validation/verification body.	New PIs will demonstrate compliance with the applicable set of eligibility criteria and enable sampling by the validation/verification body through the inclusion of sufficient technical, financial, geographic, and other relevant information within the monitoring report.	- Sampling Plan - Monitoring Report
9	Be validated at the time of verification against the applicable set of eligibility criteria.	New PIs will be validated at the time of verification against the applicable set of eligibility criteria.	- Monitoring Report
10	Have evidence of project ownership, in respect of each project activity instance, held by the project proponent from the respective start date of each project activity instance (i.e., the date upon which the project	New PIs will provide evidence of project ownership, in respect of each project activity instance, held by the project proponent from the respective start date	- The End User Agreement

	activity instance began reducing or removing GHG emissions).	of each project activity instance.	
11	Have a start date that is the same as or later than the grouped project start date.	The start date of new PIs will be after 01/01/2024, after the start date of the GPA.	- ICS Purchase Invoices
12	Be eligible for crediting from the start date of the instance through to the end of the project crediting period (only). Note that where a new project activity instance starts in a previous verification period, no credit may be sought for GHG emission reductions or removals generated during a previous verification period (as set out in Section 3.4.4) and new instances are eligible for crediting from the start of the next verification period.	New PIs will be eligible for crediting from the start date of the instance through to the end of the project crediting period (only). For example, when a PI starts with a fixed crediting period of 10 years (fixed), the project device/stove must be proven at inclusion that it will be able to sustain through the crediting period. This may be proven through the Project Device Lifespan Specification document.	- Monitoring Report - Project Device Lifespan Specification
13	Only eligible for crediting from the start of the verification period in which they were added to the grouped project.	Crediting Periods of New PIs will only start after the date that the project has been included into the grouped project.	- Monitoring Report
14	Not be or have been enrolled in another VCS project.	New PIs must declare that it has not or have been enrolled in another VCS project.	- Project Letter of Undertaking
15	Adhere to the clustering and capacity limit requirements for multiple project activity instances set out in 3.6.8 - 3.6.9 of the VCS Standard.	New PIs will adhere to the clustering and capacity limit requirements set out in Section 3.6.8 – 3.6.9 whereby the Project	- GPS Coordinates of ICS end user.

		participant (PP) shall include all project activity instances within ten kilometers of another instance of the same project activity and with the same project proponent and where a capacity limit applies to a project activity included in the project, no project activity instance shall exceed such limit.	

1.5 Project Proponent

Organization name	Tasman Environmental Markets Asia Pacific Pte. Ltd.
Contact person	Dr. Gabriel Machovsky Capuska
Title	Head of Science and Sustainability
Address	15th Floor, 31 Market Street, Sydney, NSW 2000, Australia
Telephone	+61 3 5977 1286
Email	gabriel@tem.com.au

1.6 Other Entities Involved in the Project

Tasman Environmental Markets Asia Pacific Pte. Ltd. is the sole entity involved in the project.

1.7 Ownership

The project ownership is with Tasman Environmental Markets Asia Pacific Pte. Ltd.

TEM has also consulted with national authorities such as the PNG Forest Authority, wherein a Letter of Non-Objection to the project activity has been received.

During the registration of ICS, the participating households will sign an agreement to transfer the ownership rights of the carbon assets generated from this project to the project proponent.

1.8 Project Start Date

The estimated date of commissioning of ICS Phase I is the 01/01/2024.

1.9 Project Crediting Period

Crediting Period: Fixed

Total Number of Years: 10 Years

Start and End Date: 01/01/2024 to 31/12/2033

1.10 Project Scale and Estimated GHG Emission Reductions or Removals

Project Scale	
Project	X
Large project	

The emission reduction table below accounts for the scaling up of the project over the 10-year crediting period, starting from 40,000 ICS in the first year, up to 100,000 ICS in the third year:

Year	Estimated GHG emission reductions or removals (tCO_2e)
Year 1	140,716.61
Year 2	266,124.72
Year 3	251,631.60
Year 4	297,388.88
Year 5	281,153.30
Year 6	265,784.70
Year 7	251,237.50
Year 8	237,468.48
Year 9	224,436.69
Year 10	212,103.29
Total estimated ERs	2,428,045.79
Total number of crediting years	10
Average annual ERs	242,804.58

1.11 Description of the Project Activity

The project involves distribution of fuel-efficient ICS to replace the baseline cookstoves in households. Prior to the implementation of the project activity, households use non-renewable wood biomass for their fuel needs. The baseline appliance being replaced by the project is an open fire (typically based on the three-stone concept).

List of facilities, systems, and equipment in operation under the existing scenario prior to the implementation of the project:

In the baseline scenario, no improvement projects relating to efficiently combusting woody biomass for cookstoves had been implemented, as such, wood fuel use has steadily been increasing as economic pressure has been increasing. The distance to wood harvesting sites increases ever more as fuel demand increases.

The ICSs reduce GHG emissions from biomass burning through improved combustion efficiency of wood fuel and decreased wood fuel consumption. This is achievable through improved heat transfer to cooking pots through the insulated walls and design of the stove top as compared to the baseline scenario and traditional cooking methods over open- and three-stone fires, wherein woody biomass would be burnt at a lower efficiency, incurring higher GHG emissions.

List and arrangement of main manufacturing technologies and equipment involved:

The project envisages to use the highest performance ICS in the market known as G3 Burn rocket stove with an adjustable pot skirt (see figure 1 and table 1).

Figure 1. G3 Burn rocket stove (also known as Kuniokoa or Ecoa wood cookstove) with adjustable pot skirt.

Table 1. Technical description of G3 Burn rocket stove based on manufactured specifications.

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Parameter	Description
Thermal efficiency with pot skirt	50.8%[1]

[1] Reference document to validator: WBT test report by CREEC Laboratory

Efficiency	Tier 4
Emissions	Tier 3-4
Dimensions	32.1 cm height, 28.2 cm diameter
Construction materials	▪ Stove Body: Galvalume ▪ Pot Rest: Stainless Steel ▪ Pot Skirt: Stainless Steel ▪ Burning Chamber: Stainless Steel ▪ Fuel Feeding Door: Stainless Steel ▪ Stick Shelf: CRCA ▪ Legs: Aluzinc
Fuel	Firewood, bamboo, crop residue, other type of biomass
Life Span	10 years

The types of and levels of service provided by ICSs:

Level of Service:
Project Instances will provide ICS based on the G3 Burn rocket stove specifications as stated above, delivering a level of service at least equivalent to the baseline appliance (open fire used for household cooking). The ICS distributed under Project Instance (G3 Burn Rocket Stove, also known as Kuniokoa or Ecoa wood cookstove) will be specified in the monitoring report.

Type of Service:
The G3 Burn rocket stoves will deliver a specified high-power thermal efficiency of at least 25% or greater and evidenced by a manufacturer's specification and WBT certificate. This is a significant improvement on the baseline open fire thermal efficiency default of 10% (as per AMS II.G).

Data collection of ICS end-user

Project proponent must gather the necessary information to identify households using its ICS during the project. To facilitate this process, each ICS will be assigned a unique serial number. This number will be recorded during the registration process together with the following information (as appropriate and as available):

- Name of ICS user or head of the household
- Address / GPS of ICS household
- Phone number of ICS user or household, where available.
- Stove model
- Date of distribution/installation
- ICS serial number
- Retailer/distributer information

The information collected will be stored in which will serve as project database for project monitoring and sampling purposes.

1.12 Project Location

The GPA will distribute ICS to households within the project boundary of PNG (Latitude: 6.3150° S Longitude: 143.9555° E). The first project instance is projected to be within the Highlands Region (Figure 2), and will include the following areas: SHP, WHP, EHP and JP (see Table 1 &

Figure 2). Based on the PNG census 2011, the total population size of these four Highland Provinces was 1,792,931[2] and it is estimate that has substantially increased.

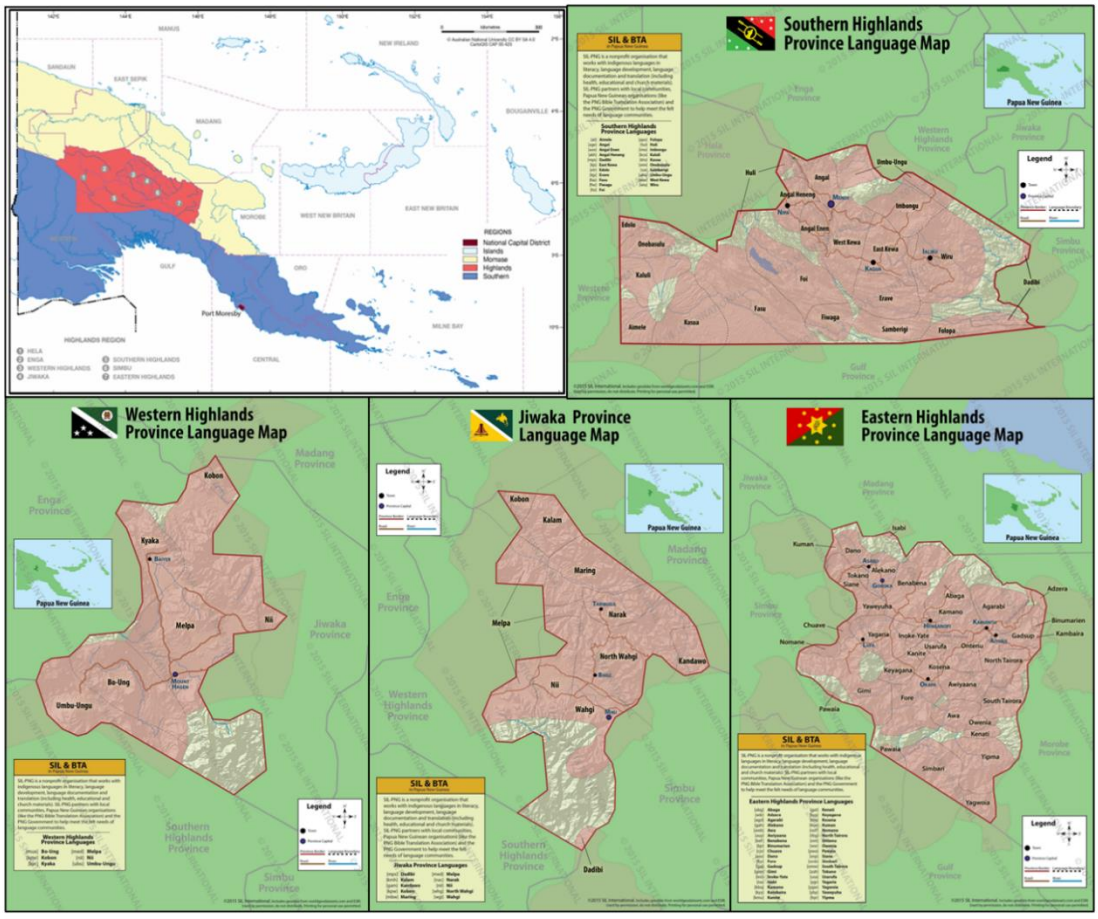


Figure 2. Map of Papua New Guinea including the Highlands Region (top left) and maps of the four different provinces included in the first project instance, Southern Highlands Province (top right), Western Highlands Province (bottom left), Jiwaka Province (bottom center) and Eastern Highlands Province (bottom right). Maps extracted from *www.pnglanguages.sil.org*

Table 1. The Geographic coordinates of the four provinces involved as the first project instances of the group activity in Papua New Guinea.

S/N	Location	Latitude	Longitude
1.	Southern Highlands Province	6.4179° S	143.5636° E
2.	Eastern Highlands Province	6.5862° S	145.6690° E

[2] National Statistics Office, Papua New Guinea National Population & Housing Census 2011, 'Count me in' (2011)

3.	Western Highlands Province	5.8310° S	144.1720° E
4.	Jiwaka Province	5.8564° S	144.5218° E

1.13 Conditions Prior to Project Initiation

The conditions prior to project initiation are 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 pre project devices are inefficient three stone fired or conventional systems lacking improved combustion air supply mechanism and flue gas ventilation system i.e., traditional stoves. The baseline scenario is the same as the conditions existing prior to the project initiation i.e., continue the use of traditional cook stoves (Please refer to section 3.4 – Baseline Scenario).

1.14 Compliance with Laws, Statutes and Other Regulatory Frameworks

There are no laws and regulations governing the use of ICS in PNG. The project is a voluntary effort by the project proponent.

There is no negative concern made on the ICS project from the above law.

Additionally, TEM maintains a close relationship with PNG's National Authorities and constantly updates them on the project activity. As an example, on the 31/01/2023, TEM had consulted with PNG's Forest Authority (PNGF) and Climate Change and Development Authority (CCDA). During the consultations, the draft PDD and Local Stakeholder Consultation Plan were provided to the leadership of the government bodies for their comments. However, no comments have been received.

