Samoa's NDC Implementation Roadmap and Investment Plan 2021

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IMPLEMENTING PARTNERS

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IN CONTRIBUTION TO

SPECIAL THANKS

Cover photo: 750kW Afolau Biomass Gasification Plant
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Foreword

I am pleased to present Samoa's Implementation Roadmap and Investment Plan towards the achievement of Samoa's Second Nationally Determined Contributions (NDCs) which was submitted to the United Nations Framework Convention on Climate Change (UNFCCC) in July 2021.

Notwithstanding Samoa's negligible global greenhouse gas emissions at 0.0006 per cent, we remain committed to doing our part to save our people and planet as a member of our global community and family. Climate change is an existential threat to all of humanity. There is great urgency and much to do therefore, to substantially accelerate our efforts at all levels to limit global temperatures to 1.5°C. To achieve this, we each need to play our part to ensure the survival of our common home for generations to come.

Samoa's Implementation Roadmap and Investment Plan to achieve its NDC targets will see emission reductions in identified key sectors including the Electricity, Transport, Waste, Tourism, Marine, Agriculture and Forestry. The successful implementation of this plan will considerably advance Samoa's transition to a low carbon economy. I am pleased to note that work is already underway with our partners to develop concepts and full project proposals to get these projects on the ground right away.

I call on our partners, international and regional climate financing institutions to support Samoa's bold move to a low carbon economy. We cannot do this without the requisite climate financing needed to implement our plans and realise our ultimate global ambitions. Help us help our people and planet.

I acknowledge with much appreciation the support of our partners who have made this work possible. Faafetai tele to the Governments of Germany, Australia, and New Zealand through the Regional Pacific NDC Hub for financing the development of Samoa's NDC Implementation Roadmap and Investment Plan. I thank also the Global Green Growth Institute (GGGI) as the implementing partner, Castalia, SPREP and UNDP for their technical support.

Lastly, I want to thank all our stakeholders who contributed to the development of this Plan in particular the Ministry of Finance (MOF), Ministry of Works, Transport and Infrastructure (MWTI), Ministry of Agriculture and Fisheries (MAF), Ministry of Police and Prison, (MPP) Electric Power Corporation (EPC), Scientific Organisation of Samoa (SROS), Samoa Tourism Authority (STA), Samoa Shipping Corporation (SSC) and SUNGO. The Ministry of Natural Resources and Environment (MNRE) could not have done this without your collaboration and partnership. Faafetai tele lava.

Hon. Toeolesulusulu Cedric Pose Salesa Schuster
Minister for Ministry of Natural Resources and Environment


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Abbreviations and Acronyms

3NC	Third National Communication
ADB	Asian Development Bank
ADO	Automotive diesel oil
AFOLU	Agriculture, forestry, and other land use
BAU	Business as usual
BUR	Biennial Update Report
CBS	Central Bank of Samoa
cc	Cubic capacity
CO_2-e	Carbon dioxide equivalent
DBS	Development Bank of Samoa
EE	Energy efficiency
EPC	Electric Power Corporation
ESS	Environmental and Social Safeguards
EVs	Electric vehicle
FTE	Full-time staff equivalent
GDP	Gross domestic product
Gg	Gigagram
GoS	Government of Samoa
GGGI	Global Green Growth Institute
GHG	Greenhouse gas
ha	Hectare
ICE	Internal combustion engine
IPP	Independent power producer
kW	Kilowatt
LTA	Land Transport Authority
MAF	Ministry of Agriculture and Fisheries
MCIL	Ministry of Commerce, Industry and Labour
MCR	Ministry of Customs and Revenue
MNRE	Ministry of Natural Resources & Environment
MoF	Ministry of Finance
MPPC	Ministry of Police, Prisons and Corrections
MSW	Municipal Solid Waste

MW	Megawatt
MWCSD	Ministry of Women, Community and Social Development
MWh	Megawatt-hour
MWTI	Ministry of Works, Transport & Infrastructure
NDC	Nationally determined contribution
NBS	National Bank of Samoa
PUMA	Planning Urban Management Agency
RE	Renewable energy
REDD+	Reducing Emissions from Deforestation and Forest Degradation
SPA	Samoa Ports Authority
SBS	Samoa Bureau of Statistics
SCS	Samoa Conservation Society
SHA	Samoa Hotel Authority
SIDS	Small Island Developing States
SNC	Samoa's Second National Communication to the UNFCCC
SROS	Scientific Research Organization of Samoa
SPC	The Pacific Community
SPREP	Secretariat of Pacific Regional Environment Program
SPTO	South Pacific Tourism Organization
SSC	Samoa Shipping Corporation
SSS	Samoa Shipping Services
STA	Samoa Tourism Authority
SWA	Samoa Water Authority
t	Tonne
TA	Technical assistance
ULP	Unleaded petroleum
WB	World Bank
WST	Samoan Tālā

Executive Summary

Context

Samoa seeks to accelerate and enhance the implementation of its Nationally Determined Contribution (NDC) to global climate change mitigation efforts. This NDC Implementation Roadmap and NDC Investment Plan (NDC Roadmap and Plan) is delivered as part of the work program of the Regional Pacific NDC Hub to the Government of Samoa (GoS), through the Global Green Growth Institute (GGGI) which is an implementation partner of the NDC Hub. GGGI engaged Castalia to assist with this objective. The NDC Roadmap and Plan sets out practical steps and tangible projects that can achieve the NDC goals, and it will support Samoa in achieving its Second NDC targets.

This document comprises an NDC Implementation Roadmap and an NDC Investment Plan, which includes a project pipeline. These strategic documents provide a plan for the GoS to achieve its Second NDC targets using mitigation actions in the electricity, transport (land and maritime), waste, tourism, marine, and agriculture, forestry, and other land use (AFOLU) sectors. Successful implementation of mitigation projects in the AFOLU and marine sector can also contribute to achieving adaptation targets detailed in Samoa's Second NDC. The NDC Roadmap and Plan is also intended to help generate interest from potential implementation partners, including donors and private investors for implementing the pipeline of GHG mitigation projects outlined in Appendix A.

Samoa's emissions profile

Samoa's emissions profile is dominated by GHG emissions from the energy sector (including electricity generation and transport). According to Samoa's Second National Communication to the UNFCCC, Samoa's total GHG emissions were 352,030 tCO_2-e in 2007[1]. 50 percent of this total comes from the energy sector, while 38 percent comes from the AFOLU sector. Waste and industrial processes emit a comparatively small amount of greenhouse gasses (GHGs) in Samoa.

Samoa's First NDC

In an effort to reduce its emissions, Samoa published its First NDC in 2015. Samoa's First NDC focuses primarily on reducing emissions from the energy sector (specifically from electricity generation). The main quantitative goal included in Samoa's First NDC was to reach 100 percent renewable energy in electricity generation by 2017 and maintain this through 2025, conditional on external support.

A significant effort has been made to implement the First NDC, particularly in the electricity sector. Currently, Samoa has achieved 50 percent renewable energy in electricity generation[2].

[1] Samoa's last comprehensive GHG inventory was prepared in 2007. It monitored the years 2000 to 2007 for each sector. Samoa is in the process of updating its GHG inventory to reflect changes since 2007. However, given the urgency of developing a Second NDC for Samoa, the Government has requested that 2007 data be used throughout the NDC Roadmap and Plan (rather than waiting for the updated inventory to be published).

[2] EPC data, mentioned at the Consultation Workshop.

However, the country still has some way to go to reach its renewable energy targets[3]. At present, operational emissions in the electricity sector are estimated as 48,225 tCO_2-e per annum.

Samoa's Second NDC

Samoa recognized scope to reduce GHG emissions in sectors beyond the electricity sector, including in the transport (land and maritime), waste, tourism, marine, and AFOLU sectors[4]. It also saw adaptation potential in the AFOLU and marine sectors. Therefore, Samoa developed and published its Second NDC in 2021. This Second NDC states that Samoa aims to reduce overall GHG emissions by 26 percent in 2030 compared to 2007 levels (or by 91 Gg CO_2-e compared to the new reference year once Samoa's GHG emissions inventory has been updated). The projects outlined in the NDC Roadmap and Plan helped to inform the GHG emissions reduction targets and adaptation targets in Samoa's Second NDC.

Samoa's First and Second NDCs are discussed in more detail in section 2.4.

Constraints to NDC implementation

This NDC Roadmap and Plan considers several key constraints to mitigation projects across the priority sectors. Constraints include budget limitations, human capacity (including the number of staff available and experience required), public awareness, regulatory, legal, and institutional constraints, market structure, and data deficiencies. Constraints for each sector, and suggestions for how they could be overcome, are discussed in section 4.

GHG mitigation opportunities identified

This NDC Roadmap and Plan identifies 21 GHG mitigation opportunities in Samoa. This list comprises four opportunities in the electricity sector, five opportunities in the land transport sector, five opportunities in the maritime transport sector, one opportunity in the waste sector, one opportunity in the tourism sector, one opportunity in the marine sector, and four opportunities in the AFOLU sector. Opportunities were ranked using a multicriteria analysis considering mitigation potential, cost effectiveness, and capacity requirements, and the views of stakeholders in Samoa. The multicriteria analysis is outlined in section 5.1.

Table 0.1 details the GHG mitigation opportunities for each sector (in order of priority), along with indicative investment needs to 2030, the annual GHG mitigation potential in 2030, and the cumulative GHG mitigation potential by 2030. The information detailed in this table provides summary information about each project and does not take into account implementation constraints[5]. This information is not the complete set of data used to prioritize projects—the methodology for pipeline prioritization is outlined in section 5.1.

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[3] Samoa has achieved 50 percent renewable energy generation. (EPC data, mentioned at the Consultation Workshop).

[4] These were defined as 'priority sectors', and the Roadmap and Plan focusses on identifying mitigation opportunities in these sectors.

[5] The information detailed in this table provides summary information about each project. This information is not the complete set of data used to prioritize projects—the methodology for pipeline prioritization is outlined in section 5.

The projects in this table are also not sequenced, taking into account capacity constraints in Samoa. Sequenced projects are detailed in section 5 and section 7.

Table 0.1: GHG mitigation opportunities in Samoa

Opportunity	Pipeline priority Rank	Indicative investment need to 2030 (US$)[6]	Annual GHG emissions reduction in 2030 (tCO_2-e)	Cumulative GHG emissions reduction by 2030 (tCO_2-e)[7]
Electricity sector				
Building energy efficiency program	2	250,000	3,046	15,230
Grid stabilization projects	3	5,050,000	2,218	15,526
Network loss reduction program	6	2,000,000	1,108	7,756
Refrigeration efficiency program	13	1,100,000	575	3,738
Land transport sector				
Shared electric cars	8	14,679,000	1,074	8,055
Electrification of commercial fleets	14	18,402,000	2,181	9,815
Electrification of government and municipal fleets	17	10,649,000	644	2,898
Electrification of Samoa's light vehicle fleet	19	42,506,000	1,457	6,557
Shared electric micro mobility	20	382,000	6	51
Maritime transport sector				
Transport optimization and energy efficiency review	7	75,000	1,121	5,605
Shore side electric supply for at berth vessels	12	50,000	144	1,080
Electric ferry	15	29,000,000	1,370	6,850
Biodiesel ferry	16	897,000	247	1976
Expansion of solar panel project	18	1,305,000	144	1,008
Waste sector				
Landfill gas collection system	11	2,752,000	1,214	9,712
Tourism sector				
Energy efficient appliances	10	250,000	545	2,998
Marine sector				

[6] Indicative investment needs are the costs that must be funded by one or a mix of different revenue streams if the project is to proceed.

[7] The GHG emissions reduction estimate calculations are explained in the concept notes in Appendix A.

Mangrove restoration and planting	9	935,000	1,683	8,415
AFOLU sector				
Agroforestry support program	1	122,000	21,169	127,014
National forestry plan	4	3,877,000	80,553	563,871[8]
Manure management using anaerobic digesters	5	1,095,000	2,055	14,385
Improving the efficiency and precision of fertilizer use	21	546,000	15	113

Note: Mitigation figures (tCO_2-e) are rounded to the nearest ton; indicative investment needs are rounded to the nearest US$1,000.
Note: This table reports indicative investment need and GHG emissions reduction potential without taking into account implementation constraints.

Once implementation constraints are considered, these GHG mitigation opportunities have the potential to reduce GHG emissions by 802,124 tCO_2-e by 2030, with an annual mitigation potential of 122,151 tCO_2-e in 2030. These mitigation opportunities would reduce GHG emissions in Samoa in 2030 by 34 percent relative to 2007 levels[9]. When combined with Samoa's annual GHG mitigation from renewable generation[10], these mitigation opportunities would reduce GHG emissions in Samoa in 2030 by 48 percent relative to 2007 levels[11]. The opportunities are estimated to have an indicative investment need of US$135,414,000 by 2030[12].

Additional management, monitoring, and evaluation costs of implementing pipeline projects will need to be considered. These costs should be built into funding applications and carefully scoped during the project design phase. Where funding for these additional activities may be a limiting factor, Samoa could consider proposing the establishment of donor-funded Project Management Units (PMUs) to relieve a proportion of the additional administrative burden on government agencies. The NDC projects included in this NDC Roadmap and Plan should be seen as a provisional list of mitigation opportunities. Samoa will continue to add to these projects as new opportunities arise, and new opportunities should be equally assessed and

[8] GHG emissions reduction potential is dominated by the 'National forestry plan' project.

[9] Samoa's total GHG emissions is 352,030 tCO_2-e (352.03 Gg CO_2-e) (as at 2007).

[10] Samoa's annual GHG mitigation from renewable generation is 48,225 tCO_2-e.

[11] The GHG emissions reduction potential of the projects in this NDC Roadmap and Plan (as well as the GHG emissions reduction potential of the renewable energy projects) is higher than the GHG emissions reduction target outlined in Samoa's Second NDC. This is because stakeholders in Samoa recommended that the '2 million trees' project be extended and included in the 'National forestry plan' project, which significantly increases the GHG emissions reduction potential in the AFOLU sector. This recommendation was provided after Samoa's Second NDC was published.

[12] If implementation constraints are removed, these GHG mitigation opportunities have the potential to reduce GHG emissions in Samoa by 812,651 tCO_2-e by 2030, have an annual GHG mitigation potential of 122,569 tCO_2-e in 2030, and are estimated to have an indicative investment need of US$135,922,000 by 2030. These figures are reported in Table 0.1.

prioritized as those included in this NDC Roadmap and Plan[13]. Ministries and Implementing Agencies in each sector should be encouraged to continue innovating and to contribute to subsequent versions of this work.

Each of the mitigation opportunities included in the project pipeline requires funding arrangements that meet their full costs. Some of the projects included in the pipeline will require financing[14]. A detailed discussion on funding and financing requirements for each project is included in section 6.

Potential sources of funding are shown in Table 0.2.

Table 0.2: Potential sources of funding for mitigation projects in Samoa

Donor Funding	
Name of Donor	**Type of Funding Support**
World Bank (International Development Association)	Grants, TA, and capacity building
Asian Development Bank	Grants, TA, and capacity building
Green Climate Fund	Grants, TA, and capacity building
Global Environment Facility	Grants, TA, and capacity building
UNDP[15]	Grants, TA, and capacity building
GGGI	TA and capacity building
New Zealand Ministry of Foreign Affairs and Trade	Bilateral ODA grants
Australian Department of Foreign Affairs and Trade	Bilateral ODA grants
People's Republic of China	Bilateral ODA grants
UK Department for International Development	Bilateral ODA grants

[13] A provisional list of ideas for additional NDC projects is included in Appendix B. These ideas were raised or revived by stakeholders during the final validation of the NDC Roadmap and Plan.

[14] When planning projects, it is important to make a clear distinction between funding and financing:

- Funding refers to the need for the project to cover all costs over the life of the project, including the costs of financing. Funding could be provided by one or a combination of the following three sources:
  - Grants from international donors
  - Government funding (from the government's budgets – paid for by taxes or other government revenue sources)
  - User fees from those who benefit from the projects.
- Financing deals with the timing mismatch between when expenses are incurred and when revenues are received. For NDC projects, finance could be provided by one or both of the following two sources:
  - Commercial finance from private lenders (this can sometimes be coupled with credit enhancements such as credit guarantees or risk sharing facilities)
  - Concessional finance from international donors (these would be in the form of sovereign lending).

[15] UNDP provides financial and technical support to projects through Global Environment Facility (GEF) and Green Climate Fund (GCF).

Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)	Bilateral ODA grants
Japanese International Cooperation Agency	Bilateral ODA grants
European Union	Multilateral ODA grants
Sources of Government Funding	
Ministry of Finance	
Ministry of Agriculture and Fisheries	
Ministry of Natural Resources and Environment	
Ministry of Works, Transport, and Infrastructure	
Ministry of Commerce, Industry, and Labor	
Ministry of Police, Prisons and Corrections	
Samoa Tourism Authority	
Local Government Agencies	
Types of User Fees	
Revenue from user tariffs	
Avoided costs[16]	

Potential sources of finance are shown in Table 0.3.

Table 0.3: Potential sources of finance for mitigation projects in Samoa

Concessional Finance	Commercial Finance
▪ **World Bank** ▪ **Asian Development Bank** ▪ **European Investment Bank** ▪ **People's Republic of China** ▪ **Australian Aid** ▪ **European Union** ▪ **Green Climate Fund** ▪ **Global Environment Facility** ▪ **International Renewable Energy Agency (IRENA)**	▪ ANZ Bank Samoa Limited ▪ Development Bank of Samoa ▪ National Bank of Samoa ▪ Samoa Commercial Bank ▪ Bank South Pacific (BSP)

[16] Avoided costs is the incremental cost that is not incurred when the additional output is not produced. For example, the cost of paying for diesel for a generator may be avoided when a solar panel is installed.

Finance through market instruments under Article 6 of the Paris Agreement is yet to be negotiated. However, it is possible that, over the course of this plan, Samoa could finance GHG emissions reduction projects by taking part in international carbon markets. Given the early stages of Article 6 negotiations, possible financing arrangements under Article 6 have not been included in the NDC Roadmap and Plan. However, this could be considered as a possible financing solution for Samoa in the future.

Samoa could further increase the availability of funding and finance to climate change projects by establishing a Climate Change Trust Fund. Climate change trust funds can help to mobilize domestic, bilateral, development partner, and philanthropic resources towards funding climate change projects. Climate Change trust funds are becoming common in the Pacific, and are guided by national legislation and objectives, which reduces their reporting requirements and operational fees, and can make project funding more streamlined.

Implementation plan

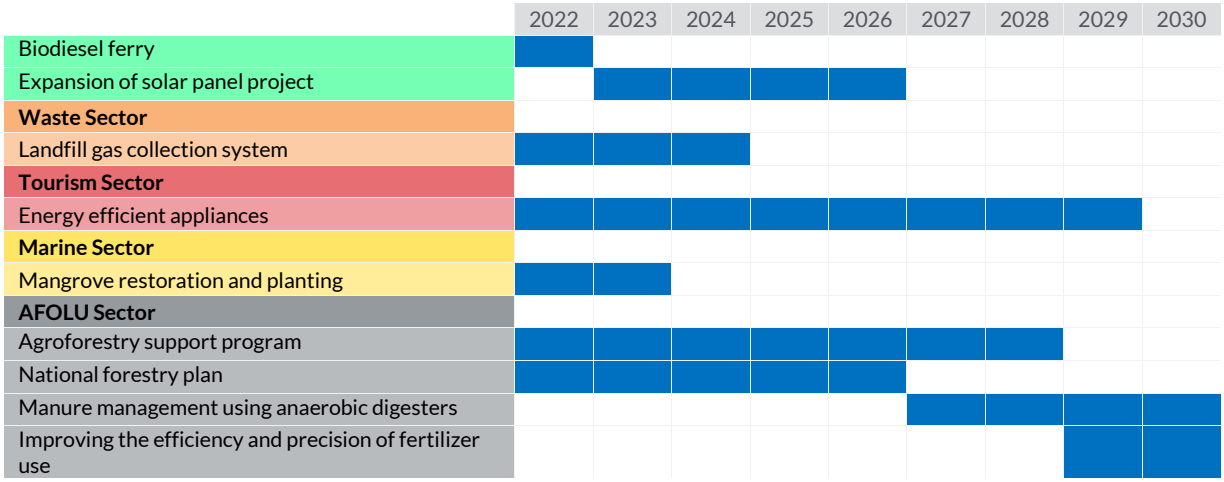
Institutional capacity constraints mean that it is not feasible to implement all of the GHG mitigation projects concurrently. Therefore, in line with the advice of stakeholders, projects are sequenced in order of priority, while also ensuring that there are no more than six projects happening concurrently in the electricity sector, no more than four projects happening concurrently in each of the land transport, maritime transport, and waste sectors, and no more than two projects happening concurrently in each of the tourism, marine, and AFOLU sectors.

The prioritized sequencing of GHG mitigation opportunities, taking into account stakeholders' advice on the number of projects that can happen concurrently in each sector, is shown in Table 0.4, below[17].

Table 0.4: Prioritized sequence of GHG mitigation opportunities

Project	2022	2023	2024	2025	2026	2027	2028	2029	2030
Electricity Sector									
Building energy efficiency program	■	■							
Grid stabilization projects	■	■							
Network loss reduction program	■	■	■	■	■				
Refrigeration efficiency program	■	■	■	■	■				
Land Transport Sector									
Shared electric cars	■								
Electrification of commercial fleets	■	■	■	■	■	■	■	■	■
Electrification of government and municipal fleets	■	■	■	■	■	■	■	■	■
Electrification of Samoa's light vehicle fleet	■	■	■	■	■	■	■	■	■
Shared electric micro mobility		■	■	■	■	■	■	■	■
Maritime Transport Sector									
Transport optimization and energy efficiency review	■	■	■	■	■	■			
Shore side electric supply for at berth vessels	■	■							
Electric ferry	■	■	■	■					

[17] We asked stakeholders in Samoa to identify how many projects can be implemented concurrently in each sector. This table shows the prioritized projects, taking into account stakeholders' views on how many projects can be run concurrently in each sector between 2022-2030.



Monitoring and evaluation framework, and guidelines for promoting gender and social inclusion and environmental and social safeguards

The implementation plan is guided by a monitoring and evaluation framework comprising three parts:

- A reporting structure that assigns responsibility for actions to specific government employees
- A monitoring structure that tracks progress in a transparent manner
- An evaluation structure that outlines the consequences for completing—or not completing—actions in time.

Under the monitoring framework, government staff responsible for implementing the NDC should assign responsibility for each project in three tiers:

- NDC Supervisor—The person from a government ministry ultimately responsible for overseeing the implementation of Samoa's NDC
- Sector Leaders—Individuals from government ministries responsible for implementing specific actions in each of the priority sectors of this Roadmap and Plan and reporting on progress to the NDC Supervisor
- Executors—Individuals from government ministries responsible for carrying out the day-to-day tasks required to manage and implement the priority projects in each sector.

Sector Leaders should meet quarterly with their Executors to track day-to-day tasks and liaise with the external consultants[18]. Sector leaders should give six-monthly briefings to the NDC Supervisor, updating them on progress on the mitigation projects in their sector. The NDC Supervisor should be responsible for reporting annually on NDC implementation progress.

Gender and social inclusion considerations should be integrated across all elements of project design and implementation. The NDC Supervisor and Sector Leaders overseeing NDC projects in Samoa should promote gender and social inclusion in these projects by implementing

[18] External consultants maybe be used by GoS to implement projects, for example if specialty skills are required.

effective measures to limit occupational segregation and pay gaps, minimize health risks, and combat gender-based violence. The International Finance Corporation's (IFC) Environmental and Social (E&S) Performance Standards should also be used to assist Samoa in managing key environmental and social risks.

1 Introduction

Samoa submitted its First NDC (First NDC) to the United Nations Framework Convention on Climate Change (UNFCCC) in September 2015[19], which aimed to reach 100 percent renewable energy for electricity generation in 2017, and maintain this through to 2025. This commitment was conditional on external support. Samoa built on its First NDC, identifying key priority sectors for GHG emissions reduction—electricity, transport (land and maritime), waste, tourism, marine, and AFOLU. This NDC Implementation Roadmap and NDC Investment Plan (NDC Roadmap and Plan) is delivered as part of the work program of the Regional Pacific NDC Hub to the GoS, through GGGI which is an implementation partner of the NDC Hub. GGGI engaged Castalia to assist with this objective.

The NDC Roadmap and Plan comprises two key strategic documents:

- An **Implementation Roadmap,** including information about Samoa's specific context, such as Samoa's emissions profile, targets in Samoa's First and Second NDCs, as well as information about the priority sectors and institutional capacity. The roadmap also includes an implementation plan, which details a strategy for preparing and procuring projects and monitoring implementation.
- An **Investment Plan,** which includes a **project pipeline**[20] of promising GHG mitigation projects across Samoa's priority sectors[21], outlining potential GHG emissions reductions, costs, co-benefits, capacity requirements, and potential to attract funding. The project pipeline is outlined in Appendix A. It also highlights funding and financing requirements for projects, supporting measures that may need to be put in place to attract finance, and environmental and social considerations.

The NDC Roadmap and Plan sets out practical steps for the GoS to successfully implement the projects in the pipeline, and is also intended to help generate interest from potential implementation partners, including donors and private investors for implementing the pipeline of projects.

The GHG mitigation projects in the pipeline, as well as other adaptation projects, helped inform the targets in Samoa's Second NDC (Second NDC), submitted to the UNFCCC in July 2021[22].

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[19] Samoa's First NDC is available here: https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Samoa%20First/Samoa%20INDC_Submission%20to%20UNFCCC.pdf

[20] Samoa's Sustainable Development Goals (SDGs), and national policies and strategies were reviewed throughout developing the NDC Roadmap and Plan. This review was key to ensuring synergies between different areas of government policy and targets.

[21] Some projects have both adaptation and GHG mitigation potential

[22] Samoa's Second NDC is available here: https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Samoa%20Second/Samoa%27s%20Second%20NDC%20for%20UNFCCC%20Submission.pdf

Samoa's Second NDC is an ambitious document, especially for a Small Island Developing State (SIDS) in the Pacific, that sets out Samoa's commitment to mitigating GHG emissions and increasing the country's climate change adaptation and resilience measures. Successful implementation of the projects included in the NDC Roadmap and Plan will contribute to GHG emissions reductions and help Samoa achieve the adaptation and mitigation targets set out in its Second NDC[23]. Total GHG mitigation potential and investment need for each sector is included in Table 1.1[24].

Table 1.1: Sequenced cumulative GHG emissions reduction by 2030 and indicative investment need to 2030 for priority sectors

Sector	Cumulative GHG emissions reduction by 2030 (tCO_2-e)[25]	Indicative investment need to 2030 (US$)
Electricity	42,250	8,400,000
Land transport	27,369	86,602,000
Maritime transport	16,375	31,327,000
Waste	9,712	2,752,000
Tourism	2,998	250,000
Marine	8,415	935,000
AFOLU	695,006[26]	5,148,000

Note: This table displays the sequenced cumulative GHG emissions reduction by 2030 and indicative investment need to 2030

Samoa's NDC Roadmap and Plan has been developed in close collaboration with stakeholders in Samoa. This collaboration has helped to build consensus, ensure the plans were feasible and provided momentum for implementation.

Consultation was undertaken in three phases:

- **Phase one** involved three main parts: an initial project kick-off call with the GoS, the NDC Hub, and the management consulting company Castalia; virtual meetings with sector champions;[27] and a Cross-sector Workshop held on 23 November 2020, during which participants from various ministries and departments, and other relevant institutions convened to discuss opportunities in each focus sector.

[23] As noted in Samoa's Second NDC, some projects have both adaptation and GHG mitigation potential. The expected GHG emission reduction potential of adaptation projects was taken into account when determining GHG emissions reduction targets in Samoa's Second NDC.

Successful implementation of these projects will also contribute to adaptation targets detailed in Samoa's Second NDC.

[24] Further detail about the investment need and GHG mitigation potential in each sector is included in Section 5.

[25] The GHG emissions reduction estimate calculations are explained in the concept notes in Appendix A.

[26] GHG emissions reduction potential in the AFOLU sector is dominated by the 'National forestry plan' project.

[27] Sector champions are stakeholders located in Samoa. The GoS facilitated the connection between the sector champions and Castalia. Sector champions were engaged to help the consultants source information, get in touch with companies or other stakeholders in the sector, fact-check, and test ideas informally.

This consultation phase informed the draft Implementation Roadmap and Investment Plan.

- **Phase two** involved two main parts: feedback from GGGI and the GoS on the first draft of the NDC Roadmap and Plan, and discussion of the contents of this draft document at cross-sector consultation and validation workshops. Feedback was received in written format as well as verbally during the workshop.
- **Phase three** involved engagement with relevant ministries and institutions, as well as the sector champions on an as-needed basis, to gather additional information about national circumstances, sector context, and projects in the project pipeline.

2 National circumstances, including NDC targets and emissions profile

2.1 National circumstances

The Independent State of Samoa consists of two main islands, Savai'i (1,700 square kilometers) and Upolu (1,100 square kilometers), and eight smaller islands, making up a total land area of 2,900 square kilometers (km^2)[28]. The capital, Apia, is located on Upolu. Samoa has mountainous terrain as well as narrow coastal settlements[29].

Samoa's total population is approximately 202,500[30]. Of this total, approximately 77 percent live on Upolu, 22 percent live on Savai'i, and the remaining population lives on the outer islands of Manono and Apolima[31]. Approximately 19 percent of Samoa's population live in urban areas, while 81 percent live in rural areas[32]. The country has approximately 340 villages, which are divided into 43 districts. The districts are grouped into four regions: Apia Urban Area (AUA), North-West Upolu (NWU), Rest of Upolu (ROU) and Savaii (SAV)[33].

Samoa's Gross Domestic Product (GDP) for the year ended December 2020 was US$733 million, with a per capita GDP of US$3,630[34]. The service sector (tertiary sector) is the largest contributing sector, making up approximately 74 percent of total nominal GDP in 2019[35]. The primary sectors (including agriculture and fisheries) share of GDP has declined in recent years, contributing approximately 10 percent of GDP in 2019[36].

Samoa is extremely vulnerable to the impacts of climate change, and is experiencing more frequent and extreme rainfall, longer droughts, and sea-level rise[37]. About 70 percent of Samoa's population and infrastructure is located in low-lying coastal areas[38]. The country's primary industries, such as agriculture and fishing, have been particularly impacted by changing weather patterns and natural disasters[39].

[28] https://www.sbs.gov.ws/digi/2017%20-%20Samoa%20Bureau%20of%20Statistics%20-%20Statistical%20Abstract.pdf

[29] https://www.sbs.gov.ws/digi/2017%20-%20Samoa%20Bureau%20of%20Statistics%20-%20Statistical%20Abstract.pdf

[30] As of 2020—https://www.sbs.gov.ws/population

[31] https://www.sbs.gov.ws/digi/2017%20-%20Samoa%20Bureau%20of%20Statistics%20-%20Statistical%20Abstract.pdf

[32] https://www.sbs.gov.ws/population

[33] https://www.sbs.gov.ws/digi/2017%20-%20Samoa%20Bureau%20of%20Statistics%20-%20Statistical%20Abstract.pdf

[34] 2013 constant prices—https://www.sbs.gov.ws/images/sbs-documents/Finance/GDP/2020/q/GDPReport-December2020quarter.pdf

[35] https://www.sbs.gov.ws/images/sbs-documents/Finance/GDP/GDP_Report-December2019Final.pdf

[36] https://www.sbs.gov.ws/images/sbs-documents/Finance/GDP/GDP_Report-December2019Final.pdf

[37] https://unfccc.int/resource/docs/natc/samnc2.pdf

[38] https://www.adaptation-undp.org/explore/polynesia/samoa

[39] https://www.sbs.gov.ws/digi/2017%20-%20Samoa%20Bureau%20of%20Statistics%20-%20Statistical%20Abstract.pdf

2.2 Existing sectoral strategies, plans, and policies relevant to mitigation projects

Several national and sectoral strategies, plans, and policies are relevant to climate change mitigation efforts in Samoa, and provide valuable context for and input to the NDC Roadmap and Plan. These key documents, which were reviewed when developing the NDC Roadmap and Plan, are detailed in Table 2.1 below.

Table 2.1: Key documents relevant to mitigation projects

Document title	Description
Overarching documents	
Samoa 2040 (2021)	This document provides a roadmap to navigate Samoa's development over the next twenty years. It focuses on tourism, agriculture and fishing, digital economy, and labor mobility, with the goal of boosting economic growth, creating employment, generating government revenues, and raising standards of living. Samoa 2040 complements the Strategy for the Development of Samoa (SDS).
Low Emission Development Strategy (draft 2021)	This strategy has been released in draft form and is not yet publicly available. It reviews and updates the previous GHG Abatement Strategy (2008-2018), identifies gaps, and explores sectors to achieve further greenhouse gas emission reductions.
National Policy for Gender Equality 2021-2031 (2021)	This policy was developed from the review of Samoa's first Gender Equality Policy and captures an up-to-date snapshot of Samoa's obligations at a national, regional, and international level related to gender equality and the rights of women and girls.
Inclusive Governance Policy 2021-2031 (2021)	This policy aims to ensure that all decision-making bodies and groups are inclusive of all voices who live in the community. While this policy has close links with the Gender Equality and Rights of Women and Girls Policy and the Persons with Disability national policy, this policy focuses on social inclusion at all levels, from government and urban to rural and village-based community structures.
National Appropriate Mitigation Actions Plan (NAMA) (2018)	This plan contains Samoa's strategic commitment to reducing GHG emissions in the transport sector.
Community Integrated Management Plans (CIM Plans) (2018)	CIM Plans (for each district of Samoa) are envisaged as blueprints for climate change interventions across all development sectors, reflecting the programmatic approach to climate resilience adaptation taken by the GoS. The CMI Plans are linked to the Strategy for the Development of Samoa 2016/17 – 2019/20 and the relevant ministry sector plans.
National Environment Sector Plan 2017-2021 (NESP) (2017)	This plan updates the NESP 2013-2016 and outlines a roadmap to achieve four long-term outcomes. These goals include sustainable management and development of natural resources and environment, increasing the sustainability and resilience of Samoa's built environment, and climate change and disaster risk management across all sectors.

