THE GOVERNMENT OF THE INDEPENDENT STATE OF PAPUA NEW GUINEA

Barrier Analysis and Enabling Framework Report

Mitigation

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Supported by

Barrier Analysis and Enabling Framework Report – Climate Change Mitigation

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DISCLAIMER

This Barrier Analysis and Enabling Framework report has been funded by the Global Environment Facility (GEF) and implemented by the United Nations Environment Programme (UNEP) through the UNEP Copenhagen Climate Centre (UNEP-CCC) in collaboration with the Asian Institute of Technology (AIT). The lead agency for this assessment in Papua New Guinea is the Climate Change and Development Authority (CCDA). While every effort has been made to ensure the accuracy, reliability, and completeness of the information presented in this report, the findings, interpretations, and conclusions are those of the author and do not necessarily reflect the views or policies of the GEF, UNEP, the UNEP Copenhagen Climate Centre, Asian Institute of Technology or the Climate Change and Development Authority. The report is intended for informational purposes only and should not be considered as an endorsement of any particular technology or course of action. No guarantee is made regarding the applicability, accuracy, or effectiveness of the recommendations within this report. Readers are encouraged to seek professional advice before making decisions based on the information provided. The authors and funding entities disclaim any liability for any loss or damage resulting from the use or reliance on this report.

Foreword

Papua New Guinea (PNG), as a Small Island Developing State (SIDS) and one of the world's most climate-vulnerable countries, faces growing risks from the adverse impacts of climate change. Rising greenhouse gas (GHG) emissions globally continue to drive extreme weather events, threaten biodiversity, and undermine sustainable development. While PNG's contribution to global emissions is relatively small, the country is committed to playing its part in the global effort to limit temperature rise through low-emission development pathways.

As a Party to the United Nations Framework Convention on Climate Change (UNFCCC) and the Paris Agreement, PNG has set ambitious mitigation targets in its Enhanced Nationally Determined Contribution (NDC). These include actions to reduce emissions from energy, transport, and land use, land-use change and forestry (LULUCF) sectors, prioritising the transition to renewable energy, improving energy efficiency, reducing deforestation, and promoting sustainable agriculture and forestry practices.

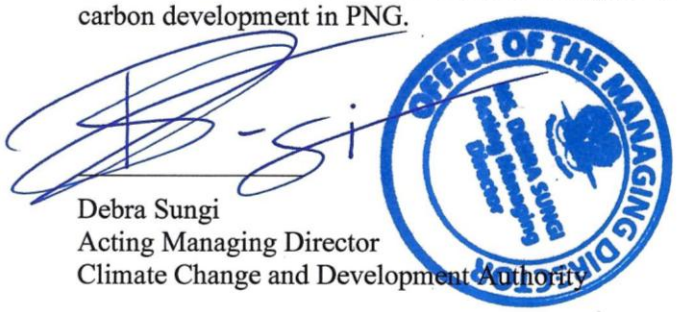
To support the implementation of these commitments, PNG is undertaking a Technology Needs Assessment (TNA), that identifies and prioritises climate change mitigation technologies and strengthens the enabling environment for their deployment. The TNA helps to guide strategic investments, facilitate technology transfer, and inform policies that can accelerate PNG's transition to a low-carbon economy.

The TNA is being coordinated by the Climate Change and Development Authority (CCDA) in partnership with the United Nations Environment Programme Copenhagen Climate Centre (UNEP-CCC) and the Asian Institute of Technology (AIT), with financial support from the Global Environment Facility (GEF). The process has brought together key stakeholders from the government, private sector, academia, civil society, and development partners to ensure that identified technology solutions are locally appropriate, scalable, and aligned with PNG's national development priorities.

This Barrier Analysis and Enabling Framework (BAEF) Report represents the second stage of PNG's TNA. Building on the earlier Identification and Prioritisation of Technologies Report, the BAEF focuses on identifying key barriers to the uptake of selected mitigation technologies in priority sectors and proposes practical measures to overcome these barriers, ranging from policy reforms and institutional strengthening to capacity building and financing mechanisms.

The completion of this report marks a critical step in PNG's climate mitigation journey. It provides a strong foundation for the development of Technology Action Plans that will guide the country in mobilising support and investment to scale up clean, efficient, and low-emission technologies.

I acknowledge the efforts of all individuals and organisations who have contributed to this important national initiative. I look forward to the practical application of the findings and recommendations from the BAEF and to the transformative impact of climate technologies in driving sustainable, low-carbon development in PNG.



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Acknowledgement

This Barrier Analysis and Enabling Framework report has been made possible through the collaborative efforts of numerous individuals and institutions dedicated to supporting climate change mitigation in PNG through the identification and deployment of appropriate technologies.

We express our sincere appreciation to the CCDA for its leadership and coordination of the TNA process. CCDA's guidance has been instrumental in driving this important national effort, particularly in facilitating cross-sectoral dialogue and stakeholder engagement throughout the BAEF phase.

We gratefully acknowledge the support from the Global Environment Facility (GEF) and the United Nations Environment Programme (UNEP), particularly through the UNEP Copenhagen Climate Centre (UNEP-CCC) and the Asian Institute of Technology (AIT). Their ongoing commitment to enabling low-carbon development and technology transfer has been vital in the successful completion of this report.

We would also like to recognise the valuable contributions from stakeholders in the Energy, Transport and Land Use, Land Use Change and Forestry (LULUCF) sectors. Special thanks go to the PNG Forest Authority (PNGFA), Department of Lands and Physical Planning (DLPP), Department of Agriculture and Livestock (DAL), Department of Transport (DOT), PNG Power Limited, and the National Energy Authority (NEA). Their inputs, data, and technical expertise played a key role in identifying sector-specific barriers and formulating enabling measures for the selected mitigation technologies.

Lastly, we extend our deep appreciation to all the stakeholders, experts, and institutional partners who participated in consultations, workshops, and reviews throughout the BAEF process. Their engagement has been critical in ensuring that the recommendations of this report are context-specific, actionable, and aligned with PNG's sustainable development and climate mitigation priorities.

Together, these contributions have strengthened the foundation for the next phase of the TNA, the development of Technology Action Plans, and will support PNG's ongoing efforts to accelerate the uptake of environmentally sound technologies for a low-emission future.

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Acronyms and Abbreviations

AFOLU	Agriculture, Forest, and Other Land Use
BAEF	Barrier Analysis and Enabling Framework
CCDA	Climate Change and Development Authority
CO_2e	Carbon Dioxide Equivalent
EV	Electric Vehicle
GEF	Global Environment Facility
GHG	Greenhouse Gas
GIS	Geographic Information System
Kt	Kilotonnes
LULUCF	Land Use, Land-Use Change, and Forestry
MCA	Multi-Criteria Analysis
Mt	Megatonnes
MTDP	Medium Term Development Plan
NDC	Nationally Determined Contributions
NGO	Non-Governmental Organization
PES	Payment for Ecosystem Services
PNG	Papua New Guinea
PNGFA	Papua New Guinea Forest Authority
REDD+	Reducing Emissions from Deforestation and Forest Degradation (plus conservation, sustainable management of forests, and enhancement of forest carbon stocks)
SDGs	Sustainable Development Goals
TNA	Technology Needs Assessment
TAP	Technology Action Plan
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change

Executive Summary

Papua New Guinea (PNG) completed the first output of its Technology Needs Assessment (TNA) process in December 2024, identifying priority sectors and technologies for climate change mitigation. The second output of the TNA process, presented in this report, focuses on identifying the key barriers to the transfer, adoption, and diffusion of the prioritised mitigation technologies and outlines a set of enabling measures to overcome these challenges.

Based on PNG's national greenhouse gas (GHG) inventory and priorities set out in the Enhanced Nationally Determined Contribution (2020), the Energy, Transport, and Land Use Land Use Change and Forestry (LULUCF) sectors were identified as key contributors to emissions and therefore critical for mitigation actions.

From the first output of the TNA process, there were three technologies prioritised for the energy sector. This includes 1. Cook Stoves in Biomass Gasification; 2. Solar Power Plant; and 3. Hydropower Plant. Two technologies were prioritised for the transport sector, which include: 1. Electric Vehicles; and 2. Hybrid Vehicles. While three technologies were prioritised for the LULIUCF Sector, which include: 1. Reduced Deforestation and Forest Degradation; 2. Reforestation and Rehabilitation; 3. Sustainable Land Use Planning.

However, stakeholders agreed by consensus to only select one technology per sector to conduct the Barrier Analysis and Enabling Framework (BAEF). Thus, the following mitigation technologies were prioritised for barrier analysis: (1) *Cook Stoves in Biomass Gasification* for the Energy sector, (2) *Electric Vehicles* for the Transport sector, and (3) *Reduced Deforestation and Forest Degradation* for the LULUCF sector.

This second TNA report identifies economic, policy, technical, institutional, social, and awareness barriers to the adoption and scaling of these technologies. It also presents an enabling framework with recommended interventions tailored to PNG's context to promote technology deployment.

PNG's energy mix relies heavily on hydropower and diesel, with diesel use in rural areas contributing significantly to GHG emissions. Between 2000 and 2017, emissions from the sector rose by 90%. The Enhanced NDC (2020) targets 50% carbon neutrality and increasing renewables from 30% (2015) to 78% (2030).

The energy consumption in the residential sector in 2022, as per PNG's energy balance table compiled by the Asia Pacific Energy Research Centre, consists of 1430 kilotonnes of oil equivalent (ktoe) of traditional fuel wood, 35 ktoe of kerosene, 3 ktoe of Liquid Petroleum Gas, and 42 ktoe of electricity.

The TNA prioritised Cook Stoves in Biomass Gasification as the top mitigation technology for the energy sector, with a 2040 target for 20% rural household penetration. These stoves reduce emissions by up to 50% compared to traditional biomass stoves and offer health and environmental co-benefits.

However, the adoption of biomass gasification cook stoves in PNG faces multiple barriers, including high upfront costs, weak supply chains, lack of policy and regulatory support, technical challenges with fuel quality and product standards, limited public-private collaboration, inadequate government and workforce capacity, and low awareness and cultural resistance. These economic, institutional, and social constraints hinder the scale-up of clean cooking solutions, especially in rural and low-income communities.

To overcome the barriers to adopting biomass gasification cook stoves in PNG, a mix of economic and non-financial measures is proposed. These include implementing targeted subsidies and microfinance schemes, establishing regional distribution hubs, and developing clear policies and legal frameworks. Technical support through feedstock centres and national stove standards, enhanced public-private partnerships, a dedicated government unit, and a national training program will strengthen institutional capacity. Socially inclusive outreach, nationwide awareness campaigns, and strategic

media partnerships are also vital to increase public acceptance and ensure equitable access, especially for women and marginalized groups.

To overcome barriers in adopting biomass gasification cook stoves in PNG, an enabling framework is proposed that includes a dedicated national policy, establishment of a coordinating government unit, promotion of public-private partnerships, and strategic media engagement. These measures aim to reduce costs, build institutional capacity, strengthen distribution, and increase public awareness to support widespread adoption, especially in rural areas.

Emissions from the transport sector in PNG nearly doubled from 888 kt CO_2e (2000) to 1,946 kt CO_2e (2017), driven by economic and population growth. PNG's Enhanced NDC targets 50% carbon neutrality in transport by 2030. The TNA prioritised Electric Vehicles (EVs), with a 5% urban fleet target by 2040.

Electric vehicle (EV) adoption in PNG faces major economic, technical, and institutional barriers, including high upfront and import costs, lack of charging infrastructure, absence of a supportive policy and regulatory framework, and limited public awareness. Challenges are compounded by low government capacity, minimal public-private collaboration, and cultural resistance to new technologies, especially in rural areas. Without targeted interventions, these barriers will continue to hinder PNG's transition to clean transport.

To accelerate electric vehicle (EV) adoption in PNG, a comprehensive set of economic and non-financial measures is proposed, including green financing options, dedicated EV policies and regulations, expansion of charging infrastructure, public-private partnerships, institutional capacity building, inclusive support programs, and nationwide awareness campaigns. These actions aim to lower costs, improve infrastructure, strengthen governance, and boost public acceptance of EVs.

To accelerate electric vehicle (EV) adoption in PNG, an enabling framework will include the development of a dedicated EV policy with financial incentives and infrastructure support, the establishment of a public-private task force to drive investment and collaboration, the creation of a government EV unit for policy coordination and implementation, and nationwide awareness campaigns through media partnerships to build public trust and promote EV uptake.

PNG has one of the largest tropical rainforest covers globally, with forests spanning over 78% of its land area. The main drivers of deforestation include agricultural expansion (especially oil palm), logging, infrastructure development, and shifting cultivation. PNG's Enhanced NDC targets a reduction of 10,000 ktCO_2e per year by 2030 from the LULUCF sector, through REDD+, sustainable forest management, and reforestation.

The TNA prioritised *Reduced Deforestation and Forest Degradation* as the top mitigation technology. Complementary measures include land-use planning, reforestation, protected area management, environmental safeguards, sustainable palm oil, and domestic timber processing. Targets include reducing forest loss by 25%, training 70 officers, and mobilizing USD 50 million in REDD+ finance.

PNG faces significant economic, policy, technical, institutional, social, and informational barriers to effective forest conservation. Heavy dependence on logging and subsistence agriculture, limited alternative livelihoods, weak law enforcement, unclear land tenure, inadequate technical capacity, fragmented institutional coordination, gender inequality, and low public awareness all hinder sustainable forest management. These challenges must be addressed holistically to reduce deforestation and enhance climate mitigation through forest protection.

To overcome barriers to forest conservation, Papua New Guinea aims to implement a mix of financial and non-financial measures, including scaling up Payments for Ecosystem Services (PES), supporting alternative livelihoods, mobilising climate finance, and engaging the private sector. Key non-financial actions include strengthening forest law enforcement, recognising customary land rights, enhancing technical skills, improving institutional coordination, promoting community-based and gender-inclusive forest management, and expanding public awareness and forest education nationwide.

To enable the effective implementation of deforestation-reducing technologies, Papua New Guinea will establish an integrated framework addressing financial, policy, technical, institutional, social, and informational barriers. Key measures include financial incentives like PES and REDD+, support for alternative livelihoods, policy harmonisation, recognition of customary land rights, technical capacity-building, institutional coordination, inclusive community-based forest management, and nationwide awareness and education campaigns to promote forest stewardship and sustainable land use.

Chapter 1 Introduction

1.1 Purpose

This report provides an analysis of the key barriers that may hinder the effective implementation of climate mitigation technologies prioritised for Papua New Guinea (PNG). The analysis focuses on the three key sectors identified by the Government of Papua New Guinea (GoPNG) as critical to low-emissions development, namely, Energy, Transport, and Land Use, Land Use Change and Forestry (LULUCF). As the second major output under PNG's Technology Needs Assessment (TNA) process, this document builds on the first TNA report, which identified and prioritised technologies most relevant to national circumstances and development priorities. That first reporttitled *Technology Needs Assessment Report: Climate Change Mitigation Technologies in Energy, Transport, and LULUCF Sectors of PNG*, was finalised and submitted in December 2024, forming the foundation for the current analysis.

This current report outlines the methodology used to assess sector-specific and cross-cutting barriers, and proposes targeted policy reform and access to finance to support the successful deployment and scaling of these technologies in PNG's unique context.