The acknowledgment letters from the abovementioned authorities can be made available to validators upon request.

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 registered, nor is it seeking registration 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.

1.16 Other Forms of Credit

1.16.1 Emissions Trading Programs and Other Binding Limits

The project is not included in an emissions 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.

Supply Chain (Scope 3) Emissions

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 [organization name(s)] [name of good or service]" since the project's start date?

☐ Yes ☒ No

Response:

The project activity involves the distribution of ICSs to households within PNG. The boundary of the emission reductions is limited to the decrease in firewood consumption of each household, hence there are no indirect upstream or downstream GHG emissions to the organization's supply chain.

Has the project proponent posted a public statement saying, "VCUs may be issued for the greenhouse gas emission reductions and removals associated with [name of good or service][describe the region or location, including organization name(s), where practicable]."

☒ Yes ☐ No

Response:

All End-Users taking part in the project activity are notified during the onboarding stage of the projects (when the ICS is given to them) that the ICSs given to them are part of the project activity and may issue greenhouse gas emission reductions and removals associated with the project proponent. This is also highlighted in detail during the Local Stakeholder Consultations that are held prior to the project activity commencing.

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

Response:

When procuring the ICSs, the project participant buys over all rights of the ICSs from the producer/retailer. This includes all carbon rights and environmental attributes that may come from the use of these goods. Additionally, it will be explicitly stated in the commercial contract between the project proponent and the ICS supplier that when procuring ICSs for the full-scale

project, the cookstove supplier will not make any claim to the carbon attributes coming from the ICS. As such, there is no risk of Scope 3 emissions double claiming.

TEM will continuously make know to the community and all end-users of the project that these ICSs will generate VCUs issued for greenhouse gas emissions.

1.17 Sustainable Development Contributions

The contributions of proposed project activity towards sustainable development are explained with indicators viz. social, economic, environmental, and technological well-being as follows:

Social Benefits:

- Reduces drudgery of locals of rural areas by reducing time spent for firewood collection and the wood loads the family members needs to carry. Reduction in firewood requirement would help in spending more time in productive activities such as education, employment etc.

- Improves overall health (particularly diseases related to respiratory system) of all the members of the family by reducing smoke/indoor air pollution in the kitchen.

Environmental benefits:

- Reducing rate of forest degradation /deforestation in the project area. Conservation of forest will enhance forest ecosystems and reduce soil erosion and loss of biodiversity as a consequence of deforestation.

- Reduce indoor pollution – improved cookstoves emits less smoke and reduces health impact (morbidity and mortality from respiratory diseases and other health hazards), as well as the medical expenditure involved.

Economic benefits:

- Employment opportunities for local communities involved in monitoring, training of users, undertaking periodic maintenance and post lifetime replacement.

Technological benefits:

- Introduction of new technology (i.e., ICS) to rural communities.

- Knowledge transfer to trainers including technicians for pertaining training to users over system operation and maintenance.

- Demonstration of a successful project at household level will create replication potential in other states and countries.

1.18 Additional Information Relevant to the Project

Leakage Management

As per the methodology VMR0006 v1.2, the project activity will apply an adjustment factor to account for leakage related to the non-renewable woody biomass saved by the project activity (Adj_{LE}). The procedures from the latest version of AMS-II.G. must be applied. Adj_{LE} is fixed at validation.

According to AMS-II.G v13, leakage related to the non-renewable woody biomass saved by the project activity shall be assessed based on ex post surveys of users and the areas from which this woody biomass is sourced (using 90/30 precision for a selection of samples). The potential source of leakage due to the use/diversion of non-renewable woody biomass saved under the project activity by non-project households/users that previously used renewable energy sources shall be considered. If this leakage assessment quantifies an increase in the use of non-renewable woody biomass by the non-project households/users, that is attributable to the project activity, then $B_{old,i,j}$ is adjusted to account for the quantified leakage.

Alternatively, $B_{y,savings,i,j}$ is multiplied by a net to gross adjustment factor of 0.95 to account for leakages, in which case surveys are not required. This is the method the Project Participant will be utilizing, therefore, sampling surveys is not required.

Commercially Sensitive Information

No commercially sensitive information has been excluded from the public version of the project description.

Further Information

Not applicable.

2 SAFEGUARDS

2.1 No Net Harm

The project will only bring positive impacts on environmental and socio-economic aspects as elaborated in Section 1.17. No potential negative environmental or socio-economic impacts have been identified for the project.

Our baseline analysis showed that only 10% of the 220 households surveyed from the local communities involved in this project activity purchased firewood from local vendors. During all the face-to-face Local Stakeholder Consultations (LSCs), members of these communities expressed their consensus that the project did not impose any risk. When people were asked if

this project was going to disturb those who are making their living by selling firewood, the response was that with ICS, there are many benefits they can foresee than making a living out of selling firewood.

2.2 Local Stakeholder Consultation

Baseline Study Workshop and Trainings

Prior to conducting the baseline survey, a total of 26 local field assistants and coordinators were trained on how to collect data, measure, and identify firewood species and food used for daily consumption and to observe the level of smoke. These field assistants and coordinators consisted of primary school teachers, including students and nursing officers who lived among the communities where the households in this survey resided, and were able to conduct the survey in lingua franca Tok Pisin.

The workshops focused on helping field assistants understand the carbon cycle, how a carbon project worked, and the importance of accurate data collected.

Engagement with Broader Communities

Following the training workshops, the baseline survey was conducted in November 2022, spanning a period of 3 weeks. The survey incorporated two main rounds of data collection, the first round collecting general details such as personal information, stove and cooking information, baseline firewood information and food source and type.

The second round of data collection involved controlled cooking tests where measurements of firewood and foods were taken using both the baseline and project stove. During this process, firewood measurements were taken twice, before and after cooking using scale weights to measure both firewood and food.

The duration of cooking and level of smoke (thick, thin, light grey, medium thick, etc) produced while cooking was also recorded to note the reduction of time spent and level of smoke within the dwelling when using the project stove.

For more information, please refer to the file titled: TEM 2023_Cookstoves Highlands region report_v2.pdf, and the audited file titled: SPFEC Letter to TEM-Review of Cookstoves Highlands region report_17-04-2024.pdf).

Local Stakeholder Consultation (LSC)

The LSCs took place in four provinces involved as the first project instances (SHP, WHP, JP, EHP) as indicated in Table 2.

Table 2. The dates and venues in which the face-to-face local stakeholder consultations took place within the proposed four provinces involved as the first project instances.

S/N	Province	Date
1	Southern Highlands Province	13/03/2023
2	Western Highlands Province	15/03/2023
3	Jiwaka Province	17/03/2023
4	Eastern Highlands Province	20/03/2023

Prior to the LSCs, TEM utilized several media outlets to advertise the event to the provinces. These efforts were fulfilled using:

- Newspaper Advertisements
- Letters of Notification to Provincial Governments
- Radio Broadcasts
- Invitation Letters to Churches
- Social Media Posting

- Webinar
- Email to PNG Australia Alumni Association (PNGAAA) members

All advertising outlets were done in a staggered format with the aim of keeping stakeholders informed and aware of the LSCs that would be happening within their provinces. For exact dates of advertisements being published, please refer to Appendix I: LSCs Outreach.

The stakeholders engaged in this project were people or groups of people that were directly or indirectly affected by the project as well as those who were interested in the project and or had the ability to influence its outcome either positively or negatively. They include:

- Representatives from the provincial administration
- Representatives from Women Groups
- Representatives from Churches
- Ward councilors
- Heads of households both male and female
- Key informants such as teachers, community health workers etc.
- Improved Cookstove (ICS) users (SHP & WHP only)
- Youth leaders and
- Educated elites (lecturers, nursing officers, Health Extension Officers, Police personals etc.)

Southern Highlands Province LSC

A total of 159 people attended this LSC on the 13th of March 2023 held at Kumin Catholic Mission in Mendi, SHP. Including those who commuted into Mendi from various districts, there were public servants such as nursing officers, police, teachers and church elders and pastors present during the consultation.

Figure 3. Pictured above, a demonstration by Ms. Magret Yangpin and Mr. Richard Manda – SHP Field Assistants.

The LSC was facilitated by Mr. Michael Kisombo, the project Manager with Simi Oa Consultancy Services who was engaged by TEM did a power point presentation after welcoming and acknowledging all the stakeholders that were present. The PowerPoint slides were prepared in English, and explained in *tok pidgin*, the common language where most could understand well as those participated came from different local dialects.

Attendees were briefed of the purpose of the meeting, and informed of the:

- Carbon cycle and the important role it played within their forests.
- Findings of the Baseline Study conducted in the Highlands region including SHP and WHP (file titled: TEM 2023_Cookstoves Highlands region report_v2.pdf)
- The Verra registration process
- The role of carbon finance in the project activity
- Indicative timeline and implementation plan of the project

Two field assistants were then invited to demonstrate and to explain how the improved cookstove is used using the sample that was exhibited during the LSC. That was further reinforced by one of the users who was also invited to give her experience on how she is currently using the ICS and explained the benefits her family is experiencing.

After the presentation, stakeholders were given the opportunity to ask questions and provide their reflections. For the summary of questions asked and subsequent answers provided by TEM, please refer to Appendix II: Stakeholder Feedback.

After the discussions, there were about 29 feedback forms that were received through the feedback forms. These feedback forms may be made available to validators upon request.

Western Highlands Province LSC

A total of 61 people attended this LSC on the 15th of March 2023 held at Kuri Lodge in Mt Hagen, WHP. Participants who attended came from different backgrounds and electorates or districts. The LSC was also covered by Radio Eagle (local radio station) that was present all throughout the presentation.

Figure 4. Group photograph at the Western Highlands Province LSC

Prior to the introductions and presentation, Pastor Enoc Wan of Hagen Central – Pentacoastal church opened the session with a word of prayer. Mr. Michael Kisombo then introduced the project and invited his field assistants to introduce themselves. He then proceeded with the presentation using *tok pidgin*.

He gave a brief introduction of the flow of his presentation and explained the purpose of the meeting. He then introduced the project activity before giving an overview of the carbon emissions and the forests' role in restoring carbon and its impact if most forests are destroyed. Following the background of the project, he explained the baseline study conducted in WHP and the results attained from the survey and invited end users (from the baseline study) present to explain how they are currently using the improved cookstoves to date and its impacts on them.

To note, the presentation was made to be more simplified so that more participants would easily understand its contents. The change was made upon reflection of feedback received during the SHP LSC where participants asked for technical concepts to be broken down to commonly used languages and analogies. For example, the concept of carbon emission destroying the ozone layer; Mr. Kisombo would explain it as 'bad air that destroys the blanket protecting sun and earth "and so on.

Two volunteers in the group gave their reflections and how they are using the cookstove. Both spoke highly of the impacts the ICS had on their families. Michael then asked Tony (one of the fields assistants) to demonstrate how the improved cookstove is used. After that presentation, Mr. Kisombo proceeded with the explanation of the Verra registration process and role of carbon finance and continued to explain the large-scale project, its indicative timeline and implementation schedule.

After the presentation, stakeholders were given the opportunity to ask questions and to give their reflections followed by a closing prayer by Pastor Enoc. 29 feedback forms were received through the feedback forms out of the 61 participants.

Jiwaka Province LSC

More than 90 people attended this LSC on the 17th of March 2023 held at Jiwaka Mission Resort (JMR) in Banz, Jiwaka. During initial consultations to invite the provincial administrator to the

LSC, the provincial administrator showed great support for the project and was able to communicate widely to his people to participate. Due to work commitments, he sent his Deputy Administrator to attend the local stakeholder consultation instead.

Figure 5. Presenter Michael Kisombo (right) and the Deputy Administrator (Left)

Mr. Michael Kisombo led the discussions with a welcome and thanked everyone who came to Jiwaka Mission Resort for the local stakeholders meeting. He also did the presentation in *tok pidgin* – aided by the slides on power-point that was used in two other provinces. Similar to past LSCs, the topic on carbon cycle and the destruction of the ozone layer was simplified to the level of the participants. This topic was further elaborated on and supported by a few participants who had wider experience working or teaching in schools in this area of specialty.

The baseline in SHP and WHP and the coordinators of these projects, Mr. Patrick Wapiyu and Arnold Terry, were also on hand to explain the results of the baseline study and demonstrate how the improved cookstove was used. After these discussions, Mr. Kisombo continued with the presentations on the purpose of the stakeholder meeting, the verra registration process, carbon finance and the sustainable goals that this project is meeting. Towards the end, the indicative timeline and implementation schedule was explained before allowing for question-and-answer session.

There were about 29 feedback forms received through the feedback forms out of the 90 registered participants.