Document title	Description
Strategy for the Development of Samoa (SDS) 2016-2020 (2016)	This strategy identifies four priority areas of development and 14 key outcomes to be achieved for Samoa.
Samoa's Nationally Determined Contribution (NDC) (2015 and 2021)	This document is the committed contribution of the Independent State of Samoa under the Paris Agreement of the United Nations Framework Convention on Climate Change (UNFCCC). Samoa submitted its First NDC in 2015[40] and submitted its Second NDC in July 2021[41].
Second National Communication to the UNFCCC (2009)	This document provides information on the progress made by Samoa in implementing the United Nations Framework Convention on Climate Change (UNFCCC) and includes the national inventory of anthropogenic GHG emissions (based on 2007 figures).
GHG Inventory (2007)	This document presents Samoa's GHG emissions, covering the years 1994-2007. This emissions profile in this document is the most recent GHG emissions for Samoa.
Electricity sector	
National Building Code of Samoa (NBC) (2017)	A performance-based set of standards that provides objectives and descriptions of how a building and site should be constructed to achieve a structurally-sound and sustainable built environment.
Energy Management Act 2020	This Act sets minimum energy performance standards (MEPS)
Energy Sector Plan 2017-2022 (2017)	This plan identifies the main areas for development in Samoa's energy sector. It has a particular focus on renewable energy, electricity services, energy efficiency, transport, petroleum management, and sector coordination.
Land transport sector	
Transport Sector Plan 2013-2018 (2013)	This plan is a sector framework to guide the development and funding of the transport sector to ensure environmentally sustainable, energy-efficient, and socially responsible transport sector. The plan focuses on improving and climate-proofing Samoa's road transport network, maritime services, air transport services.
Planning and Urban Management (Environment Impact Assessment) Regulations 2007	These regulations clarify the environment impact assessment (EIA) process and requirements. Regulations are supported by the Planning and Urban Management Act 2004.
Land Transport Authority Act 2007	This Act established the Land Transport Authority (LTA) and mandated it to provide a safe and environmentally friendly land transportation network for Samoa.
Planning and Urban Management Act 2004	The Act legislates a framework for planning the use, development, management, and protection of land in Samoa in the present and long-term interests of all Samoans and for related purposes.

[40] https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Samoa%20First/Samoa%20INDC_Submission%20to%20UNFCCC.pdf

[41] https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Samoa%20Second/Samoa%27s%20Second%20NDC%20for%20UNFCCC%20Submission.pdf

Document title	Description
Ministry of Works Act 2002	This Act reformed the law relating to public works by re-defining the role of the Public Works Department through the transfer of some of its functions to the private sector, and by revising the Department's functions and powers in relation to the regulation of building construction, planning, urban management and the provision and maintenance of roads, bridges, seawalls, and related public assets.
Maritime transport sector	
Transport Sector Plan 2013-2018 (2013)	This plan is a sector framework to guide the development and funding of the transport sector to ensure environmentally sustainable, energy-efficient, and socially responsible transport sector. The plan focuses on improving and climate-proofing Samoa's road transport network, maritime services, air transport services.
Fisheries Management Act 2016	This Act regulates and controls the conservation, management, and development of fisheries and the licensing of Samoan fishing vessels and foreign fishing vessels.
Marine Pollution Prevention Act 2008	This Act aims to prevent pollution to the marine environment and legislates for responses to marine pollution incidents emanating from vessels, and other matters related to the implementation of international marine pollution conventions.
Shipping Act 1998	This Act consolidated and amended the law relating to Shipping and Seamen and to control the registration, safety, and manning of ships, and to give effect to various international maritime conventions, and for related purposes.
Waste sector	
National Waste Management Strategy 2019-2023 (NWMS)	This strategy guides the waste management of Samoa for the period of 2019 to 2023 and sets out goals, including targeting solid wastes and chemical and hazardous wastes.
Water and Sanitation Sector Plan (WSSP) (2017)	This plan covers the period 2016-2020 outlines the plan to address climate change impacts on water resources, expand the water resources, address capacity gaps, and improve awareness on hygiene and sanitation issues.
Waste Management Act 2010	This Act provides for the collection and disposal of solid waste and the management of all wastes in Samoa, and for related purposes.
Samoa Water Authority (Sewerage and Wastewater) Regulations 2009	These regulations make provision with respect to sewerage and wastewater functions of the Authority and matters regarding sewerage in Samoa. Regulations are supported by the Samoa Water Authority Act 2003.
Samoa Water Authority Act 2003	This Act legislates the continued operations of the Samoa Water Authority (established by the Water Authority Act 1993/1994), promotes its financial independence and its role as a provider of economically viable services through an accountable management structure.
Tourism sector	
Tourism Sector Plan 2014-2019 (2014)	This plan is a roadmap to grow Samoa's tourism sector sustainably.

Document title	Description
	Marine sector
Samoa Ocean Strategy (SOS) (2020)	This strategy outlines a pathway towards sustainable management of Samoa's ocean and marine resources, including protecting ecological habitats and marine wildlife, and safeguarding important sources of food, income and economic growth derived from Samoa's ocean.
	AFOLU sector
Agriculture Sector Plan 2016-2020 (ASP)	This plan provides the framework to guide coherent programs and actions from all key stakeholders to achieve the goal of increased food, nutrition, and income security in Samoa.

2.3 Emissions profile

Samoa's total GHG emissions were 352.03 Gg CO_2-e in 2007[42]. In 2007, the energy sector was the largest source of GHG emissions, contributing 50 percent of total emissions, followed by AFOLU, contributing 38 percent. Waste and industrial processes emit a comparatively small amount of GHGs in Samoa. Table 2.2 presents a summary of GHG emissions by sector in 2007.

Table 2.2: Summary of Samoa's GHG emissions by sector (2007)

Sector	GHG emissions (Gg CO_2-e)	Percent of total emissions (%)
Energy	174.35	50%
Industrial processes and product use	9.51	3%
Agriculture, forestry, and other land use	135.37	38%
Waste	32.81	9%
Total emissions	**352.03**	100%

Source: Samoa's National GHG Inventory, 2007

Table 2.3 breaks down the sources of GHG emissions from the energy sector in 2007. Land transport accounts for the majority of emissions from the energy sector, followed by electricity generation.

[42] Samoa's last comprehensive GHG inventory was prepared in 2007. It monitored the years 2000 to 2007 for each sector. Samoa is in the process of updating its GHG inventory to reflect changes since 2007. However, given the urgency of developing a Second NDC for Samoa, the Government has requested that 2007 data be used throughout the NDC Roadmap and Plan (rather than waiting for the updated inventory to be published).

Table 2.3: GHG emissions from the energy sector in Samoa (2007)

Source	GHG emissions (Gg CO_2-e)	Percent of total emissions (%)
Land transport	95.02	54%
Electricity generation	44.21	25%
Manufacturing and construction	16.30	9%
Residential energy use	6.22	4%
Fishing	5.70	3%
Domestic shipping	5.51	3%
Commercial and institutional	1.39	1%
Total	174.35	100%

Source: Samoa's National GHG Inventory, 2007

Table 2.4 ranks the top six sub-sector sources of GHG emissions in 2007. Land transport emits the most GHG, accounting for 27 percent of total emissions.

Table 2.4: Top six sources of GHG emissions in Samoa (2007)

Source	Emissions (Gg CO_2-e)	Percent of total emissions
Land transport	95.11	27%
Livestock farming	88.36	25%
N_2O from agricultural soils	47.01	13%
Electricity generation	44.21	13%
Other energy consumption	34.14	10%
Wastewater	25.44	7%
Total	335.15	95%

Source: Samoa's National GHG Inventory, 2007

2.4 NDC targets

GHG emissions in Samoa are very small on a global scale. Despite this, as an island nation at particular risk of the adverse impacts of climate change, Samoa is keen to play its part in global climate change mitigation efforts.

2.4.1 First NDC targets

Samoa's First NDC focused primarily on reducing emissions from the energy sector

Samoa included the following target in its First NDC:

"[Samoa is] committed to reducing its [greenhouse gas] GHG emissions from the Electricity sub-sector through the adoption of a 100% Renewable energy target for electricity generation through to the year 2025"[43]

GoS is committed to increasing the use of renewables for electricity generation to improve sustainability and strengthen Samoa's energy sector. Reducing the use of fossil fuels can also have a significant economic benefit by reducing expenditure on fuel imports.

Samoa has achieved 50 percent renewable electricity generation[44]

Some national mitigation projects have already been implemented or are currently underway, contributing to GHG emissions reductions in multiple sectors. For example, the passenger ferry, Lady Samoa III, recently had solar panels installed on the roof. There has also been an initiative to restore mangroves through the establishment of mangrove conservation areas. Implemented or planned projects in each sector are detailed in Appendix D.

However, Samoa has some way to go to reach its renewable energy targets

Limited financial capability and other constraints are hindering Samoa's ability to make faster progress in reducing emissions[45]. Samoa is not on track to achieve the targets set in its First NDC. Reaching 100 percent renewable electricity generation in 2017 and maintaining this through 2025 would have reduced operational (scope 1) emissions from the electricity sector to zero[46]. However, the renewable electricity percentage in Samoa in 2021 was 50 percent[47]. This is an increase in renewable energy share by 24 percentage points (from 26 percent in 2014).

Although the share of renewable energy has increased, total electricity generation also increased from 126,800 MWh in 2014 to 132,000 MWh in 2019. While Samoa was one of the few countries that accounted for an increase in generation when setting its NDC targets, this increase still partially offsets the reduction in GHG emissions from increased renewable energy.

At present, estimated operational GHG emissions in the electricity sector are 48,225 tCO_2-e per annum[48]. Assuming the GHG emissions intensity of non-renewable electricity production remained constant, estimated GHG emissions from the electricity sector reduced by 12 percent between 2014 and 2019.

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43 Targets in Samoa's First NDC are conditional on external support.

44 EPC data, mentioned at the Consultation Workshop.

45 Feedback provided by stakeholders at the Consultation Workshop.

46 Scope 1 emissions are direct GHG emissions that occur from sources that are controlled or owned by an organization (e.g., emissions associated with fuel combustion in boilers, furnaces, vehicles). For more information on scope 1 emissions, see EPA's website here: https://www.epa.gov/climateleadership/scope-1-and-scope-2-inventory-guidance

47 EPC data, mentioned at the Consultation Workshop.

48 Electricity production: https://www.indexmundi.com/g/g.aspx?v=79&c=ws&l=en; renewable energy contribution: https://www.hydroreview.com/2019/06/26/hydro-review-small-islands-of-samoa-lead-renewable-energy-efforts/#gref

2.4.2 Second NDC targets

Samoa recognized scope to reduce GHG emissions and increase adaptation in sectors other than electricity sector

Samoa included the following mitigation targets in its Second NDC:

> *"Samoa aims to reduce overall GHG emissions by 26 percent in 2030 compared to 2007 levels (or by 91 Gg CO_2-e compared to the new reference year once Samoa's GHG emissions inventory has been updated)"*

This economy-wide GHG emissions reduction target comprises the following sector-specific mitigation targets:

- Energy—reduce GHG emissions in the energy sector[49] by 30 percent in 2030 compared to 2007 levels (or by 53 Gg CO_2-ecompared to the new reference year once the GHG emissions inventory is updated)[50]
- Waste—reduce GHG emissions in the waste sector by 4 percent in 2030 compared to 2007 levels (or by 1.2 Gg CO_2-ecompared to the new reference year once the GHG emissions inventory is updated)
- AFOLU—reduce GHG emissions in the AFOLU sector by 26 percent in 2030 compared to 2007 levels (or by 35.2 Gg CO_2-ecompared to the new reference year once the GHG emissions inventory is updated).

Samoa included the following adaptation targets in its Second NDC:

Samoa aims to adapt to climate change by building on adaptation activities identified in Samoa's National Adaptation Plan of Action (NAPA)[51] in the fisheries, coastal zones, forestry, village community, agriculture, and food security sectors. In addition to the actions outlined in its NAPA, Samoa wishes to communicate the following quantitative targets that contribute to adaptation in the AFOLU and marine sectors[52]:

- Marine—expand the area of mangrove forests in Samoa by 5 percent by 2030 relative to 2018
- AFOLU—expand the area under agroforestry to an additional 5 percent of agricultural land by 2030 relative to 2018.

GHG mitigation and adaptation targets are conditional on external financial and technical support.

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[49] To ensure accuracy against GHG emissions reported in 2007, the energy sector includes the electricity, land transport, maritime transport, and tourism sub-sectors. Each sub-sector has specific means to achieve the overall energy sector target.

[50] To avoid double counting, the GHG emissions reductions of the 100 percent renewable electricity sector project is taken as the total GHG emissions reduction potential in the electricity sub-sector.

[51] The Samoa National Adaptation Program of Action, 2005 (NAPA). Available at: https://unfccc.int/resource/docs/napa/sam01.pdf

[52] It is expected that these adaptation targets will also contribute to mitigation. The expected GHG emissions reduction potential of the three adaptation targets were taken into account when determining the GHG emissions reduction targets.

Samoa is in the process of updating its GHG inventory to reflect changes since 2007

Samoa's Third National Communication (3NC) and First Biennial Update Report (BUR) are currently under development. However, preliminary findings are not yet available and are not expected until late 2021. The BUR will include an updated GHG Inventory. SIDS have flexibility in their submissions under the Paris Agreement to update its targets. Therefore, Samoa has included an alternative specification of the overall mitigation target to ensure it can use updated information on national emissions when this becomes available.

Targets in Samoa's Second NDC were informed by the pipeline of projects in the NDC Roadmap and Plan

Successful implementation of the projects included in the NDC Roadmap and Plan will contribute to GHG emissions reductions and help Samoa achieve the adaptation and mitigation targets set out in its Second NDC[53].

3 Institutional Context

This section provides a general overview of the government agencies in Samoa that are likely to play a part in implementing the country's NDC. It also notes capacity constraints and institutional barriers that will need to be navigated in order to achieve Samoa's mitigation targets.

Table 3.1 details the key government agencies and other organizations and their capacity for NDC implementation (in terms of number of full-time staff equivalent (FTE)). This information was gathered through consultations with, and a survey completed by, participants at the Consultation Workshop (19 March 2021).

All institutions have some capacity to implement and manage climate change mitigation projects. However, each institution faces barriers to NDC implementation. Overarching institutional barriers to NDC implementation include:

- Lack of budget for new projects
- Conflicting or shifting priorities of institutions, particularly due to the COVID-19 pandemic and measles epidemic
- Limited human capacity to implement and manage projects
- Coordination challenges within and between institutions—GoS has recently recognized the importance of collaboration between multiple institutions because many projects are cross-sectoral
- Capacity building required to advance technical skills, understandings of technological changes, and knowledge of projects, and to improve project implementation, management, and monitoring skills
- Limited data about GHG emissions, which restricts policy and decision-making processes
- Unlike countries that have declared climate change as a national emergency, Samoa does not have a legislative commitment to reduce GHG emissions. This has resulted in delays to the design and implementation of GHG emission reduction projects.

Table 3.1: Key institutions, their capacity, and barriers to NDC implementation

Institution	Roles and relationship to NDC implementation	Number of FTE available for NDC implementation[54]
Electric Power Corporation (EPC)	EPC is a government-owned corporation responsible or the generation, transmission, distribution, and selling of electricity in Samoa.	0.4
Land Transport Authority (LTA)	LTA is responsible for sustaining and improving Samoa's road network, including managing road projects.	0.4
Ministry of Agriculture and Fisheries (MAF)	MAF provides regulatory and technical advice, training, and support for subsistence and commercial farmers, agri-processors, and exporters. MAF's focus is also on improved food security and sustainable agricultural production.	0.4
Ministry of Commerce, Industry and Labour (MCIL)	MCIL is responsible for apprenticeships, trainings, and industrial relations. It is also responsible for company registration and compliance, foreign investment promotion, and administering of private sector funding scheme.	0.15
Ministry of Finance (MoF)	▪ MoF is responsible for climate resilience investment and coordination, which seeks to develop and implement appropriate financing modalities for climate resilience. ▪ The Energy Division within MoF is responsible for energy policy. It also manages registration of and monitors energy-efficient refrigerators and freezers.	0.8
Ministry of Police, Prisons and Corrections (MPPC)	MPPC has jurisdiction of traffic legislation, and maintains data on traffic-related accidents and infringements. MPPC also has a Road to Safety Strategy which puts a high priority on coordinated efforts in all the key	2.0[55]

[54] Number of FTE based on number of staff available to manage climate change mitigation projects and amount of time (in hours) available to manage climate change mitigation projects per week.

[55] Available staff work in supporting services, such as the policy and planning, finance, and assets unit, rather than Police Officers themselves.

	areas of road safety. MPPC is also responsible for Vehicle and Drivers License Registration Section (VDLRS).	
Ministry of Natural Resources and Environment (MNRE)	MNRE leads the management of Samoa's environment and natural resources. It focuses on renewable energy, water and sanitation, forestry, disaster management, climate change, water resources, land management, and environment and conservation.	2.0
Ministry of Works, Transport, and Infrastructure (MWTI)	▪ MWTI is responsible for ensuring safe, secured, sustainable, and resilient transport, infrastructure, and development services. The land transport and maritime transport divisions have specific missions, predominantly focusing on effective, sustainable, and integrated transport networks. ▪ The Maritime Division holds the Register of Ships and Vessels, and regulates maritime in Samoa to ensure that vessels abide by Samoa's national and international maritime guidelines. ▪ Building codes and standards are regulated by Asset and Building Management Division within MWTI.	2.0
Samoa Bureau of Statistics (SBS)	SBS holds statistical information about Samoa, including about population, GDP, and Samoa's sustainable development goals.	0.4
Samoa Ports Authority (SPA)	SPA operates as a self-funded, commercially viable organization which seeks to ensure safety of ports and maritime operations, and provide effective and efficient services.	No information[56]
Samoa Shipping Corporation (SSC)	SSC provides ferry and marine shipping services.	0.4
Samoa Tourism Authority (STA)	STA has five divisions and a Tourism Climate Change Adaptation Project Unit. STA's key project provides the tourism sector with information and	0.4

[56] No information was provided by SPA about the number of FTE available for NDC implementation.

	instruments to monitor and advise the sector on climate change adaptation.	
Samoa Water Authority (SWA)	SWA provides 58 percent of water in Samoa (15 percent is supplied by independent village water schemes). It aims to effectively manage the provision of safe, reliable, and sustainable water services.	2.0[57]
Scientific Research Organization of Samoa (SROS)	SROS was established in 2006 to undertake scientific and technical research for GoS. The organization has five divisions, including the Environment & Renewable Energy (ERE) division.	2.0[58]
Secretariat of Pacific Regional Environment Program (SPREP)	SPREP is the regional organization established by the governments and Administrations of the Pacific charged with protecting and managing the environment and natural resources of the Pacific.	0.4[59]
Village Fono (councils)	Samoa has approximately 200 traditional villages (nu'u); these are traditional polities governing a group of extended families within a territory. A village Fono carries out certain powers in accordance with each village.	0.4

[57] Number of FTE at SWA is an estimate based on information from SWA about number of staff available for NDC implementation.

[58] Number of FTE at SROS is an estimate based on information from SROS about number of staff available for NDC implementation.

[59] Number of FTE at SPREP is an estimate based on information from SPREP about number of staff available for NDC implementation.

The following institutions are also relevant for NDC implementation: Ministry of Women, Community and Social Development (MWCSD), Ministry of Customs and Revenue (MCR), National Bank of Samoa (NBS), National University of Samoa (NUS), O le Siosiomaga Society, Samoa Conservation Society, Samoa Hotels Association (SHA), South Pacific Tourism Organization (SPTO)[60]. The Central Bank of Samoa (CBS) and the Development Bank of Samoa (DBS) are also important for financing NDC implementation.

[60] Identified by participants at the Consultation Workshop.

4 Sector Context

This section outlines the context for each key sector, including the key stakeholders, the specific NDC targets in each sector, and the possible constraints on NDC implementation in each sector.

4.1 Electricity sector

Renewable energy contributes 50 percent of total electricity generated in Samoa

The Electric Power Corporation (EPC) operates the country's electricity generation and distribution systems on both main islands of Samoa—Upolu and Savai'i. EPC also generates electricity from solar PV on Apolima, a small island between Upolu and Savai'i. Approximately 100 percent of Samoa's population has access to electricity[61].

Samoa's annual electricity generation was approximately 132,000 MWh/year in 2019[62]. Electricity is generated through a combination of diesel generators (16.6 MW), hydro (12.5 MW), wind (0.55 MW), and grid-connected solar PV plants (7.2 MW)[63]. Solar PV generation has increased rapidly between 2015 and 2020, particularly through attracting Independent Power Producers (IPPs). There are currently four IPPs operating renewable energy generation facilities, and EPC has indicated that additional IPPs will be considered in the future. Appendix D details the numerous electricity projects that are currently in the pipeline.

Samoa updated its electricity tariffs in 2021. These tariffs are low-to-average compared with other PICs[64]

Electricity tariffs in Samoa are approximately US$0.24/kWh for low consumers (1–50 kWh per month) and US$0.29/kWh for high consumers (51 kWh and over per month) (approximately WST $0.62/kWh and WST $0.76/kWh respectively). EPC also details cost-reflective tariffs for consumers with self-generation and non-domestic consumers[65]. According to PPA benchmarking data, EPC's standard network delivery and distribution losses are around 9 percent, compared with a regional average of 6 percent[66].

Commercial, industrial, and hotel facilities are important target sectors for energy efficiency activities

The largest electricity users in Samoa are based on Upolu island and include government, as well as commercial, industrial and hotel facilities—these facilities account for approximately 40 percent of Samoa's electricity consumption[67]. Peak demand from Upolu and Savai'i is

61 https://www.adb.org/sites/default/files/linked-documents/46044-002-ssa.pdf

62 Mau Simanu, EPC Chief Engineer. Cross Sector Workshop (23 November 2020).

63 https://cdn.auckland.ac.nz/assets/auckland/business/our-research/docs/energy-centre/polynesian-pathways-future-without-electricity-grids-nzipr-report.pdf

64 http://prdrse4all.spc.int/system/files/electricity_price_comparison_-_pacific_area_2015_final_20150615_2.pdf

65 Tariff effective from 1 September 2021. https://www.regulator.gov.ws/images/ORDERS/Electricity/2021/ORDER_2021_E80.pdf

66 https://www.ppa.org.fj/wp-content/uploads/2019/03/2017-FY-Benchmarking-Report_Publication_Final-1.pdf

67 Samoa Energy Review, https://www.mof.gov.ws/wp-content/uploads/2020/05/SAMOA-ENERGY-REVIEW-2016-Final.pdf

approximately 21 MW (18 MW and 3 MW respectively)[68]. Diesel generators are sometimes used to supplement electricity during peak demand periods, or to support the electricity supply of some rural populations[69].

Recently passed legislation focused on energy efficiency

The electricity sector is underpinned by the Electricity Act 2010, which provides the legislative framework for regulating the electricity sector, including establishing the Electricity Regulator[70]. Recently, GoS has focused on energy efficiency projects or initiatives to strengthen and improve the electricity sector[71]. GoS established the National Building Code of Samoa (NBC) in 2017, which mandated minimum energy efficiency standards for new buildings, and the Energy Management Act 2020, which set minimum energy performance standards (MEPS) for many appliances, including imported or traded household refrigerators, freezers, and air conditioners[72].

The energy sector is managed by multiple government institutions

The Energy Division of MoF is responsible for energy policy, while MNRE focuses on renewable energy and energy efficiency projects. The Office of the Regulator is an independent regulator of Samoa's electricity sector and is responsible for tariff setting and regulation of utility activities according to policy. These institutions, and other key national stakeholders, are detailed in Table 4.1.

4.1.1 Key national stakeholders in the electricity sector

Table 4.1 details the roles of the key national stakeholders in Samoa's electricity sector.

Table 4.1: Key national stakeholders in the electricity sector

Key stakeholder	Roles within the sector
Electric Power Corporation (EPC)	EPC is a government-owned corporation responsible for the generation, transmission, distribution, and selling of electricity in Samoa.
Ministry of Finance (MoF)—Energy Division	MoF is responsible for climate resilience investment and coordination, which seeks to develop and implement appropriate financing modalities for climate resilience. The Energy Division within MoF is responsible for energy policy. It also manages registration of and monitors energy-efficient refrigerators and freezers.
Ministry of Natural Resources and Environment (MNRE) – Renewable Energy Divison	MNRE leads the management of Samoa's environment and natural resources. Among other areas, it focuses on renewable energy, and is responsible for renewable energy and energy efficiency projects.

[68] https://www.adb.org/sites/default/files/linked-documents/49339-001-so.pdf

[69] Consultation with stakeholders in Samoa.

[70] http://prdrse4all.spc.int/node/4/content/samoa-electricity-act-2010-no13

[71] An ADB project (under 'Promoting Energy Efficiency in the Pacific – Phase 2' (PEEP2)) supported Samoa in improving its energy data reporting, developing energy efficiency targets, guidelines for green buildings, and energy auditing, and energy efficiency information materials.

[72] https://www.mof.gov.ws/samoa-energy-efficiency/

Key stakeholder	Roles within the sector
Office of the Regulator	The Office of the Regulator is an independent regulator of Samoa's electricity, telecommunications, broadcasting, and postal sectors. For the electricity sector, it is responsible for tariff setting and regulation of utility activities according to policy.

4.1.2 Specific NDC targets for electricity sector

Samoa's First NDC focused primarily on reducing emissions from the energy sector. Samoa included the following target in its First NDC:

> *"[Samoa is] committed to reducing its [greenhouse gas] GHG emissions from the Electricity sub-sector through the adoption of a 100% Renewable energy target for electricity generation through to the year 2025"*

Samoa has achieved 50 percent renewable electricity generation target as of March 2021[73].

Samoa's Second NDC targets reducing GHG emissions in the electricity sector by 44.2 Gg CO_2-e by 2030 compared with 2007 levels[74]. This target is based on the 2007 emissions inventory baseline, and can be applied relative to the new reference year once the GHG emissions inventory is updated. The electricity sector target makes up part of the overall energy sector target[75]. The electricity targets in Samoa's First and Second NDC are conditional on external financial support.

4.1.3 Constraints on the electricity sector

Five overarching constraints limit the implementation of mitigation projects in the land transport sector. These constraints were identified during research on the energy sector, research on potential mitigation opportunities, as well as by stakeholders in Samoa[76]. Specific barriers to each of the electricity sector pipeline projects are also outlined in the project concept notes in Appendix A.

Budget

Institutions involved in NDC implementation do not have sufficient budgets to implement and manage new projects. Private sector involvement to implement mitigation opportunities could help with budget constraints. However, funding mitigation opportunities necessary to achieve Samoa's NDC are likely to be beyond the ability of GoS and the private sector[77]. Significant international climate finance is likely to be needed[78]. Each project concept note includes a procurement method, which details how the mitigation opportunity could be funded and

[73] EPC data, mentioned at the Consultation Workshop.

[74] To avoid double counting, the GHG emissions reductions of the 100 percent renewable electricity sector project are taken as the total GHG emissions reduction potential in the electricity sub-sector.

[75] Reduce GHG emissions in the energy sector by 30 percent in 2030 compared to 2007 levels (or by 53 Gg CO_2-e compared to the new reference year once the GHG emissions inventory is updated).

[76] Stakeholders provided feedback on constraints during the Consultation Workshop (held on 19 March 2021) and the Consultation Workshop survey.

[77] Identified by stakeholders who participated in the Consultation Workshop on 19 March 2021.

[78] Identified by stakeholders who participated in the Consultation Workshop on 19 March 2021.

financed. This will help GoS find viable sources of funding to implement mitigation opportunities.

Institutional capacity

Institutions involved in NDC implementation do not have sufficient human capacity (including lack of staff members and lack of time) to implement projects. Participants suggested that no more than six projects should be run in the electricity sector at one time. To account for limited institutional capacity, projects have been prioritized and sequenced to ensure that institutions managing electricity projects have sufficient capacity.

Experience

Stakeholders in Samoa reported that staff members of institutions involved in the electricity sector may lack the experience and technical skills required to implement, manage, and monitor NDC projects. Projects included in the pipeline have been designed to incorporate capacity-building programs and technical assistance activities when needed.

Data

Stakeholders in Samoa reported that there are data constraints to NDC implementation. Although data is available about Samoa's electricity sector and energy efficiency programs, this information is not widely shared or easily available.

Coordination

Activities in the sector are not well coordinated between ministries, agencies, development partners, financial entities, private businesses, and individuals[79]. Stakeholders stated that "EPC has coordination challenges with other ministries involved in the electricity sector." In addition, there is a lack of integration and coordination between the electricity sector and the petroleum sector, particularly with sector planning[80].

Institutions must also balance priorities between grid stability and renewable energy generation projects. Stakeholders stated that "the tendency is to prioritize integrating renewable energy generation projects because they attract funding from both the donor sector and the private sector (whereas grid stability projects are government-funded); however, grid support projects are essential to enable connection of new generation projects."

Stakeholders suggested that EPC lead projects in the electricity sector. In addition, each project has an executor responsible for the project, either from EPC or any relevant agency within the energy sector[81]. Having one executor for each project enables project ownership and enforcement, and will also facilitate coordination between ministries. Section 7.2 further details the sector leader and executors.

[79] Identified by stakeholders who participated in the Consultation Workshop on 19 March 2021.

[80] Identified by stakeholders in Samoa.

[81] Identified by stakeholders in Samoa.

4.2 Land transport sector

Road networks are relatively reliable in Samoa, but are vulnerable to extreme weather events

Samoa's total public road network is approximately 2,500km of which 1,300km are national roads under the jurisdiction and active maintenance of LTA[82]. Almost all (94 percent) of the national roads network are sealed with the remaining either gravel or earth roads. Upolu has 65 percent of the national road network compared to 35 percent in Savaii.

Majority of vehicles in Samoa are Internal Combustion Engine (ICE) vehicles, which use imported fuel

There are 29,600 registered vehicles in Samoa[83]. Private cars make up approximately 60 percent of the vehicle fleet in Samoa, and construction and other labor vehicles, such as pick-ups, vans, and trucks make up approximately 28 percent. Motorbike use is limited[84]. The sector is heavily reliant on imported petrol and diesel—petrol vehicles constitute 70 percent of the vehicle fleet, while diesel vehicles make up 30 percent of the fleet. Table 4.2 details an approximate breakdown of vehicles in Samoa.

Table 4.2: Registered vehicles in Samoa

Vehicle type	Approximate quantity
Private cars	18,500
Pick-ups	4,000
Van	2,800
Taxis	2,030[85]
Trucks	1,500
Buses	445[86]
Motorcycles	250
Machineries	75
Total	**29,600**

Source: UPRDR, 2013; MPPC
Note: Unless stated otherwise, the breakdown of vehicles is estimated using an approximately projected increase based on UPRDR 2013 data

Samoa is taking steps to encourage the uptake of Electric Vehicles (EVs)

The majority of vehicles are imported from Japan; imported vehicles are subject to 15 percent value added goods and services tax (VAGST) and are required to be 10 years old or less[87].

[82] According to MWTI's comments on the Draft NDC Implementation Roadmap and Investment Plan

[83] http://prdrse4all.spc.int/data/content/samoa-2000-2013-vehicle-registration

[84] https://www.sprep.org/att/irc/ecopies/countries/samoa/118.pdf

[85] Figure provided by MPPC, 2020

[86] Figure provided by MPPC, 2020

[87] https://www.revenue.gov.ws/sub-menu/135-border-faq

However, parliament passed an Act in 2020 waiving import duties and duty excise on EVs being imported to Samoa[88]. Although there are no registered EVs in Samoa (as of June 2020)[89], GoS is interested in introducing them—EPC is running a pilot project with the purchase of ten EVs and building a charging station[90].

The sector is managed by MWTI and is underpinned by four key policies that are implemented by multiple government institutions

Land transport in Samoa is underpinned by the Ministry of Works Act 2002, the Planning and Urban Management Act 2004, the Planning and Urban Management (Environment Impact Assessment) Regulations 2007, and the Land Transport Authority Act 2007.

Land Transport Authority (LTA) is responsible for sustaining and improving Samoa's road network, including managing road projects, while the MWTI is responsible for ensuring sustainable and resilient transport and road infrastructure. MPPC maintains data on traffic-related accidents and infringements and is also responsible for vehicle registration. These institutions, and other key national stakeholders, are detailed in Table 4.5.

4.2.1 Key national sector stakeholders in land transport

Table 4.3 details the key national stakeholders in Samoa's land transport sector.

Table 4.3: Key national stakeholders in land transport

Stakeholder	Role within sector
Land Transport Authority (LTA)	LTA is responsible for sustaining and improving Samoa's road network, including managing road projects.
Ministry of Customs and Revenue (MCR)	MCR is responsible for revenue collection, border management and security, and the facilitation of legal trade and movement of goods. It is also responsible for customs duties and taxation
Ministry of Finance (MoF)	MoF is responsible for climate resilience investment and coordination, which seeks to develop and implement appropriate financing modalities for climate resilience.
Ministry of Natural Resources and Environment (MNRE)	MNRE leads the management of Samoa's environment and natural resources. It focuses on renewable energy, water and sanitation, forestry, disaster management, climate change, water resources, land management, and environment and conservation
Ministry of Police, Prisons and Corrections (MPPC)	MPPC has jurisdiction of traffic legislation, and maintains data on traffic-related accidents and infringements. MPPC also has a Road to Safety Strategy which puts a high priority on coordinated efforts in all the key areas of road safety. MPPC is also responsible for Vehicle and Drivers License Registration Section (VDLRS).
Ministry of Works, Transport, and Infrastructure (MWTI)	MWTI is responsible for ensuring safe, secure, sustainable, and resilient transport, infrastructure, and development services. They are responsible for monitoring, regulation, and policy advice to the Minister for Transport, covering air, sea, and land transport, and lead the National Road Safety Committee and the Transport Sector.

[88] https://www.revenue.gov.ws/wp-content/uploads/2020/11/Customs-Tariff-Amendment-Act-2020-Eng.pdf

MPPC, vehicle registrations as at 2020

[90] Consultation Workshop (19 March 2020)

Source: MWTI comments on the draft NDC Implementation Roadmap and Investment Plan

4.2.2 Specific NDC targets for land transport sector

Samoa's First NDC does not include a specific quantitative target for reducing land transport emissions. Samoa's Second NDC targets reducing GHG emissions in the land transport sector by 5.2 Gg CO_2-ein 2030 compared with 2007 levels. This target is based on the 2007 emissions inventory baseline, and can be applied relative to the new reference year once the GHG emissions inventory is updated. The land transport sector target makes up part of the overall energy sector target[91]. Land transport sector targets in Samoa's Second NDCs are conditional on external financial and technical support.

4.2.3 Constraints in the land transport sector

Eight overarching constraints limit the implementation of mitigation projects in the land transport sector. These constraints were identified during research on the land transport sector, research on potential mitigation opportunities, as well as by stakeholders in Samoa[92]. Specific barriers to each of the land transport sector pipeline projects are also outlined in the project concept notes in Appendix A.