1.2 Objectives of the TNA for PNG

The TNA for PNG aims to support the country's transition toward climate-resilient and low-emission development, in alignment with its enhanced Nationally Determined Contributions (NDC), the Papua New Guinea Vision 2050, and the National Climate Compatible Development Management Policy. The specific objectives of the TNA for the Climate Change Mitigation process in PNG are as follows:

1. To identify and prioritise climate technologies that are best suited to address the country's mitigation challenges across key sectors, namely, Energy, Transport, and LULUCF, through a nationally driven and inclusive consultation process involving sector experts, government representatives, civil society, and development partners. These technologies are expected to contribute not only to the country's climate goals but also to broader sustainable development objectives such as enhancing food and water security, and improving livelihoods of communities.
2. To assess and analyse the barriers - technical, institutional, financial, socio-cultural, or regulatory, that currently hinder the introduction, scaling up, and diffusion of the prioritised technologies, and to identify appropriate policy, institutional, and capacity-building measures that can help create an enabling environment for their deployment.
3. To formulate sector-specific Technology Action Plans (TAPs) that outline actionable steps, timelines, and responsible institutions for overcoming the identified barriers, and for facilitating the effective uptake, transfer, and mainstreaming of the selected technologies into national strategies and development plans.

In addition, the TNA process will support the development of concept notes for selected technologies, which can be used as the foundation for mobilising domestic and international climate finance. These concept notes will reflect the priorities identified by sectoral working groups and will be reviewed and endorsed by the national TNA Steering Committee. Ultimately, the TNA is expected to provide strategic guidance that enhances the coherence of technology-related interventions in PNG's climate agenda.

1.3 Prioritised Technologies for PNG

As part of the first output of PNG's TNA process, a structured and participatory process was undertaken to identify, assess, and prioritise key technologies that align with the country's climate change mitigation goals. This involved extensive consultations with sectoral working groups, national

experts, and representatives from government agencies, civil society, and academia. Emphasis was placed on ensuring inclusivity and representation across gender and sectors, guided by the TNA Guidance for Gender-Responsiveness.

A long list of potential technologies was first compiled through research, sectoral reports, and other relevant sources. This list was then refined through stakeholder consultations, including national workshops and one-on-one meetings, which allowed participants to evaluate each option based on relevance to PNG's unique environmental, economic, and social context.

For each shortlisted technology, detailed technology fact sheets were developed, capturing key aspects such as investment requirements, operational feasibility, co-benefits, and contribution to PNG's low-carbon development. The fact sheets also incorporated insights from consultations with technical experts and a review of similar technologies being implemented in other developing countries with comparable contexts.

Using the Multi-Criteria Analysis (MCA) framework, sectoral working groups evaluated the technologies based on criteria including financial cost, technological maturity, socio-economic impact, environmental sustainability, and alignment with national policy priorities. Each criterion was weighted according to its perceived importance in the PNG context, and the scoring process enabled transparent and evidence-based decision-making.

The outcome of this exercise was a prioritised list of climate technologies tailored to PNG's development needs and sectoral challenges. These technologies are intended to form the basis for subsequent implementation planning and resource mobilisation under the TNA. Table 1 below outlines the prioritised technologies for climate change mitigation in PNG and their weighted scores

Table 1: Prioritized Technologies for Climate Change Mitigation in PNG

Sector	**Technology**	**Rank of technology in the sector**
Energy	Cook Stoves in Biomass Gasification	1
	Solar Power Plant	2
	Hydro Power Plant	3
Transport	Electric Vehicles	1
	Hybrid Vehicles	2
LULUCF	Reduced Deforestation and Forest Degradation	1
	Sustainable Land Use Planning	2
	Reforestation and Rehabilitation	3

These prioritised technologies are aligned with PNG's Vision 2050, Medium Term Development Plan IV (2023-2027), and Enhanced NDC 2020. They also support the achievement of Sustainable Development Goals (SDGs), particularly those related to clean energy (SDG 7), climate action (SDG 13), and life on land (SDG 15). The results of this prioritisation process will feed directly into the development of sectoral Technology Action Plans and related concept notes and proposals to attract technical and financial support from climate finance mechanisms and development partners.

1.4 Process for the Identification of Barriers

The second output of PNG's TNA process is the Barrier Analysis and Enabling Framework (BAEF). This output aims to systematically identify the economic, institutional, social, policy, regulatory, technical, and information barriers that hinder the widespread deployment of the prioritised technologies. It also outlines strategic measures and enabling environments needed to overcome these obstacles and support sustainable technology adoption in the country.

1.4.1 The BAEF Process for PNG

PNG's BAEF process followed the structured guidance of the TNA framework, including:

- TNA Step-by-Step Guidebook (Haselip et al., 2019) for conducting national TNA action planning;
- Overcoming Barriers to the Transfer and Diffusion of Climate Technologies (Nygaard & Hansen, 2015) - for categorising markets and understanding constraints;
- Guidance for Gender-Responsive TNA (De Groot, 2018) - to ensure inclusivity and equity across the assessment process.

The BAEF process in PNG was participatory. It drew on both desk-based analysis and extensive stakeholder engagement across key sectors. Over the course of several weeks, in-person workshops, and one-on-one meetings were held with all key stakeholders to identify the barriers and measures to address those barriers.

Each sectoral working group engaged in a detailed review of the prioritised technologies and participated in facilitated discussions to:

- Identify the market characteristics of each technology;
- Uncover sector-specific and cross-cutting barriers;
- Analyse root causes of the most significant barriers;
- Propose actionable enabling measures.

This process was led by the PNG Climate Change and Development Authority (CCDA) supported by the mitigation consultation and the TNA Working Group.

1.4.2 Market Categorisation of Technologies

To guide the barrier analysis, each prioritised technology was placed into a market category based on its deployment characteristics, scale, and stakeholder interaction. The categories used are shown in Table 2 below, along with examples.

Table 2: Technology Categories and their Market Characteristics

Category	Description	Market characteristics examples	Technology examples
Consumer Goods	Goods specifically intended for the mass market; households, businesses and institutions.	• A high number of potential consumers • interaction with existing markets and requiring distribution, maintenance, and installer networks in the supply chain • large and complicated supply chains with	• Solar home systems, CFLs, energy-efficient air conditioners, drip irrigation tubes, seeds for drought-resistant crops.

		many actors, including producers, assemblers, importers, wholesalers, retailers and end consumers • barriers may exist in all steps in the supply chain • demand depends on consumer awareness and preferences and on commercial marketing and promotional efforts	
Capital Goods	Machinery and equipment used in the production of goods, e.g. consumer goods or electricity.	• limited number of potential sites/ consumers • relatively large capital investment • simpler market chain, i.e. few or no existing technology providers • demand is profit-driven and depends on demand for the products the capital goods are used to make	• Utility technologies, such as biomass plants, small-scale hydropower plants, or technological parts thereof. Could also be machinery used in agriculture, and technologies used in industrial processes.
Publicly Provided Goods	Technologies in this category are often (although not always) publicly owned, and production of goods and services are available (free or paid) to the public or to a large group of persons.	• very few sites • large investment, government/donor funding • public ownership or ownership by large companies • simple market chain; technology procured through national or international tenders. • investments in large-scale technologies	• Sea dykes, infrastructure (roads and bridges, sewage systems), mass transport systems (metros).

		tend to be decided at the government level and heavily dependent on existing infrastructure and policies.	
Other nonmarket goods	Non-tradable technologies transferred and diffused under non-market conditions, whether by governments, public or non-profit institutions, international donors or NGOs.	• technologies are not transferred as part of a market but within a public non-commercial domain. • serves overall political objectives, such as energy saving and poverty alleviation • donor or government funding	• Early warning systems for drought, seasonal forecast of rain for optimal planting, microfinance institutions, seed banks, and energy saving by behavioural change.

The categorisation helped frame the discussion of barriers and determine which actors and institutions need to be engaged to address them effectively.

1.4.3 Prioritising and Analysing Barriers

Each barrier identified during consultations was ranked according to its potential to significantly hinder the deployment of the respective technology in PNG. Barriers were categorised as:

Table 3: Barrier Significance Scoring Framework for Technology Adoption

Score	Significance Level	Definition	Example(s)
5	Most Significant	Likely to halt technology adoption unless targeted actions are taken	Lack of local technical capacity, policy misalignment, unclear land rights
4	Significant	Challenging, but surmountable with coordinated support	Limited awareness, insufficient financing mechanisms
3	Moderate	Present but easily addressed	Limited data availability, logistical challenges
2	Not Significant	Minimal impact but noted in planning	Minor regulatory delays

1	Not Very Significant	Negligible impact with little to no effect on implementation	Slight delay in printing awareness materials that doesn't affect the project timeline

Problem Tree Analysis was used to identify the root causes of the most significant barriers. For example, in the LULUCF sector, limited enforcement capacity were linked to challenges in forest conservation efforts. In the energy sector, limited access to affordable financing and technical knowledge were identified as key barriers to the widespread adoption of clean cookstove technologies.

1.4.4 Measures and Enabling Frameworks

To effectively overcome the barriers to the adoption and diffusion of climate mitigation technologies in PNG, an extensive set of enabling measures must be implemented. These measures should holistically address economic, institutional, technical, policy, and socio-cultural challenges while promoting long-term behavioural change and supporting sustainable market development. The following actions are proposed:

Table 4: Enabling Framework for Overcoming Barriers to Technology Adoption in PNG

Broad Categories of Measures	**Measures**
Economic and Financial	• Provide subsidies or financial incentives to lower the upfront cost of gasifier stoves for households
	• Establish microfinance or low-interest loan schemes to support adoption, especially in rural areas
	• Support local manufacturing and supply chains to reduce cost and improve accessibility
Policy, Legal, and Regulatory	• Develop national policies and standards promoting clean and efficient biomass stoves
	• Integrate gasifier stove promotion into broader national energy access and clean cooking strategies
	• Remove import duties or taxes on raw materials and clean stove components
Technical and Human Skills	Provide training to local technicians for stove installation, repair, and maintenance
	• Promote local R&D to adapt stove designs to local cooking practices and biomass types
	• Strengthen partnerships with technical institutions to build human resource capacity

Institutional and Organizational Capacity Barriers	• Establish coordination mechanisms between energy, environment, and health ministries to support clean cooking programs
	• Strengthen local organizations and cooperatives to promote and distribute gasifier stoves
	• Support public-private partnerships for large-scale deployment
Social, Cultural, and Gender Barriers	• Engage women in stove design, promotion, and dissemination programs
	• Conduct community-based demonstrations to promote cultural acceptability
	• Address gender-specific barriers to access and use of clean cooking technologies
Information and Awareness Barriers	• Launch public awareness campaigns on the health and environmental benefits of gasifier stoves
	• Promote user education and training on stove use, biomass selection, and maintenance
	• Share success stories and best practices across communities and regions

Chapter 2 Energy Sector

The energy sector in PNG relies heavily on hydropower and diesel-powered generators, along with limited contributions from natural gas, solar energy, and wind. Diesel generators, commonly used in rural and remote areas, are inefficient and contribute significantly to GHG emissions. Transitioning from these inefficient systems to more sustainable options, such as expanding hydropower capacity or incorporating solar photovoltaic (PV) systems, could significantly improve energy efficiency and reduce GHG emissions. Furthermore, adopting energy efficiency measures for buildings and industrial processes would decrease electricity demand, further minimising reliance on diesel and reducing associated emissions.

According to PNG's National Inventory Report (2000-2017), GHG emissions from the Energy sector increased from 2661 kt CO_2 eq in 2000 to 5056 kt CO_2 eq in 2017. That is an increase of 1058 CO_2 eq (90%). The main driving factor is the increase in economic activities.

PNG's Enhanced NDC 2020 sets an ambitious target to reduce GHG emissions by achieving 50 per cent carbon neutrality by 2030, compared to a business-as-usual scenario. This target includes a focus on increasing the share of renewables from 30% in 2015 to 78% in 2030.

In the TNA report, seven technologies were assessed in terms of their potential and feasibility for GHG reduction, and only three were prioritised. Table 5 below outlines these prioritised technologies, including the scores and ranking.

Table 5: The Selected Technologies for the Energy Sector

Technology Options	Total Score	Ranking
Cook Stoves In Biomass Gasification	67.3	1
Solar Power Plant	53.9	2
Hydropower Plant	53.6	3

2.1 Preliminary targets for technology transfer and diffusion

The list above was presented to the stakeholders in a workshop setting during the consultation process for the barrier analysis of these technologies. They were requested to select the most feasible technologies. The stakeholders selected through a consensus that cook stoves in biomass gasification is the most feasible technology. Thus, the barrier analysis and enabling framework will only focus on cook stoves in biomass gasification.

Furthermore, stakeholders were requested to establish a preliminary target for the transfer and diffusion of cook stoves in biomass gasification in PNG. The preliminary target established is 20% of cook stoves in biomass gasification penetration rural areas (by 2040).

2.2 Barrier analysis and possible enabling measures for Cook Stoves in Biomass Gasification

2.2.1 General description of Cook Stoves in Biomass Gasification

Cookstoves in biomass gasification systems are designed to utilize biomass materials (such as wood, crop residues, and other organic matter) for cooking by converting them into useful energy through a process called gasification. Gasification is a thermochemical process that heats biomass in a low-oxygen environment, producing a combustible gas known as producer gas, which can then be used for cooking.

These stoves are typically more efficient and cleaner than traditional open-fire stoves. Traditional Biomass Stoves (three-stone fires or simple biomass stoves) emit approximately 250-350 g of CO_2 per kWh of energy produced. Cook Stoves in Biomass Gasification (with high efficiency and clean combustion) emit around 100-200 g of CO_2 per kWh of energy produced, depending on the stove and fuel. This shows that Cook Stoves in Biomass Gasification can reduce carbon emissions by up to 50% or more compared to traditional cooking methods, though the carbon intensity still varies depending on:

- The efficiency of the gasification process
- The quality and moisture content of the biomass fuel
- The operation and maintenance of the stove

The advantages of the Cook Stoves in Biomass Gasification include:

- Health Benefits: By producing fewer harmful emissions, gasification stoves help improve indoor air quality, significantly reducing the risk of respiratory illnesses, eye irritation, and other health issues associated with traditional cooking methods
- Lower Fuel Consumption: Because gasification stoves are more efficient, they reduce the amount of wood or biomass needed for cooking. This leads to lower rates of deforestation and environmental degradation, as less biomass is harvested from forests or agricultural land.

- Reduced Time Spent Collecting Fuel: Biomass gasification stoves require less fuel to produce the same amount of heat, which means that people spend less time collecting firewood or biomass.
- Off-Grid Solution: Biomass gasification stoves are especially useful in off-grid or remote areas where access to modern energy sources like electricity or LPG is limited or unavailable.

The disadvantages of the Cook Stoves in Biomass Gasification include:

- Upfront Investment: Cook Stoves in Biomass Gasification generally have a higher initial cost than traditional stoves. This cost can be a significant barrier for low-income households, especially in rural or off-grid areas where purchasing power is limited.
- Availability of Replacement Parts: In remote areas, replacement parts or spare components for Cook Stoves in Biomass Gasification may not be readily available
- Challenging Performance in Cold or Wet Conditions: Gasification stoves may not perform as well in cold or wet conditions, particularly in areas with high humidity, where the biomass may be harder to dry or burn efficiently.
- Storage of Biomass Fuel: Proper fuel storage is critical for the efficient operation of biomass gasification stoves.