Eastern Highlands Province LSC

Around 29 people attended this LSC on the 20th of March 2023 held at Steakhouse Goroka in Goroka, EHP. The low turn-out rate may be attributed to the project being very new to the local stakeholders. Most stakeholders who attended learnt of the event word of mouth or through friends' network and face-book post. Despite a lesser number the discussions were fruitful. Almost all agreed that they see there is no harm and supported the project.

Figure 6. Community members involved in the EHP LSC at Steak House Goroka.

Similar to the first three LSCs, the presentation was conducted by Mr. Michael Kisombo in *tok pidgin* – as the common language where most could understand well. Michael followed the same presentation he did in the other three provinces. The sample ICS that was used for this LSC was displayed and a demonstration was done on how the ICS would be efficiently used. Although it was the first presentation made to the stakeholders in the Eastern Highlands Province, everyone who attended was positive with the project and supported the project activity.

After the discussions, there were about **24** feedback forms received from the 29 participants.

At the end of the LSCs, stakeholders were informed of the project's email (pngcookstoves@tem.com.au), as well as direct contact details to the local project manager and lead project manager in TEM. In all marketing documents, the project email and website were also published, to ensure stakeholders had multiple avenues to reach out to TEM with feedback, allowing for on-going communication.

Summary of Feedback Received

There was no negative feedback received during the LSC. Most questions aimed to seek clarity on how a more efficient cookstove could reduce carbon in the atmosphere, when the project could begin, and if more cookstoves could be distributed. For a complete list of questions and feedback, please refer to Appendix II: Stakeholder Feedback.

For more information, a Local Stakeholder Consultation Report is available upon request of the validator.

2.3 Environmental Impact

No negative environmental impacts have been identified from the project and environmental impact assessment (EIA) is not required for the project.

2.4 Public Comments

The project activity was listed for public comments on the Verra platform on **14/07/2023** and completed the public commenting period of 30-days on **13/08/2023**. During which, there were no public comments.

2.5 AFOLU-Specific Safeguards

This section is not applicable as the project is a non-AFOLU project.

3 APPLICATION OF METHODOLOGY

3.1 Title and Reference of Methodology

- VMR0006: Methodology for installation of High Efficiency Firewood Cookstoves v1.2.
- CDM Methodology: AMS-II.G. v13.0 "Energy efficiency measures in thermal applications of non-renewable biomass".
- CDM Guideline: Sampling and surveys for CDM project activities and programmes of activities, v4.0

3.2 Applicability of Methodology

VMR0006: Methodology for installation of High Efficiency Firewood Cookstoves v1.2

S/N	Applicability Criteria	Applicability
1	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.	**Applicable** The project activity involves the distribution of Improved Cookstoves whereby the cookstoves have an increased thermal efficiency to reduce the consumption of non-renewable biomass, therefore this criterion is met.

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).	**Applicable** The project activity is a regular project that will meet all applicability conditions of the latest version of AMS II.G. v13.0 (see table below), and be implemented in households within the project boundary, therefore this criterion is met.
3	For fuel switch activities, the following additional conditions must be met: 1. 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 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. 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).	**Not Applicable** The project activity involves the distribution of improved cookstoves with increased thermal efficiency to reduce the consumption of non-renewable biomass and is not considered a fuel switch activity according to the methodology, therefore this criterion is not applicable.

	3. More than one type of biomass may be used (e.g., briquettes and wood chips).	
4	VMR0006 must be used in conjunction with the latest version of AMS-II.G. All the procedures and requirements of AMS-II.G. must be applied unless VMR0006 indicates otherwise.	**Applicable** The project activity will adhere to the latest versions of VMR0006 and AMS-II.G, whereby all requirements of AMS-II.G. will be applied unless VMR0006 indicates otherwise.

CDM Methodology: AMS-II.G. v13.0 "Energy efficiency measures in thermal applications of non-renewable biomass"

S/N	Applicability Criteria	Applicability
1	In the case of cookstoves, 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.	**Applicable** The thermal efficiency of the stoves is 50.8%, which exceeds the required thermal efficiency of at least 25%.
2	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.	**Applicable** The maximum number of improved cookstoves is defined according to the corresponding stove performance, to ensure a maximum energy saving of 180GWth/year. Any additional emission savings will be counted within a new project instance. The first project instance covers the 4 Highlands Provinces in PNG which reportedly has 535,354 households[3]. According to ER Calculations, the maximum number of

[3] https://www.nso.gov.pg/census-surveys/national-population-housing-census/

		cookstoves deployable before reaching the 60GWh/year limit per PAI is 1,214,064 Cookstoves, therefore the first PAI meets the applicability criteria. In the event a Project Instance exceeds the 60GWh/year limit, a new Project Instance must be included.
3	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.	**Applicable** Using published literature, it can be proven that non-renewable biomass has been used in the project region since 31 December 1989, therefore this criterion is met. Refer to the end of this section for full explanation.
4	For cases where the biomass is sourced from renewable sources, the project participants should use a corresponding Type I methodology.	**Not Applicable** The Project Activity is not a fuel switch project; therefore, this criterion is not applicable.
5	The CDM-PDD or CDM-PoA-DD/CPA-DD 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).	**Applicable** In order to avoid double counting of emission reductions through the method of distribution, each ICS will carry a Unique Identifier Number (UIN) and the distribution of each device is logged into an electronic database which includes unique information for each recipient (i.e., Unique Identification Number, geographic coordinates, etc.)

		upon receipt of the device. The electronic database combined with internal checks done by the PP will ensure that no UINs are double counted. During the monitoring period, survey samples will be only taken from the UINs that are in the electronic database of end-users eliminating the risk of double counting from any other projects within the same geographical location.
6	The CDM-PDD or CDM-PoA-DD/CPA-DD 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.	**Applicable** A clause in the commercial contract will be in place for the start of the project (01/01/2024) that clearly states the manufacturer will not have any claim over the carbon rights from the cookstoves, hence eliminating the possibility of double counting.

Evidence that non-renewable biomass has been used in the project area since 1989

Fuelwood is the primary energy source for cooking and heating in the highlands region of Papua New Guinea (PNG), where 40%[4] of the population lives and has become an important component of the domestic energy market. Although, alternate energy sources have been made available within the region (e.g., electricity, kerosene, gas), these sources are not easily available or affordable. There was also an attempt to establish the common use of charcoal stoves into the community in the 1980s, however, the attempt was unsuccessful[5]. As such, since 1989, fuelwood has remained one of the major sources of domestic energy within PNG, and the most predominant across the Highlands region[3] (ACIAR, 2013).

[4] Hanson, L., Allen, B., Bourke, M., & McCarthy, T. (2001). Papua New Guinea Rural Development Handbook. (1st ed.) Australian National University.

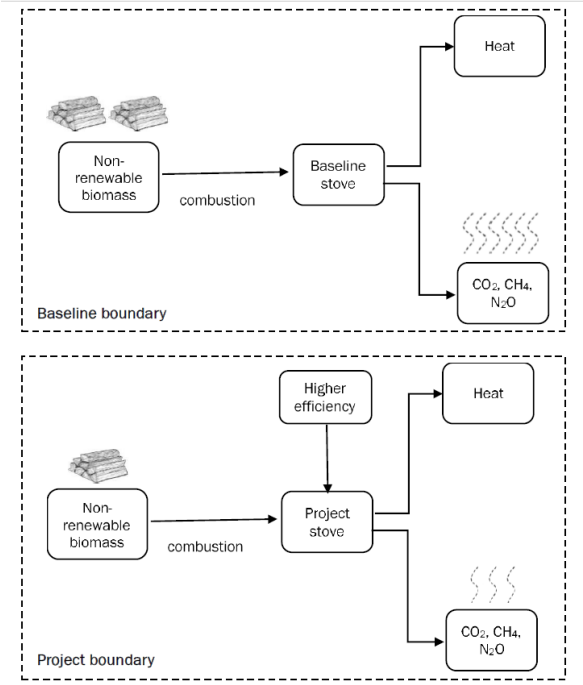
[5] Konedobu, P.N.G. : Energy Planning Unit, Department of Minerals and Energy, 1982

[3] ACIAR (Australian Centre for International Research). 2013. Promoting diverse firewood production systems in Papua New Guinea

3.3 Project Boundary

Source		Gas	Included?	Justification/Explanation
Baseline	Use of non-renewable biomass/fossil fuel	CO_2	Yes	Major Source
		CH_4	Yes	Major Source
		N_2O	Yes	Major Source
		Other	No	No other source considered
Project	Use of non-renewable biomass	CO_2	Yes	Major Source
		CH_4	Yes	Major Source
		N_2O	Yes	Major Source
		Other	No	No other source considered

The baseline and project boundaries are presented below:



Within the project boundary, less biomass burning gases and particulates are emitted.

3.4 Baseline Scenario

As per the VMR0006 v1.2 methodology, the baseline scenario is the continued use of non-renewable wood fuel (firewood/charcoal) or fossil fuel (coal/kerosene) by the target population to meet similar thermal energy needs as provided by project cookstoves in absence of project activity.

a) A third-party consultant team contracted by TEM conducted a baseline study survey during October 2022 (file titled: TEM 2023_Cookstoves Highlands region report_v2.pdf) with the results included in a report that was audited by an esteem in country forester (file titled: SPFEC Letter to TEM-Review of Cookstoves Highlands region report_17-04-2024.pdf). During which it was found that Papua New Guinea households consumed significant volumes of firewood, with reports suggesting that the consumption of up to 10 - 13 million tonnes of firewood per year. Among others, household cooking was responsible for the greatest share of energy demand as most people in the country still use traditional open fire cooking methods in both rural and urban settings. Such dependency on firewood resources not only affects the forests, but also the welfare, finance, and labour of the local families.

Typical rural households in the highland's region of Papua New Guinea cook their food using the traditional open fire method while some use open drum stoves which is still considered as traditional method:

As per the picture above, picture A. depicts cooking using Open Drum Stoves (ODS) while B. depicts Open Fire Cooking (OFC). Traditional OFC has been practiced for decades and it is still the main method for cooking to date. The ODS were introduced into the PNG society approximately 30 years ago to keep the aluminium pots clean from direct heat from carbon dioxide released from the fire and they are currently considered a traditional cooking method.

In the baseline survey, questions were structured to the type of stove that is currently being utilized in each surveyed household and the period that stove was used, The results of the survey showed that over 81.00% of the households in the Western Highland Province use traditional OFC and or ODS for cooking their meals while in Southern Highlands Province , almost 99.00% of the household rely entirely on traditional OFC and ODS for cooking. Collectively, just about 90.00% of the surveyed households use traditional OFC/ODS in the baseline study areas.

Household Selection Criteria

In addition to proving the baseline above, the project proponent will also include additional safeguards in ensuring this baseline is maintained through the lifetime of the project activity through the implementation of a 'Household Selection Criteria'.

The objective of the household selection criteria is to ensure households that are receiving the ICSs use firewood as their primary method of cooking, hence being applicable under the baseline scenario. The selection criteria will take the form of a questionnaire at the point of ICS distribution, and will include binomial questions (yes/no answers) to access the household's primary method of cooking fuel as follows:

1. Do you cook any meals in the house without using firewood?
2. Do you use charcoal for cooking in your household?
3. Do you use electric cooking in your household?
4. Do you use LPG for cooking in your household?

If any of the responses to these questions indicates that firewood is not the main fuel used in the household for cooking, the household will not be selected to participate in the project activity. This list of questions may be amended and improved upon with each cycle that ICSs are distributed.

3.5 Additionality

The methodology VMR0006 v1.2 uses activity and project methods for the demonstration of additionality.

Activity Method

Step 1: Regulatory Surplus

There is no mandated government programme or policy in the host country of this project ensuring distribution of domestic fuel-efficient cookstoves. The project is not mandated by any law, statute or regulatory framework, or for the UNFCCC non-Annex I countries, any systematically enforced law, statute or other regulatory framework.

Households may only participate voluntarily in this project. It is hereby confirmed that the proposed project is a voluntary coordinated action by TEM.

Step 2: Positive List

The applicability conditions of this methodology represent the positive list. The project meets all the applicability conditions as described in Section 3.2. The project also meets the following conditions:

1. The project distributes stoves at zero cost[6] to the end-user and has no other source of revenue other than the sale of GHG credits.
2. Project activities are not implemented as part of government schemes nor is the project supported by multilateral funds[7].

Step 3: Project Method

As the project activity meets the requirements of the positive list, there is no need to apply the investment analysis as stated in the methodology.

The project can therefore be deemed as additional.

3.6 Methodology Deviations

The project did not apply any methodological deviations.

4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

The methodology does not account for baseline emissions separately, but instead quantifies emission reductions as a function of the reduction in the amount of non-renewable biomass fuel consumption in the efficient project stoves as compared to baseline stoves.