Budget

Institutions involved in NDC implementation do not have sufficient budgets to implement and manage new projects. Private sector involvement in implementing mitigation opportunities could help with budget constraints. However, funding mitigation opportunities necessary to achieve Samoa's NDC are likely to be beyond the ability of the GoS and Samoa's private sector[93]. Significant international climate finance is likely to be needed[94]. Each project concept note includes a procurement method, which details how the mitigation opportunity could be funded and financed. This will help the GoS find viable sources of funding to implement mitigation opportunities.

Institutional capacity

Institutions involved in NDC implementation do not have sufficient capacity (including personnel and staff time) to implement projects. For example, LTA has only 0.4 FTE available for NDC implementation projects. Participants also suggested that no more than four projects should be run in the land transport sector at one time. To account for limited institutional capacity, projects have been prioritized and sequenced to ensure that no more than four projects are being managed by the land transport sector institutions concurrently.

[91] Reduce GHG emissions in the energy sector by 30 percent in 2030 compared to 2007 levels (or by 53 Gg CO_2-e compared to the new reference year once the GHG emissions inventory is updated).

[92] Stakeholders provided feedback on constraints during the Consultation Workshop (held on 19 March 2021) and the Consultation Workshop survey.

[93] Identified by stakeholders who participated in the Consultation Workshop on 19 March 2021.

[94] Identified by stakeholders who participated in the Consultation Workshop on 19 March 2021.

Experience

Stakeholders in Samoa reported that staff members of institutions involved in the land transport sector may lack the experience and technical skills required to implement, manage, and monitor NDC projects. Projects included in the pipeline have been designed to incorporate capacity-building programs and technical assistance activities when needed.

Public awareness

Stakeholders suggested that there is low awareness among government ministries and the general population of the environmental benefits and co-benefits of transitioning to low-emissions vehicles and infrastructure[95]. This is likely due to the lack of low carbon and EVs available in Samoa. Where relevant, awareness-raising programs have been included as a part of the design of the mitigation project to demonstrate the capabilities of new vehicles and encourage their uptake.

Market structure

To decarbonize land transport, the market requires clear, cost-competitive low carbon alternatives to business-as-usual (BAU) practices. Almost all vehicles registered in Samoa run on unleaded petroleum (ULP) or automotive diesel oil (ADO). Currently, there are few alternatives to fossil-fueled vehicles in Samoa. However, parliament passed a bill in 2020 waiving taxes on EVs being imported to Samoa[96]. This change could incentivize the uptake of EVs.

The land transport mitigation opportunities included in the project pipeline provide alternatives to BAU. Each project concept note details ways in which the project could be incentivized, such as through low-interest loans for commercial and retail customers for importing or purchasing low-emissions land transport vehicles.

Legal

Stakeholders suggested that legal constraints may impact the implementation of NDC projects. For example, Samoa does not have a legislative framework for EVs. The concept notes for each project outline where legislative development may be required. Legislative development may require external support, however Samoa has experience making amendments to, or introducing new legislation, such as those to incentivize EV uptake through waiving import duties and duty excise on EVs[97].

Data

Data on land transport in Samoa is limited. For example, data on traffic surveys, traffic volumes, vehicle imports, or vehicle registrations is often inaccurate, incomplete, or inaccessible[98]. Without accurate data on demand and current usage, is it challenging to understand the impacts that infrastructure changes (such as improvements to the road network) or new vehicle options (such as EVs) would have on the GHG emissions in Samoa's land transport

[95] Concerns raised by stakeholders during the Inception Mission.

[96] https://www.revenue.gov.ws/wp-content/uploads/2020/11/Customs-Tariff-Amendment-Act-2020-Eng.pdf

[97] https://www.revenue.gov.ws/wp-content/uploads/2020/11/Customs-Tariff-Amendment-Act-2020-Eng.pdf

[98] Consultation with stakeholders in Samoa and consultants' research.

sector. In addition, it is difficult to estimate possible funding sources and financing requirements for mitigation projects in the land transport sector. Data about Samoa's land transport sector has been provided by stakeholders. Some formal data was not available, or the reliability of data was unclear.

Coordination

Activities in the sector are not well coordinated between ministries, agencies, development partners, financial entities, private businesses, and individuals[99]. Significant coordination between ministries and other institutions is required to improve the NDC implementation. Coordination is particularly important between LTA and institutions in the tourism industry, such as Samoa Tourism Authority (STA) and Samoa Hotels Association (SHA).

MWTI has been appointed as the responsible institution to lead projects in the land transport sector, and an executor (from either EPC, MWTI, STA, or MOF) for each project has also been identified[100]. Supporting ministries include MPPC for law enforcement, and MCR. Having one executor for each project will enable project ownership and enforcement and will also facilitate coordination between ministries. Section 7.2 further details the sector leader and executors.

4.3 Maritime transport sector

Maritime trade and transport are key to Samoa's economy and the livelihoods of Samoans

Samoa is a maritime nation with two large islands and eight small islets. Samoa is spread over an exclusive economic zone (EEZ) of 120,000 km^2, which is the smallest in the Pacific region[101]. There are six ports in Samoa—four located on Upolu and two located on Savai'i[102]. The number of vessels and cargo arriving at Samoa's ports has increased significantly from 2013. Approximately 500 vessels visit Samoan ports each year. The primary international port is Apia at Matautu, which provides facilities for international freight movements, container ship, tanker (fuel and LPG), cruise ships, vessels, research vessels, and some of the interisland passenger ferry services[103].

More than half of the vessels in Samoan waters are not registered

There are approximately 31 registered vessels and 65 nonregistered vessels in Samoa, of which 11 are GoS vessels and 85 are privately owned[104]. Table 4.4 lists the types and number of vessels registered and non-registered in Samoa. Many households in Samoa also have a private boat used for private fishing and transportation purposes. The quantity of these boats is largely unknown, and not included in the table below.

[99] Identified by stakeholders during the Inception Mission.

[100] Identified by stakeholders in Samoa.

[101] http://www.fao.org/3/y5121e/y5121e09.htm#:~:text=At%20120%20000%20km2,%22alia%22%20catamaran%20fishing%20craft.

[102] https://www.pecc.org/resources/infrastructure-1/2394-case-study-from-apia/file

[103] https://iho.int/mtg_docs/CB/CBA/Risk/PRNI-Samoa-RA_Report-B-Main_Report.pdf ; https://www.pecc.org/resources/infrastructure-1/2394-case-study-from-apia/file

[104] MWTI Maritime Division

Table 4.4: Registered and non-registered maritime vessels in Samoa

Vessel type	Quantity
Cargo/barge	4
Fishing boat—<15 meters in length	14
Fishing boat—fishing alia	63
Outrigger sailboat	1
Passenger ferries (roro ferries)	3
Police patrol	1
Speed boat	2
Tourist boat	3
Tugboat	2
Total	93

Source: MTWI Maritime Division

The GoS provides interisland passenger services

Samoa Shipping Corporation (SSC) operates the main travel and shipping vessels in Samoa. Samoa also has two vessels (*Lady Samoa III and Fotu-o-Samoa II*) that are used for the domestic inter-island ferry service, which provide six return trips per day across the Apolima Strait (connecting Upolu and Savai'i). In 2021, SSC announced the arrival of the Samoa Express II, a third inter-island passenger ferry, which is expected to service the Upolu-Savai'i route. SSC has a once-weekly international ferry/cargo service from Apia to American Samoa (*Lady Naomi*) and to Tokelau (*SSC Fasefulu*). Charter services are also available to other islands, such as the Cook Islands. SSC also operates a barge service to carry dangerous goods from Apia to other locations on Upolu and Savai'i. The Apolima Strait is the busiest waterway in Samoa as it is the primary route for commercial vessels transiting to/from Fiji, New Zealand, and Australia[105].

Management of Samoa's maritime transport sector is split between three main institutions

The Maritime Division of the MWTI holds the Register of Ships and Vessels, and regulates maritime transport in Samoa to ensure that vessels abide by Samoa's national and international maritime guidelines. Management of port and harbor infrastructure is shared between the Samoa Ports Authority (SPA) and the SSC[106]. These institutions, and other key national stakeholders, are detailed in Table 4.5. Maritime transport in Samoa is underpinned by the Shipping Act 1998 and the Marine Pollution Prevention Act 2008[107].

4.3.1 Key national sector stakeholders in maritime transport

Table 4.5 details the key national stakeholders in Samoa's maritime transport sector.

[105] https://iho.int/mtg_docs/CB/CBA/Risk/PRNI-Samoa-RA_Report-B-Main_Report.pdf

[106] https://www.sprep.org/att/irc/ecopies/countries/samoa/118.pdf

[107] https://www.mwti.gov.ws/divisions/maritime/

Table 4.5: Key national stakeholders in maritime transport

Stakeholder	Role within sector
Ministry of Agriculture and Fisheries (MAF)	MAF provides regulatory and technical advice, training, and support for subsistence and commercial farmers, agri-processors, and exporters. MAF's focus is also on improved food security and sustainable agricultural production.
Ministry of Finance (MoF)	MoF is responsible for climate resilience investment and coordination, which seeks to develop and implement appropriate financing modalities for climate resilience.
Ministry of Natural Resources and Environment (MNRE)	MNRE leads the management of Samoa's environment and natural resources. It focuses on renewable energy, water and sanitation, forestry, disaster management, climate change, water resources, land management, and environment and conservation.
Ministry of Works, Transport, and Infrastructure (MWTI)	▪ MWTI is responsible for ensuring safe, secured, sustainable, and resilient transport, infrastructure, and development services. ▪ The maritime transport division has specific missions, predominantly focusing on effective, sustainable, and integrated maritime transport networks. ▪ The maritime transport division also holds the Register of Ships and Vessels, and regulates maritime in Samoa to ensure that vessels abide by Samoa's national and international maritime guidelines.
National University of Samoa (NUS)	NUS is the only national university in Samoa. It has a maritime training program.
Samoa Ports Authority (SPA)	SPA operates as a self-funded, commercially viable organization which seeks to ensure safety of ports and maritime operations, and provide effective and efficient services.
Samoa Shipping Corporation (SSC)	SSC provides ferry and marine shipping services.

4.3.2 Specific NDC targets for maritime transport

Samoa's First NDC does not include a specific quantitative target for reducing maritime transport emissions. Samoa's Second NDC targets reducing GHG emissions in the maritime transport sector by 3.0 Gg CO_2-ein 2030 compared with 2007 levels. This target is based on the 2007 emissions inventory baseline, and can be applied relative to the new reference year once the GHG emissions inventory is updated. The maritime transport sector target makes up part of the overall energy sector target[108]. Maritime transport sector targets in Samoa's Second NDCs are conditional on external financial and technical support.

[108] Reduce GHG emissions in the energy sector by 30 percent in 2030 compared to 2007 levels (or by 53 Gg CO_2-e compared to the new reference year once the GHG emissions inventory is updated).

4.3.3 Constraints on maritime transport sector

Three overarching constraints limit the implementation of mitigation projects in the maritime transport sector. These constraints were identified during research on the maritime transport sector, research on potential mitigation opportunities, as well as by stakeholders in Samoa[109]. Specific barriers to each of the maritime transport sector pipeline projects are also outlined in the project concept notes in Appendix A.

Budget

Institutions involved in NDC implementation do not have sufficient budgets to implement and manage new projects. Private sector involvement in implementing mitigation opportunities could help with budget constraints. However, funding mitigation opportunities necessary to achieve Samoa's NDC are likely to be beyond the ability of the GoS and the private sector[110]. Significant international climate finance is likely to be needed[111]. Each project concept note includes a procurement method, which details how the mitigation opportunity could be funded and financed. This will help the GoS find viable sources of funding to implement mitigation opportunities.

Institutional capacity

Institutions involved in NDC implementation have limited capacity (including personnel and staff time) to implement projects. For example, stakeholders in Samoa estimated that MWTI has 2.0 FTE available for NDC implementation projects. Participants also suggested that no more than four projects should be run in the maritime transport sector at one time. To account for limited institutional capacity, maritime sector projects have been prioritized and sequenced to ensure that no more than four projects are run by maritime sector institutions concurrently.

Experience

Stakeholders in Samoa reported that staff members of institutions involved in the maritime transport sector may lack the experience and technical skills required to implement, manage, and monitor NDC projects. For example, feedback from Phase I of the solar panel installation project on Lady Samoa III included that capacity building for staff is required for ongoing maintenance and operational support and to ensure successful project implementation beyond commission. Projects included in the pipeline have been designed to incorporate capacity-building programs and technical assistance activities when needed.

[109] Stakeholders provided feedback on constraints during the Consultation Workshop (held on 19 March 2021) and the Consultation Workshop survey.

[110] Identified by stakeholders who participated in the Consultation Workshop on 19 March 2021.

[111] Identified by stakeholders who participated in the Consultation Workshop on 19 March 2021.

4.4 Waste sector

The GoS provides a municipal waste collection scheme

Samoa's waste generation rate, according to MNRE, is approximately 1 kilogram (kg) per person per day[112]. The majority of Samoa's population uses the municipal waste collection scheme provided by MNRE. However, approximately 5 percent of households burn or dump their waste[113]. There are approximately 6,260 collection points in Upolu and Savai'i Islands[114]. Data about Samoa's municipal solid waste (MSW) generation is limited because regular waste assessments are not undertaken[115].

Solid waste is managed by two landfills and one recycling plant

Samoa has two landfills, Tafaigata Landfill (Upolu Island) and Vaiaata Landfill (Savai'i Island). Upolu's MSW is transferred directly to the Tafaigata landfill, which practices the Fukuoka method (a semi-aerobic landfill structure). This is the largest landfill, at approximately 100 acres. It accepts rubbish from the whole of Upolu island, including household waste, incombustible bulky waste, sludge, and medical waste[116].

There is currently one commercial-scale private sector recycler on Upolu. The company, Pacific Recyclers, is a metals recycling company, which collects and processes ferrous and nonferrous metal scrap and ships to Australia, the Republic of Korea, and New Zealand for resale[117]. Recycling that does not go to the recycling plant either goes to the landfill, or gets processed for exportation to countries overseas[118].

A tyre-recycling center is being developed adjacent to the existing metals recycler[119]. However, the country does not have a scheme in place for the effective disposal of end-of-life vehicles and white goods[120]. In 2019, Samoa announced its intention to introduce a 'waste tax' on imported plastic bottles, packaging, tyres, and cans as well as offering refunds for returned recyclable materials[121].

Coverage of wastewater is limited, but SWA intends to extend coverage

The Samoa Water Authority (SWA) is responsible for Samoa's water supply and wastewater treatment. It provides water supply by operating 14 water treatment plants and manages more than 45 boreholes. Coverage of Samoa's wastewater is concentrated to the central business district in Upolu, however SWA seeks to extend coverage, particularly to the Port of Apia[122].

[112] https://www.sprep.org/att/irc/ecopies/countries/samoa/118.pdf

[113] https://www.adb.org/sites/default/files/publication/42663/solid-waste-management-samoa.pdf

[114] https://www.sprep.org/attachments/VirLib/Samoa/national-waste-management-strategy-2019-2023.pdf

[115] https://www.adb.org/sites/default/files/publication/42663/solid-waste-management-samoa.pdf

[116] https://www.adb.org/sites/default/files/publication/42663/solid-waste-management-samoa.pdf

[117] https://www.adb.org/sites/default/files/publication/42663/solid-waste-management-samoa.pdf

[118] https://www.unep.org/news-and-stories/story/where-does-waste-go-small-island

[119] https://www.adb.org/sites/default/files/publication/42663/solid-waste-management-samoa.pdf

[120] https://www.adb.org/sites/default/files/publication/42663/solid-waste-management-samoa.pdf

[121] https://www.rnz.co.nz/international/pacific-news/386876/samoa-planning-waste-tax-on-recyclables

[122] https://www.swa.gov.ws/sites/default/files/inline-files/SWA%20Corporate%20Plan%202021-2024%2003072020_2.pdf

Sanitation is problematic due to the use of septic tanks or other waste removal processes. Despite majority of the population having plumbed toilet facilities, septic tanks are the most common way of treating waste, especially in urban areas. Rural areas often do not have a proper septic tank, and instead a hole dug into the ground[123]. The GoS has expressed serious concerns about groundwater being contaminated with waste, exposing people to water-borne diseases. Sanitation issues are also presented by households situated in water deficit areas which find it challenging to dispose of waste[124].

Management of the waste sector is split between two main institutions

The sector in is underpinned by the Waste Management Act 2010, and the Samoa Water Authority Act 2003 and Regulation 2009. The sector is managed by MNRE, which focuses on solid waste, and SWA, which is responsible for water and wastewater. These institutions, and other key national stakeholders, are detailed in Table 4.6.

4.4.1 Key national sector stakeholders in the waste sector

Table 4.6 details the key national stakeholders in Samoa's waste sector.

Table 4.6: Key national stakeholders in the waste sector

Stakeholder	Role within sector
Ministry of Agriculture and Fisheries (MAF)	MAF provides regulatory and technical advice, training, and support for subsistence and commercial farmers, agri-processors, and exporters. MAF's focus is also on improved food security and sustainable agricultural production.
Ministry of Finance (MoF)	MoF is responsible for climate resilience investment and coordination, which seeks to develop and implement appropriate financing modalities for climate resilience.
Ministry of Natural Resources and Environment (MNRE)	MNRE leads the management of Samoa's environment and natural resources. It focuses on renewable energy, water and sanitation, forestry, disaster management, climate change, water resources, land management, and environment and conservation.
Samoa Water Authority (SWA)	SWA provides 58 percent of water in Samoa (15 percent is supplied by independent village water schemes). It aims to effectively manage the provision of safe, reliable, and sustainable water services.

4.4.2 Specific NDC targets for the waste sector

Samoa's First NDC does not include a specific quantitative target for reducing waste sector emissions. Samoa's Second NDC targets reducing GHG emissions in the waste sector by 4 percent in 2030 compared to 2007 levels (or by 1.2 Gg CO_2-ecompared to the new reference

[123] https://www.sprep.org/att/irc/ecopies/countries/samoa/118.pdf

[124] https://www.sprep.org/att/irc/ecopies/countries/samoa/118.pdf

year once the GHG emissions inventory is updated). Waste sector targets in Samoa's Second NDCs are conditional on external financial and technical support.

4.4.3 Constraints on waste sector

Five overarching constraints limit the implementation of mitigation projects in the waste sector. These constraints were identified during research on the waste sector, research on potential mitigation opportunities, as well as by stakeholders in Samoa[125]. Specific barriers to the waste sector pipeline project are also outlined in the project concept notes in Appendix A.

Public awareness

Stakeholders suggested that the public and some institutions in the sector are not aware of the benefits of improving Samoa's wastewater and solid waste management. However, a plastic recycling pilot project will commence soon under J-PRISM II and UNDP CERO, which seeks to increase public awareness of waste and recycling. Where relevant, awareness-raising programs have been included as a part of the design of the mitigation project to demonstrate the capabilities of new vehicles and encourage their uptake.

Budget

Institutions involved in NDC implementation do not have sufficient budgets to implement and manage new projects. Private sector involvement in implementing mitigation opportunities could help with budget constraints. However, funding mitigation opportunities necessary to achieve Samoa's NDC are likely to be beyond the ability of the GoS and the private sector[126]. Significant international climate finance is likely to be needed[127]. Each project concept note includes a procurement method, which details how the mitigation opportunity could be funded and financed. This will help the GoS find viable sources of funding to implement mitigation opportunities.

Institutional capacity

Institutions involved in NDC implementation do not have sufficient capacity (including personnel and staff time) to implement projects. For example, MNRE has 2.0 FTE available for NDC implementation projects, which is required over multiple sectors, while SWA has 2.0 FTE available for water sector projects. Participants also suggested that no more than four projects should be run in the waste sector at one time. To account for limited institutional capacity, projects have been prioritized and sequenced to ensure that no more than four projects are being managed by the waste sector institutions concurrently.

Environmental and social

Stakeholders suggested that the affordability of monthly wastewater is tenuous, and solid waste bills are high compared with local incomes. In addition, connecting new customers to the wastewater network is costly. Only projects considered affordable are included in the final project pipeline.

[125] Stakeholders provided feedback on constraints during the Consultation Workshop (held on 19 March 2021) and the Consultation Workshop survey.

[126] Identified by stakeholders who participated in the Consultation Workshop on 19 March 2021.

[127] Identified by stakeholders who participated in the Consultation Workshop on 19 March 2021.

Market structure

Stakeholders stated that waste to electricity project proposals (including a methane project) have previously been introduced in Samoa; however, these proposals never came to fruition, and Samoa does not have local funding to complete them. Failure of past projects to reach financial close or physical completion indicates challenges with the market structure of the waste sector. The project concept note details ways in which the project could be procured, such as through a combination of international grant funding and government budget.

4.5 Tourism sector

Tourism in Samoa is a major contributor to Samoa's economy

Tourism expenditure in Samoa was estimated to be worth approximately US$183 million in 2018[128], which equals approximately US$1,000 per visitor and accounts for 20 percent of GDP[129]. Tourists predominantly arrive from Australia and New Zealand. The number of visitors to Samoa grew by an average rate of 6.7 percent between 2013 to 2017[130]. The total number of tourists to Samoa peaked at 172,000 in 2018.

Tourism has declined since 2018 due to several factors

Several events have negatively impacted Samoa's tourism sector, including Cyclone Evan, the tightening economic situation in Australia and New Zealand, reduced flights from New Zealand since 2013, the measles epidemic, and, more recently, the COVID-19 pandemic, which stopped tourism entirely to Samoa[131]. Lack of tourists due to COVID-19 restrictions has significantly contributed to Samoa's economy contracting by 8.6 percent[132].

The GoS is aiming to boost the tourism industry post-COVID-19 pandemic

The GoS, private sector, and the Samoa Tourism Authority (STA), which leads and markets Samoa's tourism industry, are looking to boost Samoa's tourism industry, particularly after the COVID-19 pandemic, while also supporting the country's sustainable development goals[133]. The Ministry of Commerce, Industry and Labour (MCIL) is also working to recover employment opportunities post-pandemic—tourism provides approximately 10 percent of Samoa's national employment; however, since the start of the pandemic, 70 percent of tourism-related jobs have been lost or downsized in Samoa, affecting around 3,500 people[134].

Projects in the tourism sector have focused on energy efficiency and renewable energy

STA and Samoa Hotels Association (SHA) are undertaking a survey to understand the renewable energy and energy efficiency potential of Samoa's tourism industry[135]. STA and SHA

[128] https://www.nztri.org.nz/sites/default/files/Samoa%20Int%20Visitor%20Survey%20Report%20Jan-Dec%202018%20Final%20(No%20Appendix).pdf

[129] https://pafpnet.spc.int/attachments/article/684/Samoa-Tourism-Sector-Plan-2014-2019.pdf

[130] Statistic reported to media by STA. https://www.samoaobserver.ws/category/article/39167#:~:text=Government%20selected%202018%20as%20the,in%20the%20last%20financial%20year

[131] https://pafpnet.spc.int/attachments/article/684/Samoa-Tourism-Sector-Plan-2014-2019.pdf

[132] https://www.rnz.co.nz/international/pacific-news/438422/from-pandemic-to-economic-crisis-samoa-s-covid-journey-one-year-on

[133] https://pafpnet.spc.int/attachments/article/684/Samoa-Tourism-Sector-Plan-2014-2019.pdf

[134] https://www.rnz.co.nz/international/pacific-news/438422/from-pandemic-to-economic-crisis-samoa-s-covid-journey-one-year-on

[135] STA and SHA, Solar Power Survey, Solarizing Samoa's Tourism Industry.

are also conducting an energy consumption assessment and developing five pilot sites for biomass or solar for tourism accommodation. These studies are important to understand the demand and potential for electricity projects in the tourism sector.

Management of the tourism sector is split between two main institutions

Ministry of Commerce, Industry and Labour (MCIL) is responsible for apprenticeships and training, which are crucial for Samoa's tourism industry, while STA monitors and advises the sector and provides businesses with information and instruments to monitor and advise the sector, including on climate change adaptation. These institutions, and other key national stakeholders, are detailed in Table 4.7.

4.5.1 Key national sector stakeholders in the tourism sector

Table 4.7 details the key national stakeholders in Samoa's tourism sector.

Table 4.7: Key national stakeholders in the tourism sector

Stakeholder	Role within sector
Ministry of Commerce, Industry and Labour (MCIL)	MCIL is responsible for apprenticeships, training, and industrial relations. It is also responsible for company registration and compliance, foreign investment promotion, and administering of private sector funding scheme.
Ministry of Finance (MoF)	MoF is responsible for climate resilience investment and coordination, which seeks to develop and implement appropriate financing modalities for climate resilience.
Ministry of Natural Resources and Environment (MNRE)	MNRE leads the management of Samoa's environment and natural resources. It focuses on renewable energy, water and sanitation, forestry, disaster management, climate change, water resources, land management, and environment and conservation.
Samoa Hotels Association (SHA)	SHA is an industry association of members who share common interests, goals and objectives for tourism and accommodation standards in Samoa.
Samoa Savai'i Tourism Association (SSTA)	SSTA was formed by a group of entrepreneurs in Savai'i to encourage the tourism industry on the big island.
Samoa Tourism Authority (STA)	STA has five divisions and a Tourism Climate Change Adaptation Project Unit. STA's key project provides the tourism sector with information and instruments to monitor and advise the sector on climate change adaptation.
South Pacific Tourism Organization (SPTO)	SPTO represents 21 government members, including Samoa, on tourism in the Pacific region.

4.5.2 Specific NDC targets for the Tourism Sector

Samoa's First NDC does not include a specific quantitative target for reducing tourism sector emissions. Samoa's Second NDC targets reducing GHG emissions in the tourism sector by 0.5 Gg CO_2-ein 2030 compared with 2007 levels. This target is based on the 2007 emissions inventory baseline, and can be applied relative to the new reference year once the GHG emissions inventory is updated. The tourism sector target makes up part of the overall energy

sector target[136]. Tourism sector targets in Samoa's Second NDCs are conditional on external financial support.

4.5.3 Constraints on Tourism Sector

Three overarching constraints limit the implementation of mitigation projects in the tourism sector. These constraints were identified during research on the tourism sector, research on potential mitigation opportunities, as well as by stakeholder in Samoa[137]. Specific barriers to the tourism pipeline project are also outlined in the project concept notes in Appendix A.

Budget

Institutions involved in NDC implementation do not have a sufficient budget to implement and manage new projects. High capital cost requirements particularly constrain the tourism sector. Private sector involvement in implementing mitigation opportunities could help with budget constraints. However, funding mitigation opportunities necessary to achieve Samoa's NDC is likely to be beyond the ability of the GoS and the private sector[138]. Significant international climate finance is likely to be needed[139]. The tourism sector concept note includes a procurement method, which details how the mitigation opportunity could be funded and financed. This will help the GoS find viable sources of funding to mitigate GHG emissions in the tourism sector.

Institutional capacity

Institutions involved in NDC implementation do not have sufficient capacity (including personnel and staff time) to implement projects. For example, STA has 0.4 FTE available for NDC implementation projects. Participants also suggested that no more than two projects should be run in the tourism sector at one time. To account for limited institutional capacity, projects have been prioritized and sequenced to ensure that no more than two projects are being managed by the tourism sector institutions concurrently.

Data

There is a lack of data and inaccurate data about projects in Samoa's tourism sector. For example, data on energy use in hotels and other buildings is out of date—the most recent was an energy audit in 2012 which focused on air conditioners in hotels. Without accurate data on demand and energy usage, it will be challenging to understand the impacts that projects in the sector will have on organizations in the tourism sector. In turn, this may reduce the incentive for organizations in the sector because benefits are not fully realized.

[136] Reduce GHG emissions in the energy sector by 30 percent in 2030 compared to 2007 levels (or by 53 Gg CO_2-e compared to the new reference year once the GHG emissions inventory is updated).

[137] Stakeholders provided feedback on constraints during the Consultation Workshop (held on 19 March 2021) and the Consultation Workshop survey.

[138] Identified by stakeholders who participated in the Consultation Workshop on 19 March 2021.

[139] Identified by stakeholders who participated in the Consultation Workshop on 19 March 2021.

4.6 Marine sector

Samoa's marine sector is an important part of Samoa's economy and culture

Samoa's ocean comprises 98 percent of its territory. Finfish catch has an approximate annual value of US$37 million in income generated, and invertebrate catch has an approximate annual value of US$86 million in income generated[140]. Coastal mangrove forests and coral reefs act as barriers to tsunamis and storms and provide a significant source of biodiversity, food security and pollution control. In addition, Samoa's ocean provides important shipping routes, and its marine habitats attract tourism[141].

Protecting Samoa's marine habitats is important for mitigating GHG emissions

Coastal mangroves and seagrasses are vital to sequestering and storing CO_2. Offshore habitats such as canyons, seamounts, water columns and the seabed offer additional goods and services such as nutrient cycling, carbon storage and sequestration, mineral resources, and high biodiversity[142]. Samoa's marine environment is facing challenges such as habitat destruction, overfishing, and pollution. This has adverse impacts on food and economic security, and resilience against climate change[143].

Samoa's ocean resources are guided by multiple sectoral strategies and policies

The sector is underpinned by the Fisheries Management Act 2016, which outlines principles for the integrated management of fisheries resources. Other important documents are:

- The Samoa Ocean Strategy (SOS), published in 2020, which seeks to manage Samoa's ocean, including protecting ecological habitats and marine wildlife, and safeguard important sources of food, income, and economic growth derived from Samoa's ocean;
- The Samoa Development Strategy 2016-2020, which emphasizes the importance of sustainable production and protection of marine resources; and
- The government's Community Integrated Management Plans (CIM Plans), which include ocean priorities, such as protection for marine species[144].

4.6.1 Key national sector stakeholders in the Marine Sector

The Fisheries Management Act 2016 and other documents are enforced by MAF, and supported by MNRE where relevant. These ministries, and other key national stakeholders, are detailed in Table 4.8. Key national sector stakeholders in the marine sector

Table 4.8 details the key national stakeholders in Samoa's Marine Sector.

[140] https://www.sprep.org/sites/default/files/documents/publications/samoa-ocean-strategy-management.pdf

[141] https://www.sprep.org/sites/default/files/documents/publications/samoa-ocean-strategy-management.pdf

[142] https://www.sprep.org/sites/default/files/documents/publications/samoa-ocean-strategy-management.pdf

[143] https://www.sprep.org/sites/default/files/documents/publications/samoa-ocean-strategy-management.pdf

[144] https://www.sprep.org/sites/default/files/documents/publications/samoa-ocean-strategy-management.pdf

Table 4.8: Key national sector stakeholders in the Marine Sector

Stakeholder	Role within sector
Ministry of Commerce, Industry and Labour (MCIL)	MCIL is responsible for apprenticeships, training, and industrial relations. It is also responsible for company registration and compliance, foreign investment promotion, and administering of private sector funding schemes.
Ministry of Finance (MoF)	MoF is responsible for climate resilience investment and coordination, which seeks to develop and implement appropriate financing modalities for climate resilience.
Ministry of Natural Resources and Environment (MNRE)	MNRE leads the management of Samoa's environment and natural resources. It focuses on renewable energy, water and sanitation, forestry, disaster management, climate change, water resources, land management, and environment and conservation. The Division of Environment and Conservation within the ministry is responsible for designing policies to protect coral reefs, and develop an integrated ecosystem-based approach (EbA) for climate change.
Ministry of Work, Transport, and Infrastructures (MWTI)	MWTI is responsible for ensuring safe, secured, sustainable, and resilient transport, infrastructure, and development services. The land transport division has specific missions, predominantly focusing on effective, sustainable, and integrated land transport networks. The Maritime Division holds the Register of Ships and Vessels The Division of Environment and Conservation within the ministry, is responsible for designing policies to protect coral reefs, and develop an integrated ecosystem-based approach (EbA) for climate change.
Samoa Ports Authority (SPA)	SPA operates as a self-funded, commercially viable organization that seeks to ensure the safety of ports and maritime operations and provide effective and efficient services.
Samoa Shipping Corporation (SSC)	SSC provides ferry and marine shipping services.
Samoa Shipping Services (SSS)	SSS provide ferry and marine shipping support services across Samoa.
Samoa Water Authority (SWA)	SWA is responsible for the provision of water and wastewater services.
The Samoa Conservation Society	The Samoa Conservation Society is a non-governmental organization dedicated to promoting the conservation of Samoa's biological diversity and natural heritage.

4.6.2 Constraints on marine sector

Three overarching constraints limit the implementation of mitigation projects in the marine sector. These constraints were identified during research on the marine sector, research on

potential mitigation opportunities, as well as by stakeholders in Samoa[145]. Specific barriers to the marine sector pipeline project are also outlined in the project concept notes in Appendix A.

Budget

Institutions involved in NDC implementation do not have sufficient budgets to implement and manage new projects. Private sector involvement in NDC implementation projects could help with budget constraints. However, financing mitigation opportunities necessary to achieve Samoa's NDC is likely to be beyond the ability of the GoS and the private sector[146]. Significant international climate finance is likely to be needed. The marine sector project concept note includes a procurement method, which details how it could be funded and, if need be, financed. This will help the GoS find viable sources of funding and finance GHG mitigation in the marine sector.

Institutional capacity

Institutions involved in NDC implementation do not have sufficient capacity (including personnel and staff time) to implement projects. For example, MNRE has 2.0 FTE available for NDC implementation projects, and MNRE's time is required over multiple sectors. Participants also suggested that no more than two projects should be run in the marine sector at one time. To account for limited institutional capacity, projects have been prioritized and sequenced to ensure that no more than two projects are being managed by the marine sector institutions concurrently.

Public awareness

Stakeholders suggested that there is low awareness among the general population and some institutions of the environmental benefits and co-benefits of marine projects[147]. Where relevant, awareness-raising programs have been included as a part of the design of the project to build public awareness and demonstrate benefits to encourage uptake.

4.7 AFOLU sector

Agriculture is an important economic sector in Samoa, that is likely to grow over time

The agricultural sector accounts for close to 40 percent of Samoa's GDP,[148] and 97 percent of households in Samoa produce some form of agricultural goods for commercial or subsistence purposes[149]. Important crops include taro (6,880 ha), bananas (7,932 ha), and cocoa (2,897 ha)[148]. Some crops have been expanding over time. For example, according to the most recent agricultural census, the area where bananas are cultivated increased by 46 percent between 2004 and 2005[148].

Growth in agricultural productivity is a core objective in Samoa. Samoa's agriculture sector plan is organized around the following four end-of-sector plan outcomes, two of which directly target increased production:

[145] Stakeholders provided feedback on constraints during the Consultation Workshop (held on 19 March 2021) and the Consultation Workshop survey.

[146] Identified by stakeholders who participated in the Consultation Workshop on 19 March 2021.

[147] Concerns raised by stakeholders during the Inception Mission.