Cook Stoves in Biomass Gasification have significant potential in PNG, where the majority of the population relies on traditional biomass fuels such as wood, charcoal, and crop residues for cooking. These methods often contribute to indoor air pollution, deforestation, and inefficient fuel use, all of which could be mitigated with the adoption of gasification technologies.

2.2.2 Identification of barriers for Cook Stoves in Biomass Gasification

The process of identifying barriers to the adoption of Cook Stoves in Biomass Gasification was undertaken in two key stages, following the methodology recommended in the TNA Guidance Handbook. The first stage involved a desk-based screening of potential barriers through a review of existing literature, including relevant policy documents, regulatory frameworks, consultant reports, and other relevant sources. This initial review helped establish a baseline understanding of the main challenges facing the deployment of the technology in PNG.

In the second stage, participatory national stakeholder consultation workshops were convened, including one-on-one meetings with the key TNA stakeholders, facilitated by the mitigation consultant and the national TNA team.

During the consultation workshop, stakeholders were presented with eight broad categories of barriers: 1. Economic and Financial; 2. Policy/Legal/Regulatory; 3. Technical; 4. Networking; 5. Institutional and Organizational; 6. Capacity Barriers; 7. Social, Cultural, and Gender Barriers; and 8. Information and Awareness Barriers.

To prioritise the barriers, stakeholders collectively scored each one based on its severity, frequency, and the extent to which it limits technology uptake. The prioritised barriers and their scores are presented in Table 6 below. A problem tree analysis, illustrating the root causes and effects of the barriers for this technology, is provided in the Annex for further reference.

Table 6: List of identified barriers and corresponding score

No	Broad Categories of Barriers	Identified Barrier	Score
A	Economic and Financial		
1		High upfront cost	5
2		Lack of established markets or supply chains	4

B	Policy, Legal, and Regulatory		
1		Absence of specific policy direction to drive the adoption of cook stoves in biomass gasification	4
2		Lack of a legal and regulatory framework to support the adoption and integration of cook stoves in biomass gasification	5
C	Technical		
1		Inconsistent Biomass Feedstock Quality and Availability	3
2		Lack of Standardization and Quality Control	5
D	Networking		
1		Limited Public-Private Partnerships	5
2		Fragmented Stakeholder Engagement	5
E	Institutional and Organizational		
1		Limited Government Capacity	5
F	Capacity Barriers		
1		Lack of Skilled Workforce	5
G	Social, Cultural, and Gender Barriers		
1		Limited Access for Women and Marginalized Groups	3
2		Resistance to Change and Technological Adoption	5
H	Information and Awareness Barriers		
1		Low Public Awareness and Acceptance	4
2		Limited Media Coverage	4

The score of the Barrier:

1: Not Very Significant

2: Not Significant

3: Moderate

4: Significant

5: Very Significant

2.2.2.1. Economic and financial barriers

(i) High Upfront cost

The high upfront cost of Cook Stoves in Biomass Gasification is a major barrier in PNG, where many households, particularly in rural areas, have limited disposable income. These stoves often cost significantly more than traditional open-fire setups, with prices ranging from USD 40 to USD 70 or more. Without access to microfinance, subsidies, or installment payment options, most low-income families cannot afford the initial investment, even if the stove offers long-term savings. This cost hurdle discourages adoption and limits market penetration, especially among the populations that would benefit most from cleaner, more efficient cooking solutions.

(ii) Lack of established markets or supply chains

The lack of established markets or supply chains for Cook Stoves in Biomass Gasification in PNG hampers widespread adoption and sustainability of the technology. In many regions, there are no reliable distribution channels for purchasing stoves, spare parts, or compatible biomass fuel, making it difficult for users to access and maintain the equipment. Additionally, the absence of local manufacturers or trained technicians leads to dependence on external suppliers, increasing costs and delays. This weak market infrastructure creates uncertainty for both consumers and potential investors, stalling the development of a self-sustaining clean cooking industry.

2.2.2.2. Non-financial barriers

(a) Policy, Legal, and Regulatory

(i) Absence of specific policy direction to drive the adoption of cook stoves in biomass gasification

The absence of a specific policy direction to support the adoption of Cook Stoves in Biomass Gasification creates uncertainty and limits coordinated action among stakeholders. Without clear government commitment, there is little incentive for private investment, program development, or long-term planning. This policy gap also weakens efforts to set standards, mobilize funding, and raise public awareness. A well-defined national policy is essential to establish priorities, provide regulatory guidance, and drive targeted interventions that can accelerate the adoption of clean cooking technologies across PNG.

(ii) Lack of a legal and regulatory framework to support the adoption and integration of cook stoves in biomass gasification

The lack of a legal and regulatory framework to support the adoption and integration of Cook Stoves in Biomass Gasification in PNG poses a significant barrier to their widespread use. Without clear standards for safety, performance, and emissions, there is no mechanism to ensure product quality or protect consumers. This regulatory gap also limits the ability to monitor market activities, enforce compliance, or offer incentives to manufacturers and distributors. Establishing a formal legal structure would provide the necessary oversight, build trust in the technology, and create an enabling environment for investment, innovation, and large-scale adoption.

(b) Technical

(i) Inconsistent Biomass Feedstock Quality and Availability

Inconsistent biomass feedstock quality and availability pose a significant technical barrier to the effective use of Cook Stoves in Biomass Gasification in PNG. These stoves require dry, uniform biomass, such as wood chips, coconut shells, or agricultural residues, for optimal performance. However, in many rural areas, feedstock is often too wet due to high humidity or the rainy climate, and the types of biomass available vary widely in size, moisture content, and energy density. This inconsistency leads to inefficient combustion, frequent stove malfunction, and reduced user satisfaction, ultimately discouraging continued use and undermining the reliability of the technology.

(ii) Lack of Standardization and Quality Control

The lack of standardization and quality control for Cook Stoves in Biomass Gasification production and distribution in PNG, undermines user trust and technology performance. Without nationally recognized standards or certification systems, stoves vary widely in design, efficiency, and safety, leading to inconsistent results and potential health or fire hazards. Poor-quality stoves may emit excessive smoke, break down quickly, or fail to deliver promised fuel savings, which can discourage users from continuing use or recommending them to others. This absence of quality assurance also makes it difficult for governments or NGOs to promote or fund large-scale adoption with confidence.

(c) Networking

(i) Limited Public-Private Partnerships

Limited public-private partnerships (PPPs) significantly hinder the scaling of Cook Stoves in Biomass Gasification initiatives in PNG. Collaboration between government bodies, NGOs, and private sector players remains weak, resulting in fragmented efforts, underutilized resources, and missed opportunities for innovation and investment. Without strong PPPs, there is limited support for developing local manufacturing, distribution networks, and user training programs. This disconnect also reduces the potential for policy incentives, such as subsidies or tax relief, which are crucial for encouraging private sector involvement and making the technology more accessible to low-income communities.

(ii) Fragmented Stakeholder Engagement

Fragmented stakeholder engagement is a key challenge in the adoption of Cook Stoves in Biomass Gasification s in PNG, as efforts to promote the technology are often disjointed and uncoordinated. Government agencies, NGOs, local businesses, and community organizations may work in isolation, leading to duplication of initiatives, inconsistent messaging, and inefficient use of resources. This lack of collaboration creates confusion among potential users, limits the effectiveness of awareness campaigns, and prevents the pooling of expertise and funding necessary to create a cohesive strategy for scaling the technology. A more unified approach is essential for maximizing impact and ensuring long-term success.

(d) Institutional and Organizational Capacity Barriers

(i) Limited Government Capacity

Limited government capacity is a significant barrier to the widespread adoption of Cook Stoves in Biomass Gasification in PNG. Many government agencies lack the technical expertise, resources, and infrastructure needed to effectively support the promotion, regulation, and scaling of clean cooking technologies. This includes challenges in creating and enforcing policies, providing financial incentives, or ensuring the availability of training for both consumers and technicians. As a result, there is insufficient guidance or oversight to foster a stable market for the technology, hindering both private sector involvement and the broader success of clean cooking initiatives across the country

(ii) Lack of Skilled Workforce

Lack of a skilled workforce is a major barrier to the adoption and maintenance of Cook Stoves in Biomass Gasification in PNG. Many rural areas lack trained technicians who can install, repair, or maintain these more complex technologies. Without local expertise, stoves may be improperly set up or fail due to a lack of maintenance, leading to poor performance and user dissatisfaction. This skill gap also limits the growth of a sustainable local market for stoves, as there is little incentive for businesses to invest in production and distribution without a readily available workforce to support the technology.

(e) Social, Cultural, and Gender Barriers

(i) Limited Access for Women and Marginalized Groups

Limited access for women and marginalized groups presents a significant barrier to the widespread adoption of Cook Stoves in Biomass Gasification in PNG. In many rural communities, women, who are often the primary cooks and responsible for gathering fuel, face economic and social barriers that prevent them from accessing cleaner, more efficient cooking technologies. Marginalized groups may experience additional challenges, such as limited financial resources, lack of awareness, or exclusion from decision-making processes that affect their access to sustainable energy solutions. As a result, these groups miss out on the health, time-saving, and financial benefits offered by cleaner cook stoves, perpetuating cycles of energy poverty and inequality.

(ii) Resistance to Change and Technological Adoption

Resistance to change and technological adoption is a significant challenge in introducing biomass gasification cook stoves in PNG. Many households, particularly in rural areas, are deeply accustomed to traditional cooking methods, such as open fires, and may view new technologies with skepticism or distrust. This resistance is often driven by concerns about the reliability, cost, and unfamiliarity of the technology, as well as cultural attachment to traditional practices.

(f) Information and Awareness Barriers

(i) Low Public Awareness and Acceptance

Low public awareness and acceptance is a critical barriers to the widespread adoption of Cook Stoves in Biomass Gasification in PNG. Many communities, especially in rural areas, are not fully informed about the environmental and health benefits of transitioning to cleaner cooking technologies. The lack of education and outreach campaigns means that people are unaware of the long-term savings, improved air quality, and reduced deforestation that gasification stoves offer.

(ii) Limited Media Coverage

Limited media coverage significantly hinders the promotion and adoption of biomass gasification cook stoves in PNG. With a lack of widespread media campaigns or coverage on the benefits of cleaner cooking technologies, many communities remain unaware of the environmental, health, and economic advantages these stoves offer.

2.2.3 Identified measures

A similar process for identifying the barriers of Cook Stoves in Biomass Gasification was also applied to identifying the measures. This was also done in the same workshop that was conducted to identify the barriers. Table 7 below outlines the measures for each barrier identified.

Table 7:List of identified measures and corresponding score

No	Broad Categories of Barriers	Identified Barrier	Score
A	Economic and Financial		
1		Implement targeted subsidies or micro-financing schemes to reduce the upfront cost	5
2		Establish and operationalize at least three regional distribution hubs	4
B	Policy, Legal, and Regulatory		
1		Develop a specific policy direction to drive the adoption of cook stoves in biomass gasification	5
2		Develop a legal and regulatory framework to support the adoption and integration of cook stoves in biomass gasification	4
C	Technical		
1		Develop and support community-based biomass feedstock collection and processing centers	3
2		Establish and enforce national standards and a certification system	5
D	Networking		
1		Facilitate the creation of public-private partnerships	5
2		Establish a multi-stakeholder coordination platform	5
E	Institutional and Organizational		

1		Establish a dedicated unit within the relevant ministry or agency	5
2		Launch a national training and certification program	5
F	Social, Cultural, and Gender Barriers		
1		Design and implement gender-sensitive outreach and training programs	3
2		Implement nationwide awareness and demonstration campaigns	5
G	Information and Awareness Barriers		
1		Launch a comprehensive public education campaign	4
2		Establish partnerships with key media outlets and influencers	4

The score of Measure:

1: Not Very Significant

2: Not Significant

3: Moderate

4: Significant

5: Very Significant

2.2.3.1 Economic and financial measures

(i) Implement targeted subsidies or micro-financing schemes to reduce the upfront cost

To address the barrier of high upfront costs, targeted subsidies or micro-financing schemes can be introduced to make Cook Stoves in Biomass Gasification more affordable for low-income households. These financial mechanisms would offer reduced initial costs through government or donor funding, enabling rural communities to access the technology without significant financial strain. Microloans could be structured with low-interest rates and flexible repayment terms, tailored to the income levels and cycles of rural populations.

(ii) Establish and operationalize at least three regional distribution hubs

Establishing and operationalizing at least three regional distribution hubs would streamline the supply chain for biomass gasification cook stoves, ensuring consistent availability and reducing logistical challenges in rural areas. These hubs would serve as centralized points for procurement, storage, and distribution, making it easier for local vendors and communities to access affordable and quality stoves. By strategically placing hubs in key regions, this initiative would help reduce transportation

costs, improve product availability, and ensure that the technology reaches more households in a timely manner. This system would also create opportunities for local employment and capacity building in rural areas.

2.2.3.2 Non-financial measures

(a) Policy, Legal, and Regulatory

(i) Develop a specific policy direction to drive the adoption of cook stoves in biomass gasification

Developing a specific policy direction to drive the adoption of Cook Stoves in Biomass Gasification would involve crafting a comprehensive national strategy that outlines clear objectives, incentives, and regulatory frameworks to promote the technology. This policy could include subsidies, tax breaks, or low-interest loans to reduce the upfront costs for households, particularly in rural areas. It would also set adoption targets, establish quality and safety standards for the cook stoves, and encourage public-private partnerships for distribution and maintenance. Additionally, the policy could integrate education and awareness campaigns to highlight the benefits of Cook Stoves in Biomass Gasification , such as improved health outcomes and environmental sustainability, ensuring broad community support and engagement.

(ii) Develop a legal and regulatory framework to support the adoption and integration of cook stoves in biomass gasification

Developing a legal and regulatory framework to support the adoption and integration of Cook Stoves in Biomass Gasification would involve creating legislation that sets out clear standards for stove performance, emissions, and safety to ensure quality and protect public health. The framework could include regulations on the certification and labelling of cook stoves, ensuring only approved models are sold and used. It would also address environmental guidelines for biomass feedstock sourcing, promoting sustainable practices. Additionally, the framework could incentivize manufacturers through tax exemptions or subsidies and establish penalties for non-compliance. Local governments would be empowered to monitor implementation and enforcement, while national policies could foster collaborations between the public and private sectors to drive widespread adoption.

(b) Technical

(i) Develop and support community-based biomass feedstock collection and processing centres

Developing and supporting community-based biomass feedstock collection and processing centres would involve working with rural communities, ward councils, and local NGOs to establish small-scale hubs that collect and process agricultural residues, coconut husks, wood chips, and other locally available biomass. These centres could be managed by community groups or women's associations, providing livelihood opportunities while ensuring a steady and sustainable supply of quality feedstock for biomass gasification cook stoves. With PNG's dispersed geography and limited infrastructure, such decentralized models are essential to reduce transportation costs and increase local ownership. Support from provincial governments and development partners could include training, equipment provision, and technical assistance, aligned with customary land ownership practices and local governance systems.

(ii) Establish and enforce national standards and a certification system

Establishing and enforcing national standards and a certification system for Cook Stoves in Biomass Gasification would ensure the safety, efficiency, and durability of stoves distributed across the country, particularly in rural and remote areas. This system would involve developing technical guidelines for design, emissions, and performance, tailored to local cooking habits and available biomass types.