4.2 Project Emissions

This methodology quantifies emission reductions based on the reduced consumption of non-renewable biomass or fossil fuels. The approach for non-renewable biomass is the same as under AMS-II.G V13.

4.3 Leakage

As per the methodology VMR0006 v1.2, the project activity will apply an adjustment factor to account for leakage related to the non-renewable woody biomass saved by the project activity (Adj_{LE}). The procedures from the latest version of AMS-II.G. must be applied. Adj_{LE} is fixed at validation.

[6] This is justified through end user agreements and validated by Earthood during the remote site visit.

[7] This is justified through TEM's Funding Letter.

According to AMS-II.G v13, leakage related to the non-renewable woody biomass saved by the project activity shall be assessed based on ex post surveys of users and the areas from which this woody biomass is sourced (using 90/30 precision for a selection of samples). The potential source of leakage due to the use/diversion of non-renewable woody biomass saved under the project activity by non-project households/users that previously used renewable energy sources shall be considered. If this leakage assessment quantifies an increase in the use of non-renewable woody biomass by the non-project households/users, that is attributable to the project activity, then $B_{old,i,j}$ is adjusted to account for the quantified leakage.

Alternatively, $B_{y,savings,i,j}$ is multiplied by a net to gross adjustment factor of 0.95 to account for leakages, in which case surveys are not required. This is the method the Project Participant will be utilizing, therefore, sampling surveys is not required.

4.4 Net GHG Emission Reductions and Removals

As per VMR0006 v1.2, project activities that are replacing baseline devices using non-renewable biomass must apply the equations of AMS-II.G. v13 (except Equations 1, 2 and 3) to determine net GHG emission reductions.

The following equation replaces Equations 1 and 2 of AMS-II.G v13:

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

ER_y	=	Emission reductions in year y (tCO2e)
$B_{y,savings,i,j}$	=	Quantity of woody biomass that is saved per project device i and batch j in year y (tonnes)
$N_{0,i,j}$	=	Number of project devices of type i and batch j commissioned (number)
$n_{y,i,j}$	=	Proportion of commissioned project devices of type i and batch j ($N_{0,i,j}$) that remain operating in year y (fraction)
μ_y	=	Adjustment to account for any continued use of pre-project devices during the year y
f_{NRBy}	=	Fraction of woody biomass that can be established as non-renewable biomass (%)
$NCV_{wood\ fuel}$	=	Net calorific value of the non-renewable woody biomass that is substituted or reduced (TJ/tonne) (2019 IPCC default: 0.0156TJ/tonne).

$EF_{wf,CO2}$	=	CO2 emission factor for the use of wood fuel in baseline scenario (2019 IPCC default for wood fuel: 112 tCO2/TJ).
$EF_{wf,nonCO2}$	=	Non-CO2 emission factor for the use of wood fuel in baseline scenario (2019 IPCC default for wood fuel: 9.46 tCO2/TJ).
Adj_{LE}	=	Adjustment factor to account for leakage related to the non-renewable woody biomass saved by the project activity (fraction) Discount factor of 0.95 is used as per AMS-II.G v13.0.
u_d	=	Uncertainty deduction for fnrb (%)

The AMS-II.G. v13.0. highlights that $B_{y,savings,i,j}$ should be determined using formulas from 4 different options. Here the Option 3 (Equation 7): Water Boiling Test, is used to determine $B_{y,savings,i,j}$:by applying different option

$B_{y,savings,i,j} = B_{old,i,j} \times (1 - \frac{\eta_{old,i,j}}{\eta_{new,i,j}})$		[Equation 7]
$B_{old,i,j}$	=	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 (tonnes/year) B_{old} is fixed as 5.56 tonnes/year as per file titled: TEM 2023_Cookstoves Highlands region report_v2.pdf
$n_{old,i,j}$	=	Efficiency of the old devices being replaced by project devices of type i and batch j (fraction) According to CDM TOOL 33, default value for a three-stone fire is 0.15.
$n_{new,i,j}$	=	Efficiency of the project device i and batch j (fraction) Manufacturer specifications on efficiency based on water boiling test (WBT) is 0.508

$\eta_{new,i,y} = \eta_p \times (DF_n)^{y-1} \times 0.94$		[Equation 5]
n_p	=	Efficiency of project cookstoves (fraction) at the start of project activity.
$(DF_n)^{y-1}$	=	Discount factor to account for efficiency loss of project cookstove per year of operation (fraction). This value may be based on manufacturer's declaration on expected loss in efficiency or through publicly available literature on relevant industry standards. Alternatively default value from VMR0006_v1.2 of 0.99 efficiency loss per year can be considered.
0.94	=	Adjustment factor to account for uncertainty related to project cookstove efficiency test.

ER Estimation for Project Instance:

For ex-ante calculation purpose, the assumption below is applied for first project activity instance:

- The first Project Instance installs 40,000 ICS in the first year, followed by another 40,000 ICS in the next, and finally 20,000 ICS in the third year to make up 100,000 ICS throughout the crediting period.
- The end date of installation of project activity instance is considered as operational date of that project activity instance.
- The life span of ICS is 10 years; thus, the operational lifetime of each project activity instance is taken as 10 years.
- Annual stove loss rate is estimated at 5% for the initial ER calculations. The value is a conservative estimate although there were no losses observed during surveys. This will be a monitored parameter for the actual ER calculations during verification.
- B_{old} is fixed as 5.56 tonnes/year as per TEM's Baseline Study of the Highlands region.
- $f_{NRB,b,y}$ is fixed as 0.81 as per TEM's literature review and baseline calculations.
    - The fNRB value is calculated using CDM Tool 30 version 4.0, using publicly available national statistics data reported by the PNG Forestry, including the forest regrowth rates from Biennial Updates made to UNFCCC in 2022. The data inputs and the sources are explained in the relevant table in Section 5.1.

- Comparison with data from Bailis et.al. (2015): The value for fNRB modelled and predicted by Bailis et. al. (2015) in PNG ranges from 0.20 to 1 for different provinces with a country average of 0.40. This study modelled the fNRB numbers using data on woodfuel demand and supply from 2009 global datasets and regrowth rates, correlated with 2,800 spatial observations, which were extrapolated for other geographies. It is unclear how many of these locations, if any, were located in PNG. The woodfuel data for PNG was obtained from the FAOSTAT global dataset for Forestry Production and Trade (2009).
- All the inputs used in the CDM Tool 30 calculation are from PNG national statistics reported by the PNG Forestry (2019) including the forest regrowth rates from Biennial Updates made to UNFCCC in 2022. These localised country specific inputs provide more confidence on the fNRB calculations than pixel-based models, as they are significantly recent than the inputs used by Bailis et. al and are independently verified by an in-county forestry expert.
- The project has increased the level of integrity in the reporting of GHG Emissions Reductions (ERs) through the following steps: 1) By working with local PNG forestry experts to accurately estimate the fNRB for the country, reaching to a conservative value of 0.81 (file titled: TEM (2023). f_{NRB} calculation_Final and audited report titled: SPFEC Letter to TEM-Review of FnRB Calculations.pdf; and 2) in alignment with new methodology requirements, additional 26% adjustments were made using the μ_d parameter in our ERs calculations. Overall, the proposed approach leads to an effective fNRB value of 0.55 (= 0.81- 0.26) bringing rigour into our estimates by reducing a potential 40% of over crediting that would have taken placed if the Old United Nations (UN) default value of fNRB (0.99) was applied.

Determination of quantity of wood biomass saved due to implementation of improved cookstoves ($B_{y,savings,i,j}$):

As per the methodology referenced AMS-II.G v13.0, equation 7 from Option 3: Water Boiling Test equation is used.

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

Where:

B_{old} = 5.56

N_{old} = 0.15

Determination of Efficiency of the project device i and batch j (fraction) ($\eta_{new,i,j}$):

As this parameter is a monitored parameter, the PP will assume an annual compounding loss factor of 5% as an example and estimation. Hence the loss factor applied for each year is estimated below:

Year (y)	$\eta_{new,i,j}$
1	0.48
2	0.47
3	0.47
4	0.46
5	0.46
6	0.45
7	0.45
8	0.45
9	0.44
10	0.44

N_{old} is a default factor taken from CDM Tool 33 V2.0 Section 5.6 point 17 a), as per AMS-II.G v13, whereby:

For a three-stone fire using firewood (not charcoal), or a cookstove with no improved combustion air supply or flue gas ventilation (i.e. without a grate or a chimney), the default value is 0.15.

Hence, the calculation for wood biomass over the crediting period is stated below:

Year	B_{old}	η_{old}	$\eta_{new,i,j}$	$[1-(\eta_{old}/\eta_{new,i,j})]$	$B_{y,savings,i,j}$
1	5.56	0.15	0.48	0.69	3.81
2	5.56	0.15	0.47	0.68	3.80
3	5.56	0.15	0.47	0.68	3.78
4	5.56	0.15	0.46	0.68	3.76
5	5.56	0.15	0.46	0.67	3.74
6	5.56	0.15	0.45	0.67	3.72
7	5.56	0.15	0.45	0.67	3.70
8	5.56	0.15	0.45	0.66	3.69

9	5.56	0.15	0.44	0.66	3.67
10	5.56	0.15	0.44	0.66	3.65

Determination of proportion of commissioned project devices that remain operational in Year y ($n_{y,i,j}$):

As this parameter is a monitored parameter, the PP will assume an annual compounding loss factor of 5% as an example and estimation. Hence the loss factor applied for each year is estimated below:

Year (y)	$n_{y,i,j}$
1	0.95
2	0.90
3	0.86
4	0.81
5	0.77
6	0.74
7	0.70
8	0.66
9	0.63
10	0.60

Determination of Emission Reductions using Equation 1:

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

Where:

μ_y = 0.90

$f_{NRB,b,y}$ = 0.81

$NCV_{biomass}$ = 0.0156 TJ/tonne of wood

$EF_{wf,CO2}$ = 112 tCO2e/TJ

$EF_{wf,non\text{-}CO2}$ = 26.23 tCO2e/TJ

Adj_{LE} = 0.95

μ_d = 0.74

The calculation for emission reductions over the crediting period is shown below:

Year	$B_{y,savings,i,j}$	$N_{0,i,j}$	$n_{y,i,j}$	μ_y	$f_{NRB,y}$	$NCV_{biomass}$	$EF_{wf,CO2} + EF_{wf,nonCO2}$	Adj_{LE}	1 - μ_d	$ER_{y,i,j}$
1	3.81	40,000	0.95	0.90	0.81	0.02	121.46	0.95	0.74	140,716.61
2	3.80	80,000	0.90	0.90	0.81	0.02	121.46	0.95	0.74	266,124.72
3	3.78	100,000	0.86	0.90	0.81	0.02	121.46	0.95	0.74	251,631.60
4	3.76	100,000	0.81	0.90	0.81	0.02	121.46	0.95	0.74	297,388.88
5	3.74	100,000	0.77	0.90	0.81	0.02	121.46	0.95	0.74	281,153.30
6	3.72	100,000	0.74	0.90	0.81	0.02	121.46	0.95	0.74	265,784.70
7	3.70	100,000	0.70	0.90	0.81	0.02	121.46	0.95	0.74	251,237.50
8	3.69	100,000	0.66	0.90	0.81	0.02	121.46	0.95	0.74	237,468.48
9	3.67	100,000	0.63	0.90	0.81	0.02	121.46	0.95	0.74	224,436.69
10	3.65	100,000	0.60	0.90	0.81	0.02	121.46	0.95	0.74	212,103.29
									Total:	2,428,045.79
									Annual Average:	242,804,58

Year	Estimated baseline emissions or removals (tCO_2e)	Estimated project emissions or removals (tCO_2e)	Estimated leakage emissions (tCO_2e)	Estimated net GHG emission reductions or removals (tCO_2e)
2024	140,716.61	0	0	140,716.61
2025	266,124.72	0	0	266,124.72
2026	251,631.60	0	0	251,631.60
2027	297,388.88	0	0	297,388.88
2028	281,153.80	0	0	281,153.30
2029	265,784.70	0	0	265,784.70
2030	251,237.50	0	0	251,237.50
2031	237,468.48	0	0	237,468.48
2032	224,436.69	0	0	224,436.69
2033	212,103.29	0	0	212,103.29
Total	2,428,045.79	0	0	2,428,045.79
			Annual Average:	242,804.58

5 MONITORING

5.1 Data and Parameters Available at Validation

Data / Parameter	$f_{,nrb,b,y}$
Data unit	Fraction
Description	Fraction of woody biomass that can be established as non-renewable biomass.
Source of data	TEM (2023). f_{NRB} calculation_Final (see letter titled: GeoNarem Letter for fNRB_Jan 23.pdf) audited by the Head of Forestry of PNG University of Technology (file titled: SPFEC Letter to TEM-Review of FnRB Calculations.pdf).