[148] Samoa's Second National Communication to the UNFCCC. Available at: https://unfccc.int/resource/docs/natc/samnc2.pdf

[149] Report on Samoa's Agricultural Survey, 2015. Available at: https://www.sbs.gov.ws/digi/2015%20Samoa%20Agricultural%20Survey.pdf

- A sustained increase in production, productivity, product quality, value-adding and marketing of agriculture and fisheries products
- In increased supply and consumption of competitively priced domestically produced food
- Sector coordination improved, and investment in food security and inclusive commercial agriculture/fisheries production systems increased
- Sustainable agricultural and fisheries resource management practices in place and climate resilience and disaster relief efforts strengthened

Forest areas in Samoa have depleted, predominantly due to commercial logging

Approximately 171,000 ha (about 60 percent) of Samoa's total land area is considered forest areas—47 percent of Upolu and 69 percent of Savaii's total land area is covered by forest[150]. Most of the forest areas are open forest[151] and secondary forest[152], 32 percent and 22 percent respectively[150], indicating a high degree of forest depletion. Depletion of forest areas is largely due to commercial logging, but also human settlements and the impact of cyclones[153].

Commercial logging has declined since its peak between 1970-1990. This is largely due to the passing of the Forest Act in 1967 and the Forest Regulations in 1969, which focused on the management of forests for commercial logging interests[154]. The GoS also introduced the Forest Policy Banning Commercial Logging in 2006[155]. However, it has been difficult to enforce forest policies in Samoa because most land is held in customary ownership, which allows for logging—customary landowners have continued to enter into arrangements with logging companies[156]. The degradation of Samoa's forest areas will likely continue as settlement, agro-deforestation, and extreme weather events increase[157].

Agriculture, forestry, and other land-use activities significantly impact GHG emissions and removals in Samoa

Gross emissions from forestry, agriculture, and other land use contribute approximately 38 percent (135,000 tCO_2-e) of Samoa's overall emissions. Livestock farming accounts for 65 percent of emissions from the AFOLU sector, mainly from enteric fermentation and animal manure[158]. Data on CO_2 removals in the AFOLU sector suggest that land-based sinks sequestered 777,000 tCO_2-e in 2007, implying that the AFOLU sector in Samoa is a significant net carbon sink. However, estimates of land-based sinks in Samoa are based on limited data, and Samoa's Second National Communication to the UNFCCC states that these estimates should be treated with caution.

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150 These figures were taken from the Agricultural Census in 2005. https://www.sprep.org/att/irc/ecopies/countries/samoa/118.pdf

151 An open forest is a formation with a discontinuous tree layer but with coverage of at least 10 percent and less than 40 percent. http://www.fao.org/3/ae217e/ae217e00.htm

152 A secondary forest is a forest regenerating largely through natural processes after significant removal or disturbance of the original forest vegetation. http://www.fao.org/3/j0628e/J0628E16.htm

153 https://www.sprep.org/att/irc/ecopies/countries/samoa/118.pdf

154 https://www.sprep.org/att/irc/ecopies/countries/samoa/118.pdf

155 https://www.rnz.co.nz/international/pacific-news/167209/samoa-government-bans-commercial-logging

156 https://www.sprep.org/att/irc/ecopies/countries/samoa/118.pdf

157 https://www.sprep.org/att/irc/ecopies/countries/samoa/118.pdf

158 Samoa's Second National Communication to the UNFCCC. Available at: https://unfccc.int/resource/docs/natc/samnc2.pdf

Agriculture is guided by Samoa's Agriculture Sector Plan

Samoa's most recent Agriculture Sector Plan was published in 2016, and covered the period 2016 – 2020. This plan has not yet been updated for the post-2020 period. MAF has the core role in delivering on the Agriculture Sector Plan. However, there are important roles for other ministries, including MOF and MNRE. These ministries, along with other key national stakeholders in the AFOLU sector, are detailed in Table 4.9.

Samoa's forest areas resources are guided by multiple sectoral strategies and policies

Two key pieces of legislation that underpin the forestry sector are the Forest Act 1967 and the Forest Management Act 2011. These Acts are reinforced by National Policy on the Conservation of Biological Diversity 2007 and the National Policy on Forestry for Sustainable Development 2007. More recently, the GoS announced its National Environment Sector Plan 2017-2021 (NESP). NESP has a mandate to protect forests (and marine sites) and improve the sustainable management and development of forests. The sector is managed by the Ministry of Natural Resources and Environment, who leads NESP.

4.7.1 Key national sector stakeholders in the AFOLU sector

Table 4.9 details the key national stakeholders in the AFOLU sector.

Table 4.9: Key national sector stakeholders in the AFOLU sector

Stakeholder	Role within sector
Ministry of Agriculture and Fisheries (MAF)	MAF provides regulatory and technical advice, training, and support for subsistence and commercial farmers, agri-processors, and exporters. MAF's focus is also on improved food security and sustainable agricultural production.
Ministry of Natural Resources and Environment (MNRE) – Forestry Division	MNRE leads the management of Samoa's environment and natural resources. It focuses on renewable energy, water and sanitation, forestry, disaster management, climate change, water resources, land management, and environment and conservation.
Ministry of Commerce, Industry and Labour (MCIL)	MCIL is responsible for apprenticeships, trainings, and industrial relations. It is also responsible for company registration and compliance, foreign investment promotion, and administering of private sector funding schemes.
The Samoa Conservation Society	The Samoa Conservation Society is a non-governmental organization dedicated to promoting the conservation of Samoa's biological diversity and natural heritage.

4.7.2 Specific NDC targets for the AFOLU sector

Samoa's First NDC does not include a specific quantitative target for reducing AFOLU sector emissions, or increasing adaptation in the AFOLU sector. Samoa's Second NDC targets both mitigation and adaptation measures for the AFOLU sector by:

- Reducing GHG emissions in the AFOLU sector by 26 percent in 2030 compared to 2007 levels (or by 35.2 Gg CO_2-e compared to the new reference year once the GHG emissions inventory is updated)
- Expanding the area under agroforestry to an additional 5 percent of agricultural land by 2030 relative to 2018.

The expected GHG emissions reduction potential of the AFOLU sector adaptation targets were taken into account when determining the overall GHG emissions reduction targets. AFOLU sector targets in Samoa's Second NDCs are conditional on external financial and technical support.

4.7.3 Constraints on AFOLU sector

Eight overarching constraints limit the implementation of mitigation projects in the AFOLU sector. These constraints were identified during research on the AFOLU sector, research on potential mitigation opportunities, as well as by stakeholders in Samoa[159]. Specific barriers to the AFOLU sector pipeline projects are also outlined in the project concept notes in Appendix A.

Budget

Institutions involved in NDC implementation in the AFOLU sector do not have sufficient budgets to implement and manage new projects. Stakeholders in Samoa identified budget limitations as the largest factor constraining efforts to prevent deforestation and promote forest restoration. While stakeholders estimated that MAF would have enough staff to manage two NDC projects concurrently, they also indicated that the Ministry would have an insufficient budget to run these additional projects. Private sector involvement in NDC implementation projects could help with budget constraints.

Institutional capacity

Institutions involved in NDC implementation in the AFOLU sector have the insufficient human capacity (including staff members and time) to implement projects. Stakeholders in Samoa identified constraints on human capacity as the second-largest factor constraining efforts to prevent deforestation and promote forest restoration. Samoa's MAF has three to five staff members available to work on NDC projects, and these staff are likely only to be able to commit three to five hours per week to these projects (0.4 FTE). While aspects of NDC projects in the AFOLU sector will be led by ministries other than MAF, these other ministries are also likely to encounter human capacity constraints.

Participants also suggested that no more than two projects should be run in the AFOLU sector at one time. To account for limited institutional capacity, projects have been prioritized and sequenced to ensure that no more than two projects are being managed by the AFOLU sector institutions concurrently.

[159] Stakeholders provided feedback on constraints during the Consultation Workshop (held on 19 March 2021) and the Consultation Workshop survey, as well as an additional survey focusing on the AFOLU sector which was sent on 2 June 2021 to participants of the Consultation Workshop.

Coordination

Stakeholders in Samoa identified coordination problems as the third-largest factor constraining potential NDC projects in the AFOLU sector. Trade-offs between objectives are common in the AFOLU sector, and many countries struggle to achieve policy coherence[160]. For example, the objective of increasing agricultural production can conflict with efforts to prevent further clearing of forested land. To manage these trade-offs, it will be crucial for MNRE, and in particular, the Forestry Services Division, to work closely with MAF on the full range of NDC projects in the AFOLU sector.

MAF has been appointed as the responsible institution to lead projects in the AFOLU sector, and an executor (from either MNRE or MAF) for each project has also been identified[161]. Having one executor for each project will enable project ownership and enforcement and will also facilitate coordination between ministries. Section 7.2 further details the sector leader and executors.

Market structure

Securing finance for agricultural sector investments in Samoa is difficult because the sector is characterized by variable income flows, low returns, and long periods between investments and income flows[162]. To manage these challenges, the Development Bank of Samoa will have to maintain the central role it has taken in financing agricultural investments in the past in Samoa.

Experience

Stakeholders in Samoa reported that staff members of institutions and communities involved in the AFOLU sector may lack the experience and technical skills required to implement, manage, and monitor NDC projects. Projects included in the pipeline have been designed to incorporate capacity-building programs and technical assistance activities when needed.

Legal

Stakeholders suggested that legal constraints may impact the implementation of NDC projects, particularly customary land ownership arrangements under the Matai system. Stakeholders stated that land ownership arrangements mean families often take significant amounts of time deciding what to do with their land, which can delay projects. Customary land ownership arrangements and their impact on project timing has been integrated into the planning and sequencing of projects.

Data

Data on the AFOLU sector in Samoa is limited. For example, estimates of land-based sinks in Samoa are based on limited data, and Samoa's SNC to the UNFCCC states that these estimates

[160] See, for example, OECD 2020. Towards Sustainable Land Use. Aligning Biodiversity, Climate and Food Policies. Available at: https://www.oecd-ilibrary.org/sites/3809b6a1-en/index.html?itemId=/content/publication/3809b6a1-en

[161] Identified by stakeholders in Samoa.

[162] Samoa's Agriculture Sector Plan 2016-2020. Available at: https://pafpnet.spc.int/attachments/article/560/ASP%20Vol%201%20Agriculture%20Sector%20Plan%2026.05.16.pdf

should be treated with caution. Data about Samoa's AFOLU sector has been provided by stakeholders in Samoa when formal data is not available, or the reliability of the data is unclear.

Public awareness

Stakeholders suggested that there is low awareness among government ministries and the general population of the environmental benefits and co-benefits of mitigation projects in the AFOLU sector.[163] Where relevant, awareness-raising programs have been included as a part of the design of the projects to build public awareness and demonstrate benefits to encourage uptake.

[163] Concerns raised by stakeholders in survey sent on 2 June 2021.

5 Opportunities to help Samoa achieve its NDC targets

This NDC Roadmap and Plan presents 21 mitigation opportunities

This NDC Roadmap and Plan identifies 21 mitigation opportunities—four in the electricity sector, five in both the land and maritime transport sectors, one opportunity in each of the waste, tourism, and marine sectors, and four opportunities in the AFOLU sector. A summary of the GHG mitigation potential and investment needs of the opportunities are discussed below.

Opportunities were ranked using a multicriteria analysis considering mitigation potential, cost-effectiveness, and capacity requirements, and the views of stakeholders in Samoa. The multicriteria analysis is outlined in section 5.1.

A concept note for each mitigation opportunity, which includes the project description, GHG emissions reduction potential, costs, procurement method, and co-benefits, can be found in Appendix A. A detailed explanation of the terminologies and assumptions used in this section is provided in Appendix B.

5.1 Prioritizing the mitigation opportunities

A multicriteria analysis, combined with a survey of the views of key stakeholders, was used to prioritize the pipeline of mitigation projects in Samoa. The methodology used is described below.

5.1.1 Methodology of prioritizing mitigation opportunities

The pipeline projects were prioritized using the following two evaluation methods:

1. A multicriteria analysis which is a combined score evaluating three important aspects of each mitigation project, namely:
    a. GHG Emissions reduction potential
    b. Cost-effectiveness
    c. Capacity required to implement

    The multicriteria analysis considered two positive criteria and one risk-related negative criterion, listed in Table 5.1 below.

2. A survey that captured the priorities of stakeholders in Samoa. Stakeholders prioritized each project using a score from 1 to 5 (in which 1 indicates they think the project should receive the lowest priority and 5 indicates they think the project should receive the highest priority).

The combined score from the multicriteria analysis was then multiplied by the average score local stakeholders assigned to the project to reach an overall project priority score. The mitigation projects were then ranked according to their overall project priority score.

Table 5.1: Multicriteria analysis criteria

Description	Unit or categorization	Scoring Protocol	Weighting
GHG Emissions reduction potential before 2030	tCO_2-e (+)	The largest mitigation project (the project with the highest GHG emissions reduction potential) was assigned a score of 1. Every other mitigation project was assigned a score below 1, based on its rank relative to other projects.	2
Cost-effectiveness of mitigation effort	(tCO_2-e/US$) (+)	The most cost-effective project was assigned a score of 1. Every other project was assigned a score below 1, based on its rank relative to other projects.	2
Capacity required to implement	(High/Medium/Low) (-)	High = 1 Medium = 0.5 Low = 0	1

The multicriteria analysis does not explicitly account for environmental and social safeguards (ESS). However, stakeholders were encouraged to think about all the benefits and tradeoffs of the projects, including environmental and social considerations, when prioritizing projects. ESS guidelines have been added to the implementation plan, see section 7.3.2, and the concept notes for each project include a brief assessment of potential environmental and social impacts.

5.2 Mitigation potential and opportunities

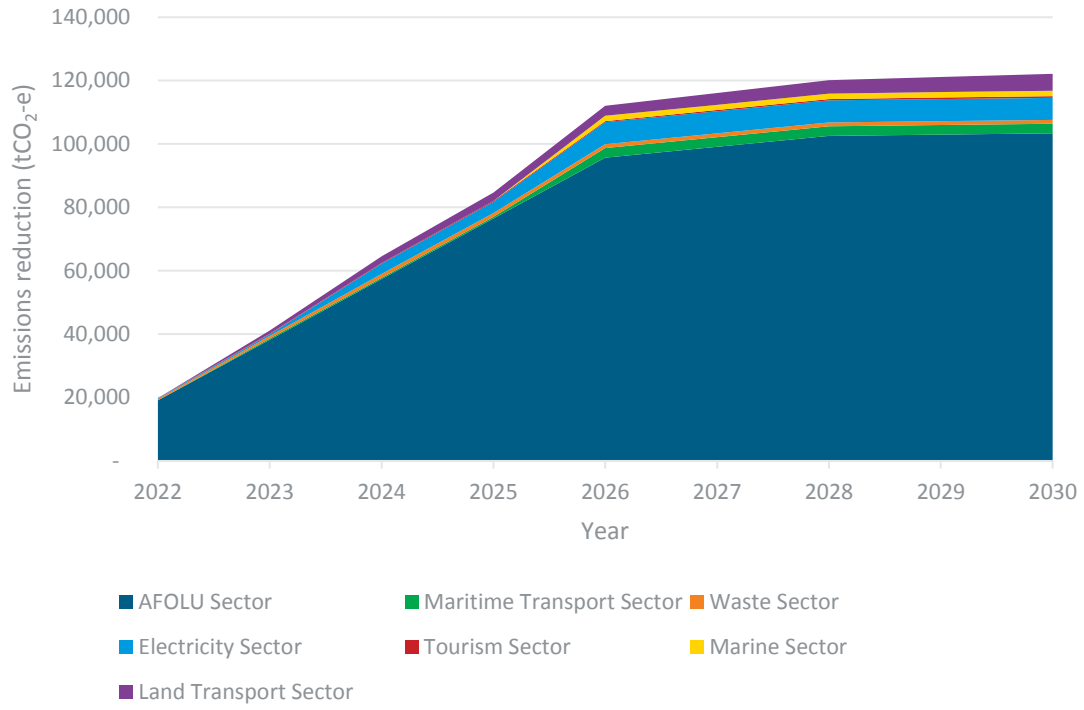
Based on this methodology, there are 21 mitigation opportunities. Once implementation constraints are considered,[164] the mitigation opportunities have:

- Potential to reduce emissions by 802,124 tCO_2-e by 2030
- An annual mitigation potential of 122,151 tCO_2-e in 2030
- An indicative investment need of US$135,414,000 by 2030.

Figure 5.1 details the cumulative GHG emissions reductions per sector from projects in the pipeline between 2022-2030.

[164] As explained in section 3 and section 4, institutional capacity constraints mean that it is not feasible to run all mitigation projects concurrently. Therefore, projects are sequenced in order of priority ensuring that there are no more than six projects happen concurrently in the electricity sector, no more than four projects happen concurrently in the land transport, maritime transport, and waste sectors, and no more than two projects happen concurrently in the tourism, marine, and AFOLU sectors.

Figure 5.1: Cumulative GHG emissions reductions 2022-2030 from pipeline projects in Samoa



Note: This graph takes into account implementation constraints

The NDC projects included in this Roadmap and Plan should be seen as a provisional list of mitigation opportunities. Samoa will continue to add to these projects as new opportunities arise, and new opportunities should be equally assessed and prioritized as those included in this Roadmap and Plan. Ministries and Implementing Agencies in each sector should be encouraged to continue innovating and to contribute to subsequent versions of this work.

5.2.1 Electricity

There are four mitigation opportunities that focus on electricity, outlined in Table 5.2 below. Once implementation constraints are considered[165], the mitigation opportunities have:

- Potential to reduce GHG emissions by 42,250 tCO_2-e by 2030
- An annual GHG mitigation potential of 6,947 tCO_2-e in 2030
- An indicative investment need of US$8,400,000 by 2030.

[165] As explained in Section 3, institutional capacity constraints mean that it is not feasible to run all mitigation projects concurrently. Therefore, projects are sequenced in order of priority ensuring that there are no more than six projects happen concurrently in the electricity sector.

Table 5.2: GHG mitigation opportunities in the electricity sector

Opportunity	Pipeline priority Rank	Indicative investment need to 2030 (US$)	Annual GHG emissions reduction in 2030 (tCO_2-e)	Cumulative GHG emissions reduction by 2030 (tCO_2-e)[166]
Building energy efficiency program	2	250,000	3,046	15,230
Grid stabilization projects	3	5,050,000	2,218	15,526
Network loss reduction program	6	2,000,000	1,108	7,756
Refrigeration efficiency program	13	1,100,000	575	3,738

Note: Mitigation figures (tCO_2-e) are rounded to the nearest ton; indicative investment needs are rounded to the nearest US$1,000; cost effectiveness is rounded to the nearest two decimal places

5.2.2 Land transport

There are five primary mitigation opportunities that focus on the land transport sector, outlined in Table 5.3 below. Once implementation constraints are considered[167], the mitigation opportunities have:

- Potential to reduce GHG emissions by 27,369 tCO_2-e by 2030
- An annual GHG mitigation potential of 5,362 tCO_2-e in 2030
- An indicative investment need of US$86,602,000 by 2030.

Table 5.3: GHG mitigation opportunities in the land transport sector

Opportunity	Pipeline priority Rank	Indicative investment need to 2030 (US$)	Annual GHG emissions reduction in 2030 (tCO_2-e)	Cumulative GHG emissions reduction by 2030 (tCO_2-e)[168]
Shared electric cars	8	14,679,000	1,074	8,055
Electrification of commercial fleets	14	18,402,000	2,181	9,815
Electrification of government and municipal fleets	17	10,649,000	644	2,898
Electrification of Samoa's light vehicle fleet	19	42,506,000	1,457	6,557

[166] The GHG emissions reduction estimate calculations are explained in the concept notes in Appendix A.

[167] As explained in Section 3, institutional capacity constraints mean that it is not feasible to run all mitigation projects concurrently. Therefore, projects are sequenced in order of priority ensuring that there are no more than four projects happen concurrently in the land transport sector.

[168] The GHG emissions reduction estimate calculations are explained in the concept notes in Appendix A.

Opportunity	Pipeline priority Rank	Indicative investment need to 2030 (US$)	Annual GHG emissions reduction in 2030 (tCO_2-e)	Cumulative GHG emissions reduction by 2030 (tCO_2-e)[168]
Shared electric micro mobility	20	365,598[169]	6	45[170]

Note: Mitigation figures (tCO_2-e) are rounded to the nearest ton; indicative investment needs are rounded to the nearest US$1,000; cost-effectiveness is rounded to the nearest two decimal places

5.2.3 Maritime transport

There are four mitigation opportunities that focus on maritime transport, outlined in Table 5.4 below. Once implementation constraints are considered[171], the mitigation opportunities have:

- Potential to reduce GHG emissions by 16,375 tCO_2-e by 2030
- An annual GHG mitigation potential of 3,026 tCO_2-e in 2030
- An indicative investment need of US$31,327,000 by 2030.

Table 5.4: GHG mitigation opportunities in the maritime transport sector

Opportunity	Pipeline priority Rank	Indicative investment need to 2030 (US$)	Annual GHG emissions reduction in 2030 (tCO_2-e)	Cumulative GHG emissions reduction by 2030 (tCO_2-e)[172]
Transport optimization and energy efficiency review	7	75,000	1,121	5,605
Shore side electric supply for at berth vessels	12	50,000	144	1,080
Electric ferry	15	29,000,000	1,370	6,850
Biodiesel ferry	16	897,000	247	1976
Expansion of solar panel project	18	1,305,000	144	864[173]

Note: Mitigation figures (tCO_2-e) are rounded to the nearest ton; indicative investment needs are rounded to the nearest US$1,000; cost-effectiveness is rounded to the nearest two decimal places

[169] If this project was implemented from 2022, the total indicative investment need of this project is US$382,000. Given Samoa's institutional capacity constraints, and the need to sequence projects, this project will be implemented from 2023, which reduces the indicative investment need to 2030 for this project.

[170] If this project was implemented in 2022, the cumulative GHG emissions reduction by 2030 would be 51 tCO_2-e. However, given Samoa's institutional capacity constraints and the need to sequence projects, this project will be implemented from 2023, which reduces the cumulative GHG emissions reduction potential by 2030.

[171] As explained in Section 3, institutional capacity constraints mean that it is not feasible to run all mitigation projects concurrently. Therefore, projects are sequenced in order of priority ensuring that there are no more than four projects happen concurrently in the maritime transport sector.

[172] The GHG emissions reduction estimate calculations are explained in the concept notes in Appendix A.

[173] If this project was implemented in 2022, the cumulative GHG emissions reduction by 2030 would be 1,008 tCO_2-e. However, given Samoa's institutional capacity constraints and the need to sequence projects, this project will be implemented from 2023, which reduces the cumulative GHG emissions reduction potential by 2030.

5.2.4 Waste

There is one mitigation opportunity that focuses on the waste sector, outlined in Table 5.5 below. Once implementation constraints are considered[174], the mitigation opportunity has:

- Potential to reduce GHG emissions by 9,712 tCO_2-e by 2030
- An annual GHG mitigation potential of 1,214 tCO_2-e in 2030
- An indicative investment need of US$2,752,000 by 2030.

Table 5.5: GHG mitigation opportunities in the waste sector

Opportunity	Pipeline priority Rank	Indicative investment need to 2030 (US$)	Annual GHG emissions reduction in 2030 (tCO_2-e)	Cumulative GHG emissions reduction by 2030 (tCO_2-e)[175]
Landfill gas collection system	11	2,752,000	1,214	9,712

Note: Mitigation figures (tCO_2-e) are rounded to the nearest ton; indicative investment needs are rounded to the nearest US$1,000; cost-effectiveness is rounded to the nearest two decimal places

5.2.5 Tourism

There is one mitigation opportunity that focuses on the tourism sector, outlined in Table 5.6 below. Once implementation constraints are considered[176], the mitigation opportunity has:

- Potential to reduce GHG emissions 2,998 tCO_2-e by 2030
- An annual GHG mitigation potential of 545 tCO_2-e in 2030
- An indicative investment need of US$250,000 by 2030.

Table 5.6: GHG mitigation opportunities in the tourism sector

Opportunity	Pipeline priority Rank	Indicative investment need to 2030 (US$)	Annual GHG emissions reduction in 2030 (tCO_2-e)	Cumulative GHG emissions reduction by 2030 (tCO_2-e)[177]
Energy efficient appliances	10	250,000	545	2,998

Note: Mitigation figures (tCO_2-e) are rounded to the nearest ton; indicative investment needs are rounded to the nearest US$1,000; cost-effectiveness is rounded to the nearest two decimal places

[174] As explained in Section 3, institutional capacity constraints mean that it is not feasible to run all mitigation projects concurrently. Therefore, projects are sequenced in order of priority ensuring that there are no more than four projects happen concurrently in the waste sector.

[175] The GHG emissions reduction estimate calculations are explained in the concept notes in Appendix A.

[176] As explained in Section 3, institutional capacity constraints mean that it is not feasible to run all mitigation projects concurrently. Therefore, projects are sequenced in order of priority ensuring that there are no more than two projects happen concurrently in the tourism sector.

[177] The GHG emissions reduction estimate calculations are explained in the concept notes in Appendix A.

5.2.6 Marine

There is one mitigation opportunity that focuses on the marine sector, outlined in Table 5.7 below. Once implementation constraints are considered[178], the mitigation opportunity has:

- Potential to reduce GHG emissions 8,415 tCO2 by 2030
- An annual GHG mitigation potential of 1,683 tCO_2-e in 2030
- An indicative investment need of US$935,000 by 2030.

Successful implementation of GHG mitigation projects in the MPAs sector can also contribute to achieving adaptation targets detailed in Samoa's Second NDC.

Table 5.7: GHG mitigation opportunities in the marine sector

Opportunity	Pipeline priority Rank	Indicative investment need to 2030 (US$)	Annual GHG emissions reduction in 2030 (tCO_2-e)	Cumulative GHG emissions reduction by 2030 (tCO_2-e)[179]
Mangrove restoration and planting	9	935,000	1,683	8,415

Note: Mitigation figures (tCO_2-e) are rounded to the nearest ton; indicative investment needs are rounded to the nearest US$1,000; cost-effectiveness is rounded to the nearest two decimal places

5.2.7 AFOLU

There are four GHG mitigation opportunities in the AFOLU sector, outlined in Table 5.8 below. Once implementation constraints are considered[180], the mitigation opportunity has:

- Potential to reduce GHG emissions 695,006 tCO_2-e by 2030[181]
- An annual GHG mitigation potential of 103,374 tCO_2-e in 2030
- An indicative investment need of US$5,148,000 by 2030.

Successful implementation of GHG mitigation projects in the AFOLU sector can also contribute to achieving adaptation targets detailed in Samoa's Second NDC.

[178] As explained in Section 3, institutional capacity constraints mean that it is not feasible to run all mitigation projects concurrently. Therefore, projects are sequenced in order of priority ensuring that there are no more than two projects happen concurrently in the marine sector.

[179] The GHG emissions reduction estimate calculations are explained in the concept notes in Appendix A.

[180] As explained in Section 3, institutional capacity constraints mean that it is not feasible to run all mitigation projects concurrently. Therefore, projects are sequenced in order of priority ensuring that there are no more than two projects happen concurrently in the AFOLU sector.

[181] GHG emissions reduction potential is dominated by the 'National forestry plan' project.

Table 5.8: GHG mitigation opportunities in the AFOLU sector

Opportunity	Pipeline priority Rank	Indicative investment need to 2030 (US$)	Annual GHG emissions reduction in 2030 (tCO_2-e)	Cumulative GHG emissions reduction by 2030 (tCO_2-e)[182]
Agroforestry support program	1	122,000	21,169	127,014
National forestry plan	4	3,877,000	80,553	563,871[183]
Manure management using anaerobic digesters	5	876,000[184]	1,644[185]	4,110[186]
Improving the efficiency and precision of fertilizer use	21	273,000[187]	8[188]	11[189]

Note: Mitigation figures (tCO_2-e) are rounded to the nearest ton; indicative investment needs are rounded to the nearest US$1,000; cost-effectiveness is rounded to the nearest two decimal places

[182] The GHG emissions reduction estimate calculations are explained in the concept notes in Appendix A.

[183] GHG emissions reduction potential in the AFOLU sector is dominated by the 'National forestry plan' project.

[184] The total indicative investment need of this project is US$1,095,000. Given Samoa's institutional capacity constraints, and the need to sequence projects, this project will not be fully implemented by 2030, which reduces the indicative investment need to 2030 for this project.

[185] Once fully implemented, this project has an annual GHG emissions reduction potential of 2,055 tCO_2-e. However, given Samoa's institutional capacity constraints, and the need to sequence projects, this project will not be fully implemented by 2030, which reduces the annual GHG emissions reduction potential in 2030.

[186] If this project was implemented in 2022, the cumulative GHG emissions reduction by 2030 would be 14,385 tCO_2-e. However, given Samoa's institutional capacity constraints, and the need to sequence projects, this project will not be fully implemented by 2030, reduces the cumulative GHG emissions reduction potential by 2030.

[187] The total indicative investment need of this project is US$546,000. Given Samoa's institutional capacity constraints, and the need to sequence projects, this project will not be fully implemented by 2030, which reduces the indicative investment need to 2030 for this project.

[188] Once fully implemented, this project has an annual GHG emissions reduction potential of 15 tCO_2-e. However, given Samoa's institutional capacity constraints, and the need to sequence projects, this project will not be fully implemented by 2030, which reduces the annual GHG emissions reduction potential in 2030.

[189] If this project was implemented in 2022, the cumulative GHG emissions reduction by 2030 would be 113 tCO_2-e. However, given Samoa's institutional capacity constraints, and the need to sequence projects, this project will not be fully implemented by 2030, reduces the cumulative GHG emissions reduction potential by 2030.

6 Financing Plan

This section outlines the principles of project funding and financing. It also identifies possible funding structures for all projects included in the pipeline and notes potential sources of finance for projects that are likely to require it.

When planning projects, it is important to make a clear distinction between funding and financing:

- Funding refers to the need for the project to cover all costs over the life of the project, including the costs of financing and implementation
- Financing deals with the timing mismatch between when expenses are incurred and when revenues are received.

To put it simply, funding is money that does not need to be repaid, while financing has to be repaid. There is a key linkage: the higher the cost of financing, the more funding is required.

There are three possible of funding for mitigation projects in Samoa

The costs of mitigation projects need to be met in full by money from one or a combination of the following three possible sources:

- Grants from international donors
- Government funding (from the government's budgets – paid for by taxes or other government revenue sources)
- User fees from those who benefit from the projects

Each of the mitigation opportunities in Samoa's project pipeline have different funding potential. Some projects are likely to be commercially viable—that is, should be funded by users. Users may either be willing to pay more due to better service or fund the project because it delivers cost savings to them. Other projects are unlikely to lead to revenues that cover their costs, so they may need either government or grant funding to proceed. In practice, many mitigation projects in Samoa will need to leverage funding from international donors if they are to proceed. Samoa is a SIDS, and it will need to carefully manage its domestic budget to maintain capacity to deal with increasingly frequent natural disasters under climate change.

Projects that cannot meet their costs through one or a combination of these three sources of funding are not viable and will not proceed.

Projects that incur large up-front costs but have viable funding sources for recovering these costs over time require finance

For NDC projects, finance is likely to come in one of two forms:

- Commercial finance from private lenders (this can sometimes be coupled with credit enhancements such as credit guarantees or risk-sharing facilities)
- Concessional finance from international donors (these would be in the form of sovereign lending)

Concessional finance includes blended finance. Public and private financial institutions are increasingly opting to blend investments they make on commercial terms with various types of concessional support. Concessional support includes advice, funding, or non-

grant instruments[190] such as debt financing, risk mitigation products, or equity investments with expectations of below-market returns. Concessional support uses scarce public funding so it must be used selectively. To access concessional support, Samoa's NDC projects will need to put forward strong evidence of potential mitigation benefits. In many cases, they will also need to demonstrate potential co-benefits, including the following co-benefits outlined under 6.8 of the Paris Agreement:

- Promoting increased adaptation and mitigation ambition
- Enhance public and private sector participation in the implementation of the NDC
- Enable opportunities for coordination across instruments and relevant institutional arrangements.

In Samoa, a key problem with securing concessional loans (such as those from multilateral development banks) to finance projects is that a commercial bank in Samoa is often required as a national counterpart. This two-step process diminishes the concessionality of the loan. To overcome this two-step process, projects can be bundled into a program of projects. This would make the pipeline of projects large enough to remove the requirement of a local commercial bank and make the concessional loan more beneficial.

Another potential challenge of financing NDC projects is that some are likely to be too small to warrant engagement in the complex procurement and approval systems that international financing institutions and, in particular concessional financing institutions have. Samoa should think about how individual projects could be aggregated with other projects across sectors. This will allow organizations to support a single, coherent program in Samoa or the Pacific more broadly. It will be easier for Samoa to get financing and concessional support for larger programs of activities covering multiple NDC projects.

Finance through market instruments under Article 6 of the Paris Agreement is yet to be negotiated. However, it is possible that, over the course of this plan, Samoa could finance GHG emissions reduction projects by taking part in international carbon markets. Given the early stages of Article 6 negotiations, possible financing arrangements under Article 6 have not been included in the NDC Roadmap and Plan. However, this could be considered as a possible financing solution for Samoa in the future.

Table 6.1, below, identifies the likely funding sources for meeting the costs of each of the pipeline projects, states whether finance will be required, and, if so, identifies the most likely type of finance. It also indicates the likelihood each project will attract private or donor funding and the capacity that would be required to implement each project. The funding and financing sources were identified in consultation with stakeholders in Samoa. The details of the possible funding and financing structures for each of the pipeline projects are presented in the procurement method section of each of the concept notes in Appendix A.

In many cases, projects could rely on a combination of grant funding, user fees, and government funding. While government funding is indicated as a possible funding source for many of the projects in the pipeline, it would often be employed to leverage donor

[190] Non-grant instruments are preferable in many cases because they provide potential return flows to the donor, and they can be designed to target specific market barriers.

capital and it would generally account for only a small share of the overall costs of the project. Given the fiscal constraints identified by stakeholders, international development partners should remain careful not to overburden the fiscal budget in Samoa with climate change mitigation projects.