(c) Networking

(i) Facilitate the creation of public-private partnerships

Facilitating the creation of public-private partnerships (PPPs) for Cook Stoves in Biomass Gasification would involve bringing together government agencies, private sector actors, NGOs, and donor partners to collaboratively support the production, distribution, and financing of clean cooking technologies.

(ii) Establish a multi-stakeholder coordination platform

Establishing a multi-stakeholder coordination platform for Cook Stoves in Biomass Gasification initiatives would create a formal space for collaboration among key actors, including government agencies, private sector manufacturers and distributors, NGOs, donor partners, research institutions, and community representatives. This platform would meet regularly to align strategies, share data and lessons learned, coordinate funding and outreach efforts, and monitor progress on national clean cooking targets. By reducing fragmentation and fostering joint planning, the platform would ensure that initiatives are culturally appropriate, technically sound, and effectively scaled, particularly in rural and remote areas. It could also serve as an advisory body to inform policy development and support the implementation of national energy and climate goals.

(d) Institutional and Organizational Capacity Barriers

(i) Establish a dedicated unit within the relevant ministry or agency

Establishing a dedicated unit within a relevant ministry would provide focused leadership and coordination for the promotion and implementation of Cook Stoves in Biomass Gasification initiatives. This unit would be responsible for policy development, stakeholder engagement, monitoring and evaluation, capacity building, and mobilizing funding for clean cooking programs. It would also coordinate with provincial and district governments to ensure effective delivery of services and alignment with local development plans. By institutionalizing this function, the government can ensure sustained attention, better resource allocation, and accountability, while reinforcing the integration of clean cooking into PNG's broader energy access, health, and climate resilience strategies.

(ii) Launch a national training and certification program

Launching a national training and certification program for Cook Stoves in Biomass Gasification would help build a skilled workforce to support the manufacture, installation, maintenance, and user education of clean cooking technologies. This program could be led by the National Energy Authority (NEA) in collaboration with vocational training centres, NGOs, and technical colleges, offering standardized curricula tailored to the needs of rural communities and local market conditions. Certification would ensure quality and consistency across practitioners, while also creating employment opportunities, especially for youth and women. By equipping technicians, entrepreneurs, and community advocates with the right skills, the program would strengthen local capacity, improve

stove performance and adoption rates, and support the long-term sustainability of clean cooking efforts in PNG.

(e) Social, Cultural, and Gender Barriers

(i) Design and implement gender-sensitive outreach and training programs

Designing and implementing gender-sensitive outreach and training programs for Cook Stoves in Biomass Gasification is essential to ensure equitable access and participation by women and marginalized groups. These programs should be community-based and culturally appropriate, delivered in local languages, and scheduled at times that accommodate women's responsibilities. Training should go beyond technical skills to include leadership, entrepreneurship, and decision-making, empowering women not just as users but as distributors, technicians, and advocates. Partnerships with women's associations, church groups, and local NGOs can enhance reach and trust. By prioritizing inclusion, these programs will help close the gender gap in energy access, improve household health and livelihoods, and strengthen the overall impact and sustainability of clean cooking initiatives in PNG.

(ii) Implement nationwide awareness and demonstration campaigns

Implementing nationwide awareness and demonstration campaigns for Cook Stoves in Biomass Gasification would be critical to increasing public understanding, acceptance, and adoption of the technology, especially in rural and remote communities. These campaigns should use culturally relevant messaging and local languages, delivered through radio, community meetings, churches, and schools, to reach diverse audiences. Live demonstrations in villages can showcase the stoves' efficiency, safety, and fuel savings compared to traditional open-fire cooking methods. Partnering with local leaders, women's groups, and NGOs would help build trust and ensure that messaging resonates with community values and priorities. By combining education with hands-on experience, these campaigns can drive behaviour change and create strong demand for clean cooking solutions across PNG.

(f) Information and Awareness Barriers

(i) Launch a comprehensive public education campaign

Launching a comprehensive public education campaign on Cook Stoves in Biomass Gasification would play a vital role in shifting public perception and encouraging widespread adoption of clean cooking technologies. This campaign should be multi-channel, using radio, posters, community theatre, social media, and school programs to educate people about the health, environmental, and economic benefits of switching from traditional open fires to cleaner alternatives. Tailored messages should address local cooking practices, debunk myths, and highlight success stories from early adopters, especially women and rural households. The campaign should also promote safe usage, proper maintenance, and sustainable biomass sourcing. Led by government agencies in collaboration with NGOs, churches, and local leaders, a well-coordinated public education effort would build awareness, trust, and momentum for lasting change in PNG's clean cooking landscape.

(ii) Establish partnerships with key media outlets and influencers

Establishing partnerships with key media outlets and influencers would significantly amplify the reach and impact of Cook Stoves in Biomass Gasification initiatives. Collaborating with national broadcasters,

local radio stations, print media, and popular social media influencers can help disseminate consistent and engaging messages about the benefits of clean cooking. Media campaigns could feature real-life stories from local communities, highlight the environmental and health benefits of gasification stoves, and promote special offers or financing options. Influencers, including local leaders, celebrities, and community figures, can help build credibility and trust, especially in remote or hard-to-reach areas. By strategically engaging these channels, the campaign can gain widespread attention, encourage dialogue, and inspire action toward adopting sustainable cooking practices throughout PNG.

2.3 Linkages of the barriers identified

Cook Stoves in Biomass Gasification was the only feasible and prioritised technology for the energy sector, as agreed by the stakeholders. Therefore, only the barriers for Cook Stoves in Biomass Gasification were identified, and thus, there is no need to make linkages with barriers of other technologies in the energy sector.

2.4 Enabling framework for overcoming the barriers in the Energy Sector

To effectively tackle the barriers that hinder the adoption of prioritized technologies in the energy sector, it is essential to develop an enabling framework that promotes the increase in penetration of Cook Stoves in Biomass Gasification. Below are four main enabling frameworks that have been identified.

1. Creating a specific policy to promote the adoption of biomass gasification cook stoves, which will include measures such as subsidies, tax incentives, or low-interest loans to help reduce the initial cost burden on households, especially in rural areas. It would set targets for adoption, establish safety and quality standards for the cook stoves, and foster public-private partnerships for their distribution and maintenance. Moreover, the policy could incorporate educational and awareness campaigns to emphasize the health and environmental benefits of biomass gasification, ensuring broad community support and participation.
2. Creating a dedicated unit within the relevant ministry would offer focused leadership and coordination for advancing biomass gasification cook stove initiatives. This unit would handle policy development, stakeholder engagement, monitoring and evaluation, capacity building, and securing funding for clean cooking programs. It would also collaborate with provincial and district governments to ensure efficient service delivery and alignment with local development goals. Institutionalizing this role would help the government maintain continuous focus, improve resource management, and enhance accountability, while supporting the integration of clean cooking solutions into Papua New Guinea's broader energy access, health, and climate resilience strategies.
3. Promoting the formation of public-private partnerships (PPPs) for biomass gasification cook stoves would require uniting government agencies, private sector companies, NGOs, and donor organizations to jointly support the production, distribution, and financing of clean cooking technologies.
4. Building partnerships with major media outlets and influencers would greatly expand the reach and effectiveness of biomass gasification cook stove initiatives. By working with national broadcasters, local radio stations, print media, and influential social media personalities, consistent and engaging messages about the advantages of clean cooking can be spread. Media campaigns could showcase success stories from local communities, emphasize the environmental and health benefits of gasification stoves, and highlight special deals or financing options. Influencers, such as local leaders, celebrities, and community figures, can lend credibility and foster trust, particularly in remote or underserved regions.

Chapter 3 Transport Sector

The demand for vehicles in PNG is steadily increasing, driven by economic development, urbanisation, and population growth. This includes a rise in used-imported vehicles, which are commonly used due to their affordability. Additionally, there is an increasing preference for vehicles with larger engine sizes, particularly four-wheel drives, which are well-suited to the challenging terrain but contribute to higher fuel consumption and greenhouse gas emissions.

According to PNG's National Inventory Report (2000-2017), GHG emissions from the transport sector increased from 888 kt CO_2 eq in 2000 to 1,946 kt CO_2 eq in 2017. That is an increase of 1058 kt CO_2 eq (119%). The main driving factor is the increase in the number of internal combustion engine vehicles.

PNG's Enhanced NDC 2020 sets an ambitious target to reduce GHG emissions by achieving 50 per cent carbon neutrality by 2030, compared to a business-as-usual scenario. This target includes a focus on sustainable transportation solutions such as the adoption of low-carbon vehicles, including electric vehicles, and the improvement of road infrastructure to be more resilient to the impacts of climate change.

In the TNA report, five technologies were assessed in terms of their potential and feasibility for GHG reduction. Table 8 below outlines the 2 prioritised technologies, including the scores and ranking.

Table 8: The selected technologies for the Transport Sector

Technology Options	Total Score	Ranking
Electric Vehicles	40.61	1
Hybrid Vehicles	40.49	2

3.1 Preliminary targets for technology transfer and diffusion

The list above was presented to the stakeholders in a workshop setting during the consultation process for the barrier analysis of these technologies. They were requested to select the most feasible technologies. The stakeholders selected through a consensus that electric vehicle is the most feasible technology. Thus, the barrier analysis and enabling framework will only focus on electric vehicles.

Furthermore, stakeholders were requested to establish a preliminary target for the transfer and diffusion of electric vehicles in PNG. The preliminary target established by the stakeholders through a consensus is 5% EV penetration of the total vehicle fleet in urban centres (by 2040).

3.2 Barrier analysis and possible enabling measures for Electric Vehicles

3.2.1 General description of Electric Vehicles

An electric vehicle (EV) is a type of vehicle that is powered entirely or partially by electricity, rather than by gasoline or diesel. The key components of an electric vehicle include an electric motor, battery pack, and electronic controller.

The carbon intensity of the electricity used to charge the vehicle depends on the mix of energy sources used to generate power. Here's an example of carbon intensity based on different energy sources:

- Coal-powered grid: The carbon intensity of electricity from coal can be around 900 to 1,200 grams of CO_2 per kWh.
- Natural gas grid: The carbon intensity of electricity from natural gas is generally around 400 to 500 grams of CO_2 per kWh.
- Renewable energy grid (wind, solar, hydro): Zero or very low emissions, typically 0 to 50 grams of CO_2 per kWh, depending on the efficiency and geographical location.
- The advantages of EVs over internal combustion engine vehicles include:
- Lower Operating Costs: EVs are more efficient than ICE vehicles. The cost of electricity per mile is usually much lower than the cost of gasoline or diesel.
- Lower Maintenance Costs: Electric vehicles have fewer moving parts compared to traditional vehicles.
- Highly Efficient: Electric motors are much more efficient at converting energy into motion than internal combustion engines. While ICE vehicles typically convert only about 20-30% of the energy from gasoline into useful power, electric motors can achieve efficiency rates of around 85-90%, making them a more energy-efficient option.
- Home Charging: One of the greatest advantages of owning an EV is the ability to charge it at home using a standard electrical outlet or a dedicated home charger

On the other end, the disadvantages of EVs include:

- Purchase Price: EVs generally have a higher initial purchase price compared to conventional gasoline or diesel vehicles, primarily due to the cost of the battery
- Driving Range: Many EVs still have a limited driving range on a single charge compared to gasoline vehicles, although this is improving.
- Insufficient Charging Stations: While the number of EV charging stations is growing, it remains insufficient in many areas, particularly rural regions or developing countries.
- Demand on the Grid: As EV adoption grows, there could be significant pressure on the electricity grid, especially in regions with limited energy generation capacity.

The potential for electric vehicles in PNG is promising, but it faces several challenges and opportunities that need to be addressed to enable widespread adoption. PNG is a developing country with a mix of urban and rural areas, and its unique geography and infrastructure pose both hurdles and potential for innovation in the EV market. Electric vehicle penetration in PNG is very low, with less than 1%.

3.2.2 Identification of barriers for Electric Vehicles

The process of identifying barriers to the adoption of Electric Vehicles was undertaken in two key stages, following the methodology recommended in the TNA Guidance Handbook. The first stage involved a desk-based screening of potential barriers through a review of existing literature, including relevant policy documents, regulatory frameworks, consultant reports, and other relevant sources. This initial review helped establish a baseline understanding of the main challenges facing the deployment of the technology in PNG.

In the second stage, participatory national stakeholder consultation workshops were convened, including one-on-one meetings with the key TNA stakeholders, facilitated by the mitigation consultant and the national TNA team.

During the consultation workshop, stakeholders were presented with eight broad categories of barriers: 1. Economic and Financial; 2. Policy/Legal/Regulatory; 3. Technical; 4. Networking; 5. Institutional and Organizational; 6. Capacity Barriers; 7. Social, Cultural, and Gender Barriers; and 8. Information and Awareness Barriers. Participants were invited to identify specific barriers under each category through a consensus-based process.

To prioritise the barriers, stakeholders collectively scored each one based on its severity, frequency, and the extent to which it limits technology uptake. The prioritised barriers and their scores are presented in Table 9 below. A problem tree analysis, illustrating the root causes and effects of the barriers for this technology, is provided in Annex I for further reference.

Table 9:List of identified barriers and corresponding score

No	Broad Categories of Barriers	Identified Barrier	Score
A	Economic and Financial		
1		High upfront cost of EVs compared to internal combustion engine vehicles	4
2		High cost of importing EVs	5
B	Policy, Legal, and Regulatory		
1		Absence of specific policy direction to drive EV transition	5
2		Lack of legal and regulatory framework to support the adoption and integration of EVs	5
C	Technical		
1		EVs unsuitable for long-distance travel or use in rural areas	5
2		Lack of charging Infrastructure	5
D	Networking		
1		Limited Public-Private Partnerships	5
2		Fragmented Stakeholder Engagement	5
E	Institutional and Organizational		
1		Limited Government Capacity	5
F	Capacity Barriers		
1		Lack of Skilled Workforce	5
G	Social, Cultural, and Gender Barriers		
1		Limited Access for Women and Marginalized Groups	3
2		Resistance to Change and Technological Adoption	5
H	Information and Awareness Barriers		

1		Low Public Awareness and Acceptance	4
2		Limited Media Coverage	4

The score of Barrier:

1: Not Very Significant

2: Not Significant

3: Moderate

4: Significant

5: Very Significant

3.2.2.1 Economic and financial barriers

(i) High upfront cost of EVs compared to internal combustion engine vehicles

In PNG, the high upfront cost of electric vehicles compared to internal combustion engine (ICE) vehicles remains a significant barrier to adoption. Limited local availability, import taxes, and a lack of government subsidies contribute to higher retail prices for EVs. Additionally, the absence of large-scale dealerships and economies of scale further inflates costs. For many Papua New Guineans, particularly in rural areas, these costs are prohibitive, making ICE vehicles a more accessible and practical choice despite their environmental impact.

(ii) High cost of importing EVs

Importing EVs into PNG entails significant costs, despite recent government initiatives to encourage adoption. While the government has repealed tariffs on EV imports to promote a greener economy, importers still face substantial expenses, including freight, insurance, and a 10% Goods and Services Tax (GST). Additional costs such as brokerage fees, quarantine clearance, port handling, safety inspections, and registration can further inflate the total expense, often doubling the original purchase price. These financial barriers make EVs less accessible to the average consumer in PNG, hindering widespread adoption despite the environmental benefits.