<table>
<tr><td>Value applied</td><td>0.81</td></tr>
<tr><td>Justification of choice of data or description of measurement methods and procedures applied</td><td>Calculated as per the CDM Methodological Tool 30 Version 4: Calculation of the fraction of non-renewable biomass.
fNRB = NRB/(NRB+RB) = 81.24%
<table>
<tr><th>Parameter</th><th>Value</th><th>Source</th></tr>
<tr><td>NRB = H - RB</td><td>25,844,547</td><td>Calculated value</td></tr>
<tr><td>RB =
MAI x (F – P)</td><td>5,967,605</td><td>Calculated value</td></tr>
<tr><td>MAI
(Mean Annual Increment, t/ha/yr)</td><td>0.69</td><td>PNG's Second Biennial Update Report to UNFCC 2022, Table 2-8, pg 25</td></tr>
<tr><td>F
(Extent of forest, ha)</td><td>35,963,272</td><td>Papua New Guinea Forest Authority (2019). Forest and Land Use Change in PNG 2000-2015, Table 7-1, p71</td></tr>
<tr><td>P
(Extent of non-accessible area, ha)</td><td>27,296,091</td><td>Papua New Guinea Forest Authority (2019). Forest and Land use change in PNG 2000-2015, p35.</td></tr>
<tr><td>H = HW x N + CE + NE</td><td>31,812,152</td><td>Calculated value</td></tr>
<tr><td>HW
(Average consumption of wood fuel per household, t)</td><td>6.8</td><td rowspan="2">Lit. reviews from Page et. al (2016), ACIAR (2013), Murphy et. al (2009), and TEM survey in project area (2023, unpublished)</td></tr>
<tr><td>N
(Number of households in surveyed area)</td><td>197,869</td></tr>
<tr><td>CE + NE
(Commercial woody biomass consumption for energy and non-energy applications respectively, t)</td><td>30,466,643</td><td>Data gathered from Papua New Guinea Forest Authority (2019). Forest and Land use change in PNG, 2000 -2015 and PNG's Second Biennial Update Report to UNFCC 2022</td></tr>
</table></td></tr>
<tr><td>Purpose of Data</td><td>Calculation of emission reductions.</td></tr>
<tr><td>Comments</td><td>N/A</td></tr>
</table>

Data / Parameter	$NCV_{woodfuel}$
Data unit	TJ/tonne
Description	Net calorific value of the non-renewable woody biomass, renewable biomass, briquettes, or pellets used in project devices
Source of data	2019 IPCC Guidelines for National Greenhouse Gas Inventories, Chapter 1, Introduction
Value applied	0.0156
Justification of choice of data or description of measurement methods and procedures applied	2019 IPCC default for wood fuel, 0.0156 TJ/tonne, based on the gross weight of the wood that is 'air-dried' may be used if fuel used in project device is woody biomass/renewable biomass.
Purpose of Data	Calculation of emission reductions.
Comments	N/A

Data / Parameter	$EF_{WF,CO2}$
Data unit	$tCO2_e/TJ$
Description	CO2 emission factor of biomass that is substituted or reduced.
Source of data	2019 IPCC Guidelines for National Greenhouse Gas Inventories, Chapter 2, Stationary Combustion
Value applied	112
Justification of choice of data or description of measurement methods and procedures applied	Methodology Default
Purpose of Data	Calculation of emission reductions.
Comments	N/A

Data / Parameter	$EF_{WF,non-CO2}$
Data unit	$tCO2_e/TJ$

Description	Non-CO2 emission factor of biomass that is substituted or reduced.
Source of data	2019 IPCC Guidelines for National Greenhouse Gas Inventories, Chapter 2, Stationary Combustion
Value applied	9.46
Justification of choice of data or description of measurement methods and procedures applied	Methodology Default
Purpose of Data	Calculation of emission reductions.
Comments	N/A

Data / Parameter	**Life Span**
Data unit	Number of years
Description	The operating lifetime of the project device. The life span should be reported if the methodology equation 5 is adopted to determine the project stove efficiency
Source of data	Manufacturer's specification
Value applied	10
Justification of choice of data or description of measurement methods and procedures applied	This parameter shall be determined ex-ante
Purpose of Data	Calculation of emission reductions.
Comments	N/A

Data / Parameter	η_{old}
Data unit	Fraction
Description	Efficiency of baseline cookstove
Source of data	Methodology Default
Value applied	0.15

Justification of choice of data or description of measurement methods and procedures applied	Methodology Default, CDM TOOL33_v2; As per AMS-II.G v13 During the baseline study TEM found that the prevailing pre-project device was a traditional three stone fire with no improved combustion air supply or flue gas ventilation, and thus, no efficiency tests were carried out (see file titled; TEM 2023_Cookstoves Highlands region report_v2.pdf). In alignment with AMS-II-G. v13.0 (p18), considering that it was not possible to conduct efficiency tests, the project adopted the default efficiency value of 0.15 provided in TOOL33_v2. .
Purpose of Data	Calculation of emission reductions.
Comments	N/A

Data / Parameter	B_{old}
Data unit	Tonnes/year
Description	Annual quantity of woody biomass that would have been used in the household in the absence of the project activity to generate useful thermal energy equivalent to that provided by the project devices.
Source of data	TEM 2023_Cookstoves Highlands region report_v2.pdf and audited by SPFEC Letter to TEM-Review of Cookstoves Highlands region report_17-04-2024.pdf
Value applied	5.56 Tonnes/year
Justification of choice of data or description of measurement methods and procedures applied	As per the applied methodology VMR0006 v1.2, the TEM (2023). Cookstoves Highlands region baseline survey report used sample surveys to determine B_{old} and have taken into consideration the following steps during its baseline study in addition to the requirements in the latest version of AMS-II.G.: 1. If the project devices are distributed in regions with heterogenous conditions (e.g., regional variations of temperature or cooking practices), the project devices must be divided into groups with homogeneous conditions. Applicability and Method Applied: Published literature that has been considered within the Baseline Survey Report shows that provinces within the PNG Highlands are characterized by similar socio-economic conditions and geography that is dominated by high mountains (over 1,000m above sea level). This in turn leading to the lowest average temperature in the

country and is not subject to seasonal fluctuations as PNG is a tropical country[8]. Such ecological conditions have led to similar behaviours in the dependence of firewood as a main energy source for cooking.

Therefore, the PNG Highlands region is considered as an homogenous project boundary[9] in which the B_{old} parameter fits the criteria to be fixed ex-ante.

2. The project proponent must use appropriate historical data or sample surveys for each group of project devices. Sample surveys must be conducted for each group, and the sampling must achieve a confidence/precision level of 90/10 for each separate group.

Applicability and Method Applied:

The Baseline Survey was designed according to the guidelines of the existent methodology VMR0006 v1.1 and conducted in October 2022 (please refer to file titled TEM 2023_Cookstoves Highlands region report_v2), The project was listed by Verra on 3 May 2023 under the same VMR0006 v1.1.

Under VMR0006 v1.1, Section 8.4 (b), p12, Baseline Survey of Local Usage, it was advised that a project target population of > 1,000 required a minimum sample size of 100 samples. The combined total population of PNG Highland Provinces surveyed in the baseline study was reported as 873,095 people (PNG Population & Housing Census 2011), as such a minimum sample size of 100 sample was required.

While the v1.1 of the applied methodology, did not require confidence/precision analysis for sample sizes, to ascertain confidence and precision levels, TEM conducted 220 random surveys rather than the 100 surveys required. This oversampling technique, in turn, improved precision of the data collected from randomly distributed surveys and significantly reduced any outliers associated with the sample.

During the start of the project validation (July 2023), the new methodology revision took place (VMR0006 v1.2), in which the mandatory 90/10 confidence/precision criteria came into effect. At that point, it was not feasible to reconduct the baseline study.

However, we applied Simple Random Sampling by Mean (SRS-Mean) as per the CDM Standard for sampling and surveys for CDM project activities and programme of

[8] ACIAR (Australian Centre for International Research). 2013. Promoting diverse firewood production systems in Papua New Guinea

[9] Further elaborated upon in the Final Verification Report, Appendix 3: Findings Overview, CL ID 12, PP Response (2)

	activities v9.0 and using the CDM Sample Size Calculator (4416_PNG Cookstoves Sample Size Calculator.xlsx) and estimated our predicted sample size to be 141 samples: Expected mean: 5.56 (calculated (calculated as per the Baseline Survey Report) Expected Standard Deviation: 4 (calculated as per the Baseline Survey Report Raw Data) Population Size: 873,095 (as per the Baseline Survey Report) Confidence/Precision: 90/10 Predicted sample size, n: 141 Relative precision: 8.0 % This oversampling technique (60% more samples than needed), in turn, improved the precision and accuracy of the data collected from simple randomly distributed surveys and significantly reduced any outliers associated with the sample.
Purpose of Data	Calculation of emission reductions
Comments	The value is fixed ex-ante.

Data / Parameter	u_d
Data unit	Fraction
Description	Uncertainty deduction for fnrb
Source of data	Estimated based on uncertainty requirements
Value applied	0.26
Justification of choice of data or description of measurement methods and procedures applied	Conservative discount factor based on uncertainty for fnrb
Purpose of Data	Calculation of emission reductions.
Comments	N/A

5.2 Data and Parameters Monitored

Data / Parameter	$N_{O,i,j}$
Data unit	Number
Description	Number of project devices of type i and batch j commissioned
Source of data	Purchase Invoices
Description of measurement methods and procedures to be applied	Purchase invoices will be validated each time a new batch of ICS is distributed as part of the project instance. Example: If the project instance takes 3 years to fully distribute all ICSs, monitoring for this parameter will only be conducted for the first 3 years.
Frequency of monitoring/recording	Yearly, when there are new commissioned ICSs
Value applied	For ex-ante emission reduction calculation, it is assumed that the project will distribute up to 40,000 ICS in Year 1, 40,000 ICS in Year 2, and 20,000 ICS in Year 3.
Monitoring equipment	N/A
QA/QC procedures to be applied	The project implementor shall maintain a distribution record to calculate this parameter.
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	N/A

Data / Parameter	Date of commissioning of batch j
Data unit	Date
Description	To establish the date of commissioning, the Project Participant may opt to group the devices in “batches” and the latest date of commissioning of a device within the batch shall be used as the date of commissioning for the entire batch
Source of data	Internal Log of Project device registrations.

Description of measurement methods and procedures to be applied	N/A
Frequency of monitoring/recording	Fixed and recorded at the time of commissioning/distribution of the last project device in the batch
Value applied	20 February 2024 Estimated as commissioning date of first project device +50 days of distribution activities.
Monitoring equipment	N/A
QA/QC procedures to be applied	N/A
Purpose of data	Calculation of emission reductions.
Calculation method	N/A
Comments	To be reported in the monitoring report

Data / Parameter	**Date of commissioning of project device i**
Data unit	Date
Description	Actual date of commissioning of the project device
Source of data	Internal Log of Project device registrations.
Description of measurement methods and procedures to be applied	N/A
Frequency of monitoring/recording	Fixed and recorded at the time of commissioning/distribution
Value applied	Distribution is estimated to start on 1st January 2024. The actual date of commission of project device will be reported in the monitoring report.
Monitoring equipment	N/A
QA/QC procedures to be applied	N/A

Purpose of data	Calculation of emission reductions.
Calculation method	N/A
Comments	To be reported in the monitoring report

Data / Parameter	$n_{y,i,j}$
Data unit	Fraction
Description	Proportion of commissioned project devices of type i and batch j ($N_{0,i,j}$) that remain operating in year y
Source of data	Monitoring survey
Description of measurement methods and procedures to be applied	The total number of devices in operation compared to the total number distributed (according to the monitoring database) will be surveyed. Measured directly or based on a representative sample. Sampling standard shall be used for determining the sample size to achieve 95/10 confidence precision according to the latest version of Standard for sampling and surveys for CDM project activities and programme of activities.
Frequency of monitoring/recording	At least once every two years (biennial)
Value applied	For ex-ante emission reduction calculation, a conservative value of 5% is estimated annually, although no losses were observed during surveys. Year 1: 0.95 Year 2: 0.90 Year 3: 0.86 Year 4: 0.81 Year 5: 0.77 Year 6: 0.74 Year 7: 0.70 Year 8: 0.66 Year 9: 0.63 Year 10: 0.60
Monitoring equipment	Monitoring Survey

QA/QC procedures to be applied	N/A
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	N/A