Table 6.1: Prioritization, GHG emissions reduction potential, investment needs, cost effectiveness, likely funding sources, need for finance, and type of finance for pipeline projects

Prioritization	Mitigation project	Cumulative GHG emissions reduction by 2030 (tCO_2-e)	Indicative investment needs (US$)[191]	Cost effectiveness ($kgCO_2$/US$)[192]	Funding Sources			Is Finance Required?	Type of Finance		Likelihood of attracting private or donor funding	Capacity required to implement
					Grants from international donors	Government funding	User fees		Commercial finance	Concessional finance		
1	Agroforestry support program	127,014	122,000	1041.10		✓		No			Medium	Low
2	Building energy efficiency program	15,230	250,000	60.92		✓	✓	Yes	✓		High	Low
3	Grid stabilization projects	15,526	5,050,000	58.81	✓	✓	✓	Yes	✓		High	Medium
4	National forestry plan	563,871	3,877,000	145.44	✓	✓		No			Medium	Medium
5	Manure management using anaerobic digesters	14,385	1,095,000	Infinite	✓		✓	Yes		✓	High	Medium
6	Network loss reduction program	7,756	2,000,000	Infinite		✓	✓	Yes	✓		Medium	Medium

[191] Total indicative investment need of each project. Sequenced costs of each project, taking into account Samoa's institutional constraints, are listed in Table 7.2.

[192] Cost effectiveness is based on total economic costs and total cumulative emissions reduction of each project. Projects with 'infinite' cost effectiveness means the projects deliver cost savings.

Prioritization	Mitigation project	Cumulative GHG emissions reduction by 2030 (tCO_2-e)	Indicative investment needs (US$)[191]	Cost effectiveness ($kgCO_2$/US$)[192]	Funding Sources			Is Finance Required?	Type of Finance		Likelihood of attracting private or donor funding	Capacity required to implement
					Grants from international donors	Government funding	User fees		Commercial finance	Concessional finance		
7	Transport optimization and energy efficiency review	5,605	75,000	74.73			✓	Yes	✓		Medium	Low
8	Shared electric cars	8,055	14,679,000	Infinite			✓	Yes	✓		High	Low
9	Mangrove restoration and planting	8,415	122,000	9.00	✓	✓		No			High	Low
10	Energy efficient appliances	2,998	250,000	11.99			✓	Yes	✓		High	Low
11	Landfill gas collection system	9,712	2,752,000	3.53	✓	✓		No			Low	Medium
12	Shore side electrical supply for at berth vessels	1,080	50,000	21.60	✓	✓		No			Medium	Low
13	Refrigeration efficiency program	3,738	1,100,000	3.40		✓		No			High	Low
14	Electrification of commercial Fleets	9,815	18,402,000	5.33	✓		✓	Yes	✓		Medium	Medium

Prioritization	Mitigation project	Cumulative GHG emissions reduction by 2030 (tCO_2-e)	Indicative investment needs (US$)[191]	Cost effectiveness ($kgCO_2$/US$)[192]	Funding Sources			Is Finance Required?	Type of Finance		Likelihood of attracting private or donor funding	Capacity required to implement
					Grants from international donors	Government funding	User fees		Commercial finance	Concessional finance		
15	Electric ferry	6,850	29,000,000	0.27	✓		✓	Yes		✓	Low	Medium
16	Biodiesel ferry	1,976	897,000	2.20	✓	✓		No			Low	Medium
17	Electrification of government and municipal fleets	2,898	10,649,000	0.27	✓	✓	✓	Yes	✓	✓	Medium	Medium
18	Expansion of solar panel project	1,008	1,305,000	1.16	✓	✓	✓	Yes	✓		High	Medium
19	Electrification of Samoa's light vehicle fleet	6,557	42,506,000	0.15	✓	✓	✓	Yes	✓	✓	Low	Medium
20	Shared electric micro mobility	51	382,000	0.16		✓	✓	No			High	Low
21	Improving the efficiency and precision of fertilizer use	113	546,000	0.2		✓		No			Low	Medium

Note: cost effectiveness is rounded to 2 decimal places

Potential sources of funding under the three categories described above are listed in Table 6.2. Samoa is one of 74 low-income counties eligible to receive support under the World Bank's International Development Association. Samoa's classification as a developing country makes it eligible for support from a wide range of international donors.

Table 6.2: Sources of funding available in Samoa

Donor Funding	
Name of Donor	**Type of Funding Support**
World Bank (International Development Association)	Grants, TA, and capacity building
Asian Development Bank	Grants, TA, and capacity building
Green Climate Fund	Grants, TA, and capacity building
Global Environment Facility	Grants, TA, and capacity building
UNDP[193]	Grants, TA, and capacity building
GGGI	TA and capacity building
New Zealand Ministry of Foreign Affairs and Trade	Bilateral ODA grants
Australian Department of Foreign Affairs and Trade	Bilateral ODA grants
People's Republic of China	Bilateral ODA grants
UK Department for International Development	Bilateral ODA grants
Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)	Bilateral ODA grants
Japanese International Cooperation Agency	Bilateral ODA grants
European Union	Multilateral ODA grants
Sources of Government Funding	
Ministry of Finance	
Ministry of Agriculture and Fisheries	
Ministry of Natural Resources and Environment	
Ministry of Works, Transport, and Infrastructure	
Ministry of Commerce, Industry, and Labour	
Ministry of Police, Prisons and Corrections	
Samoa Tourism Authority	

[193] UNDP provides financial and technical support to projects through Global Environment Facility (GEF) and Green Climate Fund (GCF).

Local Government Agencies
Types of User Fees
Revenue from user tariffs
Avoided costs[194]

Potential sources of finance under the two categories described above are listed in Table 6.3. Samoa's private financial sector is small and experience with lending to businesses and households is limited. There are four commercial banks registered in Samoa[195]. Samoa does not have a sovereign credit rating. This makes it difficult for Samoa to access funding in international bond markets, because investors cannot see the level of risk associated with investing in the debt of Samoa.

Table 6.3: Sources of finance available in Samoa

Concessional Finance	Commercial Finance
▪ **World Bank** ▪ **Asian Development Bank** ▪ **European Investment Bank** ▪ **People's Republic of China** ▪ **Australian Aid** ▪ **European Union** ▪ **Green Climate Fund** ▪ **Global Environment Facility** ▪ **International Renewable Energy Agency (IRENA)**	▪ ANZ Bank Samoa Limited ▪ Development Bank of Samoa ▪ National Bank of Samoa ▪ Samoa Commercial Bank ▪ Bank South Pacific (BSP)

Samoa could further increase the availability of funding and finance to climate change projects by establishing a Climate Change Trust Fund

Climate change trust funds can help to mobilize domestic, bilateral, development partner, and philanthropic resources towards funding climate change projects. Climate Change trust Funds are becoming common in the Pacific, with examples including the Tonga Climate Change Trust Fund, the Tuvalu Climate Change and Disaster Survival Fund, Vanuatu's National Green Energy Fund, and the Fiji Rural Electrification Fund. These funds are guided by national legislation and objectives, which reduces their reporting requirements and operational fees and can make project funding more streamlined.

Box 1 describes Tonga's Climate Change Trust Fund, which could be used as a model for establishing a similar Fund in Samoa.

[194] Avoided costs is the incremental cost that is not incurred when the additional output is not produced. For example, the cost of paying for diesel for a generator may be avoided when a solar panel is installed.

[195] https://www.cbs.gov.ws/index.php/banking-system/supervison-and-regulation/commercial-banks/

Box 1: Tonga's Climate Change Trust Fund

Tonga's Climate Change Trust Fund comprises two elements:

- An endowment account (which holds 80 percent of the initial US$4 million endowment)
- An operational account which is used to fund and finance climate change projects.

This separation is designed to ensure that the fund is self-sustaining and can offer a long-term financing mechanism for climate change projects. The intention is that sound management and governance of this fund will help Tonga to build stronger relationships with development partners and potential donors, and may attract further contributions to the fund in the future. A similar structure would be appropriate in Samoa.

7 Implementation Plan

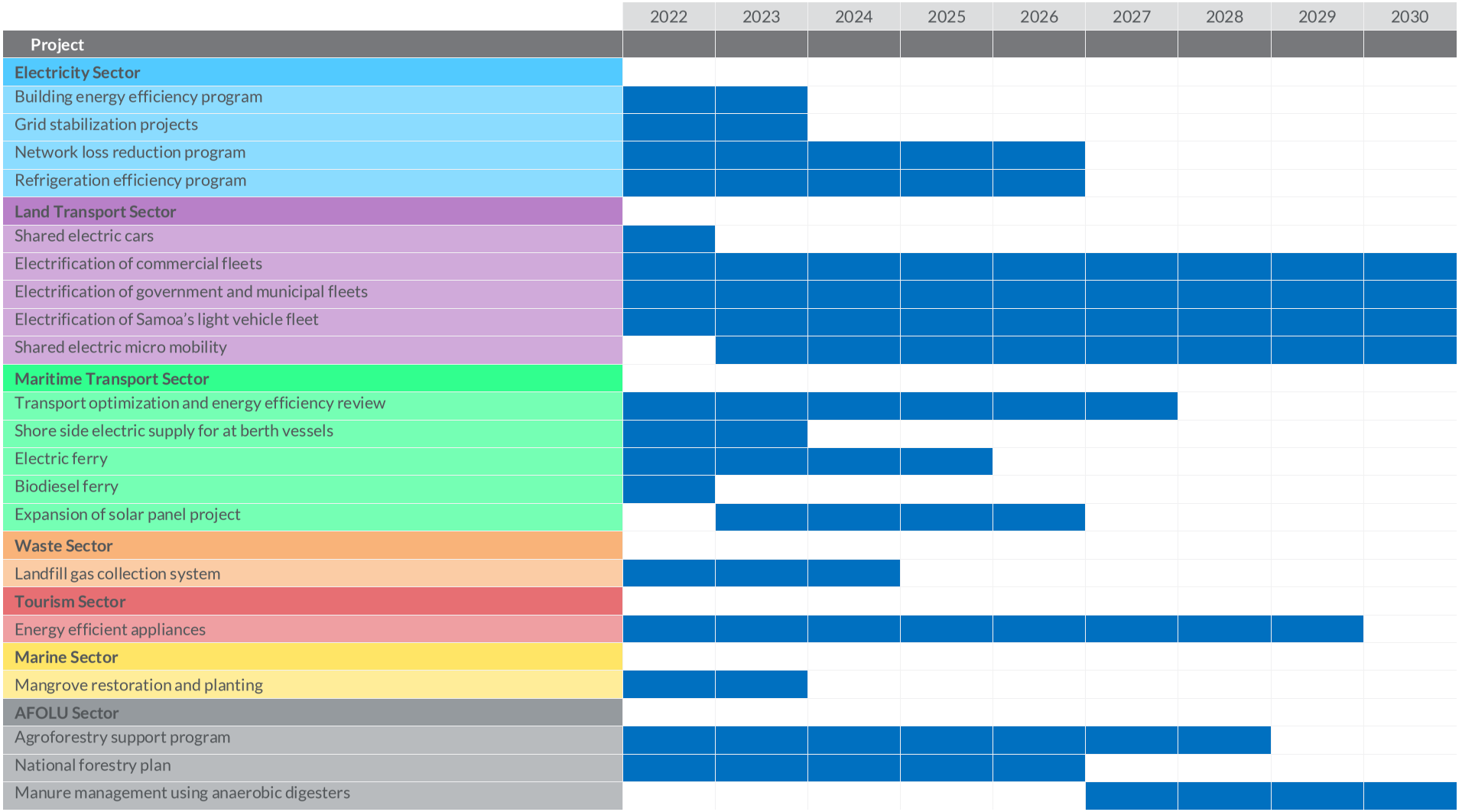
Section 7.1 shows the estimated timing and duration of each of the pipeline projects, and shows how the costs are distributed over time. Section 7.2 then outlines a monitoring evaluation framework to guide the implementation of Samoa's NDC. This monitoring and evaluation framework identifies the reporting, recording, and evaluation structures needed to manage the implementation of the pipeline projects, and identifies the party that should be responsible for each.

7.1 Timing and costs of project implementation

The timings and durations of each of the mitigation projects included in Samoa's project pipeline are shown in Table 7.1[196]. As explained in section 3, institutional capacity constraints mean that it is not feasible to run all mitigation projects concurrently. Therefore, projects are sequenced in order of priority ensuring that no more than six projects happen concurrently in the electricity sector, no more than four projects happen concurrently in each of the land transport, maritime transport, and waste sectors, and no more than two projects happen concurrently in each of the tourism, marine, and AFOLU sectors.

[196] We asked stakeholders in Samoa to identify how many projects can be implemented concurrently in each sector. This table shows the prioritized projects, taking into account stakeholders' views on how many projects can be run concurrently in each sector between 2022-2030.

Table 7.1: Timing and duration of pipeline projects



	2022	2023	2024	2025	2026	2027	2028	2029	2030
Improving the efficiency and precision of fertilizer use									

Table 7.2 shows the timings of costs (including capital and implementation costs) associated with each of the pipeline projects. These costs are sequenced, in line with Table 7.1 above.

Table 7.2: Timing of costs associated with pipeline projects (US$)

Project	2022	2023	2024	2025	2026	2027	2028	2029	2030	Cumulative (non-discounted) investment need by 2030
Electricity Sector										
Building energy efficiency program	$125,000	$125,000								$250,000
Grid stabilization projects	$2,525,000	$2,525,000								$5,050,000
Network loss reduction program	$400,000	$400,000	$400,000	$400,000	$400,000					$2,000,000
Refrigeration efficiency program	$220,000	$220,000	$220,000							$1,100,000
Land Transport Sector										
Shared electric cars	$1,294,000	$13,385,000								$14,679,000
Electrification of commercial fleets	$7,420,000	$1,372,750	$1,372,750	$1,372,750	$1,372,750	$1,372,750	$1,372,750	$1,372,750	$1,372,750	$18,402,000
Electrification of government and municipal fleets	$3,710,000	$ 867,375	$867,375	$867,375	$867,375	$867,375	$867,375	$867,375	$867,375	$10,649,000
Electrification of Samoa's light vehicle fleet	$11,130,000	$3,922,000	$3,922,000	$3,922,000	$3,922,000	$3,922,000	$3,922,000	$3,922,000	$3,922,000	$42,506,000
Shared electric micro mobility		$250,000	$16,514	$16,514	$16,514	$16,514	$16,514	$16,514	$16,514	$365,598
Maritime Transport Sector										
Transport optimization and energy efficiency review	$15,000	$15,000	$15,000	$15,000	$15,000					$75,000
Shore side electric supply for at berth vessels	$15,000	$15,000								$50,000

	2022	2023	2024	2025	2026	2027	2028	2029	2030	Cumulative (non-discounted) investment need by 2030
Electric ferry				$29,000,000						$29,000,000
Biodiesel ferry	$25,000	$109,000	$109,000	$109,000	$109,000	$109,000	$109,000	$109,000	$109,000	$897,000
Expansion of solar panel project		$435,000	$435,000	$435,000						$1,305,000
Waste Sector										
Landfill gas collection system	$917,333	$917,333	$917,333							$2,752,000
Tourism Sector										
Energy efficient appliances	$31,250	$31,250	$31,250	$31,250	$31,250	$31,250	$31,250	$31,250	$31,250	$250,000
Marine Sector										
Mangrove restoration and planting	$467,500	$467,500								$935,000
AFOLU Sector										
Agroforestry support program	$17,429	$17,429	$17,429	$17,429	$17,429	$17,429	$17,429			$122,000
National forestry plan	$775,400	$775,400	$775,400	$775,400	$775,400					$3,877,000
Manure management using anaerobic digesters						$219,000	$219,000	$219,000	$219,000	$876,000
Improving the efficiency and precision of fertilizer use								$136,500	$136,500	$273,000

7.2 Monitoring and evaluation framework

This section outlines a high-level monitoring and evaluation framework for MNRE to keep track of progress towards implementing Samoa's NDC. This framework provides a transparent system to measure progress, while building accountability and encouraging government employees to take ownership of the actions. The monitoring and evaluation framework has three components:

- A reporting structure that assigns responsibility for actions to specific government employees
- A monitoring structure that tracks progress in a transparent manner
- Guidelines on how to evaluate progress.

Under the monitoring framework, government staff responsible for implementing the NDC should assign responsibility for each project in tiers:

- NDC Supervisor—The person from a government ministry ultimately responsible for overseeing the implementation of Samoa's NDC. In this case, the consultants recommend that a senior member of MNRE should make up the top tier of the reporting structure. During consultation on this NDC Implementation Roadmap and Investment Plan, participants also highlighted the key role that MoF plays. Other participants suggested that a senior staff member from MNRE should be the NDC Supervisor because the GoS is in the process of setting up and establishing a Ministry of Climate Change and Resilience, and the Renewable Energy Division (currently sitting in MNRE) that will move under this new Ministry. The proposed monitoring and evaluation framework should start with MNRE, and move under this new Ministry once established. In the interim, the NDC Supervisor should be the CEO of MNRE. The NDC Supervisor should report to a more senior official (for example, the Minister of Natural Resources and the Environment), or someone else that the GoS determines.
- Sector Leaders—Individuals from government ministries responsible for implementing specific actions each of the seven sub-sectors of this NDC Implementation Roadmap and Investment Plan and reporting on progress to the NDC Supervisor. Figure 7.1 shows the sector leaders for each of the focus sectors nominated by MNRE.
- Executors—Individuals from government ministries responsible for carrying out the day-to-day tasks required to manage and implement the priority projects in each sector. Executors can include managers as well as line staff, who should make up the bottom tier of the structure.

Figure 7.1 shows how the reporting structure should establish an NDC Supervisor, Sector Leaders, and Executors within the GoS. This reporting structure was discussed during consultations on 19 March 2021. Stakeholders approved of the structure and gave direction on the appropriate people to fulfil each position.

Given the large number of sectors covered in the NDC Roadmap and Plan, and the limited number of officials available to lead NDC projects in Samoa, it is expected that the NDC supervisor will also act as the sector leader for waste and marine. While this will add to the NDC supervisor's workload, these sectors only contain one NDC project each, and

they may provide a useful opportunity for the NDC supervisor to understand first-hand the challenges and mechanics of implementing NDC projects.

Figure 7.1: NDC Supervisor, Sector Leaders, and Executors for implementing Samoa's NDC

Table 7.3 shows the implementing agencies that house the proposed executors responsible for delivery of each of the priority projects in Samoa's project pipeline, and supporting agencies for each project.

Table 7.3: Proposed executors responsible for priority projects

Pipeline Project	Executors (Implementing Agency)	Supporting agency(ies)	Sector
Grid stabilization projects	EPC	MOF, MWTI	Electricity
Building energy efficiency program	MNRE	MOF	
Network loss reduction program	EPC	MOF	
Refrigeration efficiency program	MOF	MNRE	
Shared electric cars	EPC	MWTI, MOF, Ministry of Customs and Revenue (MCR), MPPC	Land Transport
Electrification of commercial fleets	MWTI	MOF, MCR, MPPC	
Shared electric micro mobility	STA	MWTI, MOF, MCR	
Electrification of government and municipal fleets	MOF	MWTI, MOP, MCR, EPC, MPPC	
Electrification of Samoa's light vehicle fleet	EPC	MWTI, MOF, MCR, MPPC	
Shore side electrical supply for at berth vessels	Samoa Ports Authority (SPA)	MWTI, MOF	Maritime Transport
Transport optimization and energy efficiency review	MWTI	SPA, MOF	

Pipeline Project	Executors (Implementing Agency)	Supporting agency(ies)	Sector
Expansion of solar panel project	Samoan Shipping Corporation	MWTI	
Electric ferry	Samoa Shipping Corporation	MWTI	
Biodiesel ferry	SROS	MWTI	
Landfill gas collection system	MNRE – Division of Environment and Conservation	MWTI	Waste
Energy efficient appliances	STA	MNRE, EPC	Tourism
Mangrove restoration and replanting	MNRE	MWTI	Marine
Agroforestry support program	MNRE – Forestry Division	MAF	AFOLU
Manure management using anaerobic digesters	MAF – Livestock Division	MNRE	
National forestry plan	MNRE – Forestry Division	MAF	
Improving the efficiency and precision of fertilizer use	MAF	MNRE	

Communication is a vital part the monitoring framework—the NDC Supervisor, Sector Leaders, and Executors should frequently discuss progress on the projects under their supervision. Sector Leaders should meet quarterly with their Executors to track day-to-day tasks and liaise with the external consultants[197]. Sector Leaders are responsible for monitoring progress on implementing the NDC in a centralized monitoring spreadsheet (held by MNRE). This centralized monitoring spreadsheet should store quarterly updates on the implementation status of each of the pipeline projects, including the following information:

- Project status (Planning/Implementation/Complete)
- Funding status (Not Funded/Partially Funded/Fully Funded)
  - Target source(s) of funding (if not fully funded)
- Estimated GHG emissions reductions achieved
  - Assumptions and calculations used to estimate GHG emissions reductions
- Notes (e.g. description of new barriers encountered, or new technological developments)

The platform's information should be available to all levels of the implementation team, including Executors.

[197] External consultants maybe be used by GoS to implement projects, for example if specialty skills are required.

Sector Leaders should give 6-monthly briefings to the NDC Supervisor, updating them on progress on the mitigation projects in their sector, using the information included in the monitoring file. The NDC Supervisor should then be responsible for reporting annually on NDC implementation progress. This report should draw on the information provided by the Sector Leaders, and include an evaluation of progress on each of the pipeline projects against the Gantt chart shown in section 7.1, and it should clearly mention if the timeline needs to be extended or if resources need to be increased, to ensure pipeline projects are implemented. The report should also detail the people responsible for each project at that point in time (as these people will likely change over the course of the NDC Roadmap and Plan). This report should also note possible project opportunities to assist with future developments of NDC Roadmap and Plans. This report should be provided to the Office of the Prime Minister and released publicly.

MNRE should also evaluate progress against the timeline outlined in this implementation plan to help ensure projects are implemented on time. This evaluation should integrate key elements from the reporting and monitoring structures. For instance, evaluation should be based on the meetings that are held to report on progress—that is, meetings between the Sector Leaders and the Executors, and the Sector Leaders and the NDC Supervisor. Evaluation should also use the information that is recorded in the monitoring spreadsheet.

The evaluation requirement forces the NDC Supervisor, Sector Leaders, and Executors to assess the progress being made on all actions. The NDC Supervisor and Sector Leaders must actively evaluate which individuals are meeting targets, which are excelling, and which may need further assistance. They must decide if it will be necessary to adjust the timeline or resources to ensure successful implementation. As part of this process, the NDC Supervisor must establish clear consequences for failing to complete actions as planned. If an action cannot be completed, the Sector Leaders—along with their Executors—should be held accountable.

7.3 Guidelines for promoting gender and social inclusion and environmental and social safeguards

Integrating gender and social inclusion and environmental and social safeguards (ESS)considerations in project design and implementation planning is essential to avoid negative impacts, ensure achievement of project objectives, and improve overall development outcomes. In addition, this allows citizens of Samoa to learn additional gender and social inclusion and EES skills. The guidelines presented in this section will help to achieve these objectives and help to ensure that the NDC Roadmap and Plan reflects and addresses relevant gender and social inclusion issues and promotes community rights, engagement, and consultation in Samoa.

7.3.1 Promoting gender and social inclusion

International experience suggests large infrastructure projects tend to employ mainly men, and offer women mostly self-employment opportunities in typically female-

dominated areas (for example, hospitality services)[198]. Pre-existing gender roles and social norms, a lack of construction and engineering skills, occupational segregation by gender, and employer stereotyping are factors contributing to women's constrained ability to take advantage of new labor market opportunities in infrastructure. International evidence also suggests that safety can constitute a significant concern for women considering jobs in infrastructure[198].

Promoting gender and social inclusion in capacity building and employment in NDC projects will allow developers to maximize their opportunity to employ local labor, to contribute to local development, and to foster social acceptance for their projects. The NDC Supervisor and Sector Leaders overseeing NDC projects in Samoa should promote gender and social inclusion in these projects by implementing effective measures to limit occupational segregation and pay gaps. Measures that could contribute to this include, but are not limited to:

- Equal-pay-for-equal-work policy clauses
- Monitoring pay rates for men and women to identify if a gap exists
- Career development programs
- Creation and support of women's groups/networks
- Women's mentoring/coaching
- Implementing effective measures to create working conditions attractive to women
- Providing social protection addressing women's specific needs (for example, maternity leave)
- Promoting healthy work-life balance
- Providing vocational training
- Facilitating childcare arrangements
- Training and sensitization of human resource managers to eliminate gender bias (particularly for construction, operations, and management roles)
- Ensuring (and monitoring) appropriate safety and working conditions at project construction sites and in operational areas, particularly for women (e.g. through improved lighting)
- Collecting and publishing gender-disaggregated employment data.

International evidence also suggests that large infrastructure projects can increase exposure to health risks and gender-based violence.[198] In relation to these risks, the NDC Supervisor and Sector Leaders overseeing NDC projects should:

- Integrate the following as project design components: health education, gender-based violence prevention, and awareness campaigns on safety risks

[198] Energy Sector Management Assistance Programme (2018). *Getting to Gender Equality in Energy Infrastructure—Lessons from Electricity Generation, Transmission, and Distribution Projects*. ESMAP Technical Report 012/18.

- Consult with provincial-level authorities to discuss and agree on mitigating strategies
- Include women in all consultations and communication plans to create adequate mitigation mechanisms to protect families and promote health risk management.

7.3.2 Environmental and social safeguards

It is important that the potential environmental and social impacts of NDC projects are considered carefully, and measures are taken to avoid negative outcomes. The concept notes for each of the NDC projects included in the project pipeline include sections identifying possible environmental or social impacts. As these projects move from the concept note phase into the pre-feasibility and feasibility study phases, it is important that they undergo rigorous environmental impact assessment and social and cultural impact assessments. These assessments will help to develop a full picture of the environmental, social, and cultural impacts of the project, and will help the implementing agencies to minimize negative impacts where possible.

The International Finance Corporation's (IFC) Environmental and Social (E&S) Performance Standards provide standards and guidelines for managing eight key environmental and social risks, such as land resettlement, biodiversity, and cultural heritage[199]. The Standards help ensure commitment to sustainable development. Projects in Samoa's NDC Roadmap and Plan should use IFC's E&S Performance Standards. Utilizing this resource will assist Samoa in identifying and managing environmental and social risks.

[199] https://www.ifc.org/wps/wcm/connect/24e6bfc3-5de3-444d-be9b-226188c95454/PS_English_2012_Full-Document.pdf?MOD=AJPERES&CVID=jkV-X6h

Appendix A Project Pipeline – Project Description Tables of Mitigation Opportunities

A.1 Electricity sector

A.1.1 Building energy efficiency program

Project name: Building energy efficiency program		
Sector: Electricity	**Sub-sector: Energy efficiency**	**Project type: Audit and awareness raising**
Project description		
This project would introduce a commercial building energy efficiency incentive and support scheme to stimulate energy efficiency improvements. Although there are energy efficiency provisions in Samoa's building code, they are not being fully applied and there is a significant opportunity to improve energy efficiency in the commercial building sector. Energy audits for government buildings were done in 2011. However, there are still a lot of opportunities to improve efficiency in government buildings. This includes opportunities for retrofitting existing buildings. The commercial and government sectors, account for approximately 52 percent of Samoa's electricity consumption[200]. This project would focus on government and commercial building owners and builders/developers and would include: ▪ Free or very low-cost energy audits for commercial and government buildings ▪ Energy efficiency awareness programs comprising a training session for managers and general information materials such as posters for use in workplaces. This would build on the following actions in the government sector: ▪ A recently implemented LED lighting program that has led to 35 percent reduction in government lighting energy consumption. ▪ A cabinet directive recently requested that all government offices turn off all electricity at 4pm every Friday.		
Estimated GHG emissions reduction potential		
Studies indicate that the effect of behavioral change programs is extremely variable, with energy reductions of 5—70 percent recorded[201]. As a conservative estimate, we have assumed that 10 percent energy savings can be made through behavior change and audit programs. In Samoa, this equates to energy savings of 7,250 MWh/year. Multiplying this annual energy saving by the grid emission factor in Samoa (0.42 tCO2/MWh),[202] suggests that the total estimated potential GHG emissions reduction would be 3,046 tCO_2-e/year once the project is fully implemented. Assuming that the project starts in 2022 and GHG emissions reductions start when the project is fully implemented in 2026, the cumulative GHG emissions reduction potential by 2030 would be 15,230 tCO_2-e.		
Cost Estimates	***Estimated time scale***	

[200] EPC Annual Report 2017-2018

[201] Paune, A, and Bacher, J. The Impact of Building Occupant Behavior on Energy Efficiency and Methods to Influence It: A Review of the State of the Art, published in Energies journal, April 2018. https://www.buildup.eu/sites/default/files/content/untitled-192854-ea.pdf

[202] This grid emissions factor for Samoa was calculated based on IPCC values for the carbon content per GJ for diesel fuel, assuming a thermal efficiency factor (for a diesel genset) of 30%, and assuming that diesel accounts for 50 percent of Samoa's electricity generation (as reported by stakeholders during the consultation workshop).

The cost of running this education and audit project is estimated to be US$250,000. This assumes US$100,-000 for a TA to provide detailed training to staff in Samoa and support auditing over the first year, plus US$150,000 to develop training programs for each sector and support ongoing audit and education staff. It is assumed that the capital costs of investing in building energy efficiency are accounted for by energy cost savings. Assuming the project leads to energy savings of 10 percent, this would equate to cost savings of US$1.37 million/year based on the "energy charge" published by the Office of the Regulator (WST 0.48/kWh)[203].	▪ Implementation timeframe: 2 years to conduct audits and education programs across the commercial and government sectors ▪ Timeframe to recognize benefits: 3 years, assuming changes are implemented linearly.
Affordability	***Likely co-benefits***
The costs of the education and audit program are likely to be affordable, and represent only one tenth of one percent of Samoa's fiscal budget[204]. The costs of energy efficiency investments under this project are likely to be affordable because they are typically outweighed by the cost savings from increased energy efficiency.	Potential co-benefits of improved energy efficiency include: ▪ Energy and cost savings for businesses through energy efficiency improvements, contributing to SDG 7 (affordable and clean energy) ▪ Potential for job creation for energy efficiency work, contributing to SDG 8 (decent work and economic growth) ▪ Improvements in the efficiency of buildings in Samoa, contributing to SDG 11 (sustainable cities and communities) ▪ Awareness of benefits of energy efficient buildings could be applied to households, contributing to SDG 12 (responsible consumption and production).
Potential environmental or social impacts	
Negative ▪ It is possible that energy efficiency work could increase appliance and building waste streams in Samoa ▪ Energy efficiency investments can worsen social inequality be delivering savings to those able to afford upgrade work Positive ▪ Energy and cost savings for households and businesses through energy efficiency improvements ▪ Energy efficiency work can lead to job creation	
Procurement method	***Likelihood of attracting private or donor funding (high, medium, low)***
This education and audit program would likely need to be funded by the GoS. While energy savings would accrue to building owners, it would be difficult to collect user fees to repay the costs of the education and audit program. 12 out of 23 stakeholders in Samoa thought that grants from international donors were the most appropriate funding source for this project. However, given this project has a positive net	***High*** ▪ Private sector investment is likely to be justified due to reduced running costs if initial barriers can be overcome ▪ Donors, including ADB, are already supporting improving building codes in PICs although these are not necessarily focused on energy efficiency

[203] https://www.regulator.gov.ws/images/ORDERS/Electricity/2019/ORDER2019-E68-FinalDetermination.pdf. This includes the cost of fuel plus payments made to IPPs and should reflect the value to EPC of reduced losses. 0.48 WST = 0.19 USD on the current exchange rate. Note: as explained in Section 4.1, Samoa updated its electricity tariffs in September 2021. Samoa's new electricity tariffs are 5-10 US cents per kWh more expensive than those used in the calculations in this concept note. Therefore, cost savings from this project are likely to be greater than the estimate provided in this concept note.

[204] Samoa's fiscal budget was estimated to be US$182 million in 2016-17. Budget documents are available at: https://www.mof.gov.ws/wp-content/uploads/2019/09/Statement-on-the-Foward-Estimate-2014-2015-to-2016-2017-1.pdf

present value, international donors are unlikely to be interested in funding it. Five out of 23 stakeholders thought the project should be funded by the government, while six stakeholders also thought that the project can also be funded by user fees.	▪ Donors including the ADB have funded other energy efficiency projects across the Pacific including in Samoa (E.g. PEEP project).
Capacity requirement to implement (high, medium, or low)	***Potential barriers***
Low ▪ Support is needed to overcome initial barriers, but implementation of energy efficiency upgrades is generally straightforward, and makes use of skills and technologies that already exist in Samoa.	Potential barriers to the project may be: ▪ High capital cost, lack of knowledge, and competing business priorities may limit private investment in energy efficiency ▪ An updated awareness program and an audit program for both the commercial sector and for government buildings could encourage program uptake and help government staff enforce the Energy Efficiency Act (2017) ▪ Training and awareness on energy efficiency requirements of the building code is needed for all sectors.

A.1.2 Grid stabilization projects

Project name: Grid stabilization projects		
Sector: Electricity	**Sub-sector: Energy efficiency**	**Project type: Investment**
Project description		
This project aims to implement grid stabilization measures to enable more efficient use of renewable energy in Samoa. EPC has high penetration renewable energy (particularly solar photovoltaics (PV)) and is already able to shut off diesel at times. However, EPC needs to improve grid stability to make better use of existing renewables. Grid stabilization projects would include: ▪ Prioritization of specific locations on EPC's network requiring stabilization ▪ Battery storage (high electricity output) for rapid frequency response (as opposed to long-term energy storage) ▪ Control system tuning for existing renewable energy projects. These projects would build on grid stabilization work that EPC is already undertaking with funding from JICA. EPC is working with IPPs for new PV and battery systems. All new IPPs are required to include controls and grid stability measures and are required to coordinate with EPC's Supervisory Control and Data Acquisition (SCADA) system. Samoa currently has 10MW/13MWh of battery storage at Fiaga power station and the airport. EPC is currently planning to engage an IPP to deliver a 72MW solar and 30MW Battery energy storage systems (BESS) project for 2022. Given that EPC is already working on grid stabilization, this project would support EPC in implementing a grid stabilization project that it can own and operate according to its own priorities, with an energy storage system that prioritizes rapid response to electricity or frequency fluctuations rather than long term energy storage likely to be proposed by IPPs.		
Estimated GHG emissions reduction potential		
This project would support the integration of more renewable energy and better utilization of existing renewable energy projects Some existing solar PV projects in Samoa are currently output-limited due to grid constraints[205]. If these systems can be operated at full capacity, and future projects are not capacity-limited, this can lead to an increase in renewable energy penetration of approximately 2 percent. In Samoa, this would displace 2,640 MWh/year of diesel		

[205] ITP experience with previous solar projects in Samoa – two large systems are limited to maximum 5MW output

generation. It is important to note that many of the benefits of grid stabilization relate to reliability and quality of supply, not only GHG emissions reductions.