3.2.2.2 Non-financial barriers

(a) Policy, Legal, and Regulatory

(i) Absence of specific policy direction to drive EV transition

PNG has yet to establish a clear national strategy to guide the transition to EVs. There are no defined targets for EV adoption, nor are there supportive policy instruments such as tax incentives, subsidies, or public procurement commitments to stimulate market demand.

(ii) Lack of legal and regulatory framework to support the adoption and integration of EVs

PNG does not have a dedicated regulatory framework to support the adoption and integration of EVs. There are no laws or binding standards in place to govern key aspects such as EV safety, charging infrastructure, battery disposal, or vehicle emissions. The lack of legal provisions also extends to areas

like vehicle classification and registration, which are essential for distinguishing EVs from conventional vehicles and enabling appropriate incentives or compliance measures.

(b) Technical

(i) EVs unsuitable for long-distance travel or use in rural areas

Electric vehicles are unsuitable for long-distance travel or use in rural areas of PNG due to the lack of charging infrastructure and the limited range of many EV models. With few charging stations outside urban centres, drivers face the risk of running out of battery on long trips or in remote regions. Additionally, the country's rugged terrain, poor road conditions, and frequent power outages further reduce the practicality of EVs in rural areas. Until reliable charging networks and more suitable vehicle designs are introduced, EV adoption in these regions will remain challenging.

(ii) Lack of charging Infrastructure

PNG has very limited public and private EV charging stations, especially outside major urban areas. The absence of fast-charging networks makes EV use impractical for long-distance travel or in rural regions.

(c) Networking

(i) Limited Public-Private Partnerships

In PNG, limited public-private partnerships (PPPs) hinder the development of essential infrastructure and services needed to support EV adoption. While the government plays a crucial role in policy-making, there is a lack of collaboration with the private sector to invest in critical areas like charging stations, battery exchange facilities, and maintenance networks.

(ii) Fragmented Stakeholder Engagement

In PNG, fragmented stakeholder engagement significantly hampers the transition to EVs. Key sectors like energy, transport, and urban planning often work in isolation, with limited collaboration or coordination on EV-related policies and infrastructure development. This lack of alignment between the government, the private sector, and other relevant stakeholders results in missed opportunities to create a cohesive strategy for EV adoption

(d) Institutional and Organizational Capacity Barriers

(i) Limited Government Capacity

The government lacks dedicated departments or units focused on the promotion and regulation of electric vehicles. There is insufficient technical expertise within key institutions to develop and enforce policies, regulations, and standards for EVs, making it difficult to create a supportive environment for EV adoption.

(ii)Lack of Skilled Workforce

There is a shortage of trained professionals in both the public and private sectors who can manage, service, and maintain EVs. From mechanics to engineers, the workforce lacks the necessary skills to support EV infrastructure and vehicles, which makes it difficult to sustain the EV market in PNG.

(e) Social, Cultural, and Gender Barriers

(i) Limited Access for Women and Marginalized Groups

Women and people in rural or marginalized communities often have less access to transportation in general, and even less to emerging technologies like EVs. High upfront costs and limited financing options disproportionately affect women, who typically have lower income and financial independence in PNG.

(ii) Resistance to Change and Technological Adoption

Cultural norms and traditional ways of life in many PNG communities value continuity and are cautious toward unfamiliar technologies. This can lead to resistance or slow adoption of EVs, particularly where trust in new systems has not been established through outreach or demonstration projects.

(f) Information and Awareness Barriers

(i) Low Public Awareness and Acceptance

Many people in PNG are unfamiliar with EV technology, leading to skepticism and mistrust about its reliability, safety, and practicality. Cultural preferences for familiar, rugged, fuel-powered vehicles—especially in rural and highland areas, make communities less open to adopting new, unfamiliar technologies.

(ii) Limited Media Coverage

Local media rarely cover developments in EV technology or related policies, missing an opportunity to shape public opinion and increase awareness through accessible channels.

3.2.3 Identified measures

A similar process for identifying the barriers of electric vehicles was also applied to identifying the measures. This was also done in the same facilitative workshop that was conducted to identify the barriers. Table 10 below outlines the measures for each barrier identified.

Table 10: List of identified measures and corresponding score

No	Broad Categories of Barriers	Identified Barrier	Score
A	Economic and Financial		
1		Facilitate access to green financing or low-interest loans for EV buyers	4
2		Create a mechanism to evaluate the high cost of importing EVs	5

B	Policy, Legal, and Regulatory		
1		Develop a specific policy direction to drive EV Transition	5
2		Develop a legal and regulatory framework to support the adoption and integration of EVs	5
C	Technical		
1		Invest in expanding EV charging infrastructure along key highways and in rural hubs	5
2		Establish a national EV charging infrastructure development plan	5
D	Networking		
1		Establish a dedicated EV Public-Private Partnerships task force or coordination unit	5
2		Develop and implement a national EV stakeholder platform or coordination forum	5
E	Institutional and Organizational		
1		Establish a dedicated EV unit within the relevant ministry or agency	5
2		Launch a national EV training and certification program	5
F	Social, Cultural, and Gender Barriers		
1		Develop and roll out gender-responsive and inclusive EV support programs	3
2		Implement nationwide awareness and demonstration campaigns	5
G	Information and Awareness Barriers		
1		Launch a comprehensive public education campaign	4
2		Establish partnerships with key media outlets and influencers	4

The score of Measure:

1: Not Very Significant

2: Not Significant

3: Moderate

4: Significant

5: Very Significant

3.2.3.1 Economic and financial measures

(i) Facilitate access to green financing or low-interest loans for EV buyers

To encourage the adoption of electric vehicles (EVs), it is essential to facilitate access to green financing or low-interest loans for potential EV buyers. This can be achieved by partnering with financial institutions to offer tailored loan products that make EVs more affordable, especially for individuals and businesses in lower-income brackets. Additionally, the government could provide subsidies or interest rate reductions to further reduce the financial burden.

(ii) Create a mechanism to evaluate the high cost of importing EVs

To evaluate the high cost of importing EVs, establish a multi-stakeholder committee including government, industry experts, and financial institutions to assess import duties, taxes, and logistical costs.

3.2.3.2 Non financial measures

(a) Policy, Legal, and Regulatory

(i) Develop a specific policy direction to drive EV Transition

To drive the EV transition, a specific policy should be developed offering tax incentives, rebates, and low-interest loans for EV buyers, while expanding charging infrastructure and supporting local manufacturing. Introduce mandatory EV adoption targets and gradually phase out internal combustion engine vehicles, backed by nationwide awareness campaigns.

(ii) Develop a legal and regulatory framework to support the adoption and integration of EVs

Establish a regulatory framework that includes tax incentives, EV registration quotas, and charging infrastructure standards, alongside emission reduction targets and a phased ban on ICE vehicle sales.

(b) Technical

(i) Invest in expanding EV charging infrastructure along key highways and in rural hubs

Invest in a nationwide network of fast and standard EV charging stations along key highways and in rural areas to ensure easy access for long-distance travel and underserved regions.

(ii) Establish a national EV charging infrastructure development plan

Establish a national EV charging infrastructure development plan that outlines key goals, such as expanding charging stations across urban areas, highways, and rural hubs. This plan should include public-private partnerships, clear technical standards, and incentives for both private companies and local governments to build and maintain charging networks, ensuring broad accessibility and renewable energy integration.

(c) Networking

(i) Establish a dedicated EV Public-Private Partnerships taskforce or coordination unit

Establish a dedicated EV Public-Private Partnerships (PPP) taskforce within the relevant government agency to facilitate collaboration between the public sector, private companies, and stakeholders. This unit will focus on identifying investment opportunities, creating joint funding models, and streamlining regulations to encourage private sector participation in EV infrastructure, manufacturing, and services.

(ii) Develop and implement a national EV stakeholder platform or coordination forum

Develop and implement a national EV stakeholder platform that brings together government agencies, industry leaders, NGOs, and academic institutions to collaborate on EV policies, infrastructure, and market development. The platform will facilitate regular consultations, information sharing, and joint planning to align strategies, address challenges, and drive the adoption of electric vehicles across the country.

(d) Institutional and Organizational Capacity Barriers

(i) Establish a dedicated EV unit within the relevant ministry or agency

Establish a dedicated EV unit within the relevant government ministry or agency to lead the development and implementation of EV-related policies, programs, and regulations. This unit will be responsible for coordinating EV initiatives, securing funding, engaging stakeholders, and ensuring effective policy execution to drive the transition to electric vehicles.

(ii) Launch a national EV training and certification program

Launch a national EV training and certification program in collaboration with technical institutions, industry leaders, and government agencies to build a skilled workforce in EV manufacturing, maintenance, and charging infrastructure. The program will provide certified training in key areas such as battery management, vehicle repair, and installation of charging stations, ensuring a workforce ready to support the growing EV sector

(e) Social, Cultural, and Gender Barriers

(i) Develop and roll out gender-responsive and inclusive EV support programs

Develop and roll out gender-responsive and inclusive EV support programs that specifically target women, youth, and marginalized communities. These programs will include tailored incentives, access to financing, training opportunities, and support for women-led businesses in the EV sector, ensuring equal participation and benefits in the transition to electric mobility.

(ii) Implement nationwide awareness and demonstration campaigns

Implement nationwide awareness and demonstration campaigns to educate the public on the benefits of EVs, focusing on cost savings, environmental impact, and available incentives. These campaigns will

feature test-drive events, media outreach, and community engagement activities to showcase EV technology and encourage widespread adoption.

(f) Information and Awareness Barriers

(i) Launch a comprehensive public education campaign

Launch a comprehensive public education campaign to raise awareness about the benefits of EVs, including environmental impact, cost savings, and government incentives. The campaign will utilize social media, traditional media, community events, and partnerships with local influencers to reach diverse audiences and promote the transition to electric vehicles.

(ii) Establish partnerships with key media outlets and influencers

Establish partnerships with key media outlets and influencers to create engaging content that highlights the benefits, success stories, and real-life experiences of EV users. This approach will help increase visibility, build public trust, and accelerate the acceptance and adoption of electric vehicles across different communities.

3.3 Linkages of the barriers identified

Electric vehicle was the only feasible and prioritised technology for the transport sector, as agreed by the stakeholders. Therefore, only the barriers for EVs were identified, and thus, there is no need to make linkages with barriers of other technologies in the transport sector.

3.4 Enabling framework for overcoming the barriers in the Transport Sector

To effectively tackle the barriers that hinder the adoption of prioritized technologies in the transportation sector, it is essential to develop an enabling framework that promotes the increase in penetration of EVs. Below are four main enabling frameworks that have been identified.

1. A dedicated policy should be created that provides tax incentives, rebates, and low-interest loans for electric vehicle (EV) purchasers, alongside efforts to expand charging infrastructure and promote local EV manufacturing. The policy should also introduce mandatory EV adoption goals and progressively phase out internal combustion engine vehicles, supported by nationwide awareness campaigns to drive public understanding and participation.

2. A specialized EV Public-Private Partnerships (PPP) task force should be set up within the appropriate government agency to foster collaboration between the public sector, private companies, and other stakeholders. This unit will concentrate on identifying investment opportunities, developing joint funding models, and simplifying regulations to encourage private sector involvement in EV infrastructure, manufacturing, and related services.

3. A dedicated EV unit should be created within the relevant government ministry or agency to oversee the development and execution of EV policies, programs, and regulations. This unit will be tasked with coordinating EV-related initiatives, securing

funding, engaging stakeholders, and ensuring the successful implementation of policies to support the transition to electric vehicles.

4. Form partnerships with prominent media outlets and influencers to produce compelling content that showcases the benefits, success stories, and real-life experiences of EV users. This strategy will boost visibility, foster public trust, and speed up the acceptance and adoption of electric vehicles within diverse communities.

Chapter 4 LULUCF Sector

PNG is home to the third-largest tropical rainforest in the world, following the Amazon and the Congo basins. This rainforest is part of the island of New Guinea, which is shared by PNG and Indonesia.

In 2015, PNG's forest cover was estimated to be 78% (About 35.949 million hectares) of the total national area. The average annual deforestation rate was 0.07% for the period between 2009 and 2013, and it increased to 0.08% for the period 2014-2018 (GoPNG, 2017), which qualifies PNG as a High Forest Cover, Low Deforestation (HFLD) country. The remaining 10.2 million (22%) are cropland, grassland, settlement, wetland and other land uses (Table 11). Cropland is the second major land use, with 5.2 million hectares (11.22%), followed by grassland (2.4 million hectares or 5.27%), wetland (2.1 million hectares or 4.61%), settlement (0.4 million hectares or 0.88%), and other (0.059 million hectares or 0.13%).

Table 11: PNG Land Use Composition in 2018

Land use type	2018 (hectares)
Forest land	35,949,057.11
Cropland	5,179,577.88
Grassland	2,432,933.95
Wetlands	2,129,628.98
Settlements	404,290.72
Other land	59,277.17

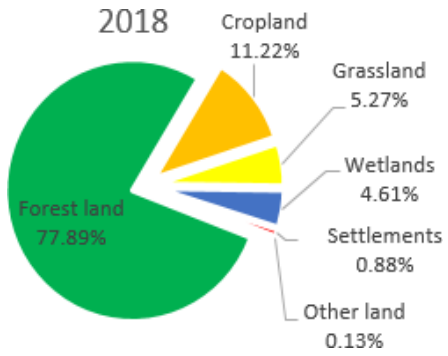


Figure 1:Land Use in PNG (2018)

Drivers of deforestation and forest degradation in PNG

Deforestation between 2000 and 2015 affected 261,528 hectares in PNG, resulting in average annual emissions of over 5 Mt CO_2e. The main cause of deforestation has been the conversion of forestland into cropland, which accounts for 87% of the total deforestation. Shifting agriculture is responsible for 63% of the deforested land, while commercial agricultural developments, particularly oil palm plantations, account for 30% of the clearing.

The impact of commercial agriculture has significantly increased since 2000, due to the rapid expansion of SABLs. Only a small portion of the 5.1 million hectare leases, have initiated activities, and

there has been an official moratorium followed by a subsequent suspension of many of them, although some logging and land conversion have still occurred.

These trends are closely tied to ongoing population growth, which has an annual growth rate of 3.1% and is likely to continue in the coming years. The demand for agricultural products driven by population growth will likely be a significant factor in forest cover conversion into shifting and permanent cropland.

Between 2000 and 2015, forest degradation affected approximately 2.5 million hectares, leading to average annual emissions of around 25 $MtCO_2e$. A significant 98.1% of these emissions were attributed to commercial logging.

This trend is expected to persist, primarily due to the area of forests currently under actual or potential concessions, which covers 8.6 and 8.4 million hectares, respectively. Since 2008, the impact of clearing to prepare land for future agricultural development in Special Agriculture Business Lease (SABL) areas has increasingly contributed to forest degradation.

Despite the ambitious goals outlined in Vision 2050, efforts to improve forest cover through reforestation and forest rehabilitation activities have been limited. The plan, as mentioned in the NRS, aims to establish 800,000 hectares of forest plantations by the middle of this century. As described in the NRS, the PNGFA estimates that approximately 60,000 hectares have been reforested so far, with a target of an additional 20,000 hectares to be achieved by 2030.