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	Manufacturer specifications on efficiency based on water boiling test (WBT).
Description of measurement methods and procedures to be applied	As per AMS-II.G Ver. 13.0, simplified approach of the "Standard for sampling and surveys for CDM project activities and programme of activities" may be used to ensure that the individual equipment produced do not vary beyond the range of acceptance limits: 1. Conduct a sample test on three cookstoves with three tests conducted for each stove. The test can be carried out by project proponents by themselves or stove manufacturers; 2. If the standard deviation of the nine test results indicated above is very small and 90/10 precision requirement is met (in this case, the value of the t-distribution for 90 per cent confidence shall be used instead of Z value), the efficiency determined is acceptable, otherwise more sample tests would be required until 90/10 precision is met.
Frequency of monitoring/recording	1) Recorded at the time of commissioning/distribution. 2) Adjusted for loss of efficiency as per paragraph 37 option (b) or (c).
Value applied	For ex-ante emission reduction calculation, a conservative value of 5% is estimated annually, although no losses were observed during surveys. Year 1: 0.48 Year 2: 0.47

	Year 3: 0.47 Year 4: 0.46 Year 5: 0.46 Year 6: 0.45 Year 7: 0.45 Year 8: 0.45 Year 9: 0.44 Year 10: 0.44
Monitoring equipment	Monitoring survey
QA/QC procedures to be applied	A 95 /10 confidence / margin of error shall be achieved for the sampling parameter irrespective of annual / biennial monitoring frequency as per para 22 of the CDM Methodology Standard: Sampling and surveys for CDM project activities and programmes of activities, Version 09.0. In the case the desired precision is not met, lower bound values shall be used against repeating the survey to determine the operational fraction of stoves.
Purpose of data	Calculation of emission reductions.
Calculation method	N/A
Comments	N/A

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 survey
Description of measurement methods and procedures to be applied	This parameter should be monitored using one of the following methods: 1) If the baseline cookstoves are decommissioned and no longer used, as determined by the monitoring survey its value is 1 and B_{old}, adjusted is equal to B_{old}. 2) If both the improved cookstove and baseline cookstoves are used together then surveys shall be conducted to record the average continued operation of baseline

	cookstoves in a sample of households. The surveys should be designed to capture the cooking habits and stove usage of households in the region, including quantification of use of baseline cookstoves, by formulating questions and/or collecting evidence to determine the frequency of usage of both the improved cookstoves and baseline cookstoves.
Frequency of monitoring/recording	At least once every two years (biennial)
Value applied	0.1
Monitoring equipment	Monitoring survey
QA/QC procedures to be applied	A 95 /10 confidence / margin of error shall be achieved for the sampling parameter irrespective of annual / biennial monitoring frequency as per para 22 of the CDM Methodology Standard: Sampling and surveys for CDM project activities and programmes of activities, Version 09.0. In the case the desired precision is not met, lower bound values shall be used against repeating the survey to determine the operational fraction of stoves.
Purpose of data	Calculation of emission reductions.
Calculation method	N/A
Comments	N/A

5.3 Monitoring Plan

Sampling Plan

The sampling plan is intended to enable the discovery of unbiased and reliable estimates of monitored parameter values used in the GHG emission reduction calculations. The sampling plan design is based on the CDM Guideline: Sampling and surveys for CDM project activities and programmes of activities, version 4.0, and will be designed to monitor the parameters listed in the Section above, which are required for calculation of the actual GHG emission reduction achieved by the project activity using ex post sampling survey.

The share of operating stoves and the continued use of pre-project devices will be determined based on sampling procedures as outlined below. The PP will be responsible for conducting the sampling surveys and maintaining a database with all operating stoves.

No monitoring for leakage through competitive uses of biomass is required, as the PP will be applying the adjustment factor for f_{NRB} in its calculations as stated in AMS-II.G v13, page 28 footnote 16.

As per the Guideline for Sampling and Surveys for CDM Project Activities and Programme of Activities, version 04, the sampling plan is the following:

1) Sampling Design

Due to the large number of ICS envisioned to be distributed as part of the project activity, it is not economically feasible to monitor each individual ICS unit distributed. Therefore, representative sampling will be undertaken as part of a project instance-wide Sampling Plan (by grouping and sampling across project activities) that is designed in line with the requirements of the "Sampling and surveys for CDM project activities and programme of activities", version 04.0.

1.1) Objective and Reliability Requirements

Sampling activities are defined at the Grouped Project-level and the sampling plan presented here will apply to assess parameter values in Project Instances to be included in the Grouped Project, either individually or in groups.

Monitored Parameters

Parameter and Type	Parameter and Type	Indicative Timing	Frequency of Monitoring Required by Methodology	Methods to be Applied
$n_{y,i,j}$ (Proportion of commissioned project devices of type i and batch j ($N_{0,i,j}$) that remain operating in year y)	Fraction	Monitoring will likely occur at least once every 12 months	At least Biennially	Field staff visual inspection of the ICS end users, and questionnaires
μ_y (Pre-project device used along with project ICS)	Fraction	Monitoring will likely occur at least once every 12 months	At least Biennially	Field staff visual inspection of the ICS end users, and questionnaires

$\eta_{new,i,j}$	Fraction	1. Recorded at the time of commissioning/distribution. 2. Monitoring will likely occur at least once every 12 months.	At least Biennially	1. Manufacturer specifications on efficiency based on water boiling test (WBT). 2. Simplified Sampling approach guided by the "Standard for sampling and surveys for CDM project activities and programme of activities".

2.1) Target Population

- The target population for the proportion of ICS still in operation ($n_{y,i,j}$ and μ_y) of this project are all households in the project database which are using fuel wood in ICS distributed under the project for cooking.
- The target population for pre project appliances (μ_y) is the set of old stoves still in use under the project database.

2.2) Sampling Frame

The projects are to be implemented in rural/semi-urban areas; thus, it is expected that the geographical locations do not have influence on the parameter of interest. Therefore, all above mentioned parameters can be assumed to be highly homogeneous for each ICS model regardless of how the end user group and distribution/installation location is defined.

1) Sampling frame for proportion of ICS in operation ($n_{y,i,j}$)

The sample frame refers to all the information sources on the Database. There are two primary mechanisms for data collection: the Registration Process for newly distributed/installed ICS and the Monitoring Survey (which includes a household questionnaire and visual inspection of ICSs) that will be used throughout the lifetime of the ICS. The detailed information collected from Registration Process is used to populate the stoves Database and the Monitoring Survey follows "Sampling and Surveys for CDM Project Activities and Programme of Activities", version 04.

As explained below (on section "Sampling Method"), to take the different characteristics of different project instances Implemented and ICS models into consideration, Project instances shall be grouped together to create a Primary Sampling Unit, which is homogenous. As per EB 86 Annex 04, Appendix-2, paragraph 1, for the use of a single sampling plan covering a group of projects, provided the homogeneity of population can be demonstrated, or differences are considered in the sample size calculation, a 95/5 confidence/precision is applied for biennial sampling.

The first step is to identify the Primary Sampling Units. Primary sampling units are project instances, which have:

Identification of Primary Sampling Units:

Primary sampling units are project instances, which have:

- The same ICS models

That is project with the same ICS model can therefore be grouped together and form a Primary Sampling Unit.

- Adjustment to account for any continued use of pre-project devices during the year(μ_y)

In line with applied approved methodology AMS-II.G v13.0, as installing data logger is not practical and if any use of pre project devise can be monitored in a common survey with other monitoring parameters; therefore, a random sub-sample within the common survey can be taken to determine continued use of old cookstoves and its proportional usage by including suitable questionnaire.

The outcome of the survey could lead two results:

1) The project ICS was completely discarded.

2) The old stoves are used along with project ICS.

TEM will be monitoring the fraction of traditional cookstoves still being used during the crediting period through the $\boldsymbol{\mu_y}$ parameter, which adjusts the overarching ER calculation for a more accurate representation of carbon abated.

In the first case, it will be simple multiplication of fraction of total number of project ICS displaced by old cookstoves by total number of cookstoves in project, to achieve precise results based on survey result sample size calculation can be repeated.

However, in the second case, surveys may be conducted if the use of data loggers to record the continued operation of baseline devices is demonstrated to be not practical, for example when the baseline device is the three-stone fire. The surveys should be designed to capture the cooking habits and stove usage of households in the region, including quantification of use of baseline devices, by formulating questions and/or collecting evidence to determine the frequency of usage of both the project devices and baseline devices.

For example, if there was only one baseline cookstove device per household and its use during the project lifespan continues along with the project stove to meet 25% of the cooking needs of the household in which case the $\mu_{y,i,j}$ parameter will be 0.25. Where a more precise data is available i.e., the thermal capacity of the project and pre-project devices and respective utilization hours, a weighted average adjustment factor may be used.

2.3) Sampling Method

For each survey, the sampling method for monitored parameters ($N_{y,i,j}$ and $\mu_{y,i,j}$) is determined by using a Simple Random Sample of the total population of distributed ICS from records generated in the monitoring database and based on the precision requirements listed above, and as required by the methodology and guidance in the Sampling Standard.

For parameter $\eta_{new,i,j}$, loss in efficiency of the project devices due to aging during the monitoring period will be accounted for using one the following methods set out in AMS-II.G v13.0:

1. Manufacturer of project devices shall confirm with technical justification based on certification by a national standards body or an appropriate certifying agent recognized by that body that no decrease in efficiency of project device is envisaged during the crediting period; or

2. Determine the rate of efficiency drop for a representative sample of the first batch of project device i in year y and assume that same rate of loss in efficiency applies to all other batches. In other words, it may be assumed that the degradation of efficiency measured in a representative sample of the first batch of project devices i apply to all subsequent batches. The efficiency of the project devices in the first batch has to be monitored annually through representative samples and this rate of loss in efficiency may be applied correspondingly to all batches.

In the event that Option 1 is not available, Option 2 will be used.

To ensure a random selection of ICS, random number generators shall be applied. Each ICS in the target population is uniquely identifiable by its unique ID number. Each ICS can thus be allocated a Sample Selection Number in each monitoring period, starting at 1 and increasing up to the total number of ICS in the Database for that pre-defined sampling frame. Applying the random number generators, the ICS can then be randomly chosen from the defined population up to the required sample size as calculated by the Project Participant.

To determine the parameters, sampling will involve the following approaches:

$n_{y,i,j}$: Visual inspection of the premises to see if ICS is operational and in use. Interview with end user if required to verify that ICS is still in use.

μ_y: Pre project device only is in use then fraction to be used to calculate total number, however if pre project device is used along with project ICS, proportion of usage of each will be determined by cooking habits evaluated by survey questionnaire during the monitoring period.

$\eta_{new,i,j}$:

1) Conduct a sample test on three cookstoves with three tests conducted for each stove. The test can be carried out by project proponents by themselves.

2) If the standard deviation of the nine test results indicated above is very small and 90/10 precision requirement is met (in this case, the value of the t-distribution for 90 per cent confidence shall be used instead of Z value), the efficiency determined is acceptable, otherwise more sample tests would be required until 90/10 precision is met.

Using the formulas in the section "Sample Size" below, the Project Participant will randomly sample the required number of ICS from the primary sampling units. It is important to note that for μ_y where partial usage of both old stoves and project ICS are observed, for each household under sample cooking habits must be taken into consideration.

2.4) Sample Size

The sample size for each monitoring activity will be the total number of ICS distributed and included in the monitoring database. The minimum sample size for each sample frame must achieve the 95/10 confidence/precision. For annual and 95/5 confidence/precision for biennial sampling. The procedure to determine the sample of households will ensure that they adequately represent the broader project population, minimizing sampling error.

In line with sampling guidelines, all can be sampled in a single survey with a random sample of households using the above-described confidence/precision levels depending on annual or biennial monitoring frequency. The $n_{y,i,j}$ and μ_y requires proportion/percentage parameters.

As per Guidelines for Sampling and surveys for CDM project activities and programmes of activities, version 09.0 paragraph 13, there are different ways available to obtain the estimates of the parameter of interest:

1. The type of parameter of interest, that is, mean value or proportion value;
2. The target value, that is, the expected value of the parameter, which should be determined using the project participants' or the coordinating/managing entity's knowledge and experience;
3. Expected variance (or standard deviation) for that measure in the sample, based on the results from similar studies including other similar CDM project activities or previous monitoring periods, pilot studies, or from the project planner's own knowledge of the data.

For the registration purpose of project, option 2 shall be applied. For the first monitoring period, values from a pilot shall be applied. For the following monitoring periods, the estimates shall be adjusted considering the results of the previous monitoring period(s) or the result from recent pilot study, which is conducted after the previous monitoring periods.