Assuming an emission factor of 0.84 tCO2/MWh for diesel generation,[206] displacing 2,640 MWh/year of diesel generation would reduce emissions by 2,218 tCO2/year once fully implemented. Assuming that this project starts in 2022, takes two years to implement, and that energy savings are negligible during this implementation phase, this project has a total GHG emissions reduction potential of 15,526 tCO2 by then end of 2030.

Cost Estimates	*Estimated time scale*
The Net Present Value (NPV) of this project is estimated to be US$-264,000. Therefore, the project has a total cost of US$264,000. **Capital costs** Capital costs for a 5MW battery project estimated at US$5 million[207]. In addition, this project would require $50,000 for an external control system expert to provide specialist advice. **Energy cost savings** The levelized cost of energy for diesel generators is US$ 297 - US$ 332 per MWh[208]. Hence total cost savings from this project would be US$ 876,480/year. **NPV** Assuming that the cost is split between the first two years of project implementation and the cost savings start to be realized in 2024 when the project is fully implemented, the NPV of the project would be US$-264,000 under a 6 percent discount rate.	Implementation – 2 years If funding is sourced in year 1, a battery could be built by the end of year 2, allowing for procurement and lead times.
Affordability	*Likely co-benefits*
The costs of the grid stabilization project are likely to be affordable, and represent less than two tenths of one percent of Samoa's fiscal budget[209]. Therefore, if financed appropriately, this project will be affordable for Samoa.	Grid strengthening projects can: ▪ Improve electricity reliability and contribute to business productivity in Samoa, contributing to SDG 11 (sustainable cities and communities) ▪ Enable stable and continuous electricity for end users in Samoa, contributing to SDG 8 (decent work and economic growth) ▪ Enable energy usage in relatively rural parts of Samoa, which will particularly benefit women, contributing to SDG 10 (reduced inequalities) and SDG 5 (gender equality)
Potential environmental or social impacts	
Negative ▪ Development of significant battery storage raises concerns about how to dispose of the battery at the end of its economic life Positive	

[206] Based on IPCC values for the carbon content per GJ for diesel fuel, assuming a thermal efficiency factor (for a diesel genset) of 30%.

[207] ITP internal references based on current projects in Australia

[208] https://www.lazard.com/media/1777/levelized_cost_of_energy_-_version_80.pdf

[209] Samoa's fiscal budget was estimated to be US$182 million in 2016-17. Budget documents are available at: https://www.mof.gov.ws/wp-content/uploads/2019/09/Statement-on-the-Foward-Estimate-2014-2015-to-2016-2017-1.pdf

▪ Reduced demand for diesel reduces expenditure on diesel and risk of fuel spills ▪ Reduced demand for diesel generation reduces local noise and air pollution	
Procurement method	***Likelihood of attracting private or donor funding (high, medium, low)***
Government funding and user fees are likely to be the most appropriate funding sources for this project. Given its positive net present value, this project could be financed using commercial finance. 14 out of 21 stakeholders in Samoa thought that grants from international donors would be the most appropriate funding source for this project. However, given this project has a positive net present value, international donors are unlikely to be interested in funding it. Four out of 21 stakeholders thought the project should be funded by the government. Three stakeholders also thought that the project can also be funded by user fees.	***High*** ▪ There is currently a high level of interest in battery projects from donors and private investors, particularly when storage projects are paired with RE projects ▪ IPPs have already expressed interest in battery storage projects in Samoa[210] although none have yet been contracted and built.
Capacity requirement to implement (high, medium, or low)	***Potential barriers***
Medium Upskilling will be required for EPC staff and government staff to manage and maintain new infrastructure.	Potential barriers to the project include: ▪ Growing variable renewable energy generation is likely to introduce new grid stability challenges ▪ Grid stabilization projects require skilled technicians which may require external capabilities ▪ Existing technicians might already be burdened with multiple projects, which may lead to diluted commitment.

A.1.3 Network loss reduction program

Project name: Network loss reduction program		
Sector: Electricity	**Sub-sector: Energy efficiency**	**Project type: Investment**
Project description		
This project would focus on reducing losses in the electricity distribution network by 2 percent to reduce the total amount of electricity generation required. Since the new Fiaga Power Station was completed, EPC has increased its diesel generation efficiency in addition to renewable energy capacity, making it a high performer in generation efficiency by regional standards. However, there are still improvements to be made in reducing distribution network losses through monitoring and upgrades to network equipment. This could include modernizing ageing assets such as transformers and some sections of electricity lines, and improved monitoring to enable more accurate sizing and efficient operation of existing assets. Data from Pacific Power Utilities Benchmarking Report indicates that network losses in Samoa are in the range of 7—10 percent in 2017[211] though limited recent data has been published. The PPA's "Quantification of Power system losses"[212] published in 2012 showed relatively high losses of 14 percent (including 7.5 percent non-technical losses). This indicates that EPC has made significant progress on loss reduction since 2012. Non-technical losses include		

[210] For example, see the EDF solar PV and battery project.

[211] https://www.ppa.org.fj/wp-content/uploads/2019/03/2017-FY-Benchmarking-Report_Publication_Final-1.pdf

[212] https://www.ppa.org.fj/wp-content/uploads/2019/03/2017-FY-Benchmarking-Report_Publication_Final-1.pdf

electricity theft, losses due to meter tampering or meter damage, and unmetered loads and these have been significantly reduced through improved metering and inspections.

EPC is already doing a loss reduction program and agree that this is an important initiative. During consultations, energy sector stakeholders agreed that 2 percent reduction in network losses is reasonable. EPC representatives stated that EPC has already reduced losses down to 8 percent through network and metering improvements. 6—7 percent should be possible and indicates good performance. Most Pacific utilities have much higher losses.

EPC currently has pre-paid meters for most residential customers and is introducing smart meters with remote monitoring for commercial customers. Remote monitoring expected to help identify metering problems including tampering.

Estimated GHG emissions reduction potential	
This project would reduce the amount of electricity required from all generation sources in Samoa. Stakeholders in Samoa indicated that a well-designed network loss reduction program has the potential to reduce network losses by 2 percent. In Samoa, this would save 2,640 MWh/year. Assuming the grid emission factor in Samoa is 0.42 tCO2/MWh,[213] the total estimated potential GHG emissions reduction would be 1,108 tCO2/year once the project is fully implemented. Assuming this project starts in 2022, and GHG emissions reductions increase at a linear rate over five years to reach 1,108 tCO_2-e/year in 2026, the cumulative GHG emissions reduction potential of this project would be 7,756 tCO_2-e by 2030.	
Cost Estimates	*Estimated time scale*
The Net Present Value of this project is estimated to be US$ 824,000. **Capital costs** The capital cost of this project is estimated to be US$2 million over a 5-year period. The $2 million cost estimate is based on the cost of a similar ADB project in the Marshall Islands, involving monitoring and investigation of network assets, metering improvements and a staged replacement plan. It does not include the cost of replacing all transformers etc., as EPC should be covering replacement of ageing equipment in their regular budgets. **Energy cost savings** This project would deliver energy cost savings of $500,000/year due to reduced losses. This estimate is based on the regulator's "energy charge" component of the tariff (WST 0.48)[214] multiplied by the assumed energy savings (2,640 MWh/year). **Net present value** If the project starts in 2022, and the project capital costs and energy cost savings both increase at a linear rate over the first five years of the project, to reach US$2,000,000 and US$500,000/year, respectively, in 2026, the NPV of the project	5 years, assuming that changes are staged linearly over this period, allowing EPC to factor asset replacements into their planning.

[213] This grid emissions factor for Samoa was calculated based on IPCC values for the carbon content per GJ for diesel fuel, assuming a thermal efficiency factor (for a diesel genset) of 30%, and assuming that diesel accounts for 50 percent of Samoa's electricity generation (as reported by stakeholders during the consultation workshop).

[214] https://www.regulator.gov.ws/images/ORDERS/Electricity/2019/ORDER2019-E68-FinalDetermination.pdf. This includes the cost of fuel plus payments made to IPPs and should reflect the value to EPC of reduced losses. 0.48 WST = 0.19 USD on the current exchange rate. Note: as explained in Section 4.1, Samoa updated its electricity tariffs in September 2021. Samoa's new electricity tariffs are 5-10 US cents per kWh more expensive than those used in the calculations in this concept note. Therefore, cost savings from this project are likely to be greater than the estimate provided in this concept note.

<table>
<tr><td>between 2022 and 2030 would be US$ 824,000 under a 6 percent discount rate.</td><td></td></tr>
<tr><td>Affordability</td><td>Likely co-benefits</td></tr>
<tr><td>This project has a positive net present value, meaning that the capital costs of the project are outweighed by the cost savings over time, accounting for the time value of money. Therefore, if financed appropriately, this project will be affordable for Samoa.</td><td>The network loss reduction program can:
Improve reliability of electricity in Samoa through replacement of underperforming or ageing assets, contributing to SDG 7 (affordable and clean energy), SDG 11 (sustainable cities and communities), and SDG 12 (responsible consumption and production)
Support EPC's longer-term asset management and monitoring, improving internal capability, contributing to SDG 8 (decent work and economic growth) and SDG 11 (sustainable cities and communities)
Improve financial balance of the EPC and the load curve, enabling stable and continuous electricity for end users in Samoa, contributing to SDG8 (decent work and economic growth) and SDG9 (industry innovation and infrastructure)
Enable gains in energy and reduced capital-intensive investments which will contribute to SDG 7 (affordable and clean energy).</td></tr>
<tr><td colspan="2">Potential environmental or social impacts</td></tr>
<tr><td colspan="2">Negative
Transmission and distribution infrastructure upgrades can cause localized disturbance and impact local amenity values
Positive
Improvements in the reliability and affordability of electricity can help to reduce energy poverty, and empower those who are currently most affected</td></tr>
<tr><td>Procurement method</td><td>Likelihood of attracting private or donor funding (high, medium, low)</td></tr>
<tr><td>Government funding and user fees are likely sources of funding for this project. Given its positive net present value, this project could be financed using commercial finance.
11 out of 20 stakeholders in Samoa thought that grants from international donors was the most appropriate funding source for this project. However, given this project has a positive net present value, international donors are unlikely to be interested in funding it.
Six out of 20 stakeholders thought the project should be funded by the government. Three stakeholders also thought that the project can also be funded by user fees.</td><td>Medium
The ADB and the World Bank have both provided funding for network improvement programs across the Pacific region, including in the Marshall Islands, the Cook Islands, and Samoa. In Samoa, ADB has provided a concessional loan for network loss reduction programs previously.</td></tr>
<tr><td>Capacity requirement to implement (high, medium, or low)</td><td>Potential barriers</td></tr>
<tr><td>Medium
While EPC has experience with network improvement projects, Samoa may still require external advice to prioritize network investments.</td><td>Potential barriers of this project include:
High costs for EPC
Competition for the workforce between several other projects, and diluted commitments from existing workforce
Competition for funding between generation projects and distribution projects—stakeholders suggested that competing priorities is a challenge in the sector.</td></tr>
</table>

A.1.4 Refrigeration efficiency program

Project name: Refrigeration efficiency program		
Sector: Electricity	**Sub-sector: Energy efficiency**	**Project type: Audit and awareness raising**
Project description		
This project would provide an incentive program for commercial businesses to improve refrigeration efficiency. Incentives would include an energy audit and "soft loan" support for upgrading refrigeration systems. The suggested program would support approximately 20 commercial premises. Samoa has already implemented a minimum energy performance standard for residential refrigeration appliances including fridges and freezers. Larger commercial refrigeration equipment and cool rooms are not covered by these standards but contribute significantly to energy use. Energy efficiency upgrades will provide cost savings to business owners, but upfront cost and energy knowledge are common barriers. Commercial operators would likely be open to soft loan or incentive programs to install more efficient refrigeration. Awareness programs will help commercial operators to understand costs and benefits. Detailed auditing, including energy monitoring, is necessary to clarify possible savings and educate business owners.		
Estimated GHG emissions reduction potential		
The commercial sector (excluding hotels) accounts for approximately 33 percent of electricity consumption in Samoa[215]; of this, nearly 30 percent is consumed by the top 20 large customers with refrigeration being their biggest load[216]. Assuming that a well-designed refrigeration efficiency program can lead to a 10 percent improvement in overall energy efficiency, this project would lead to energy savings of 1,370 MWh/year for the top 20 major stores in Samoa. Multiplying this annual energy saving by the grid emission factor in Samoa (0.42 tCO2/MWh),[217] suggests that the GHG emissions reduction potential of this project would be 575 tCO_2-e/year once fully implemented. Assuming that the audit program takes place in 2022, and GHG emissions reductions increase at a linear rate from 2023 to reach 575 tCO_2-e/year in 2026, the cumulative GHG emissions reduction potential of this project to 2030 would be 3,738tCO_2-e.		
Cost Estimates	***Estimated time scale***	
The cost of running this audit and soft loan program is estimated to be US$1,100,000. This assumes US$100,000 for an external TA to conduct detailed audits and train government staff. This estimate is based on previous costs of technical assistance programs in Samoa and the region. It is assumed that a soft loan program to support these investments would cost US$ 1 million. It is assumed that the capital costs of investing in refrigeration efficiency are accounted for by energy cost savings. Assuming the project leads to energy savings of 10 percent for the top 20 major stores in Samoa, this would equate to cost savings of US$ 260,000/year based on the "energy	Five years ▪ Audit program in Year one ▪ Implementation of more efficient systems staged linearly over years two to five.	

[215] EPC Annual Report 2017-2018

[216] Personal communication with stakeholders in Samoa, 2015-2016

[217] This grid emissions factor for Samoa was calculated based on IPCC values for the carbon content per GJ for diesel fuel, assuming a thermal efficiency factor (for a diesel genset) of 30%, and assuming that diesel accounts for 50 percent of Samoa's electricity generation (as reported by stakeholders during the consultation workshop).

<table>
<tr><td>charge" published by the Office of the Regulator (WST 0.48/kWh)[218].</td><td></td></tr>
<tr><td>Affordability</td><td>Likely co-benefits</td></tr>
<tr><td>The costs of the education and audit program are likely to be affordable, and represent only half a percent of Samoa's fiscal budget[219].
The costs of refrigeration energy efficiency investments under this project are likely to be affordable because they are typically outweighed by the cost savings from increased energy efficiency.</td><td>The possible co-benefits of a refrigeration efficiency program include:
▪ Energy and cost savings for businesses through energy efficiency improvements, contributing to SDG 7 (affordable and clean energy)
▪ Potential for job creation for energy efficiency work, contributing to SDG 8 (decent work and economic growth)
▪ Improvements in the efficiency of buildings in Samoa, contributing to SDG 11 (sustainable cities and communities)
▪ Awareness of benefits of energy efficient refrigeration could be applied to other appliances, contributing to SDG 12 (responsible consumption and production).</td></tr>
<tr><td colspan="2">Potential environmental or social impacts</td></tr>
<tr><td colspan="2">Negative
▪ Upgrading refrigeration equipment may increase streams of appliance and construction waste and cause localized disturbance while work is ongoing
Positive
▪ Increased refrigeration energy efficiency can lower operating costs for the businesses partaking in upgrades
▪ Lower operating costs for businesses should lead to lower prices for consumers</td></tr>
<tr><td>Procurement method</td><td>Likelihood of attracting private or donor funding (high, medium, low)</td></tr>
<tr><td>Government funding and user fees are likely sources of funding for this project.
13 out of 24 stakeholders in Samoa thought that grants from international donors were the most appropriate funding source for this project, whereas five out of 24 stakeholders thought the project should be funded by the government.
Six stakeholders also thought that the project can also be funded by user fees.</td><td>High
This project is likely to be able to attract private sector investment because the reduced running costs are likely to outweigh the capital outlay over time.
This project may also be able to leverage international donor funding. Donors have supported capacity building for energy efficiency in the Pacific, including the PEEP program in Samoa</td></tr>
<tr><td>Capacity requirement to implement (high, medium, or low)</td><td>Potential barriers</td></tr>
</table>

[218] https://www.regulator.gov.ws/images/ORDERS/Electricity/2019/ORDER2019-E68-FinalDetermination.pdf. This includes the cost of fuel plus payments made to IPPs and should reflect the value to EPC of reduced losses. 0.48 WST = 0.19 USD on the current exchange rate. Note: as explained in Section 4.1, Samoa updated its electricity tariffs in September 2021. Samoa's new electricity tariffs are 5-10 US cents per kWh more expensive than those used in the calculations in this concept note. Therefore, cost savings from this project are likely to be greater than the estimate provided in this concept note.

[219] Samoa's fiscal budget was estimated to be US$182 million in 2016-17. Budget documents are available at: https://www.mof.gov.ws/wp-content/uploads/2019/09/Statement-on-the-Foward-Estimate-2014-2015-to-2016-2017-1.pdf

Low ▪ Once audits have been completed, implementation of this project would be straightforward and should not require external expertise. Ongoing support for energy efficiency awareness and education would be required but could be provided as part of a broader program.	Potential barriers to this project ▪ Enforcement of the program may be challenging ▪ For business owners, upfront cost could be a barrier, even if there are savings to be made in the longer term ▪ Lack of awareness and education on energy efficiency could limit program uptake and compliance.

A.2 Land transport sector

A.2.1 Shared electric cars

Project name: Shared electric cars		
Sector: Land transport	**Sub-sector: EVs**	**Project type: investment**
Project description		

This project aims to introduce 200 shared electric cars over the next 10 years, that can potentially displace 2,000 privately owned vehicles (studies have found that one shared EV can replace 10 privately owned cars)[220].

Shared EVs can be picked up from EV charging hubs which will be placed in strategic locations across Samoa (e.g., hotels and supermarkets). This project offers the opportunity for individuals to lower (or remove) the cost of owning a vehicle by only paying for a vehicle when it is used. A shared electric car scheme can be seen as an extension of standard car hire, but it is more convenient for locals and tourists to hire vehicles for short term use. Stakeholders in Samoa stated that "people in Samoa are considering ridesharing and car-pooling options (like those in Tonga), particularly to reduce road congestion."

The project could be led and financed by a private developer, and could be part of a national Mobility as a Service (MaaS) solution. MaaS is a service that through a joint digital channel enabling users to plan, book, and pay for multiple types of mobility services. A fully developed solution may offer the user a single monthly subscription that can be used across multiple mobility options. This project would include the development of a fully bespoke government owned MaaS platform.

International case studies highlight best practice for structuring a shared EV project. These lessons learned should be considered in Samoa:

- In Utrecht in the Netherlands, a car share scheme called We Drive Solar has a fleet of around 70 EVs, which are focused in a single neighborhood (a pertinent example to a small island nation like Samoa) and are parked in charging plazas which We Drive Solar owns. The company focuses on people who would use the cars on a regular basis. We Drive Solar is particularly innovative because the vehicles are charged through roof-mounted Solar PV which uses bi-directional charging infrastructure as 'mobile storage'[221]—when the EV is charged, alternating current (AC) energy from the grid is converted to direct current (DC) energy which is stored in the car battery. These technologies make it possible for EVs to be used as a backup storage system and a source of energy[222]. Bi-directional EVs offer fast, short-term storage to balance the grid—We Drive solar is supporting Utrecht's grid while also encouraging the adoption of EVs.

Milan, Italy, has multiple car share schemes operating EVs, including ShareNow and Sharengo, which amount to 3,000 car share vehicles. These schemes are a mixture of free floating and station-based car share services, with dedicated charging infrastructure associated with EV car share parking spaces. Some cars are leased under contract from the city government for up to seven years. Milan has a long-term vision for electric car sharing, and the city is implementing regulations to ensure electrification of car sharing services from 2024. From 1st January 2024, car share companies are obliged to switch to EVs for any new purchases or substitutes into the scheme, and they must pay the city authority EUR 1,200 (US$1,428) per year per space, unless the vehicle is electric which means the cost is waived. 17 percent of the 3,000 car share vehicles in the city are now electric. This example illustrates the importance and success of long-term strategy and planning to ensure the success of an EV project.

[220] https://www.transportenvironment.org/sites/te/files/publications/Does-sharing-cars-really-reduce-car-use-June%202017.pdf

[221] https://blog.wallbox.com/why-bidirectional-charging-is-the-next-big-thing-for-ev-owners/#index_0

[222] https://www.renewableenergyworld.com/storage/is-the-future-of-ev-charging-bidirectional/#gref

<table>
<tr><td colspan="2">Estimated GHG emissions reduction potential</td></tr>
<tr><td colspan="2">It is assumed that each shared electric car introduced under this project displaces 10 privately-owned ICEVs. The average privately-owned ICEV in Samoa has an annual mileage of 3,650km and emits 0.537 tCO_2-e per year. Therefore, each shared electric car would reduce emissions by 5.37 tCO_2-e per year, meaning that this project would reduce emissions by 1,074 tCO_2-e per year once the 200 shared electric cars are in full use.

Assuming charging infrastructure is installed in 2022, the full fleet of 200 shared electric cars is introduced in 2023, and GHG emissions reductions increase at a linear rate over two years as usage increases to reach 1,074 tCO_2-e/year in 2024, the cumulative GHG emissions reduction potential between 2022 and 2030 would be 8,055 tCO_2-e.</td></tr>
<tr><td>Cost Estimates</td><td>Estimated time scale</td></tr>
<tr><td>Cost of charging infrastructure

Samoa would require up to 5 small charging hubs to support the electric shared fleet. A small charging hub could cost US$97,000 up to US$220,000 with solar and storage and can charge up to six vehicles at a time[223]. Assuming that the cost of developing charging infrastructure in Samoa will be at the extreme high end of this range, five small charging hubs to support the shared EV fleet would cost US$ 1,100,000.

EV costs

Assuming that a shared EV has an average annual mileage of 36,500km (equivalent to ten privately owned cars in Samoa), the costs of owning and operating this vehicle for eight years from 2023 to 2030 would be US$ 66,925. Therefore, the total costs of purchasing and operating a fleet of 200 shared electric cars over this period would be US$ 13,385,000, assuming a 6 percent discount rate.

Cost of an MaaS Platform

From the urban strategy consultancy's international experience, the cost of developing a fully bespoke digital MaaS platform for a country the size of Samoa would be US$194,000.

Savings from displaced ICEVs

Assuming that each shared electric car displaces 10 privately-owned ICEVs, this would avoid capital costs of US$327,250 and annual operational costs of US$5,730. Therefore, a project to provide 200 shared EVs would avoid ICEV costs of US$66,895,000 between 2023 and 2030, assuming a 6 percent discount rate.

Total costs

Assuming that charging infrastructure and the MaaS Platform is constructed in 2022, the fleet of shared EVs is introduced in 2023, and vehicle cost savings increase at a linear rate over two years as usage increases to reach US$ 750,600 per year in 2024, the net present value of this project would be US$ 53,046,000 between 2022 and 2030 at a 6 percent discount rate.</td><td>EV car share schemes have been implemented in cities across the world. Madrid provides an example of a best practice free-floating electric car share scheme. Such schemes are ready for immediate implementation, with several global companies looking to expand their offering to new markets. However, it can take months to build up the required customer base to make the solution sustainable.</td></tr>
<tr><td>Affordability</td><td>Likely co-benefits</td></tr>
</table>

[223] Figures have been estimated from real life Dundee City Council, Scotland projects

The total cost of ownership for ICE vehicles in Samoa is US$46,171 (for 10 years lifetime costs). If these vehicles travel 3,650 km are per year for 10 years, then total cost of ownership for ICE vehicle in Samoa is US$1.26 per km (US$46,171/(3,650*10)). In New Zealand, shared EVs cost approximately US$0.30 per km.[224] A similar price for shared EVs would likely apply in Samoa. Therefore, using shared EVs is more affordable than using a private ICE vehicle in Samoa.	▪ Additional benefits include: ▪ Offers sustainable transport options to users at relatively low cost compared to car ownership, contributing to SDG 11 (sustainable cities and communities) ▪ Reduced number of vehicles on the road which relieves congestion, reduces problems caused by derelict vehicles, and improves air quality and noise, contributing to SDG 3 (good health and well-being) and SDG 11 (sustainable cities and communities) ▪ Provides early opportunity for the population to test EVs at a relatively low cost, contributing to SDG 9 (industry, innovation, and infrastructure) ▪ The decarbonization of transport would lead to a reduction in reliance on diesel and allow Samoa to use only on locally produced and stored electricity, contributing to SDG 7 (affordable and clean energy) and SDG 13 (climate action) ▪ If powered by renewable energy sources, the hubs can provide a steady market for locally produced renewable electricity, contributing to SDG 7 (affordable and clean energy) SDG 8 (decent work and economic growth), and SDG 9 (industry, innovation, and infrastructure) ▪ Linking this solution to renewable energy production and a storage solution will reduce reliance on diesel and ensure a constant supply, contributing to SDG 13 (climate action) and SDG 7 (affordable and clean energy) ▪ Reduce household costs of fuel, contributing to SDG 8 (decent work and economic growth).
Potential environmental or social impacts	
Negative ▪ Construction of charging infrastructure can cause local disturbance including noise pollution, dust, sediment pollution, and increased streams of construction waste ▪ This project will lead to increases in EV batteries that require careful disposal/recycling at the end of their economic lives Positive ▪ This project would greatly reduce transport costs and may extend transport services to those who cannot currently afford them ▪ This project would reduce local air and noise pollution from ICE vehicles. It would also reduce the total number of vehicles in Samoa's light vehicle fleet, and this reduce the stream of vehicles that need to be scrapped each year.	
Procurement method	***Likelihood of attracting private or donor funding (high, medium, low)***
This project can be procured through commercial finance for the capital costs of vehicles and charging infrastructure. Given the affordability of shared EVs, user fees can be used to pay back commercial loan. 13 out of 22 stakeholders in Samoa thought that grants from international donors was the most appropriate funding source for this project, whereas 2 out of 22 stakeholders thought the project should be funded by the government. Six stakeholders also thought that the project can also be funded by user fees.	***High*** Given the high net present value of this project, it is likely to be able to attract private investors and fund all costs over time through user fees. This project may attract established car share schemes or car hire organizations. Many organizations are now looking at MaaS as the future of transport and are willing to invest in bringing these systems to new markets.

[224] https://www.cityhop.co.nz/rates/

Capacity requirement to implement (high, medium, or low)	*Potential barriers*
Low Established car sharing and car hire organizations are well-placed to deliver this project. This project would require little additional technical support from the GoS.	This project may encounter the following barriers: ▪ Sharing vehicles may challenge cultural sensitivities in Samoa. Stakeholders during consultation noted the preference for sharing vehicles with others in their family, implying that there may be less willingness to share with stranger ▪ Stakeholders stated that using a shared EV will need to cost the same or less than existing services to ensure uptake—awareness raising about the financial benefits of using shared EVs may be required to encourage uptake ▪ Stakeholders stated that people will not be comfortable charging shared EVs at home due to electricity costs. Public charging can be strategically placed to ensure the success of this project ▪ Consumers may need training on how to charge and use shared EVs ▪ It may take longer than expected to build up a broad customer base of people who regularly use shared EVs. Consumers may need to be made aware of the cost-effectiveness of shared EVs ▪ This project may face opposition from people and businesses servicing Samoa's current fleet of ICE vehicles. For example, service station owners may be concerned about falling demand for fuel (stakeholders during the consultation workshop discussed the reliance of some families on fuel shops), and auto mechanics may be concerned about falling demand for engine maintenance ▪ EV models are new to the Samoan market meaning that vehicle certification and registration may present barriers. This may be particularly problematic for smaller and cheaper EV models that may lack the safety features of larger cars and/or may rely on lead-acid batteries with greater potential for environmental contamination ▪ Changes to legislative framework are required because there is no definition of the EVs in the Land Transport Authority Act (2007) as it currently stands.

A.2.2 Electrification of commercial fleets

Project name: Electrification of commercial fleets		
Sector: Land transport	**Sub-sector: EVs**	**Project type: Investment**
Project description		
This project works with the private sector to transition 50 percent of commercial vehicles in Samoa to EVs by 2030. This would be driven largely by a national information and communications campaign emphasizing the benefits of EVs for commercial operators, and the provision of tax benefits to incentivize EV purchase. Stakeholders in Samoa were positive about this project, stating: ▪ Electrifying the commercial fleet could have a strong case because the fleet travels approximately 40km per day ▪ Taxi drivers are already adopting hybrid vehicles which means they are likely to adopt EVs ▪ The uptake of the project can be supported if the government provides an enabling environment for the transition for taxi companies (which are private owned), which as by accommodating short term losses, building awareness for long term benefits of transition, and supporting them in adapting to changes in the land transport sector.		

The whole life cycle costs of EVs are now approaching those of diesel vehicles. This is mainly due to a reduction in maintenance and fuel costs[225]. Commercial vehicles typically have significantly higher annual mileage than privately owned vehicles because they are used more frequently. This means that the operational costs of ownership (fuel and maintenance) are generally higher for commercial vehicles, making EVs a more attractive option. The introduction of a comprehensive charging infrastructure network can support the electrification of taxis and commercial fleets (such as delivery vans and tradesmen vans).

There are a number of new technologies coming to the market that allow a commercial driver to take their vehicle home and utilize a home charger attached to their house, with the energy bill being sent directly to their employers. These solutions can save time and money by removing the need for vehicles to return to a depot at the end of the day. The Smart charging solutions also mean that if the household has their own EVs then they can make use of the charger but only pay for their personal consumption. This can be a cost-effective way of introducing home chargers. A further option could be to allow commercial vehicles to park at charging hubs overnight that tend to be underused during this period, this significantly improves the utilization rates for the charge points and makes private investment more likely. It can also be easier to turn this into a secure parking environment.

In successful cities for EV adoption there has been a policy of sharing charging infrastructure between the public and industry. This reduces the overall need for charging infrastructure to be deployed and helps improve the utilization rates at charging hubs, this is vital to help develop the business case for private investment.

The switch to EVs can not only support the reduction of CO_2 within a region but it can also deliver significant and instant improvements to air quality due to the zero emissions. Due to the fact it has been over 10 years since the first mass-produced EVs were introduced, the secondhand market is starting to develop across the world, meaning that EVs are now becoming more affordable.

International case studies highlight best practice for structuring an EV project for commercial fleets. These lessons learned should be considered in Samoa:

- Dundee, Scotland, is recognized as one of Europe's leading cities in the deployment of EVs. Dundee has a typical taxi fleet for a small city, with over 700 taxis serving a population of 150,000. 19 percent (almost one in five) of taxis and private hire vehicles are now electric. This transition was achieved through policy changes, incentives, and infrastructure to support and encourage the trade to make the switch to EVs. For example,
  - The first electric taxi was introduced in 2015, and in 2018, the Dundee City Council installed three charging hubs with six rapid charge points at each hub. These hubs have registered over 100,000 charging sessions per year. Over 65 percent of usage at these hubs is from commercial organizations. Taxi companies report that the creation of this infrastructure was crucial to their willingness to switch to EVs
  - Dundee City Council introduced significant changes to taxi licensing policy—all new private hire licenses (known as 'plates') have to be electric for the life of the plate, and if a driver wishes to change a personal plate into a company plate, then it would have to be electric for the lifetime of that plate
  - Annual safety inspections fees are £11 (US$15.50) lower for electric taxis, passing on savings from avoiding emissions test and engine oil tests on to the vehicle operator
  - Until November 2019, EVs had access to free electricity at charge points and free parking in any Dundee City Council bay. The tariffs introduced are designed to cover costs only and still lead to operational savings for drivers, but were created to build better long-term sustainability into the business model for the city.
- In Nairobi, Kenya, private provision of charging hubs is supporting an electric ride-hailing venture. Nopia Ride, a private provider, is installing charging hubs to support the expansion of its electric ride hailing fleet. Nopia Ride has installed three hubs equipped with DC Fast Chargers in shopping malls cross the city, and it is scaling up from 50 EVs to the goal of having 1,500 vehicles on the road by the end of 2021. This growth is led in part by driver demand—lower running costs of EVs has resulted in a 30-50 percent increase in earnings.
- In Berlin, Germany, over the past six years DHL (a logistics delivery company) has deployed 1,000 electric logistics vehicles (including delivery vans, e-bikes, and e-trikes, and e-cargo bikes) across its Berlin depots. Electrifying DHL's logistics processes has been a key part of the company's zero-emissions strategy.

Estimated GHG emissions reduction potential

[225] https://www.kia.com/dm/discover-kia/ask/are-electric-cars-cheaper-to-maintain.html

<table>
<tr><td colspan="2">We assume that commercial vehicles in Samoa have an average yearly milage of 14,600 km (40 km per day) and emit 0.15 kgCO_2-e/km travelled. Therefore, each electric commercial vehicle will save 2.149 tCO_2-e each year.

Data from 2013 suggest that there are 2,030 registered commercial vehicles (taxis) in Samoa.[226] If 50 percent of these registered commercial vehicles (1,015 vehicles) were to be replaced with EVs by 2030, this would result in GHG emissions reduction of 2,181 tCO_2-e per year in 2030.

Assuming charging infrastructure is installed in 2022, and GHG emissions reductions start in 2023 and increase at a linear rate to reach 2,181 tCO_2-e in 2030, the cumulative GHG emissions reduction potential to 2030 would be 9,815 tCO_2-e.</td></tr>
<tr><td>Cost Estimates</td><td>Estimated time scale</td></tr>
<tr><td>Cost of vehicles

Based on modelling the capital and operating costs of commercial ICEV and EVs in Samoa, the electrification of 50 percent of Samoa's commercial vehicle fleet would cost US$10,982,000. This modelling compared the lifetime costs (in net present value terms) of commercial EVs vs ICVs in Samoa. At current prices, electric commercial vehicles are still US$10,820 more expensive over their lifetimes. Samoa would have to replace 1,015 ICEV cars with EVs to reach 50 percent electrification of the commercial vehicle fleet, meaning the additional unfunded costs of this transition would be US$10,982,000.

Cost of charging infrastructure

The cost of charging infrastructure varies depending on several external factors such as grid connection costs, shipping costs, and public land acquisition. A benchmark to tie these costs to is the charging hub provision built recently in Dundee, Scotland, where a recently constructed charging hub with 9 chargers (3 fast (22kW), 6 rapid (50kW)), a solar array of 36 kW installed capacity, and battery storage of 90 kWh, 60 kW output (this has the capacity for charging 18 vehicles) cost US$1,427,000. Assuming the cost to install charging, infrastructure is 30 percent higher in Samoa than in Scotland, the cost of this charging hub in Samoa would be US$ 1,855,000. Assuming four charging hubs are required, total cost of building charging infrastructure would be US$ 7,420,000.

Total project cost

The total cost of this project (including vehicle costs and charging infrastructure costs) would be US$ 18,402,000.</td><td>This project would take nine years to implement.

EV charging hubs can take between 6—12 months to install depending on land conditions, availability of hardware elements and electricity connection.