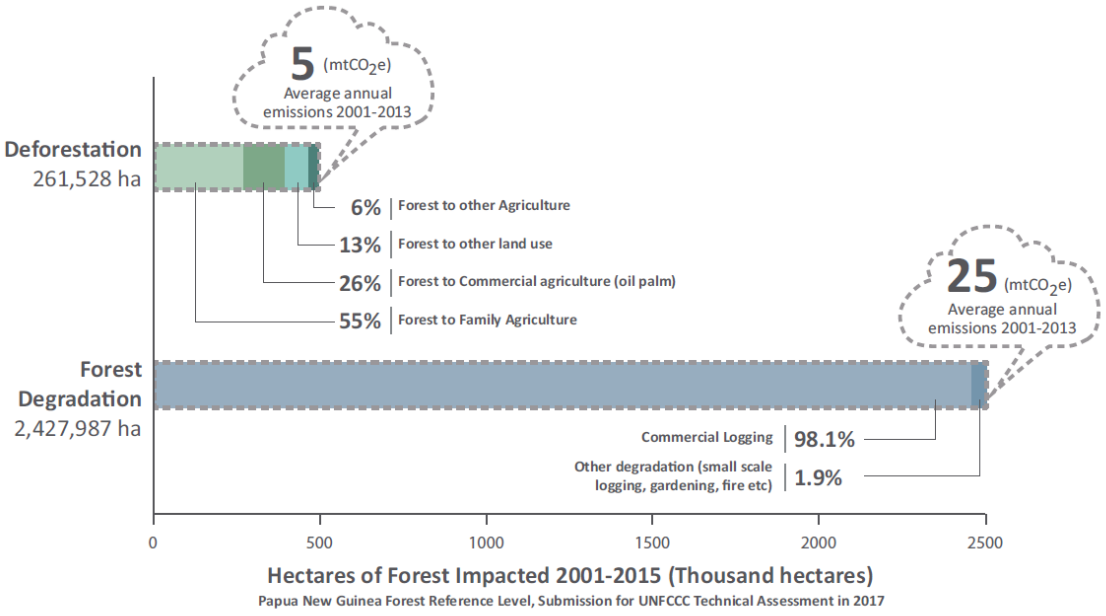


Figure 2: Drivers of deforestation and forest degradation impact in PNG. Source: PNG National REDD+ Strategy

Like other Small Island Developing States (SIDS), PNG has contributed minimally to global greenhouse gas (GHG) emissions but remains highly vulnerable to the adverse impacts of climate change. Coastal communities, which house the majority of the population, are at increasing risk from sea-level rise, saltwater intrusion, and the resulting threats to agriculture, freshwater availability, and food security.

To respond to these challenges and strengthen its LULUCF-sector mitigation strategies, PNG has prioritised a set of mitigation technologies through national consultations, expert input, and multi-criteria analysis processes conducted as part of the Technology Needs Assessment. The prioritised technologies including the scores and rankin are in Table 12 below.

Table 12: Prioritised Mitigation Technologies for the LULUCF Sector in PNG

Technology Options	Total Score	Ranking

Reduced Deforestation and Forest Degradation	72.82	1
Reforestation and Rehabilitation	66.03	3
Sustainable Land Use Planning	65.45	2

4.1 Preliminary targets for technology transfer and diffusion in the LULUCF Sector

PNG has some of the largest remaining tropical forests in the world but these forests are under growing pressure from commercial agriculture, subsistence agriculture, and commercial logging. In the years 2011, 2013, 2014 and 2015 the LULUCF sector was a net source. Then in 2016 and 2017 the LULUCF sector became a net sink due to decrease in logging and agriculture activities. The BUR2 reports that net emissions from the LULUCF sector were -12,724.94 kt CO_2 eq in 2017, down from -20,488.12 kt CO_2 eq in 2000, reflecting a total reduction in removals of -7,763.18 kt CO_2 eq.

Despite these pressures, PNG has committed to reversing forest loss and enhancing carbon sequestration through initiatives like REDD+, sustainable forest management, and forest conservation. The Enhanced NDC sets a national target to reduce emissions from deforestation and forest degradation by 10,000 kt CO_2eq per year by 2030, and to promote reforestation, afforestation, and sustainable forest management practices.

Much of PNG's land is classified as customary land, often under communal ownership, and typically characterised by a mosaic landscape of primary forest, secondary growth, fallow land, and subsistence farms. These landscapes are vulnerable to degradation from human activities, which not only contribute to GHG emissions but also impact biodiversity, soil fertility, water quality, and food availability.

PNG's soils have also suffered from years of shifting agriculture, particularly slash-and-burn, which reduces organic matter and nutrient retention. These practices have degraded large areas of formerly productive land, making them less resilient to climate change.

To address these challenges, PNG's approach to technology transfer and climate change mitigation in LULUCF sector aligns with targets and actions identified within the National Climate-Compatible Development Management Policy, National REDD+ Strategy, MTDP IV[1], Sustainable Development Goals (SDG), the PNG SDG13 Roadmap, Enhanced NDC 2020, and key sector policies and plans such as the National Forest Policy, National Sustainable Land Use Policy and the AFOLU Mitigation Plan.

The Enhanced NDC Implementation Plan (2021-2030) identifies five actions to help reduce emissions and enhanced removals from the LULUCF sector:

- Enhance monitoring and enforcement of timber legality standard;
- Regulate small-scale timber (>500m3 pa);
- Enhance supply of planted timber and reforestation;
- Establish enhanced policy environment for forest governance; and
- Establish a transition package for 'old' timber concessions.

These actions could deliver around 54,000 kt CO_2 eq in emission reduction and removals by 2030 against 2015 levels. In this context, the TNA process will identify priority technologies and develop enabling conditions for their diffusion. This includes building capacity, improving access to finance,

[1] PNG Medium Term Development Plan IV (2023–2027)

and addressing institutional and regulatory barriers to promote low-carbon, climate-resilient development across PNG's LULUCF sector.

From the list of prioritized technologies outlined in Table 12 above, stakeholders agreed by consensus to select Reduced Deforestation and Forest Degradation as the feasible technology for the LULUCF sector.

Table 13: Framework for Technology Prioritisation and Target Setting in PNG's LULUCF Sector

No	Prioritised Technology	Category
1	Reduced Deforestation and Forest Degradation	Other non-market goods

The preliminary targets for technology transfer and diffusion in the LULUCF sector are outlined in Table 14 below.

Table 14: Preliminary targets for the LULUCF sector

No	Prioritised Technology	Target
1	Reduced Deforestation and Forest Degradation	• 70 provincial forestry and environment officers are trained in forest monitoring, enforcement, and GIS applications • Mobilise USD 50 million in REDD+ financing to support sustainable forest management and community incentives by 2030 • Reduce national deforestation and forest degradation by at least 25 percent by 2030 compared to the 2015 baseline

4.2 Barrier analysis and possible enabling measures for Reduced Deforestation and Forest Degradation

The diffusion barriers and enabling measures for the "Reduced Deforestation and Forest Degradation" technology were discussed and prioritised during stakeholder consultation workshops involving CCDA, PNGFA, DLPP, DAL, Private sector, NGOs, and Research Institutions. Expert interviews and a review of relevant policies, including the National REDD+ Strategy, National Forest Policy and National Sustainable Land Use Policy, were conducted to deepen understanding. A problem tree was also developed to support the identification of key barriers and appropriate enabling measures.

4.2.1 General description of Reduced Deforestation and Forest Degradation

Reduced Deforestation and Forest Degradation is a vital mitigation technology for PNG, where approximately 78% of the land area is covered by forests, most of which are under customary ownership. This approach promotes the conservation, sustainable management, and restoration of forest ecosystems, thereby reducing GHG emissions and enhancing carbon sequestration. It also supports biodiversity conservation, watershed protection, and the sustainability of forest-dependent livelihoods.

The technology addresses key drivers of forest loss such as illegal logging, unsustainable agriculture, and infrastructure expansion by promoting land-use planning, sustainable forest management (SFM), and stricter enforcement of forestry regulations. A central component of REDD+ is the establishment of robust forest monitoring systems that integrate remote sensing, Geographic Information Systems (GIS), and field-based data collection to assess forest cover, degradation, and carbon stocks over time.

In PNG, institutions such as the CCDA and the PNGFA are working to build national capacity for monitoring, reporting, and verification (MRV) of forest emissions and removals. Data collection systems, which include Collect Earth and National Forest Inventory (NFI) are being developed to include not only forest area and biomass, but also non-timber forest products, biodiversity indicators, and socio-economic information relevant to local communities and customary landowners. These systems rely on a combination of aerial data interpretation and structured field surveys, including the use of cluster plots and stratified sampling techniques.

REDD+ contributes directly to PNG's NDC by reducing emissions from the LULUCF sector. Forest conservation and restoration enhance carbon sinks by sequestering CO_2 through increased biomass and improved soil organic carbon. Rehabilitating degraded lands through reforestation and community-based conservation further strengthens these carbon sinks and helps reverse historical forest degradation.

In addition to climate benefits, REDD+ offers long-term economic opportunities such as sustainable timber harvesting, eco-tourism, and participation in carbon markets. Socially, it supports community resilience by involving landowners in conservation planning and enhancing forest-based livelihoods, an essential contribution in a country like PNG, where approximately 85% of the population depends on forests for their livelihoods[2]. Environmentally, REDD+ helps maintain biodiversity, prevents soil erosion, protects watersheds, and safeguards critical habitats for native species.

4.2.2 Identification of barriers for Reduced Deforestation and Forest Degradation

The process of identifying barriers to the adoption of Reduced Deforestation and Forest Degradation in two key stages, following the methodology recommended in the TNA Guidance Handbook. The first stage involved a desk-based screening of potential barriers through a review of existing literature, including relevant policy documents, regulatory frameworks, consultant reports, and other relevant sources. This initial review helped establish a baseline understanding of the main challenges facing the deployment of the technology in PNG.

In the second stage, participatory national stakeholder consultation workshops were convened, including one-on-one meetings with the key TNA stakeholders, facilitated by the mitigation consultant and the national TNA team.

During this workshop, stakeholders were presented with six broad categories of barriers: 1. Economic and Financial; 2. Policy, Legal, and Regulatory; 3. Technical and Human Skills; 4. Institutional and

[2] https://www.aciar.gov.au/publication/aop2022/papua-new-guinea (2022)

Organizational; 5. Social, Cultural, and Gender; and 6. Information and Awareness. , Participants were invited to identify specific barriers under each category through a consensus-based process.

To prioritise the barriers, stakeholders collectively scored each one based on its severity, frequency, and the extent to which it limits technology uptake. The prioritised barriers and their scores are presented in Table 15 below. A problem tree analysis, illustrating the root causes and effects of the barriers for this technology, is provided in Annex I for further reference.

Table 15: List of identified barriers and corresponding score

No	Barrier Category	Identified Barriers	Score
A	Economic and Financial		
1		Heavy dependence on income from logging and subsistence agriculture, leading to forest conversion	5
2		Limited access to alternative and sustainable livelihood opportunities	4
3		Absence of strong financial incentives for forest conservation (e.g., PES, REDD+)	1
4		Lack of long-term, sustainable financing mechanisms for forest protection	3
B	Policy, Legal, and Regulatory		
1		Weak enforcement of forest protection laws and land-use regulations	3
2		Conflicting sectoral policies (e.g., agriculture, forestry, mining, and infrastructure)	4
3		Unclear land tenure and forest ownership rights, especially for customary landowners	4
4		Forest protection not adequately mainstreamed in national development strategies	2
C	Technical and Human Skills		
1		Limited technical capacity for forest inventory, monitoring, and GHG reporting	1
2		Shortage of trained personnel (e.g., forest rangers, GIS and remote sensing experts)	1
3		Underutilization of modern technologies for MRV and land-use change tracking	2
D	Institutional and Organizational		

1		Overlapping mandates and weak coordination among agencies managing land and forests	3
2		Insufficient implementation capacity at subnational and local levels	4
3		Limited partnerships between government, civil society, communities, and the private sector	3
E	Social, Cultural, and Gender		
1		Traditional land-use practices such as slash-and-burn agriculture contributing to deforestation	4
2		Gender inequalities in forest governance and benefit-sharing mechanisms	4
3		Cultural reliance on forest resources with minimal focus on sustainable management	4
F	Information and Awareness		
1		Low awareness of the long-term value and co-benefits of forest conservation	3
2		Limited communication of legal rights, conservation incentives, and programs	3
3		Inadequate exposure to success stories or models of sustainable forest and land management	4

The score of Barrier:

1: Not Very Significant

2: Not Significant

3: Moderate

4: Significant

5: Very Significant

4.2.2.1 Economic and financial barriers

a) Heavy Dependence on Logging and Subsistence Agriculture

A significant portion of PNG's economy and rural livelihoods is heavily reliant on logging and subsistence agriculture. In 2021, the country exported over 3 million cubic meters of logs, generating substantial revenue. However, customary landowners received only about $6 per cubic meter, equating to roughly 6% of the total log export revenues. Additionally, subsistence agriculture is the backbone of PNG's food production sector, contributing 25% to the Gross Domestic Product (GDP) and providing employment and income for the rural majority. This dependence on activities that often lead to forest conversion poses a challenge to conservation efforts.

b) Limited Access to Alternative and Sustainable Livelihood Opportunities

The lack of viable alternative livelihoods compels communities to engage in practices detrimental to forests. While initiatives like the Tree Kangaroo Conservation Program have introduced sustainable practices such as organic coffee farming, these programs are localized and not yet widespread. The absence of scalable and sustainable economic alternatives hinders the transition away from forest-degrading activities.

c) Absence of Strong Financial Incentives for Forest Conservation

Mechanisms like Payment for Ecosystem Services (PES) and REDD+ are designed to provide financial incentives for conservation. However, in PNG, the implementation of such schemes faces challenges. For instance, while the National REDD+ Benefit Sharing and Distribution Guidelines have been established, the actual distribution of benefits to local communities remains limited. This gap reduces the motivation for communities to engage in forest conservation.

d) Lack of Long-Term, Sustainable Financing Mechanisms for Forest Protection

Sustainable financing is crucial for the ongoing protection of forests. Currently, PNG lacks robust, long-term financing mechanisms dedicated to forest conservation. While there are projects like the Sustainable Financing of Papua New Guinea's Protected Area Network, which has a budget of USD $11.5 million, such initiatives are limited in scope and duration. The absence of enduring financial structures undermines the sustainability of conservation efforts.

4.2.2.2 Non-financial barriers

1. Policy, Legal, and Regulatory Barriers

a) Weak Enforcement of Forest Protection Laws and Land-Use Regulations

While PNG has established legal frameworks, such as the Forestry Act 1991, to regulate forest activities, enforcement remains a significant challenge. Instances of unauthorised logging and land-use changes persist, often due to limited resources and capacity within enforcement agencies. Additionally, the penalties stipulated for unlawful forest use are relatively low and may not serve as effective deterrents. This weak enforcement undermines efforts to reduce deforestation and forest degradation in the country.

b) Conflicting Sectoral Policies

PNG's economic development strategies often prioritise sectors like agriculture, mining, and infrastructure, which can conflict with forest conservation goals. For instance, the issuance of Special Agricultural Business Leases (SABLs) has led to large-scale deforestation under the guise of agricultural development, undermining forest protection efforts.

c) Unclear Land Tenure and Forest Ownership Rights

Approximately 97% of land in PNG is under customary tenure, governed by traditional laws and practices. The lack of formal documentation and clear legal recognition of these customary rights leads to disputes and challenges in implementing forest conservation initiatives, as landowners may be excluded from decision-making processes.

d) Inadequate Integration of Forest Protection in National Development Strategies

Forest conservation is not sufficiently mainstreamed into PNG's broader national development plans. This lack of integration results in limited allocation of resources and attention to forest protection, hindering the implementation of sustainable forest management practices.