To estimate the sample size for parameters $n_{y,i,j}$ and μ_y the following equation is used:

$$n \geq \frac{1.96^2 \, N \times p \, (1-p)}{(N-1) \times 0.1^2 \times p^2 + 1.96^2 \times p(1-p)}$$

n	=	Sample size
N	=	Population size (Total number of households/ICS)

p	=	Expected proportion

In case the resulting sample size to achieve the desired confidence/precision levels is smaller than 30 ICS, a minimum sample size of 30 shall be chosen when the parameter of interest is a proportion in line with para 14 of Standard: Sampling and surveys for CDM project activities and programmes of activities, Version 9.0.

TEM envisages distribution of 40,000 ICSs in Year 1. Hence, population size, N, is taken as 40,000 household/ICS (assuming 1 ICS per household).

With an expected ICS loss rate of 5%, it is expected that 95% of ICS will be operational, hence the expected proportion p for $n_{y,i,j}$ is taken as 0.95.

Oversampling will be conducted to ensure that the required level of precision is met, not only to compensate for any attrition, outliers or non-response associated with the sample, but also to prevent a situation at the analysis stage where the required reliability is not achieved, and additional sampling efforts would be required.

2.5) Data Recording

The distribution record including user information will be collected and recorded at the point of distribution by the staff or distributors. Alongside the unique serial number, information recorded will include:

- Name of cookstove user
- Address/GPS of cookstove household
- Phone number of cookstove user
- Cookstove model
- Date of distribution and installation
- Name of the staff that delivered and installed the cookstove.
- Photographic evidence

The information collected from the end-user will be transferred to an electronic database, which will be updated regularly. The distribution record carries all distribution information including the traditional stove type (charcoal stove/firewood stove) used prior to ICS installation, name of representative member of household, phone number (if available and user-permitted for sharing), address etc. Likewise, monitoring records are transferred from each monitoring organization, if any, to the PP. PP will ensure that appropriate records are maintained for the project activity.

A record keeping system and unique identification of the project is made possible by user's information collected through the End-User Agreement and compiled in distribution records. This will include end-user name, identification number and address/location of the user's house,

stove unique serial code and distribution date. The record keeping system will ensure that each ICS can be traced to the project activity to avoid double counting.

The Monitoring Plan applied in this project involves several key elements that ensure that the PP 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 emissions reductions on the basis of the amount of non-renewable biomass saved by the ICS in the project activity.

The key elements are the following:

- Project database management
- Sample Plan for the Monitoring Survey
- Data Quality, Consistency and Duplication Checks
- Monitoring Reporting

The TEM Country Manager will have overall responsibility for the implementation of the monitoring plan. The information collected will be stored in the electronic database and will be updated on ongoing basis by trained staff.

Data collection will be conducted by a dedicated monitoring team of trained individuals, from TEM. All technical staff responsible for installation and maintenance of the stoves will be trained in terms of the understanding the requirements on the monitoring system.

2.6) Organizational Structure

The project will be managed by TEM as the project participant. The roles and responsibilities are shown in the table below:

Person/Entity	Responsibility

TEM Country Manager, Field Coordinator and Field Assistants	• Oversee operation of distribution centres; execution of set up activities; works with project manager on all planning. • Execution of set up activities such as recruitment and training, reporting of monitoring data. • Logistics Manager: planning; identification of target households; contractor management; overall day to day management of installation staff; weekly and monthly reporting. • Data administrators: monitoring database management; accounting; data reconciliations; monthly reporting • Pre- & Post-distribution data collection: conveying project messages; distributing the project; signing up householders wanting a stove; sign up data capture; distribution data capture • Distribution team: management of distribution process; ensuring quality stove distributions. • Monitoring team: gathering compliance monitoring data; gathering marketing data; data input

TEM Head of Science and Sustainability	• Project planning and management; issue and risk management. • Oversight of management system & signoff on ICS procurement and monitoring reports, review of competencies of team members • Technical review team: technical review of process and documentation and monitoring reports. • Compliance Manager/Consultant: writing PD & monitoring reports, ensuring compliance with VCS rules.

Elaboration of Tasks:

Person/Entity	Task	Responsibility
TEM Country Manager, Field Coordinator and Field Assistants	Manufacturing and logistics	Depending on the stove model, complete stoves or components for the stoves are: • Manufactured (some imported, others produced locally) by a stove manufacturer. • Stoves are distributed to warehouses within project region. • Coordinate the distribution of stoves to recipient households
TEM Country Manager, Field Coordinator and Field Assistants	Household identification	• Work with local community leaders and other partners to help identify recipient households suitable for the distribution of a stove.

		• Establish partnership with community leaders, NGOs and other local organizations, local partner will initiate a communication process to ensure that households understand the benefits of the stoves, that cultural issues are addressed and that users are trained in the optimal use and performance of the stove. • TEM PNG team prior distribution will visit recipient communities in each region and ensure recipients understand and acknowledge the conditions for participation in the project. Ensure each stove is assigned a unique distribution number chronologically to avoid any double counting thought the use of an electronic database
TEM Country Manager, Field Coordinator and Field Assistants	Distribution	• TEM PNG team train stove distribution teams to distribute stoves. • Coordinate the receipt of stoves and components in the distribution process. • TEM PNG team will be trained in the distribution of the stove to a standardized delivery and communication procedure. TEM PNG team will be responsible for physically distributing the ICSs to the recipient household
TEM Country Manager, Field Coordinator and Field Assistants	Data Capture	• The information collected from the TEM PNG team during the distribution of ICS, from end-users and interactions on the monitoring phase of the project will be transferred to an electronic database, which will be updated regularly. The database will include a unique reference number for each stove to avoid double counting. • TEM PNG team checks the quality of ICS and record keeping work.

		If the work is satisfactory, distribution data is collected by the TEM PNG team
TEM Head of Science and Sustainability	Monitoring	Monitoring activities will be conducted as follows: • Surveys completed in the field by trained local monitoring teams. • Data captured by the monitoring teams is passed to the TEM Head of Science and Sustainability • Data is checked for completeness, consistency, and accuracy. • Project manager summarizes data in a report to TEM Head of Science and Sustainability • Writing of monitoring reports for each monitoring period. • Technical review by in-house technical team

2.7) QA/QC

In order to minimize sampling errors, such as non-responses and errors, the field team will practice over-sampling from the population to ensure a total number of respondents that meets the required level of precision. This will ensure the integrity of the sample group and maintains the randomness of participant selection. All samples' groups will be re-selected for each monitoring period / year, as appropriate for the parameter in question.

If the required level of precision is not achieved, then further surveys may be completed, or the lower bound value adopted in the calculations.

Where a survey may not be completed, or where there is a non-response, the reasons shall be clearly documented in the survey questionnaire.

APPENDIX I: SUPPORTING FILES

- TEM (2023) fNRB calculation _FINAL.xlsx
- GeoNarem Letter for fNRB_Jan 23.pdf (third-party forested that prepared the fNRB calculations)
- SPFEC Letter to TEM-Review of FnRB Calculations.pdf (third-party auditor)

- TEM 2023_Cookstoves Highlands region report_v2.pdf
- SPFEC Letter to TEM-Review of Cookstoves Highlands region report_17-04-2024.pdf (third-party auditor)

- VSC4416_Cookstoves Provinces.zip: contains a kml file that describes provincial boundaries.
- VSC4416_Cookstoves Provinces_Districts_LLGs.zip: contains a kml that describes the provincial, districts and their LLGs boundaries.

APPENDIX II: LSC OUTREACH

1. **Newspaper Advertisements:**

There were two newspapers published nationally in PNG. As the project activity would be a grouped project activity, TEM saw the importance of announcing the to the public and informing stakeholders of the project, as well as brief them on the upcoming local stakeholder consultations happening in the Highlands Provinces. The following table shows the date of when these advertisements were published in the newspaper:

S/N	Publishing House	Advertisement Published on: (date)	Supporting Documentation
1	Post Courier Newspaper	14/02/2023	Invoices from respective newspapers for publishing, picture of advertisement in newspapers

2. Letters of Notification to Provincial Governments:

Letters of Notification were also hand delivered to provincial government administrative assistants to brief them on the project activity as well as the consequent co-benefits to their local community that came with the project. Together with the Letter of Notification, a project brief was also attached to aid their understanding. The following table shows the dates of when the letters of no-objection were received from the provincial governments:

S/N	Province	Document Received on: (date)	Supporting Documentation
1	Western Highlands Province	13/02/2023	Letter of No-Objection
2	Jiwaka Province	15/02/2023	
3	Eastern Highlands Province	16/02/2023	
4	Southern Highlands Province	08/03/2023	

During TEM's consultations with the provincial governments, the administrative assistants expressed a high level of interest in the project and were supportive of its implementation.

3. Radio Broadcasts

To further TEM's outreach into the Highlands Provinces regarding the LSCs, radio broadcasts were utilized. All radio broadcasts were done by the National Broadcasting Commission which then broadcasted TEM's announcements to individual provinces at a frequency of 1 time a day, over 10 days. Each province-level broadcast would then inform the specific province of the date, location and time of which the LSC was happening within their area. The following table shows the start and end dates of these broadcasts:

S/N	Province	Start of Broadcast: (date)	End of Broadcast: (date)
1	Western Highlands Province	29/02/2023	12/03/2023
2	Jiwaka Province	29/02/2023	12/03/2023

The radio broadcast could only be done for 2 highlands provinces as it was found that the radio stations for the remaining two provinces had been shut down.

4. Invitation to Churches

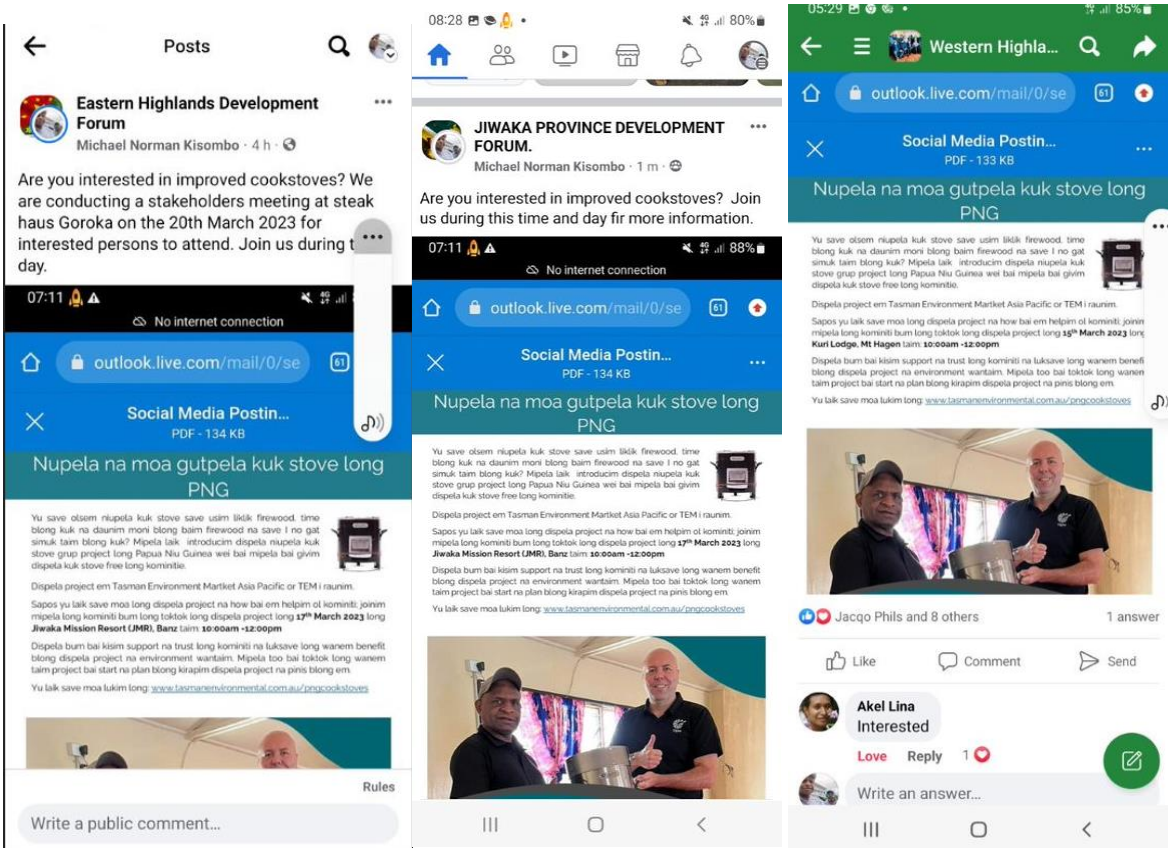
TEM is aware that churches and church leaders play an important role in the local community within PNG. As such, invitations to churches were also hand delivered to churches within each province to invite church leaders and elders to participate in the LSC, as well as spread the word about the importance of the LSC within their community by word-of-mouth. The following table shows the dates these invitations were delivered to churches within the provinces:

S/N	Province	Delivery of Invitation: (date)	Supporting Documentation
1	Southern Highlands Province	10/02/2023	Acknowledgement of Receipt by Church Bodies: SHP

2	Western Highlands Province	15/03/2023	Acknowledgement of Receipt by Church Bodies: WHP, Jiwaka, EHP
3	Jiwaka Province	17/03/2023	
4	Eastern Highlands Province	20/03/2023	

5. Social Media Postings

TEM also understood that the majority of the stakeholders received news of events happening within their area through social media. For this, flyers depicting the details of the LSC, and introduction of the project were developed and posted on each province's dedicated Facebook development forums to further boost stakeholder awareness of the LSC. Postings of these flyers started on 13/03/2023.