Once charging infrastructure is in place, it is estimated that the electrification of the 80 percent of the commercial vehicle fleet in Samoa will take place over eight years between 2023 and 2030.</td></tr>
<tr><td>Affordability</td><td>Likely co-benefits</td></tr>
<tr><td>For commercial vehicles, the total additional lifetime cost of owning an EV would be US$10,820. This would be unaffordable for most businesses and organizations in Samoa. Developing appropriate charging infrastructure</td><td>▪ Increasing the penetration of EVs can reduce urban air pollutants, thereby improving air quality and noise, thus contributing to SDG 3 (good health and well-being) and SDG 11 (sustainable cities and communities)</td></tr>
</table>

[226] Data on vehicle registrations provided by Samoa's Ministry of Police on 21 July 2021.

<table>
<tr><td>for these vehicles would cost US$7,310 per vehicle, which is also likely to be unaffordable if paid for through user fees alone. This project should not go ahead without internal donor support is secured to cover the viability gap.</td><td>▪ The decarbonization of transport would lead to a reduction in reliance on diesel and allow Samoa to use only on locally produced and stored electricity, contributing to SDG 7 (affordable and clean energy) and SDG 13 (climate action)
▪ If powered by renewable energy sources, the hubs can provide a steady market for locally produced renewable electricity, contributing to SDG 7 (affordable and clean energy) SDG 8 (decent work and economic growth), and SDG 9 (industry, innovation, and infrastructure)
▪ Linking this solution to renewable energy production and a storage solution will reduce reliance on diesel and ensure a constant supply, contributing to SDG 13 (climate action) and SDG 7 (affordable and clean energy)
▪ Reduced noise and urban air pollutant emissions, leading to improvements in public health contributing to SDG 3 (good health and well-being)
▪ Reduce costs of fuel for commercial businesses, contributing to SDG 8 (decent work and economic growth).</td></tr>
<tr><td colspan="2">Potential environmental or social impacts</td></tr>
<tr><td colspan="2">Negative
▪ Construction of charging infrastructure can cause local disturbance including noise pollution, dust, sediment pollution, and increased streams of construction waste
▪ This project will lead to increases in EV batteries that require careful disposal/recycling at the end of their economic lives
Positive
▪ This project would reduce local air and noise pollution from ICE vehicles. EVs also have significantly longer economic lifetimes than ICEVs, so this project would reduce the stream of vehicles that need to be scrapped each year.</td></tr>
<tr><td>Procurement method</td><td>Likelihood of attracting private or donor funding (high, medium, low)</td></tr>
<tr><td>This project can be procured through donor viability-gap funding for the capital cost of EVs, coupled with commercial finance for charging infrastructure. This project should not go ahead unless support from international donors is secured.
11 out of 20 stakeholders in Samoa thought that grants from international donors was the most appropriate funding source for this project, whereas one out of 20 stakeholders thought the project should be funded by the government.
Six stakeholders also thought that the project can also be funded by user fees.</td><td>Medium
▪ Given EVs are not commercially viable in Samoa at present, this project would not attract private funding sufficient to cover its costs. While this would be a highly visible climate change mitigation project, the high costs and reasonably modest GHG emissions reduction potential may limit interest from international donors.
▪ However, given commercial fleets are used more often than private cars, this project is more cost effective than efforts to electrify the broader light vehicle fleet in Samoa. Therefore, it would likely receive funding before broader EV projects would.</td></tr>
<tr><td>Capacity requirement to implement (high, medium, or low)</td><td>Potential barriers</td></tr>
<tr><td>Medium
▪ If charging hubs are delivered by a private organization, then they would require support from the Samoan government to identify suitable locations and provide relevant permissions
▪ If the charging network is delivered by the government, then technical assistance may be required to determine the correct specifications in the most appropriate locations</td><td>Potential barriers to the project include:
▪ Government needs to work with privately owned taxi companies to accommodate losses, build awareness around this project, and support them in adapting to changes in the land transport sector. This project should not go ahead without internal donor support. This funding would ensure that commercial drivers are not disadvantaged by the effort to transition to EVs—and that the new EVs would be commercially equivalent to their current vehicles
▪ A lack of infrastructure can also be a significant challenge to organizations making the switch to EVs</td></tr>
</table>

▪ EVs will need specialized maintenance, although repairs are needed less often than for ICVs. If Samoa transitions 10 percent of its fleet to EVs, it is likely that demand for specialized EV maintenance will be met by the private sector.	▪ Changes to legislative framework are required because there is no definition of the EVs in the Land Transport Authority Act (2007) as it currently stands.

A.2.3 Electrification of government and municipal fleets

Project name: Electrification of government and municipal fleets		
Sector: Land transport	**Sub-sector: EVs**	**Project type: investment**
Project description		
This project aims to progressively convert Samoa's government and municipal light vehicle fleets to EVs. This project originally aimed to electrify 100 percent of Samoa's government-owned vehicle fleets by 2030, however, based on feedback from the consultation workshop and reservations held by the stakeholders, the target was revised to electrifying 75 percent of Samoa's government-owned vehicles. This was subsequently revised to 50 percent of Samoa's government-owned vehicles following a further round of written feedback from MWTI. This project would build on work being undertaken by EPC to import 10 EVs and construct a charging station to power these vehicles. This project also originally looked at electrifying government and municipal fleet specialty vehicles (as well as light vehicles), however stakeholders stated that specialty vehicles are not realistic candidates for electrification. To support the transition to EVs it is vital that the government at whatever level is seen to lead by example. Before a city/region or country can ask individuals or firms to make the transition to electric transport it is important that they prove that the technology works and demonstrate the effectives of the vehicles and the associated charging infrastructure. This approach has been particularly successful in Dundee, Scotland where the municipal fleet has converted over 40 percent of its small van and car fleet to EVs already and has a commitment to make this 100 percent over the next 2-3 years as part of the standard replacement program. This has allowed the local government to engage with the taxi trade and provide them with tests, data, and use cases to help inform them of the benefits of switching to EVs. This collaboration has helped a quarter of the taxi fleet switching to EVs in the last 5-6 years. Stakeholders in Samoa also emphasized the importance of the government leading by example, demonstrating the capabilities of EVs, and fixing problems when they arise. To optimize the charging infrastructure needed to support the government and municipal fleet, it is important to account for these vehicles when looking at appropriate locations for any charge points. Municipal fleets tend to have very structured charging patterns which can help to secure external investment in the network as they are guaranteeing an income for the operator. According to stakeholders in Samoa, there are approximately 1,200 light vehicles in Samoa's government fleet. There are a large number of electric car manufacturers and models that will be appropriate for Samoa's government-owned light vehicle fleet. Adopting EV alternatives would reduce greenhouse gas and urban air pollution emissions, as well as noise impact and Health & Safety issues of HAVS (Hand Arm Vibration Syndrome).		
Estimated GHG emissions reduction potential		
Assuming that there are 1,200 vehicles in the government's fleet of light vehicles[227], electrifying 50 percent of government fleet would mean electrifying 600 light vehicles. Replacing a typical light ICEV that has a yearly mileage of 7,300 km[228] with an electric version will save around 1.074 tCO_2-e per year. Therefore, replacing 50 percent of the government's light vehicle fleet with EVs would save 644 tCO_2-e per year. Assuming charging infrastructure is installed in 2022, GHG emissions reductions start in 2023 and increase at a linear rate to reach 644 tCO_2-e in 2030, the cumulative GHG emissions reduction potential to 2030 would be 2,898 tCO_2-e.		
Cost Estimates	***Estimated time scale***	
Cost of light vehicles	Electric light duty vehicles are readily available in the current market. EV charging hubs can take between 6—12 months to	

[227] This figure was estimated by MWTI in their written comments on the Draft NDC Implementation Roadmap and Investment Plan.

[228] According to MWTI, government owned vehicles have an average annual mileage in the order of 7,300 km.

<table>
<tr><td>Based on modelling the capital and operating costs of ICEV and EVs in Samoa, the total cost of electrifying 600 standard cars would be US$6,939,000.

This modelling compared the lifetime costs (in net present value terms) of EVs vs ICEVs in Samoa. At current prices, despite having US$161 lower operating costs per year (annual mileage 3,650 km), EVs are still US$11,565 more expensive over their lifetimes.

Cost of charging infrastructure

The cost of charging infrastructure varies depending on several external factors such as grid connection costs, shipping costs, and public land acquisition. A benchmark to tie these costs to is the charging hub provision built recently in Dundee, Scotland, where a recently constructed charging hub with 9 chargers (3 fast (22kW), 6 rapid (50kW)), a solar array of 36 kW installed capacity, and battery storage of 90 kWh, 60 kW output (this has the capacity for charging 18 vehicles) cost US$1,427,000. Assuming the cost to install charging, infrastructure is 30 percent higher in Samoa than in Scotland, the cost of this charging hub in Samoa would be US$ 1,855,000. Assuming two of these charging hubs are required to power the vehicles included in this project, the cost of charging infrastructure would be US$ 3,710,000.

Total project cost

The total cost of this project (including light vehicle costs and charging infrastructure costs) would be US$10,649,000.</td><td>install depending on land conditions, availability of hardware elements and electricity connection.

It is estimated that the electrification of the 10 percent of Samoa's government-owned vehicle fleet will take place over eight years between 2023 and 2030.</td></tr>
<tr><td>Affordability</td><td>Likely co-benefits</td></tr>
<tr><td>Government vehicle fleets are usually funded by general taxation. The average cost of this project would be US$12.09 per capita year in Samoa, which should be affordable to consumers in Samoa.

To support the introduction of EVs within the government and municipal fleets consideration needs to be made regarding infrastructure. This can be municipal fleet only chargers at locations where the vehicles or based, however a more cost-effective option is to utilize the same charge points that are being used across other electrification projects.</td><td>▪ Seeing government bodies make the switch to EVs gives the public confidence to also make the switch to private EVs, and provides an instant demand for charging infrastructure in a region and so can encourage private investment. This would contribute to SDG 11 (sustainable cities and communities) and SDG 9 (industry, innovation, and infrastructure)
▪ Reduced noise and urban air pollutant emissions, leading to improvements in public health contributing to SDG 3 (good health and well-being)
▪ Lower operating costs, specifically maintenance and fuel; contributing to SDG 7 (affordable and clean energy).</td></tr>
<tr><td colspan="2">Potential environmental or social impacts</td></tr>
<tr><td colspan="2">Negative
▪ Construction of charging infrastructure can cause local disturbance including noise pollution, dust, sediment pollution, and increased streams of construction waste
▪ This project will lead to increases in EV batteries that require careful disposal/recycling at the end of their economic lives
Positive
▪ This project would reduce local air and noise pollution from ICE vehicles. EVs also have significantly longer economic lifetimes than ICEVs, so this project would reduce the stream of vehicles that need to be scrapped each year.</td></tr>
</table>

Procurement method	*Likelihood of attracting private or donor funding (high, medium, low)*
This project can be procured through donor viability-gap funding for the capital cost of EVs, coupled with commercial and/or concessional finance for charging infrastructure. Government funding could also support charging infrastructure. This project should not go ahead unless support from international donors is secured. 13 out of 22 stakeholders in Samoa thought that grants from international donors was the most appropriate funding source for this project, whereas four out of 22 stakeholders thought the project should be funded by the government. Five stakeholders also thought that the project can also be funded by user fees.	*Medium* ▪ Government and municipal fleets are traditionally funded through rates and taxation. The GoS could therefore fund the electrification of its fleets through taxes and rates. However, the government must consider whether this is a priority for the fiscal budget ▪ If this project is not considered a priority for the fiscal budget, it would have to secure donor funding. While this project would be reasonably high profile with significant co-benefits for Samoa, the high costs and reasonably modest GHG emissions reduction potential may limit the interest of international donors.
Capacity requirement to implement (high, medium, or low)	*Potential barriers*
Medium ▪ Requires specific charging infrastructure to support vehicle operations. Technical assistance may be required to determine the correct specifications in the most appropriate locations ▪ The replacement of government-owned light vehicles with EVs would not require significant capacity building. This can be a straightforward replacement program that can commence as soon as finance is available.	Potential barriers to this project include: ▪ Whether a ministry can use EVs is dependent on the nature of the work each ministry performs. Therefore, the uptake of EVs might be slow across different ministries ▪ Lack of charging infrastructure can limit the number of vehicles able to be introduced into the fleets ▪ Changes to legislative framework are required because there is no definition of the EVs in the Land Transport Authority Act (2007) as it currently stands.

A.2.4 Electrification of Samoa's light vehicle fleet

Project name: Electrification of Samoa's light vehicle fleet		
Sector: Land transport	**Sub-sector: Transport infrastructure**	**Project type: Investment**
Project description		
This project develops both public and private EV charging infrastructure to enable greater uptake of EVs between now and 2030. The project aims to phase out 10 percent of Samoa's light vehicle fleet with EVs by 2030. Public charging infrastructure including a network of fast charging stations will encourage the uptake of EVs in Samoa. EV charging hubs are publicly available stations that are solely dedicated to charging EVs. They provide charging solutions for different transport modes on a single site. EV charging hubs that couple solar generation and onsite battery storage can ensure that locally produced renewable energy can be fully utilized. The strategic positioning of these sites can support the transition to EVs. To determine the number of chargers required to support the switch of 10 percent of the light electric fleet in Samoa we can start by using recognized ratios for the number of rapid and fast charger. The ICCT identifies a number of factors that identify the required number of chargers, however due to the relatively low milage of vehicles in Samoa we have adjusted these to reflect the requirements and have identified the requirement for three rapid charging hubs, comprising six rapid chargers and three double fast chargers[229]. This should be further supported by an additional 26 fast chargers 7-22kw located at venues where people will tend to leave their cars for extended periods, such as work		

[229] https://theicct.org/sites/default/files/publications/EV-charging-metrics-aug2020.pdf

or leisure activities. This will give a total of 18 rapid chargers and 35 double fast chargers; this should easily support the number of electric cars being deployed.

As well as charging hubs, home and workplace charging solutions that combine solar and small home battery systems can deliver benefits to end users. These solutions are currently being developed with V2X capabilities, where the vehicle can act a storage entity to provide electricity back to the required location. This technology can help deal with grid capacity issues, peak shaving, and matching renewable generation with vehicle charging patterns.

The switch to EVs can not only support the reduction of CO_2 within a region but it can also deliver significant and instant improvements to air quality due to the zero emissions at the tailpipe. Due to the fact it has been over 10 years since the 1st mass produced EVs were introduced the 2nd hand market is starting to develop across the world, meaning that EVs are now becoming affordable for the majority.

The whole life costs of EVs are now beginning to be analyzed and they compare favorably to similar diesel vehicles, this is mainly due to a reduction in maintenance and fuel costs. For example:

- Organizations such as Kia stating, "No oil to change, no engine to manage, with fewer parts to wear down, electric cars are cost-efficient and easier to maintain than internal combustion engine vehicles[230]."
- The Natural Resources Defense Council stated that in certain parts of the US "Over the anticipated 15-year life span of a vehicle, the electricity required to run a battery-powered electric car can be as much as $14,480 cheaper than fueling up an internal combustion vehicle."[231] Due to the relatively small number of miles travelled per year by cars in Samoa the lifetime of the vehicles is likely to be extended with batteries in 10-year-old cars still having a relatively healthy state of charge.

Samoa and the World Bank are currently preparing a road sector operation, the Enhanced Road Access Project (ERAP), to help enhance access to all road users by improving road networks. Electrification of vehicles is in line with the objective of the ERAP project. A public consultation may be required on how many EVs Samoa currently has. There is no database tracking the number of hybrid or EVs in the country. However, stakeholders believe that there are no registered EVs in Samoa (as of June 2020)[232].

International case studies highlight best practice for structuring an EV project. These lessons learned should be considered in Samoa:

- San Francisco is a pertinent example of best practice for supporting private EV adoption without large fiscal subsidies. There has been long-term support for organic market growth of EVs in the city. In 2015, the EV Working Group was formed to catalyze EV adoption. In 2017, it developed the City's EV Roadmap, targeting six key areas with concrete aims for 2020 to 2025. The EV Roadmap put forward an accelerated path toward electrification of all forms of private transportation. This illustration of best practice can advise and direct Samoa's EV strategy. The key policy takeaway from this example is that it is important to have a formal governance structures with a broad range of stakeholders working to a common vision.
- Norway has the highest percentage of EVs in new car sales of any country in the world. A combination of policies has led to a rapid transition from 75 percent of new sales being diesel in 2010 to 75 percent EV in 2020, with more than 300,000 EVs now on the road. One of the key policies was EVs accessing bus lanes to incentivize uptake. National targets and purchase tax exemptions supported the transition across Norway. The largest fiscal incentives are the purchase/import tax and VAT exemptions. Vehicle purchasers who buy a new EV are exempt from these taxes, reducing the cost of a new vehicle by around a quarter, and bring the capital cost of EVs in line, if not lower than, their conventional alternatives. This example is key to showing that it is important to have long-term planning in incentives.

Feedback from stakeholders in Samoa was generally positive about the concept of supporting EVs. Stakeholders said that this project is relevant, but will depend on the availability of resources, particularly charging infrastructure. Stakeholders pointed out that legislation reform might help uptake of these project. For example, the government's legislation on axle load limits may increase uptake of EVs. Stakeholders in Samoa also made the following points about electrification of the light vehicle fleet:

- Targets for electrification should be kept as low as possible—5 to 10 percent is feasible if EPC builds charging infrastructure
- The uptake of EV is only viable for certain people, and certain use cases
- The total light vehicle fleet will likely increase

[230] https://www.kia.com/dm/discover-kia/ask/are-electric-cars-cheaper-to-maintain.html

[231] https://www.nrdc.org/stories/electric-vs-gas-it-cheaper-drive-ev

[232] MPPC, vehicle registrations as at 2020

- Most petrol stations are privately owned and building charging infrastructure in those petrol stations may not be as feasible
- As most vehicles in Samoa are privately owned, and not regulated by the government (except licensing), it will be important to incentivize the project to make EVs attractive to the public
- There is already incentive from government through a Custom Act (from the Ministry of Revenue), which make import of EVs exempt from duty tax
- EPC is running a pilot project with the purchase of 10 EVs and building a charging station. It is unclear what research and due diligence EPC has done. EPC is the first government office to use EVs
- It might be worthwhile to start electrifying government vehicles. This will allow Samoa to learn what relevant issues there will be, so that future electrification (particularly of the private sector) will be improved.

Estimated GHG emissions reduction potential

Replacing an ICEV that has a yearly mileage of 3,650 km with an electric version will save around 0.537 tCO_2-e per year. Based on international projections for fleet composition, it is ambitious but achievable to assume that 10 percent of the ICEV fleet could transition to electric by 2030. Stakeholders in Samoa also agreed that it would be reasonable to assume 10 percent fleet electrification by 2030. If 10 percent of the 27,134 registered vehicles on the road in Samoa[233] were to make the switch to electric by 2030, GHG emissions reductions will ramp-up progressively over time to 1,457 tCO_2-e annually once 10 percent electrification is achieved.

Assuming charging infrastructure is installed in 2022, and GHG emissions reductions start in 2023 and increase at a linear rate to reach 1,457 tCO_2-e in 2030, the cumulative GHG emissions reduction potential to 2030 would be 6,557 tCO_2-e.

Cost Estimates	*Estimated time scale*
Cost of vehicles Based on modelling the capital and operating costs of ICEV and EVs in Samoa, the electrification of 10 percent of ICEV vehicle fleet in Samoa would cost US$26.6 million. This modelling compared the lifetime costs (in net present value terms) of EVs vs ICVs in Samoa. At current prices, despite having US$161 lower operating costs per year (annual mileage 3,650 km), EVs are still US$11,565 more expensive over their lifetimes. Samoa would have to replace 2,713 ICEV cars with EVs to reach 10 percent electrification of the light vehicle fleet, meaning the additional unfunded costs of this transition would be US$31,376,000. **Cost of charging infrastructure** The cost of charging infrastructure varies depending on several external factors such as grid connection costs, shipping costs, and public land acquisition. A benchmark to tie these costs to is the charging hub provision built recently in Dundee, Scotland, where a recently constructed charging hub with 9 chargers (3 fast (22kW), 6 rapid (50kW)), a solar array of 36 kW installed capacity, and battery storage of 90 kWh, 60 kW output (this has the capacity for charging 18 vehicles) cost US$1,427,000. Assuming the cost to install charging, infrastructure is 30 percent higher in Samoa than in Scotland, the cost of this charging hub in Samoa would be US$ 1,855,000. Assuming six charging hubs are required, total	EV charging hubs can take between 6—12 months to install depending on land conditions, availability of hardware elements and power connection. It is estimated that the electrification of the 10 percent of light vehicle fleet in Samoa will take place over eight years between 2023 and 2030.

[233] The number of registered vehicles in Samoa was provided by the Ministry of Police on 18 July 2021.

<table>
<tr><td>cost of building charging infrastructure would be US$ 11,130,000.
Total project cost
The total cost of this project (including vehicle costs and charging infrastructure costs) would be US$ 42,506,000.</td><td></td></tr>
<tr><td>Affordability</td><td>Likely co-benefits</td></tr>
<tr><td>Converting to an EV would cost the vehicle owner an average of US$11,565 over the lifetime of the vehicle. In the absence of international grant funding, therefore, this project would not be affordable for people in Samoa.</td><td>▪ Increasing the penetration of EVs can reduce urban air pollutants, thereby improving air quality and noise, thus contributing to SDG 3 (good health and well-being) and SDG 11 (sustainable cities and communities)
▪ The decarbonization of transport would lead to a reduction in reliance on diesel contributing to SDG 7 (affordable and clean energy) and SDG 13 (climate action)
▪ If powered by renewable sources energy, the hubs can provide a steady market for locally produced renewable electricity, contributing to SDG 7 (affordable and clean energy) SDG 8 (decent work and economic growth), and SDG 9 (industry, innovation, and infrastructure)
▪ Linking this solution to renewable energy production and a storage solution will reduce reliance on diesel and ensure a constant supply, contributing to SDG 13 (climate action) and SDG 7 (affordable and clean energy)
▪ Reduce household costs of fuel, contributing to SDG 8 (decent work and economic growth).</td></tr>
<tr><td colspan="2">Potential environmental or social impacts</td></tr>
<tr><td colspan="2">Negative
▪ Construction of charging infrastructure can cause local disturbance including noise pollution, dust, sediment pollution, and increased streams of construction waste
▪ This project will lead to increases in EV batteries that require careful disposal/recycling at the end of their economic lives
Positive
▪ This project would reduce local air and noise pollution from ICE vehicles. EVs also have significantly longer economic lifetimes than ICEVs, so this project would reduce the stream of vehicles that need to be scrapped each year.</td></tr>
<tr><td>Procurement method</td><td>Likelihood of attracting private or donor funding (high, medium, low)</td></tr>
<tr><td>This project can be procured through donor viability-gap funding for the capital cost of EVs, coupled with commercial and/or concessional finance for charging infrastructure. Government funding could also support charging infrastructure. This project should not go ahead unless support from international donors is secured.
15 out of 22 stakeholders in Samoa thought that grants from international donors was the most appropriate funding source for this project, whereas three out of 22 stakeholders thought the project should be funded by the government. Four stakeholders also thought that the project could be funded by user fees.</td><td>Low
Given EVs are not commercially viable in Samoa at present, this project would not attract private funding sufficient to cover its costs. While this would be a highly visible climate change mitigation project, the high costs and reasonably modest GHG emissions reduction potential may limit interest from international donors.</td></tr>
<tr><td>Capacity requirement to implement (high, medium, or low)</td><td>Potential barriers</td></tr>
</table>

Medium ▪ If charging hubs are delivered by a private organization, then they would require support from the Samoan government to identify suitable locations and provide relevant permissions ▪ If the charging network is delivered by the government, then technical assistance may be required to determine the correct specifications in the most appropriate locations ▪ EVs will need specialized maintenance, although repairs are needed less often than for ICVs. If Samoa transitions 10 percent of its fleet to EVs, it is likely that demand for specialized EV maintenance will be met by the private sector.	▪ Charging infrastructure is a major issue. Progress on charging infrastructure is dependent on other sectors making progress, for example, renewable energy storage capacities ▪ The disparity in price points between second-hand ICE automobiles and new highly efficient vehicle will be a barrier to market acceptance. However the 2nd hand EV market is starting to develop with it being over 10 years since the 1st mass produced cars entered the market ▪ Changes to legislative framework are required because there is no definition of the EVs in the Land Transport Authority Act (2007) as it currently stands.

A.2.5 Shared electric micro mobility

Project name: Shared electric micro mobility		
Sector: Land transport	**Sub-sector: Micro mobility**	**Project type: Investment**
Project description		

This project aims to introduce a shared electric e-scooters in Apia that can potentially reduce car dependency and therefore reduce emissions. The scheme can use free-floating assets which are charged by the asset owners overnight/when required or docked schemes where the assets are retuned to a charging station when not in use.

The introduction of shared e-scooter schemes are becoming more popular across the globe. Micro mobility devices (such as e-scooters and e-bikes) are now available in over 600 cities across more than 50 countries worldwide. These schemes, if properly implemented, can reduce the number of cars on the road and encourage more active travel.

Shared electric micro mobility (e-mobility) schemes can feature in a national Mobility as a Service (MaaS) solution. MaaS is a service that through a joint digital channel enabling users to plan, book, and pay for multiple types of mobility services. A fully developed solution may offer the user a single monthly subscription that can be used across multiple mobility options.

Consideration should be given to fixed or free-floating schemes as each one has their advantages and disadvantages; it is noted that a number of cities have been moving away from free floating schemes to significant misuse of the schemes. The case studies included provide some background on the challenges that introducing these schemes can bring.

One of the main lessons learned is that these schemes need to be introduced along with policies and regulations to ensure that use is controlled in some manner. In the UK it is illegal to ride an e-scooter on the road apart from in a few cities who are currently trialing hire schemes only. However, the rise of e-scooters continues to grow in an unregulated way.

The schemes can be relatively cheap to introduce and yet if introduced properly can have an immediate impact on short journeys, which are often the most polluting journeys for older vehicles.

Feedback received during consultation included:

- If people in Samoa e-scooters are an easier option to travel around and reduce time, these projects have potential
- "For e-scooters, work closely with the Hotel Association of Samoa and STA to import e-scooters that will be used by tourists visiting Samoa. E-scooters could be located at each hotel"
- Having a e-scooters at each hotel is a great opportunity going forward. "A pilot program could support a couple of e-scooters and can be monitored by SHA." Due to COVID-19, the tourism industry has limited financial resources.

International case studies highlight best practice for structuring a micro-mobility project. These lessons learned should be considered in Samoa:

- Santa Monica, USA, was the first city to see the spread of dock less e-scooters. In 2017, Santa Monica became the first city to see hundreds of e-scooters deployed across the city. With no municipal regulation, permits, or requirements, and a high number of tourists visiting the city to use the devices, it was viewed by micro mobility providers as an ideal test ground. In September 2018, these e-scooters became regulated with permits from the city. These were issued to four companies with a vehicle cap. Throughout the 18-month pilot, data was collected to understand how people used the vehicles, what the challenges were, and how they could be addressed. As a result,

Santa Monica still has the early dynamism of a start-up market in micro mobility – with no requirement for suppliers to provide docks – but in the context of publicly-regulated market which the city's authorities can shape.

- Building on a successful bike share scheme, the city of Paris is regulating operators who have now deployed thousands of electric bikes and e-scooters. Paris is globally recognized for its work in shared micro mobility, and a combination of regulation, financial support, and spatial policy has built on this reputation in newer technologies.
- Paris faced challenges in potential conflicts over use of public space. Many bikes and micro mobility vehicles drive and park on sidewalks, often in central areas with high density of pedestrians. This led to concerns over the impact on pedestrians, particularly elderly and disabled citizens. To resolve this issue, the City created 2500 stations with 15,000 parking spots reserved for e-scooters. Docked e-bikes have approximately 32,000 parking spaces across the city.
- Legislation has been enacted nationally and by city authorities to ensure devices benefit the city. Since 2019, micro mobility operators (except the Velib scheme) pay a fee to operate in the city. These operators are limited on the number of devices they can deploy in the city. Free floating micro mobility devices can only park in the 2,500 spaces the city has allocated for this purpose, or in car/motorcycle on-street spaces.
- The Velib docked e-bike sharing scheme was procured with financial support from the city. The management contract is for 15 years (starting in 2018) held by a syndicate of 31 local authorities in and around Paris.

Both examples detailed here illustrate the importance of regulation and permits when establishing micro mobility schemes. If Samoa chooses to implement a scheme, consideration of this best practice is advisable.

Estimated GHG emissions reduction potential

Surveys have shown that people who ride e-scooters use them to replace a car ride in almost 10 percent of cases[234]. Assuming that a fleet of 100 shared e-scooters is introduced in Apia, one in 75 car owners in Apia use these scooters, and that these people reduce their car usage by 10 percent because of the availability of e-scooters, average car usage would reduce by 0.133 percent in Apia. There are approximately 9,200 cars in Apia,[235] meaning that this project would be equivalent to taking 12 cars off the road in Samoa.

The average privately-owned ICEV in Samoa has an annual mileage of 3,650km and emits 0.537 tCO_2-e per year. Therefore, this project has the potential to reduce emissions by 6 tCO_2-e per year once the e-scooters are in full use.

Assuming this fleet of e-scooters is introduced in 2022, and GHG emissions reductions increase at a linear rate over two years as usage increases to reach 6 tCO_2-e in 2023, the cumulative GHG emissions reduction potential between 2022 and 2030 would be 51 tCO_2-e.

Cost Estimates	*Estimated time scale*
Capital costs It would cost roughly US$250,000 to set up a shared e-scooter scheme in Apia comprising 100 free-floating e-scooters. **Operational costs** The average operating costs of an e-scooter is US$ 191 per year. Therefore, the operational costs of this micro mobility project would be US$ 19,100 per year. **Vehicle cost savings** This project would lead to a 10 percent reduction in car mileage for one in 75 of Apia's privately-owned ICEVs (123 cars). Assuming an average mileage of 3,650km, this would reduce total car mileage in Apia by 44,895 km/year. Assuming an	This scheme would take one year to implement. Shared electric micro mobility schemes can be introduced at short notice and provide instant benefits. Projects are very scalable with small initial investment required.

[234] https://www.fleeteurope.com/en/last-mile/europe/features/do-scooters-replace-cars?t%5B0%5D=e-scooter&t%5B1%5D=Lime&t%5B2%5D=Uber&t%5B3%5D=Public%20transport&curl=1

[235] This estimate is based on the assumption that 40 percent of Samoa's privately owned vehicles are in Apia.

<table>
<tr><td>average fuel consumption of 6.4 l/100km,[236] and a fuel cost of US$ 0.9 per liter,[237] the fuel cost savings of this project would be roughly US$ 2,586 per year.
Total costs
Assuming this fleet of e-scooters is introduced in 2022, and vehicle cost savings increase at a linear rate over two years as usage increases to reach US$ 2,486 per year in 2023, the net present cost of this project could be US$ 332,000 between 2022 and 2030 at a 6 percent discount rate.</td><td></td></tr>
<tr><td>Affordability</td><td>Likely co-benefits</td></tr>
<tr><td>A similar e-scooter scheme in New Zealand costs $1 for scooter hire and 30 cents for each additional minute[238].
However, the cost of such a scheme is likely to be much cheaper in Samoa when adjusted for purchasing power and if the costs are subsidized by the government can be an affordable solution for consumers in Samoa.</td><td>Electric micro mobility can:
▪ Provide travel solutions for those who cannot or do not wish to drive or travel on public transport, contributing to SDG 11 (sustainable cities and communities)
▪ Promote physical exercise through active transport, contributing to SDG 3 (good health and wellbeing)
▪ Reduce urban air pollution, contributing to SDG 3 (good health and wellbeing) and SDG 11 (sustainable cities and communities)
▪ Reduce congestion contributing to SDG 11 (sustainable cities and communities)
▪ Reduce reliance on imported fossil fuels, contributing to SDG 13 (climate action), SDG 7 (affordable and clean energy), and SDG 12 (responsible consumption and production)
▪ Reduce risks associated with oil spills and contamination of both the coastal marine environment and freshwater, contributing to SDG 14 (life below water), SDG 6 (clean water and sanitation)
▪ Reduce household costs of fuel, contributing to SDG 8 (decent work and economic growth).</td></tr>
<tr><td colspan="2">Potential environmental or social impacts</td></tr>
<tr><td colspan="2">Negative
▪ Experience globally shows that electric scooters often cause tensions over mixed-use space, and may increase risk to pedestrians of ridden on pavements, or to scooter riders if ridden on roads
▪ This project will lead to increases in electric scooters that require careful disposal/recycling at the end of their economic lives
Positive
▪ This project would greatly reduce transport costs and may extend transport services to those who cannot currently afford them
▪ This project would reduce local air and noise pollution from ICE vehicles.</td></tr>
<tr><td>Procurement method</td><td>Likelihood of attracting private or donor funding (high, medium, low)</td></tr>
<tr><td>Shared electric scooters and supporting infrastructure could be provided by the</td><td>High</td></tr>
</table>

[236] Based on the average fuel consumption of a Toyota Yaris:(https://www.google.com/search?q=toyota+yaris+fuel+consumption&rlz=1C1GCEU_enNZ929NZ929&oq=toyota+yaris+fuel+consumption&aqs=chrome.0.0i457j0i20i263j0l5j0i20i263.6757j0j9&sourceid=chrome&ie=UTF-8)

[237] https://samoaglobalnews.com/december-2020-fuel-prices/

[238] https://www.stuff.co.nz/the-press/news/107911180/the-lowdown-on-lime-scooters-new-zealands-newest-transport-trend

government, and the costs of the project could be recovered over time through user fees. While 13 out of 21 stakeholders in Samoa thought that grants from international donors was the most appropriate funding source for this project, it is unlikely that international donors would fund a project that has the potential to cover its own costs. Furthermore, given the bureaucratic hurdles of allocating grants, it is unlikely international donors would fund such a small transport project.	▪ Given the high net present value of this project, it is likely to be able to fund all costs over time through user fees. Therefore, government investment in micro mobility assets would be repaid over time. ▪ This project may also be able to attract established micro mobility companies. Many organizations are now looking at MaaS as the future of transport and are willing to invest in bringing these systems to new markets.
Capacity requirement to implement (high, medium, or low)	***Potential barriers***
Low Where e-scooters are legal then micro mobility schemes require very little capacity to implement. However, lessons from other cities and countries show that some level of regulation on suppliers and number of vehicles can support the development of a sustainable network. Santa Monica, California has an appropriate best practice example that can be used.	This project may encounter the following barriers: ▪ Cultural sensitivities in Samoa may not be appropriate for micro mobility (such as traditional dress) ▪ This project will require people to adjust their lifestyles, which can be difficult ▪ Having a mix of solutions that include e-bikes and e-scooters may ensure that the solution works for the majority of the population, with the user having the choice.