2. Technical and Human Skill Barriers

a) Limited Technical Capacity for Forest Inventory, Monitoring, and GHG Reporting

PNG has made progress in developing its National Forest Monitoring System (NFMS) and National Forest Inventory (NFI). However, challenges persist in terms of local technical expertise and capacity to conduct comprehensive forest inventories and GHG reporting, which are essential for REDD+ implementation.

b) Shortage of Trained Personnel

There is a limited pool of skilled professionals, such as GIS and remote sensing experts, which hinders effective forest monitoring and management. This gap in human resources limits the country's ability to implement and sustain forest conservation programs.

c) Underutilisation of Modern Technologies for MRV and Land-Use Change Tracking

Modern tools and technologies for Measurement, Reporting, and Verification (MRV) and land-use change tracking are underutilized. This limits the efficiency and accuracy of monitoring deforestation and forest degradation.

3. Institutional and Organisational Capacity Barriers

a) Overlapping Mandates and Weak Coordination Among Agencies

Multiple government agencies in PNG have overlapping responsibilities concerning land and forest management, leading to coordination challenges. This fragmentation results in inefficiencies and conflicts in policy implementation and enforcement.

b) Insufficient Implementation Capacity at Subnational and Local Levels

Provincial and local government bodies often lack the necessary resources, training, and authority to effectively implement forest conservation policies. This deficiency hinders the translation of national strategies into actionable plans at the community level.

c) Limited Partnerships Between Government, Civil Society, Communities, and the Private Sector

Collaboration among various stakeholders is essential for successful forest conservation. However, in PNG, partnerships between government entities, non-governmental organisations, local communities, and the private sector are limited, reducing the effectiveness and reach of conservation initiatives.

4. Social, Cultural, and Gender Barriers

a) Traditional Land-Use Practices Contributing to Deforestation

Practices such as slash-and-burn agriculture, deeply rooted in PNG's cultural traditions, contribute to deforestation and forest degradation. Changing these practices requires culturally sensitive approaches and community engagement.

b) Gender Inequalities in Forest Governance and Benefit-Sharing Mechanisms

Women in PNG often have limited participation in forest governance and decision-making processes, despite their significant roles in forest resource utilisation. This gender disparity affects the equitable distribution of benefits from forest conservation programs and undermines the inclusivity of such initiatives.

c) Cultural Reliance on Forest Resources with Minimal Focus on Sustainable Management

Forests are integral to the cultural and subsistence needs of many PNG communities. However, this reliance often lacks an emphasis on sustainable management practices, leading to overexploitation and degradation of forest resources.

5. Information and Awareness Barriers

a) Low Awareness of the Long-Term Value and Co-Benefits of Forest Conservation

Many communities and stakeholders in PNG are unaware of the long-term ecological and economic benefits of forest conservation, such as biodiversity preservation, climate regulation, and sustainable livelihoods. This lack of awareness hinders community support for conservation efforts.

b) Limited Communication of Legal Rights, Conservation Incentives, and Programs

Information regarding legal rights, available conservation incentives, and programs like REDD+ is not effectively disseminated to local communities. This communication gap prevents stakeholders from fully engaging in and benefiting from forest conservation initiatives.

c) Inadequate Exposure to Success Stories or Models of Sustainable Forest and Land Management

Sharing successful examples of sustainable forest management can inspire and guide communities in adopting similar practices. However, such success stories are not widely shared or accessible in PNG, limiting opportunities for learning and replication.

4.2.3 Identified measures

This section outlines the key economic, financial, and non-financial measures identified by the PNG TNA team in consultations with the TNA stakeholders to address the primary barriers to implementing the Reduced Deforestation and Forest Degradation technology in PNG. The process was led by the Mitigation Consultant in close collaboration with the TNA Coordinator and CCDA. The measures were informed by a root cause analysis derived from a problem tree. The table below outlines the measures for each barrier identified.

Table 16: Identified Measures to Address Barriers to Reduced Deforestation and Forest Degradation

No	Broad Categories of Measures	Measures Description	Score
A	Economic and Financial		
1		Provide financial incentives for forest conservation and sustainable land use (e.g., Payments for Ecosystem Services)	4
2		Support alternative livelihoods to reduce dependency on forest resources	4
3		Mobilise climate finance and REDD+ results-based payments to support forest protection	4
4		Encourage private sector investment in sustainable forest enterprises	4
B	Policy, Legal, and Regulatory		
1		Strengthen enforcement of forest protection laws and penalties for illegal logging and land clearing	4

2		Harmonise land use and forestry policies to reduce overlapping mandates and conflicting priorities	4
3		Recognise customary land rights and integrate them into forest governance frameworks	4
C	Technical and Human Skills		
1		Build capacity of local communities and forestry officials in sustainable forest management practices	2
2		Provide technical training on forest monitoring, GIS, and remote sensing	3
3		Enhance skills in reforestation and forest restoration techniques	3
D	Institutional and Organizational Capacity Barriers		
1		Strengthen coordination among forestry, environment, and land agencies	4
2		Establish or improve forest monitoring systems and reporting structures	2
3		Develop institutional frameworks for REDD+ implementation and benefit-sharing	2
E	Social, Cultural, and Gender Barriers		
1		Promote community-based forest management that incorporates traditional knowledge	3
2		Ensure gender equality in decision-making processes and access to forest resources	4
3		Address social drivers of deforestation, such as population pressure and land tenure disputes	4
F	Information and Awareness Barriers		
1		Conduct awareness campaigns on the value of forests and the impacts of deforestation	4
2		Improve access to information on forest governance, land rights, and environmental policies	4
3		Support education programs at all levels to instill environmental values and sustainable land practices	4

The score of Measure:

1: Not Very Significant

2: Not Significant

3: Moderate

4: Significant

5: Very Significant

4.2.3.1 Economic and financial measures

i. Provide financial incentives for forest conservation and sustainable land use.

Provide financial incentives for the forest conservation introduced and scale up mechanisms such as Payments for Ecosystem Services (PES) and conditional transfers to incentivize forest conservation by local communities and landowners. Such financial incentives can compensate for the opportunity costs of avoided deforestation.

ii. Support alternative livelihoods to reduce forest dependency.

Develop and finance alternative income-generating activities such as eco-tourism, agroforestry, and sustainable agriculture to decrease reliance on forest extraction, especially in rural and forest-adjacent communities.

iii. Mobilise climate finance and REDD+ result-based payments.

Assess international climate finance from the Green Climate Fund and other sources to support REDD+ implementation, including forest monitoring, restoration, and livelihood enhancement programs.

iv. Attract private sector investment in sustainable forest enterprises.

Promote partnerships with the private sector for sustainable forestry operations, including value-added wood processing, bamboo production, and sustainable timber certification schemes.

4.2.3.2 Non financial measures

(a) Policy, Legal and Regulatory Measures

(i) Strengthen enforcement of the forest protection laws.

Enhance the capacity of enforcement agencies to combat illegal logging and land clearing, including through satellite monitoring, on-ground patrolling, and stricter penalties.

(ii) Harmonise land use and forestry policies.

Address overlapping mandates and policy inconsistencies by aligning national policies on forestry, land, environment, and agriculture under an integrated land use planning framework.

(iii) Recognise and formalise customary land rights.

Work with local landowners and communities to integrate customary land tenure into national forest governance frameworks, supporting participatory land use mapping and legal recognition.

(b) Technical and Human Skill Development Measures

(i) Build capacity in sustainable forest management

Deliver hands-on training to provincial forestry officers and landowners on sustainable forest harvesting, fire prevention, and ecosystem-based forest management.

(ii) Improve technical skills in forest monitoring

Provide targeted training on the use of geographic information systems (GIS), remote sensing, drones, and forest inventory tools to strengthen PNG's forest monitoring systems.

(iii) Enhance skills in reforestation and forest restoration

Promote technical know-how on native species reforestation, enrichment planting, and rehabilitation of degraded forest lands through nurseries and demonstration sites.

(c) Institutional and Organisational Capacity Measures

(i) Strengthen inter-agency coordination

Establish a coordination mechanism involving the CCDA, PNG Forest Authority, Department of Lands and Physical Planning, and CEPA to harmonize forest-related programs.

(ii) Improve forest monitoring and reporting systems

Develop and operationalize a national forest monitoring system (NFMS) integrated with the national GHG inventory and accessible to stakeholders at all levels.

(iii) Establish REDD+ implementation and benefit-sharing frameworks

Develop clear institutional arrangements for REDD+ implementation, including a transparent and equitable benefit-sharing mechanism that ensures incentives reach communities and landowners.

(d) Social, Cultural and Gender Measures

(i) Promote community-based forest management (CBFM)

Scale up CBFM programs that integrate traditional knowledge and customary practices, with clear roles for clans and landowner groups in decision-making and monitoring.

(ii) Ensure gender equity in forest governance

Implement policies and programs that promote the active participation of women in forest governance, ensuring equal access to forest resources and capacity-building opportunities.

(iii) Address social drivers of deforestation

Develop integrated programs that tackle underlying social issues such as population growth, urban expansion, and land tenure disputes that contribute to forest degradation.

(e) Information and Awareness Measures

(i) Conduct public awareness campaigns on forest value

Launch nationwide campaigns using radio, schools, and social media to promote the economic, ecological, and cultural value of forests, and the long-term risks of deforestation.

(ii) Improve access to forest governance and land rights information

Create publicly accessible platforms for sharing information on forest laws, land tenure arrangements, and REDD+ activities, particularly in rural communities.

(iii) Integrate forest education in the school curricula

Support the incorporation of forest and climate change education into primary, secondary, and tertiary curricula to build a generation of environmentally conscious citizens.

4. 3 Linkages of the barriers identified

Reduced Deforestation and Forest Degradation was the only feasible and prioritised technology identified for the LULUCF sector by stakeholders. As such, only the barriers related to this technology were assessed. Therefore, there are no linkages to be made with barriers from other technologies within the LULUCF sector.

4.4 Enabling framework for overcoming the barriers in LULUCF

To effectively overcome the barriers hindering the implementation of technologies that reduce deforestation and forest degradation in PNG, an enabling framework is needed to address financial, institutional, technical, policy, social, and informational challenges. Below are six main enabling frameworks that have been identified:

1. Establishing financial incentives and alternative livelihood programs is critical to address economic and financial constraints. This includes implementing PES schemes and REDD+ to compensate landowners and communities for conserving forests. Alongside this, support for sustainable income-generating activities such as agroforestry, eco-tourism, and climate-smart agriculture can reduce dependency on logging or forest conversion. Mobilising climate finance, particularly from REDD+ results-based payments and the Green Climate Fund (GCF), will be essential to support these programs. Furthermore, encouraging private sector investment in sustainable forest-based enterprises like certified timber and non-timber forest products will contribute to economic diversification while preserving forest cover.

2. Strengthening policy coherence and legal frameworks is necessary to eliminate conflicting mandates and improve forest governance. This includes improving law enforcement capacity through the use of technologies such as satellite monitoring, ground-based forest monitoring, and the imposition of stricter penalties for unauthorised logging and land clearing. A comprehensive review and harmonisation of forestry, agriculture and land use policies is needed to ensure aligned objectives. Additionally, recognising and protecting customary land ownership is also key since most forests are owned by communities. This can be done through land mapping and legal recognition processes, giving landowners more power and responsibility in managing forests.

3. Investing in technical capacity-building and knowledge transfer will help overcome skill and information gaps. This involves providing structured training programs for community members, provincial forest officers, and other relevant stakeholders in areas such as sustainable forest management, GIS, remote sensing, and reforestation. On-the-ground demonstration projects can offer practical learning experiences. Building capacity in using modern forest monitoring technologies such as drones, satellite data platforms, and forest inventory tools will significantly enhance PNG's ability to monitor forest cover and verify emissions reductions under REDD+ and other climate frameworks.

4. Enhancing institutional coordination and governance systems is crucial to addressing organisational barriers. The establishment of an inter-agency coordination body or enhancement of existing ones comprising the CCDA, PNGFA, CEPA, DAL, and the DLPP will improve cross-sectoral collaboration and streamline forest-related interventions. Strengthening REDD+ institutional frameworks, including the development of transparent benefit-sharing mechanisms, will ensure that local communities and customary landowners are equitably rewarded. Additionally, there is also a need for a strong national forest monitoring system that tracks forest changes and emissions in a transparent and accessible way which will enhance transparency, accountability, and informed decision-making.

5. Scaling up inclusive, community-based forest management (CBFM) will help address social and cultural barriers. Integrating traditional ecological knowledge and customary practices into forest governance enhances local ownership and sustainability. Promoting gender equity by ensuring that women participate in forest decision-making processes and access forest-related benefits is also vital. Broader social drivers of deforestation, such as land disputes, population pressures, and infrastructure development, should be addressed through participatory land-use planning, community engagement, and conflict resolution initiatives.

6. Implementing nationwide awareness and environmental education campaigns will overcome information and knowledge barriers. This includes designing communication strategies using local languages, radio, social media, and school-based programs to inform citizens about the importance of forests, the threats they face, and the benefits of conservation. Improving access to legal and technical information on land tenure, forest rights, and conservation initiatives, especially in rural and forest-dependent communities, will empower stakeholders to take informed action. Embedding environmental education in the formal school curriculum will cultivate a generation of environmentally responsible citizens committed to protecting PNG's forests.

Chapter 5 Conclusion

PNG faces multifaceted barriers across its key sectors, mainly energy, transport, and forestry, that impede the adoption of sustainable technologies critical to its climate, health, and development goals. In the energy sector, the adoption of biomass gasification cook stoves, an essential clean cooking technology, is constrained by financial, technical, institutional, social, and informational obstacles. The transport sector grapples with high upfront costs and infrastructural challenges, slowing EV uptake. In forestry, economic dependency on logging, weak governance, unclear land tenure, and limited technical capacity fuel ongoing deforestation and forest degradation.

To address these challenges holistically, PNG requires a robust enabling framework emphasizing financial incentives, coherent policies, capacity building, institutional coordination, and broad-based social engagement.

In the energy sector, promoting biomass gasification cook stoves requires targeted subsidies, micro-financing, and regional hubs to improve access. A strong policy and legal framework should set quality and safety standards and incentivize stakeholders. Establishing a dedicated government unit, fostering public-private partnerships, and creating multi-stakeholder platforms will enhance coordination. Building community feedstock centers, national training programs, and gender-sensitive outreach campaigns will boost capacity and equitable adoption, while media partnerships will strengthen awareness and trust nationwide.

For the transport sector, implementation of targeted EV policies featuring tax incentives, low-interest loans, and phased internal combustion engine vehicle phase-outs will accelerate EV penetration. Establishing dedicated government units and PPPs will improve coordination, while nationwide awareness campaigns and media engagement will foster public acceptance and demand.