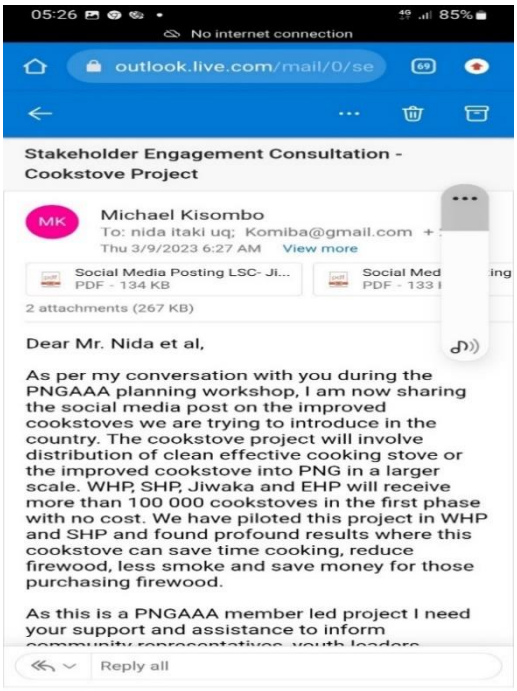


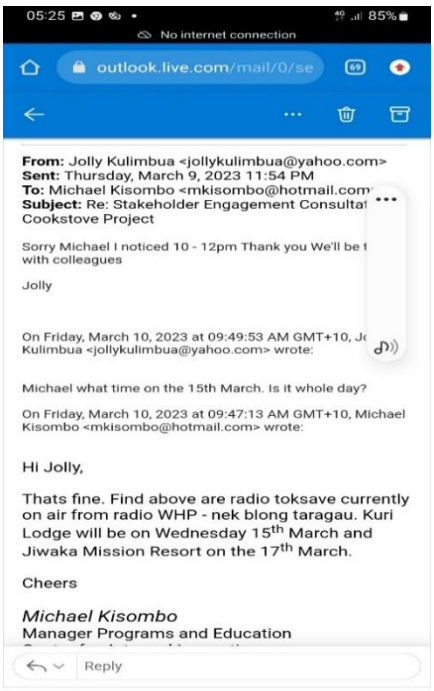
6. Email to PNG Australia Alumni Association (PNGAAA) members

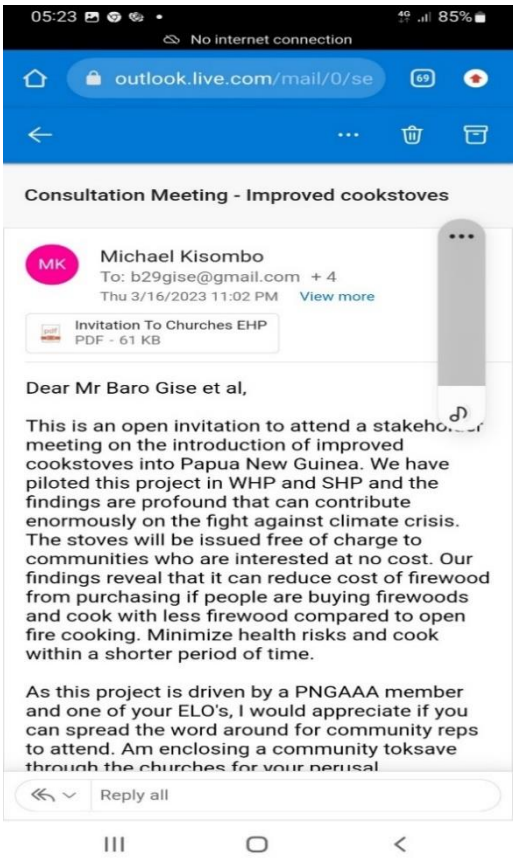
From within TEM's local partner's connections, TEM also reached out to members from WHP and EHP via email. The table below shows the dates these emails were sent out:

S/N	Province	Date of Email Sent: (date)
1	WHP	09/03/2023
2	EHP	16/03/2023

Screenshots of the emails sent out can also be found below:







APPENDIX III: STAKEHOLDER FEEDBACK

1. **Southern Highlands Province:**

Questions:

S/N	Question	Answer
1	Ms Julie Ponaria (a teacher from SHP) enquired that there are many big countries contributing to the destruction of the ozone layer and now trying to give (us) cookstoves to stop carbon emissions. She asked if there is a story behind this small cookstove?	Yes, there are many industrial countries that are destroying the ozone layer because they have big factories and industries. We (people of PNG) also do so when cutting down trees for farming and cooking etc... This project is to reduce carbon emissions by using less firewood for daily needs. Hence, saving trees that consume carbon and restore them. That is the story behind this project.
2	Ps Joseph Yapasi of Tente Ward 2 commented that 50 000 cookstoves is not sufficient to cater for all households in Southern Highlands and there may be risks when distribution. Therefore, he suggested that distribution be more targeted. E.g distribute through church networks or distribute to a particular district first and later target other districts.	It was noted for TEM to decide.
3	Ms Regina Kamerepa pointed out that since the cookstoves are going to be issued free, people are likely to rush to get one. Hence, can also steal or pull them from the distributors during the distribution. And asked how TEM would manage that scenario?	This is a threat we are aware of and are working on a strategy on how this can be mitigated during distribution. Currently, it is planned that security will be present during the distribution process. End-users will also be advised to keep their cookstoves in a safe place to deter theft of the device.

Reflections:

S/N	Reflections
1	A youth rep commented that the level of presentation was too technical and high given the understanding level of the communities and stakeholders present asked if the presentation can be more tailored to their understanding level.

2	A youth rep commented that the level of presentation was too technical and high given the understanding level of the communities and stakeholders present asked if the presentation can be more tailored to their understanding level.
3	A youth rep commented that the level of presentation was too technical and high given the understanding level of the communities and stakeholders present asked if the presentation can be more tailored to their understanding level.
4	Mr. Peter Wari who is in charge of climate change in the province acknowledged the project as it was really going to benefit the community. He further stressed about the importance of the project activity and encouraged the stakeholders to support the project.
5	Most stakeholders mentioned that there is an increase in the usage of firewood and most of their trees (caussarina/yar) are diminishing because people are either chopping them to sell as there is a high demand or for household use. Therefore, the introduction of such cookstoves will be relieving for them.
6	Most stakeholders mentioned that there is an increase in the usage of firewood and most of their trees (caussarina/yar) are diminishing because people are either chopping them to sell as there is a high demand or for household use. Therefore, the introduction of such cookstoves will be relieving for them.
7	Another youth mentioned that he provides firewood for three separate houses as most are windows who have no husbands. With the new cookstove, he believes will relieve him from time and struggles he is facing foraging for firewood for all he's mothers.
8	A Health worker emphasized that inhaling of smoke using normal open fire cooking is contributing to a lot of respiratory illnesses and with the introduction of the improved cookstove she believes will minimize such especially mothers and girls.
9	Besides the above reflections and questions, there were quiet a good number of people giving positive comments and supported the project activity. They even asked to increase the volume from 50 000 cookstoves to enough to cater for all households the province.

2. **Western Highlands Province:**

Questions:

S/N	Question	Answer
1	Mr. Frank Kuri Cr from Mul Baiyer asked, since it's going to affect the rural communities, can the councilors get involved?	Yes, Councilors will get involved to identify heads of households but we do not want this project to be politicized, either be councilors or local MPs.
2	Mr. Nida L Taki, a lecturer at the Agriculture College, Mt Hagen asked if there are further studies made to determine the level of smoke that is given out during normal open fire cooking to see how much carbon emissions are produced.	That's an interesting question. However, this project used observation method to observe the level of smoke when cooking both

		during the control cooking test and open fire cooking.
3	Mr Dickson Wia stressed that firewood is not only used for cooking in the highlands but for other purposes too. Will this cookstove provide for all?	Yes, we use firewood for many other purposes like for heat, light, storytelling etc. This cookstove is for cooking and it can also heat up the house.
4	Rex Parak enquired if the design of the cookstove can be made locally?	The brand and model of cookstove was chosen specifically for its high efficiency. TEM will consider a local brand in the future if it fits the specifications required to yield the highest efficiency in the combustion of firewood.

Reflections:

S/N	Reflections
1	The District Administrator for Dei District thanked the team for introducing this new innovative idea of cooking as people in his electorate are running out of firewood. He welcomed the project initiative and asked to include all rural communities in his electorate.
2	Those who came from the urban centers also requested that they should be given priority as they are using a lot of money to purchase firewood and its already becoming a burden.
3	One of the participants mentioned that the project is very beneficial as it saves time foraging for firewood and a financial relief in buying firewood.
4	A youth mentioned that this project will benefit the youth as he sees that firewood are already running out.
5	Another supported by saying, the initiative taken by TEM is indeed very vital to reduce carbon monoxide as well as relieving economic burden and reduce health related issues. She suggested that it would be good to involve the councilors.
6	One said, this project must not stop after 10 years. It must continue till the world ends.

7	A health worker supported the project by saying, as a health worker this project if rolled out effectively will help reduce the number of sicknesses like pneumonia, chronic obstructive lung disease and eye diseases as well.

3. **Jiwaka Province:**

Questions:

S/N	Question	Answer
1	Mr. Lumun Mingal asked how can PNG be compensated well since we are less carbon emitters yet are asked to further reduce the emissions through such cookstove project?	This cookstove project aims to contribute to the wellbeing of the stakeholders in PNG by lessening the burden of purchasing or collecting firewood and improving the respiratory health of end-users exposed to hazardous smoke from the burning of firewood. Cookstoves being distributed for free is paid for through carbon finance and is one method of compensating stakeholders using the carbon credit scheme.

Reflections:

S/N	Reflections
1	A local landowner thanked TEM for this initiative and welcomed everyone to JMR. Having said that he suggested that this project be based there as it is the model village for Jiwaka and must be made the main distribution point.
2	Another said, there are many NGOs like IOM, UNICEF, etc. who come and deliver similar community-based projects but we the people seem to sell those items. He was worried the cookstoves might be sold in a similar manner and appealed to other participants to discourage such practices.
3	A female teacher mentioned that as a teacher she moves from one area to another with kerosine stoves and with the introduction of the improved cooking stove, hers and other teachers would benefit greatly. Not only that but emphasized that they usually ask their students to bring firewood for them once a week and this project will ease that burden.

4	Another person suggested that every household in Jiwaka must receive a cookstove as they are facing difficulties in looking for firewood.
5	Sammy Buka of Banz mentioned that the project is a bottom up where local communities will benefit. He said it's a sickness free project.
6	There were other supportive comments like, TEM must continue this project to other provinces in PNG, delivered through churches, schools and LLG wards.
7	When asked if there are risks involved like those of you selling firewood, would this project affect you? Everyone said no, not at all as they see there is a lot of benefit to the rural communities.
8.	Someone also wanted more than 50 000 cookstoves in Jiwaka as they believe they are good people.

4. **Eastern Highlands Province:**

Questions:

S/N	Question	Answer
1	Mr Rex Yagusa mentioned that there is a high possibility of the cookstoves being stolen by thieves or destroyed by natural and man-made disasters and asked in such a case, how can we register these complains or cases?	Currently, it is planned that security will be present during the distribution process. End-users will also be advised to keep their cookstoves in a safe place to deter theft of the device.

Reflections:

S/N	Reflections
1	One of the ladies (video graphed) mentioned that this cookstove will lessen the burden for those mothers in the rural setting. She said if they don't sell, there is no money to purchase firewood so they would use plastics and cardboard to cook. This project will really relieve those struggling mothers living in the urban areas.
2	Another suggested having the distribution point centralized and allowing only genuine households to collect. Later field officers can be sent to their locations for registration such as GPS points etc.

3	Someone in the group mentioned that economic benefits are huge as they will be working as the project team to distribute.
4	Those who attended expressed support for the project and demanded if more is distributed in EHP given their population density.
5	No risks or harm mentioned when implementing this project.
6	One participant mentioned that tree-cutting is happening almost every day. More supplies to meet population will help reduce carbon emission.