In the forestry sector, strategies should include scaling up PES and REDD+ schemes, supporting alternative livelihoods such as agroforestry and climate-smart agriculture, mobilizing international climate finance, and strengthening private sector investment in sustainable forest enterprises. Harmonizing land use policies, formalizing customary land rights, enhancing law enforcement with modern monitoring technologies, and fostering inclusive community-based forest management are critical governance priorities.

List of References

Government of Papua New Guinea. (2025). *Technology Needs Assessment Report: Climate Change Mitigation Technologies in Energy, Transport, and LULUCF Sectors of PNG.* Port Moresby: Climate Change and Development Authority

Papua New Guinea Climate Change and Development Authority. (2022). *Papua New Guinea Action Plan for Enhanced Transparency Framework on AFOLU and REDD+ National Forest Monitoring System 2022-2025.* Port Moresby: Climate Change and Development Authority.

Papua New Guinea Climate Change and Development Authority. (2020). *Papua New Guinea Enhanced Nationally Determined Contribution*. Port Moresby: Climate Change and Development Authority.

Papua New Guinea Climate Change and Development Authority. (2019). *Papua New Guinea First Biennial Update Report to the UNFCCC*. Port Moresby: Climate Change and Development Authority.

Papua New Guinea Forest Authority. (2022). *Papua New Guinea Forest and Land Use Change Assessment 2019 Update*. Port Moresby: PNG Forest Authority

Papua New Guinea Climate Change and Development Authority. (2012). *Papua New Guinea National Inventory Report 2000-2017*. Port Moresby: Climate Change and Development Authority.

Papua New Guinea Climate Change and Development Authority. (2017). *Papua New Guinea National REDD+ Strategy 2017-2027*. Port Moresby: Climate Change and Development Authority.

Papua New Guinea Climate Change and Development Authority. (2021). *Papua New Guinea Revised Enhanced NDC 2020 Implementation Plan (2021–2030)*. Port Moresby: Climate Change and Development Authority.

Papua New Guinea Climate Change and Development Authority. (2022). *Papua New Guinea Second Biennial Update Report to the UNFCCC*. Port Moresby: Climate Change and Development Authority.

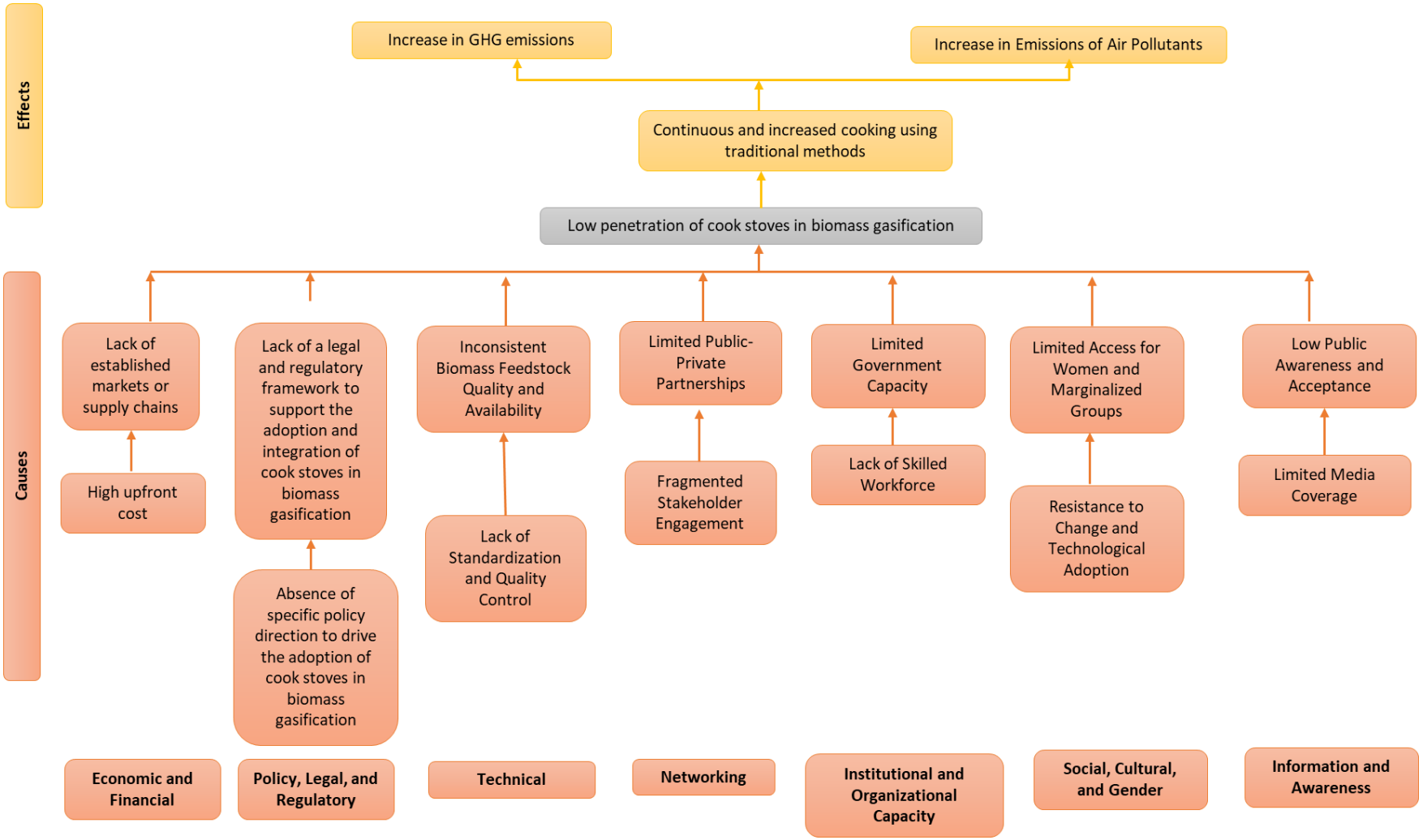
United Nations Environment Programme and Technology University of Denmark Partnership (UNEP DTU Partnership). (2019). *Guidelines for a gender-responsive Technology Needs Assessment*. Copenhagen: UNEP Copenhagen Climate Centre.

United Nations Environment Programme and Technology University of Denmark Partnership (UNEP DTU Partnership). (2019). *Guidelines for Technology Needs Assessments*. Copenhagen: UNEP Copenhagen Climate Centre.

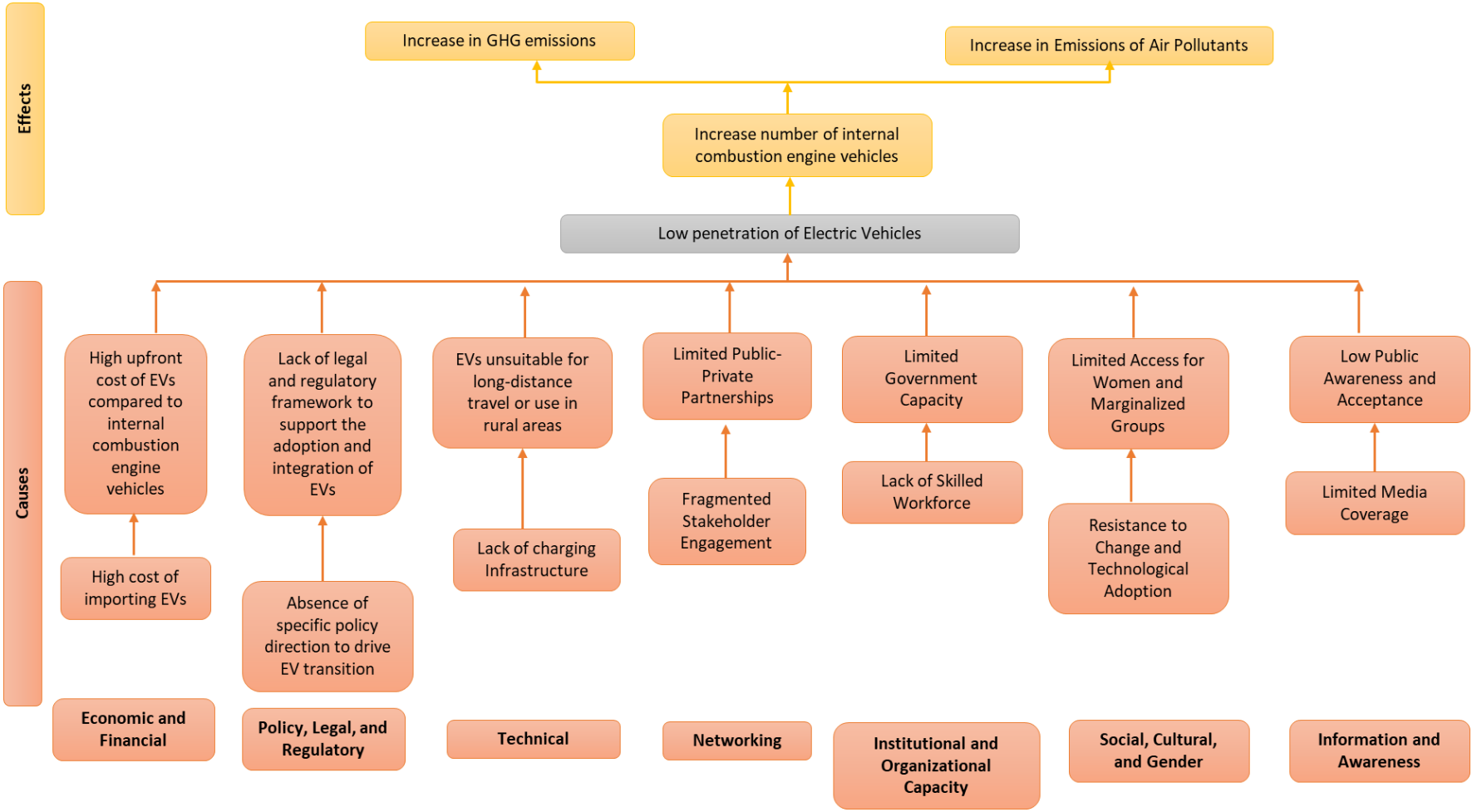
United Nations Environment Programme and Technology University of Denmark Partnership (UNEP DTU Partnership). (2018). *Overcoming Barriers to Transfer and Diffusion of Climate Technologies (Second Edition)*: Copenhagen: UNEP Copenhagen Climate Centre.

Annex I: Problem trees

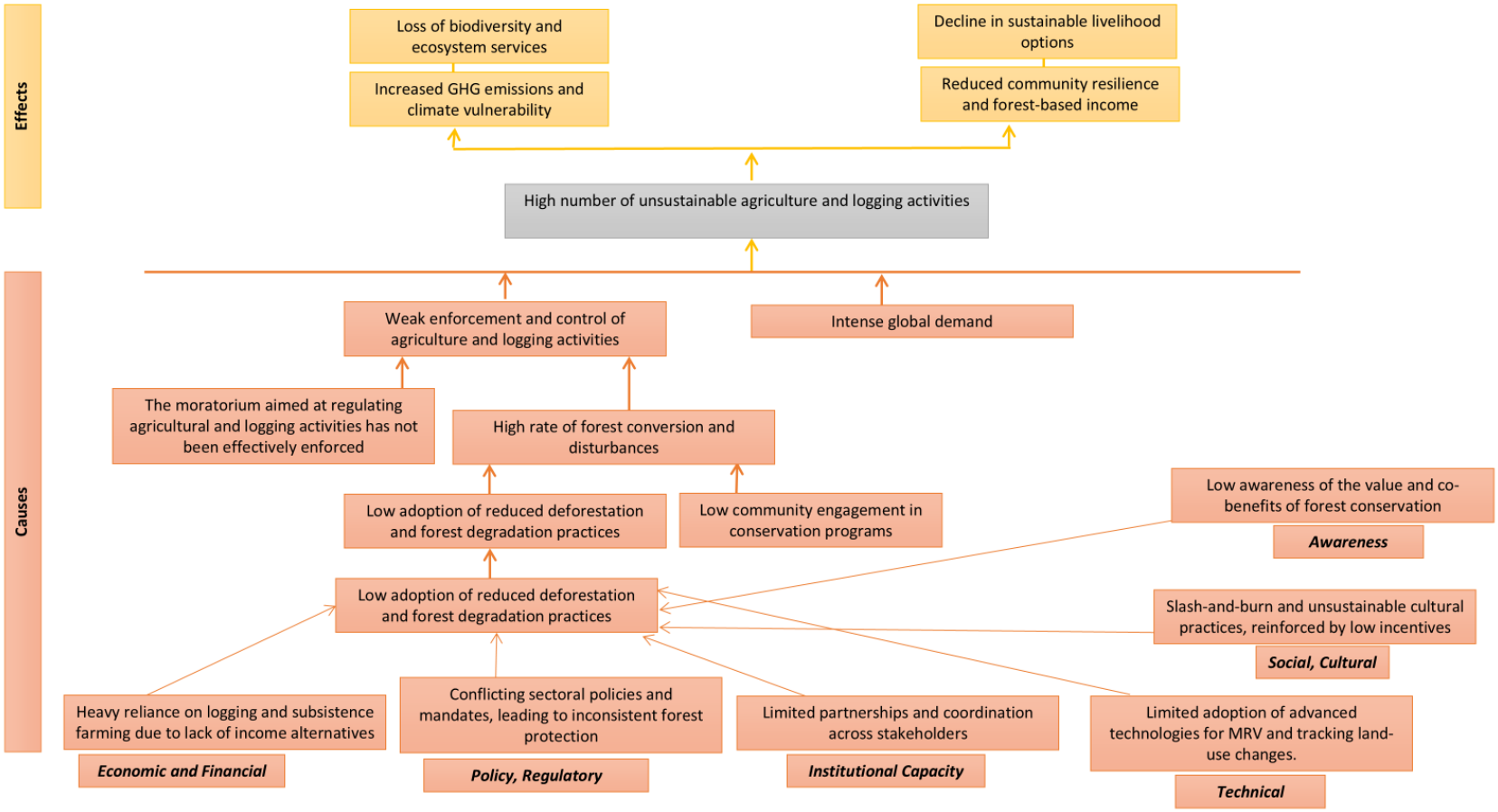
a) Problem tree for Cook Stoves in Biomass Gasification



b) Problem Tree for Electric Vehicles



c) Problem Tree for Reduced Deforestation and Forest Degradation



Annex II: List of stakeholders involved and their contacts

a) Mitigation Technical Working Group Workshop to Finalise BAEF Report

WORKING SESSION TO FINALISE PNG'S FIRST BIENNIAL TRANSPARENCY REPORT AND BARRIER ANALYSIS & ENABLING FRAMEWORK (BAEF) REPORT

23rd to 25th April, 2025

TUNA BAY, Port Moresby, NCD

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18	George Lowman	EF	Embedded Expert		[signature]
19					
20					
21					
22					

CCDA General Manager Mr. William Lakain presenting his opening remarks at the workshop

- CCDA MRV Manager and TNA Coordinator Mr. Jason Paniu giving his presentation

CCDA and Its Key Stakeholders at the Workshop:





b) TNA Mitigation Barrier Analysis and Enabling Framework Workshop

Technology Needs Assessment: Mitigation Barrier Analysis Mini-Workshop

Date: 17 April 2025

Venue: CCDA Office

Sign Up sheet

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