A.3 Maritime transport sector

A.3.1 Transport optimization and energy efficiency review

Project name: Transport optimization and energy efficiency review		
Sector: Maritime transport	**Sub-sector: Energy efficiency**	**Project type: Information**
Project description		
This project aims to conduct a detailed energy efficiency audit and analysis of transport energy efficiency. This project is designed to establish a strong data and evidenced based foundation for an emission reductions program. Establishing a clear understanding of the current (typical and forecast) emission sources is an essentially pre-cursor to any project development. It will establish the basis on which sound decision making can be made on the most cost-effective options. Generally, carbon GHG emissions reductions can be achieved in three main methods 1. Reducing energy consumption by improving energy efficiency of the systems or technology employed – at its simplest level LED lighting is a good example 2. Reducing energy consumption by improving efficiency through driver behavior changes – for example, minimizing idling and encouraging drivers to drive to engine optimum efficiency specifications 3. Reducing energy consumption through optimization of the system – for example, route selections. The majority of energy reduction opportunities will provide a co-benefit of reduced costs. The project should include robust analysis on emission sources, routes, energy influencers (such as human behavior factors, or engine efficiencies) to determine where the opportunities are for reductions. Ports of Auckland undertook a similar style audit at the outset of its emission program and the final report is provided for reference. An experienced Energy Auditor should be used, and the cope should include the energy consumption in the system, opportunities for improvements, costs and impacts of options, and where relevant payback period for projects. The following should be audited and analyzed: ▪ Opportunities to improve energy efficiency of maritime transport vessels and associated land-based vehicles and buildings, such as thorough replacing light fittings on vessels with LEDs, or upgrading other equipment to more energy efficient options as the equipment approaches the end of its useful life ▪ Behavioral opportunities, which will relate to the way operators use vehicles and buildings. In the consultation workshop, participants emphasized the need for behavior training and awareness		

- Transport route optimization (including during bad weather events), to identify opportunities to improve system efficiency. In the consultation workshop, participants stated that weather plays a significant part in driver decisions. This will be particularly important as climate change impacts Samoa's weather patterns.

Ports of Auckland (POAL) example:

POAL have analyzed and managed behavioral changes of its drivers. POAL analyzed driver behavior using GPS data of the vessel (i.e., a tugboat or pilot boat). This analysis showed that:

- There was a wide range of operating behavior between drivers—some drivers would leave before the required time and would sit idling, while others would wait and then speed to be on time
- Fuel consumption differed considerably between drivers

POAL developed an optimum timeframe for drivers to leave the port based on efficiency of fuel consumption, speed, vessel specifications, and specific conditions. Drivers were given transparency on fuel consumption.

POAL is also trying to identify idling with its land-based vehicles. Stakeholders stated that this project could be expanded or adapted in the future to combat idling vehicles, such as buses.

Estimated GHG emissions reduction potential

Similar energy efficiency programs, such as the work completed at Ports of Auckland Limited, identified in the order of 5-10 percent energy savings. The POAL Energy Audit offered LED lighting replacement projects that had payback periods of between 3 and 5 years, in addition to the emission reduction resulting. Driver behavior changes can offer similar savings but is dependent on the existing driver behaviors and might be at the low end of this range. Ports of Auckland undertook a review of driver behaviors and estimate that improvements in the range of 5-10 percent were achievable.

We assume that energy efficiency programs can reduce emissions by 10 percent for the maritime sector, across water-borne vessels and shore side infrastructure, for the driver behavior and energy efficiency opportunities. Route optimization also has significant emission reduction potential. However, considerable stakeholder and customer impacts need to be considered. Route optimization opportunities will also need to consider essential service requirements and potentially constraints related to service level requirements for some ferry or cargo services.

The energy sector accounts for 50 percent of total emissions from Samoa[239]. Assuming the maritime transport sector is six percent of the total emissions from the energy sector, total emissions from maritime transport in Samoa is 11,210 tCO_2-e annually. The estimated total GHG emissions reduction potential of this project would be 1,121 tCO_2-e per year once fully implemented.

Assuming that this project starts in 2022 and takes four years to complete, and GHG emissions reductions only start after it is complete in 2026, the cumulative GHG reduction potential of this project by 2030 is 5,605 tCO2.

Cost Estimates	*Estimated time scale*
Based on similar transport optimization and energy efficiency work in the region, this project can be expected to cost between US$50,000-US$100,000 should be considered. For the purposes of comparing projects, it is assumed that this project would have an investment need of US$ 75,000 (the mid-point of this range). This investment need would cover driver behavior training and would involve an external consultancy to support and undertake data collection. Projects identified for implementation for energy efficiency improvements would typically be financially cost neutral against operational expenses (OpEx) for a 3-5-year period.	▪ The review and analysis should be done early in the roadmap and may take 6—12 months ▪ Route optimization may require 12–24 months to implement depending on stakeholder or customer needs and expectation ▪ Driver behavior training could be implemented over a 6-month period. ▪ It would then take approximately 2–4 years to implement projects (such as LEDs or replacing equipment with energy efficient alternatives as the equipment approaches the end of its useful life).
Affordability	***Likely co-benefits***
The implementation of the project should be relatively affordable for the Samoan people	▪ Energy efficiency improvements bring upstream benefits by reducing energy demands, and in most cases will also deliver

[239] https://www.sprep.org/att/irc/ecopies/countries/samoa/118.pdf

because the implementation of energy efficiency improvements is financially cost neutral against OpEx.	operational expenditure reductions, contributing to SDG 7 (affordable and clean energy) and SDG 12 (responsible consumption and production) ▪ Typically, energy efficiency improvements can also be used as a conduit for raising awareness of energy efficiency and cost reductions which people can then take and consider for their personal lives, contributing to SDG 7 (affordable and clean energy) and SDG 11 (sustainable cities and communities) ▪ Contributes to affordable and clean energy solutions, contributing to SDG 7 (affordable and clean energy) ▪ Reduced demand on the national grid can ensure continuous and reliable electric supply, contributing to SDG 9 (industry, innovation, and infrastructure).
Potential environmental or social impacts	
Positive ▪ Increased energy efficiency can lower operating costs for maritime transport operators ▪ Lower operating costs for maritime transport operators should lead to lower prices for consumers	
Procurement method	***Likelihood of attracting private or donor funding (high, medium, low)***
Given the project is expected to be cost neutral over time, commercial finance could be used, and the project could be funded through fuel cost savings. While 13 out of 22 stakeholders in Samoa thought that grants from international donors was the most appropriate funding source for this project, it is unlikely that international donors would consider funding a project that is expected to be cost neutral. Five out of 22 stakeholders thought the project should be funded by the government. Four stakeholders thought that the project could also thought the project could be funded by user fees.	***Medium*** This review project would likely be too small to warrant donor funding. However, it might be possible to access donor funding for this project if it were bundled with other energy efficiency or transport sector projects into a larger program of investments. In many cases, investments in transport energy efficiency will be profitable, meaning that the case for donor funding is weak. However, these investments are likely to be able to attract private funding.
Capacity requirement to implement (high, medium, or low)	***Potential barriers***
Low This project would require a specialist energy auditor to undertake a high-level review of energy efficiency opportunities, however this has been accounted for in the project cost. Within organizations it is possible to develop emissions inventories with a small amount of external assistance to identify emission sources and set targets.	This project may encounter the following barriers: ▪ Lack of awareness of transport optimization and energy efficiency, thereby limiting success of the project ▪ Energy efficiency standards are difficult to enforce ▪ Driver related behavioral change may be difficult to realize; stakeholders suggested that people may have limited inclination to change.

A.3.2 Shore side electrical supply for at berth vessels

Project name: Shore side electrical supply for at berth vessels		
Sector: Maritime transport	**Sub-sector: Energy efficiency**	**Project type: Investment**
Project description		
This pilot project focuses on equipping three medium-sized vessels with shore-side plug-in capabilities. The project will focus on three small-medium sized vessels that require a standard distribution grid level electricity supply. Therefore,		

this project would not require construction of large dedicated high-voltage electricity supply facilities that would be needed for large cargo or passenger ships.

Vessels that operate on diesel or other marine fuels such as Heavy Fuel Oil (HFO) typically need to have some electricity to operate on-board services while at berth. Shore-side power connections provide electricity to vessels while at berth to enable the vessels to turn off other power sources operated by hydrocarbon fuels. Running diesel generators, auxiliary engines or main engines at berth emits contaminants that impact air quality at berth and contribute to carbon emissions.

Where grid capacity is insufficient to accommodate connection, local generation should be considered. For large cargo ships visiting Samoa that operate on HFO, a local diesel generation shoreside power facility would provide modest improvements in air quality and carbon emission reductions. The recommended future state, however, is for local renewable energy such as a solar array to be planned for supplying the power requirements.

Ports of Auckland has undertaken several feasibility studies for shore power at their Cruise berths and at their Container Terminal. The feasibility studies are provided as reference documents. The reports show that international cruise vessels have large electricity demand at berth due the on-board services. Container vessels are smaller. However, both require significant shoreside electrical infrastructure with high cost. Ports of Auckland's (POAL) reports illustrate that the financial cases are typically weak for these projects, at the current levels of vessel capability to connect. For the cruise berths, POAL identified that only a small percentage of the ships visiting POAL had the capability to connect to shore power, but many of these had high repeat calls, meaning approximately 30 percent of cruise vessel calls would be shore power capable.

This project could potentially be done in parallel or in conjunction with the Green Port component of the Apia Port Project in partnership with ADB[240].

Estimated GHG emissions reduction potential

This pilot project focuses on equipping three medium-sized vessels with shore-side plug-in capabilities. Experience from other projects in the region shows that shore side plug-in facilities can reduce vessel emissions by 3.5 percent. Assuming that the targeted vessels have average annual emissions of 1,370 tCO_2-e,[241] the total GHG emissions reduction potential of this project would be 144 tCO_2-e in 2030.

Assuming that this project starts in 2022, and GHG emissions reductions increase at a linear rate from 2023 to reach 144 tCO_2-e in 2024, this project would have an emission reduction potential of 1,080 tCO_2-e between now and 2030.

Cost Estimates	*Estimated time scale*
Based on experience from similar projects in the region, this project would cost roughly US$50,000 to equip three small-medium sized cargo and passenger transport vessels with shore-side plug-in capabilities. It is assumed that electricity costs roughly equal the fuel savings under this project.	It is assumed that the shore side plug in facilities can be constructed in 2 years.
Affordability	***Likely co-benefits***
The total cost of this pilot project is estimated to be US 50,000, which is roughly 2 percent of MWTI's annual budget[242]. Therefore, this project is likely to be affordable for the GoS.	▪ Positive health impacts from improved air quality and reduced noise levels of vessels at berth, contributing to SDG3 (good health and well-being) and SDG 11 (sustainable cities and communities) ▪ Linking this solution to renewable energy production and a storage solution will reduce reliance on diesel and can ensure a constant energy supply, contributing to SDG 13 (climate action) and SDG 7 (affordable and clean energy) ▪ If powered by renewable energy sources, the plug-in facility can provide a steady market for locally produced renewable electricity, contributing to SDG 7 (affordable and clean energy)

[240] This possibility was raised by MWTI in their comments on the Draft NDC Implementation Roadmap and Investment Plan.

[241] This estimate assumes that small passenger and cargo ships travel an average of 100km per day, burn 14.01 liters of fuel per km, and that each liter of fuel burned emits 2.68 kg CO_2-e.

[242] MWTI's budget was estimated to be US$22 million in 2016-17. Budget documents are available at: https://www.mof.gov.ws/wp-content/uploads/2019/09/Statement-on-the-Foward-Estimate-2014-2015-to-2016-2017-1.pdf

	SDG 8 (decent work and economic growth), and SDG 9 (industry, innovation, and infrastructure).
Potential environmental or social impacts	
Negative ▪ Shore side infrastructure upgrades can cause localized disturbance and impact local amenity values ▪ This project would increase demand for electricity, which may make it more difficult for EPC to reach 100 percent renewable generation Positive ▪ Reduced demand for marine diesel reduces operating costs and risk of fuel spills ▪ This project would lead to a reduction in local air and noise pollution as it allows vessels to turn their engines off when at berth.	
Procurement method	***Likelihood of attracting private or donor funding (high, medium, low)***
If run as a single project, shore side plug-in facilities would likely need to be provided by the government through the MWTI budget. While 12 out of 22 stakeholders in Samoa thought that grants from international donors was the most appropriate funding source for this project, given the bureaucratic hurdles of allocating grants, it is unlikely international donors would fund such a small transport project in isolation. However, it may be possible to bundle this project into a program of maritime sector projects that could be funded by international donors. Stakeholders in Samoa also suggested that a joint financing arrangement between MoF and MWTI could be feasible.	***Medium*** This project may be attractive to donors if a detailed business case assessment was able to show an economic case of the project with a clear commercial viability gap.
Capacity requirement to implement (high, medium, or low)	***Potential barriers***
Low Once vessels are equipped with shore side plug in capabilities, it is reasonably straightforward to connect vessels to electricity when they are at berth.	This project may encounter the following barriers: ▪ Installing plug-in facilities on vessels may require vessels to be moved out of service temporarily while the necessary adjustments are made to the vessel ▪ Ports of Auckland (POAL) stated that cruise and container vessels may not be shore-power capable until post 2030, therefore the project might not be useful for some vessels visiting Samoa—a feasibility project would have to be completed to understand demand at Samoa's port ▪ Legislative changes could be required.

A.3.3 Electric ferry

Project name: Electric ferry		
Sector: Maritime transport	**Sub-sector: Passenger transport**	**Project type: Investment**
Project description		
Currently Samoa has two passenger ferries, which use fossil fuels. This project involves replacing one of these ferries with an electric ferry, powered by a dedicated solar facility.		

Electric ferries are entering the passenger ferry market, particularly used for short or medium distances. New 60 m electric vessels can sail 40 km with up to 200 passengers and 30 cars onboard on a single charge.[243] An electric ferry would require charging infrastructure at applicable berthing locations. As soon as the ferry reaches its docking position the charger connects to the onboard unit. Charging takes approximately 30 minutes.

East By West in Wellington New Zealand are building an electric ferry. Their ferry is considerably smaller ferry at 19m long and 135 passengers. East By West has announced they are installing small charging infrastructure which will not have a fast charge capability. They intend to upgrade to larger charging infrastructure within the first 2 years of operation.

The charging infrastructure will likely require its own local electricity supply as the demand may exceed existing grid spare capacity. This project assumes that a dedicated solar facility is developed to power an electric ferry in Samoa.

As with other technology projects, there must be robust technical support, training, upskilling and ongoing operations and maintenance support provided to the team. This will support a successful project and longevity of the positive impacts. Other technology projects have fallen over when the local team are not provided adequate training to troubleshoot and resolve technology issues.

Estimated GHG emissions reduction potential

This project has the potential to eliminate emissions for the replaced vessel which is equivalent to 1,370 tCO_2-e (assuming that small passenger and cargo ships travel an average of 100km per day, burn 14.01 liters of fuel per km, and that each liter of fuel burned emits 2.68 kg CO_2-e).

Total GHG emissions reductions between 2026 (when stakeholders indicate this project could be implemented) and 2030 is 6,850 tCO_2-e. Additional reductions could be made if the project is implemented more quickly.

Cost Estimates	*Estimated time scale*
The capital cost of this project is estimated to be US$29 million. A large electric ferry suitable to replace one of Samoa's two passenger ferries is estimated to cost in the order of US$20 million[244]. The shoreside infrastructure is estimated to cost in the order of US$3 million, with a further US$ 6 million for a 4MW solar facility. This investment would lead to fuel cost savings of US$480,530 per year[245]. Assuming that this project is implemented in 2026, the net present value of this investment would be US$-25,449,000 between 2026 and 2030.	We assume that there is a ferry due for retirement in 2022, which could be replaced immediately by an electric ferry. However, stakeholders at the consultation workshop indicated this might take more than 5 years. We have assumed that the project could be implemented by 2025.
Affordability	***Likely co-benefits***
This project would cost approximately US$129 per person in Samoa for transport services that are very similar to what people currently enjoy. This is therefore likely to be unaffordable for Samoa, and it should not go ahead unless Samoa is able to access grant funding from international donors.	▪ Air quality and noise improvements will result in positive health impacts, contributing to SDG 3 (good health and well-being) ▪ Electric ferries typically result in strong social support, contributing to SDG 11 (sustainable cities and communities), SDG 12 (responsible consumption and production), and SDG 9 (industry, innovation, and infrastructure) ▪ Maintenance costs are much lower—a diesel engine has about 30,000 moving parts, while only the bearings require maintenance in an electric motor. This will contribute to SDG 8

[243] https://www.bbc.com/news/business-50233206

[244] Electric vessels typically cost two to three times more than fossil fuel incumbent variants. Ports of Auckland announced that their electric tug is costing twice that of a standard tug. East-West Ferries announced that their Wellington ferry in New Zealand, will cost NZD$4m, noting its smaller size.

[245] Assuming that 1) the electric ferry replaces a diesel ferry that travels an average of 100km/day and burns fuel at a rate of 14.01 liters per km, and 2) automotive diesel oil costs US$ 93 cents per liter (equivalent to the pre-tax price reported for Samoa in SPC's Pacific Fuel Price Monitor – available at: http://prdrse4all.spc.int/system/files/2nd_quarter_2014_pacific_fuel_price_monitor.pdf

<table>
<tr><td></td><td>(decent work and economic growth) and SDG 9 (industry, innovation, and infrastructure)
▪ If powered by renewable energy sources, the ferry can provide a steady market for locally produced renewable electricity, contributing to SDG 7 (affordable and clean energy) SDG 8 (decent work and economic growth), and SDG 9 (industry, innovation, and infrastructure)
▪ Linking this solution to renewable energy production and a storage solution will reduce reliance on diesel and ensure a constant supply, contributing to SDG 13 (climate action) and SDG 7 (affordable and clean energy)
▪ Reduced marine pollution risk from oil spills, contributing to SDG 14 (life below water)
▪ Electric ferry improves air quality by reducing fossil fuels, contributing to SDG 3 (good health and well-being) and SDG 11 (sustainable cities and communities).</td></tr>
<tr><td colspan="2">Potential environmental or social impacts</td></tr>
<tr><td colspan="2">Negative
▪ Construction of charging infrastructure can cause local disturbance including noise pollution, dust, sediment, and marine pollution, and increased streams of construction waste
▪ This the electric ferry, and its battery pack in particular would require carful disassembly and disposal/recycling at the end of its economic life
▪ The high cost of this project may be partially pushed on to consumers, and may reduce access to maritime transport for some people
Positive
▪ This project would reduce local air and noise pollution from traditional ferries.
▪ It would also reduce the risk or marine diesel spillage in Samoa</td></tr>
<tr><td>Procurement method</td><td>Likelihood of attracting private or donor funding (high, medium, low)</td></tr>
<tr><td>The high net present cost of this project means that grants from international donors will need to be the primary source of funding for this project. In the consultation workshop, 13 out of 24 stakeholders thought that grants from international donors would be the appropriate method to fund this project.
A proportion of the costs of the project could be funded through user fees (as ferry operators would be able to save on fuel costs while charging ferry users the same rate as the standard diesel ferries). The capital cost outlay for this proportion of the project could be funded using concessional financing.</td><td>Low
International donors are unlikely to fund this project because it has high cost and only modest GHG emissions reduction potential. Therefore, donors are likely to favor more cost-effective climate change mitigation projects in Samoa.</td></tr>
<tr><td>Capacity requirement to implement (high, medium, or low)</td><td>Potential barriers</td></tr>
<tr><td>Medium
While operation of an electric ferry is likely to be very similar to standard ferry operation, this project would require a large amount of technical expertise to develop the electricity systems and charging facilities for this electric ferry. Port staff would also likely need training in the safe operation of high voltage charging connections.</td><td>This project may encounter the following barriers:
▪ Securing funding is difficult due to high costs, including significant upfront costs, funding required for technicians and retraining, and funding systems for operation and maintenance
▪ Samoa's voltage network is 230V. Some of the larger vessels are known to be 260V and the distribution boards will need to be upgraded
▪ Charging time may be prohibitive.</td></tr>
</table>

A.3.4 Biodiesel ferry

Project name: Biodiesel ferry		
Sector: Maritime transport	**Sub-sector: Energy efficiency**	**Project type: Information, Investment**

Project description

This project aims to undertake a biodiesel feasibility study, and then replace diesel on one passenger ferry in Samoa with second generation renewable diesel. This project does not involve purchasing a new ferry. Instead, available biodiesel has appropriate composition to work in existing fossil diesel engines and has received approval from many marine original equipment manufacturer (OEM).

The project would begin with a feasibility study to understand the technical and economic requirements to replacing or blending diesel with second generation renewable diesel. The feasibility study should look at technical compliance, safety, cost, supply chain issues, and emission reduction potential. Ports of Auckland is trailing the NRD and will be able to provide useful feedback to the study. The study should also review the feasibility of using locally produced biofuel (by looking at the previous biofuel trial, discussed below), as well as importing biofuel. The feasibility study will also determine the ferry that will be most amenable to biodiesel.

Neste, a Finnish fuel company, has a product known as Neste Renewable Diesel (NRD), which is a second-generation biofuel. The main benefits of NRD is that, due to its premium quality and performance over first-generation biofuels, Neste has obtained approvals from most of the major marine engine manufacturers. Ports of Auckland has assessed the engine manufacturers' approvals against their fleet engine makes and are satisfied that their tug boats, pilot boats, and container handling equipment, all have engines within the suite of manufacturers' approvals. This gives Ports of Auckland confidence to use the product without risking negative impacts on the engines or voided warranties. It is considered highly likely that manufacturers' approvals will either be existing or obtainable for the diesel engines currently operating in the Samoa maritime sector.

Neste Renewable Diesel has three product variants each made from a specific feedstock for the variant. Only one of the product variants is recommended here, being the Residual Waste Stream product. The feedstock for this product is from residual waste streams rather than feedstocks competing with other land uses. The residual waste streams are typically, waste cooking oil, waste streams from timber processing and animal fats. The Neste product has a long shelf life and can be stored for extended periods either pure or blended with diesel. The product can be imported in ISO-Containers and does not require any bespoke infrastructure. It is possible for the product to be shipped pre-blended. This would further mitigate any risk of additional infrastructure being required to handled and distribute the fuel.

The Land Transport Agency in Samoa undertook research on biofuels 2009-2014 which included a land transport trial. They used B10 in the pilot and was found to be unsuitable for vehicles in Samoa. The biofuel was being produced locally from coconut oil. Despite the outcome of the trial, the Land Transport Agency are open to trailing B20 and other renewable diesel. In the consultation workshop, participants stated that B20 blend with diesel would be an ideal starting point, and they expect that most of Samoa's current diesel engines would be capable of accepting a blend. Typically, they use Class 2, 3, and 4 diesels. Stakeholders also suggested the trials could consider whether ferries use biofuel in a separate tank to 100 percent diesel, so that for conditions where energy demand was high the ferry could rely on pure diesel.

Estimated GHG emissions reduction potential

Second generation biodiesel can reduce GHG emissions by approximately 90 percent relative to normal diesel. Therefore, assuming that second generation biofuel is blended with normal diesel to a concentration of 20 percent, it would be capable of reducing vessel emissions by 18 percent.

Assuming that the targeted vessels have average annual emissions of 1,370 tCO_2-e,[246] the GHG emissions reduction potential of this project would be 247 tCO_2-e per year once implemented. If this fuel substitution begins in 2023, this project could reduce emissions by 1,976 tCO_2-e by 2030.

[246] This estimate assumes that small passenger and cargo ships travel an average of 100km per day, burn 14.01 liters of fuel per km, and that each liter of fuel burned emits 2.68 kg CO_2-e.

Cost Estimates	*Estimated time scale*
A feasibility study to identify key opportunities and barriers would cost US$ 25,000. We estimate the cost of renewable diesel is US$2.0, this makes it just under USD$1.07 premium in pricing over conventional diesel in Samoa[247]. For diesel consumption of 511,365 liters,[248] a 20 percent blend would cost an additional US$109,000 per year. If the feasibility study is conducted in 2022 and fuel substitution begins in 2023, this project would cost an additional US$ 897,000 by 2030.	This project would take one year to implement. A feasibility study could be implemented within 6 months. The product is available globally and small trials could be implemented over the course of a year after the feasibility study, and if successful, the product could be adopted into use by 2023. The stakeholders in Samoa indicated, this might take more than five years to implement. However, it may be that this is based on a view of building a plant locally or within the Pacific region.
Affordability	*Likely co-benefits*
The additional cost of switching one passenger ferry to a biodiesel blend in Samoa would be US$ 897,000 between now and 2030. This would materially increase the cost of ferry services in Samoa, likely making these services unaffordable for some people, while having no discernible impact on the services delivered to customers.	▪ Renewable diesel improves air quality by reducing particulate matter, nitrous oxides, hydrocarbons, and carbon monoxide. This will contribute to SDG 3 (good health and well-being) and SDG 11 (sustainable cities and communities) ▪ Feedstock used for biofuel could provide a reliable income stream for coconut plantations, contributing to SDG 8 (decent work and economic growth).
Potential environmental or social impacts	
Negative ▪ Biodiesel production has been linked to deforestation in some parts of the world and has well-known trade-offs with food production. While second generation biofuels attempt to eliminate these risks by using waste streams, tracking the supply chain may be challenging given the generic nature of the commodity ▪ The high cost of this project may be partially pushed on to consumers, and may reduce access to maritime transport for some people	
Procurement method	*Likelihood of attracting private or donor funding (high, medium, low)*
Given the substantial cost of this project, and the negligible impact on the services provided, this project would have to be funded either by the government or from international donors. However, careful consideration should be given to whether this project would be a good use of Samoa's limited fiscal budget. 13 out of 23 stakeholders in Samoa thought that grants from international donors was the most appropriate funding source for this project, whereas six out of 23 stakeholders thought the project should be funded by the government.	*Low* ▪ The high cost of biodiesel means that there are likely to be cheaper ways to reduce emissions ▪ Many donors are also hesitant to fund biofuels because of real or perceived environmental damage caused by its production.
Capacity requirement to implement (high, medium, or low)	*Potential barriers*
Medium The fuels available have wide ranging approvals which mean that little additional reviews are required. Typically, it will require significant	This project may encounter the following barriers: ▪ It may be difficult to find an appropriate feedstock for domestic production of biofuels

[247] Diesel is assumed to cost US$ 93 cents per liter (equivalent to the pre-tax price reported for Samoa in SPC's Pacific Fuel Price Monitor) – available at: http://prdrse4all.spc.int/system/files/2nd_quarter_2014_pacific_fuel_price_monitor.pdf

[248] This estimate assumes that small passenger and cargo ships travel an average of 100km per day, burn 14.01 liters of fuel per km.

engagement with stakeholders, particularly the operators to get their buy-in to adopt the fuels. This requires some resource and time commitment.	▪ Development of a reliable international supply chain for biodiesel may be challenging, particularly if only small quantities are required ▪ Procurement of second-generation biodiesel could be challenging. There is no supply of these types of vessels or engines in New Zealand, so they would likely need to be shipped from Singapore or Europe as is the case for the current supply for Ports of Auckland ▪ If producing it locally, supply of feedstock is unreliable and costly—coconut plantations have problems with limited supply due to invasive beetles and competition for food sources. In addition, drying the feedstock requires a lot of energy. It would ideally suit partnering with our Pacific neighbors as the demand regionally grows ▪ Local people get more money selling coconuts as food or other uses rather than as copra for biofuel ▪ Not enough workers to collect the coconuts as people can make more money going to Australia or New Zealand as seasonal workers.

A.3.5 Expansion of solar panel project

Project name: Expansion of solar panel project		
Sector: Maritime transport	**Sub-sector: Energy efficiency**	**Project type: Investment**
Project description		
This project aims to reinvigorate and continue the existing project of installing solar panels on vessels in Samoa by re-establishing an existing system and adding new solar facilities to two more vessels in Samoa. The solar panels provide renewable electricity supply to support on-board services on the vessel, while at berth and when under propulsion. The solar panels are not intended to provide electricity for propulsion of the vessels. This follows a previous project to install solar panels on the Lady Samoa III. In the consultation workshop, stakeholders stated that technical issues arose during the Lady Samoa III solar panel project due to a lack of technical skills and training. The batteries for the Lady Samoa III system were removed to be used elsewhere, rendering the solar panels inoperable. The stakeholders emphasized the need for the teams to have robust training on new technologies when they are installed. Further they reinforced the need to include capacity building, and ongoing maintenance and operational support to ensure successful implementation beyond commissioning through the operational phases. It is recommended that initially the project focuses on re-establishing the Lady Samoa III panels and installing the requisite batteries, providing training and ongoing support, before extending this project to two other vessels.		
Estimated GHG emissions reduction potential		
This project is assumed to reduce emissions at an equivalent rate to shore side electricity connection. The project would focus on equipping three medium-sized vessels with solar power systems. Experience from other projects in the region shows that auxiliary power systems can reduce vessel emissions by 3.5 percent. Assuming that the targeted vessels have average annual emissions of 1,370 tCO_2-e,[249] the total GHG emissions reduction potential of this project would be 144 tCO_2-e in 2030. Assuming that this project starts in 2022, and facilities become operational on the Lady Samoa III in 2023, on one additional vessel in 2024, and in a third vessel in 2025, this project would have an emission reduction potential of 1,008 tCO_2-e between now and 2030.		
Cost Estimates	***Estimated time scale***	

[249] This estimate assumes that small passenger and cargo ships travel an average of 100km per day, burn 14.01 liters of fuel per km, and that each liter of fuel burned emits 2.68 kg CO_2-e.

<table>
<tr><td>The estimated investment needed to install separate 150kW solar systems of three vessels in Samoa is US$ 1,305,000.
The installation costs of a 150 kW system range from US$420,000 to US$450,000. For the proposes of comparing this against other NDC projects, it is assumed that the cost in Samoa is at the mid-point of this range (US$ 435,000). The cost of these systems can be expected to decrease over time, based on what has been seen for land-based installations[250].
This investment would lead to fuel cost savings of US$ 50,400 per year from 2025 onwards[251].
Assuming that this project starts in 2022, and facilities become operational on the Lady Samoa III in 2023, on one additional vessel in 2024, and in a third vessel in 2025, the net present value of this project between now and 2030 would be US$ -867,000.</td><td>This project would take four years to implement.
The Lady Samoa III should be the first priority given she has previously had the solar panels installed. It is reasonable to expect that emission reductions from the Lady Samoa III would begin in 2023. Solar facilities could then be installed on one additional vessel in 2024 and a third vessel in 2025.</td></tr>
<tr><td>Affordability</td><td>Likely co-benefits</td></tr>
<tr><td>The additional cost of expanding the solar panel project in Samoa would be US$ 876,000 between now and 2030. This would materially increase the cost of ferry services in Samoa, likely making these services unaffordable for some people, while having no discernible impact on the services delivered to customers.</td><td>▪ The project can reduce 70 percent of the operation cost of the vessel, contributing to SDG 7 (affordable and clean energy)
▪ Solar panels will reduce reliance on diesel and ensure a constant supply, contributing to SDG 13 (climate action) and SDG 7 (affordable and clean energy)
▪ Typically, energy efficiency improvements and renewable energy projects can also be used as a conduit for raising awareness of energy efficiency and cost reductions which people can then take and consider for their personal lives, contributing to SDG 7 (affordable and clean energy) and SDG 11 (sustainable cities and communities).</td></tr>
<tr><td colspan="2">Potential environmental or social impacts</td></tr>
<tr><td colspan="2">Negative
▪ The high cost of this project may be partially pushed on to consumers, and may reduce access to maritime transport for some people
▪ The addition of solar panels creates new waste streams, and there is risk that the solar system may degrade/malfunction and become worthless
Positive
▪ Reduced demand for marine diesel reduces operating costs and risk of fuel spills
▪ This project would lead to a reduction in local air and noise pollution as it allows vessels to turn their engines off when at berth or when not moving at sea.</td></tr>
<tr><td>Procurement method</td><td>Likelihood of attracting private or donor funding (high, medium, low)</td></tr>
<tr><td>Given the substantial net present cost of this project, the majority of its funding would need to come from either the government or from international donors. However, careful</td><td>High
This project would build on an existing project that has already secured international donor funding. The Maritime Technology Cooperation Centre (M.T.C.C-Pacific) project to install solar</td></tr>
</table>

[250] https://glomeep.imo.org/technology/solar-panels/#:~:text=An%20estimated%20system%20for%20vessel,seen%20for%20land%20based%20installations.

[251] Assuming that 1) solar panels reduce fuel consumption by 3.5 percent, 2) the target vessels travel an average of 100km/day and burn fuel at a rate of 14.01 liters per km, and 2) automotive diesel oil costs US$ 93 cents per liter (equivalent to the pre-tax price reported for Samoa in SPC's Pacific Fuel Price Monitor) – available at: http://prdrse4all.spc.int/system/files/2nd_quarter_2014_pacific_fuel_price_monitor.pdf

consideration should be given to whether this project would be a good use of Samoa's limited fiscal budget. 15 out of 26 stakeholders in Samoa thought that grants from international donors was the most appropriate funding source for this project, while only six out of 26 stakeholders thought the project should be funded by the government. A proportion of the costs of the project could be funded through user fees (as ferry operators would be able to save on fuel costs while charging ferry users the same rate as the standard diesel ferries). The capital cost outlay for this proportion of the project could be funded using commercial financing.	power system in Lady Samoa III has been funded by the European Union (E.U) and implemented by the International Maritime Organization.
Capacity requirement to implement (high, medium, or low)	***Potential barriers***
Medium While this project can leverage experience from an existing project in Samoa, capacity building and ongoing maintenance and operational support is required to ensure successful implementation and maintenance of the technology. The fact that the solar power system on the Lady Samoa III is not currently operational highlights the need for ongoing technical support in Samoa.	This project may encounter the following barriers: ▪ Lack of skilled technicians for operation support ▪ Solar panels on Lady Samoa, implemented through another project, are no longer operational. Without the correct maintenance training, this could happen again with any additional solar panels.

A.4 Waste sector

A.4.1 Landfill gas collection system

Project name: Landfill gas collection system		
Sector: Waste	**Sub-sector: Gas collection**	**Project type: Mitigation**

Project description

This project aims to install a geomembrane over 50 percent of Samoa's landfill area. Currently, Samoa uses a compact plate to manage waste at the landfill. The GHG emissions reduction potential of Samoa's landfill can be improved by implementing a geomembrane final cover on a completed cell. Once a cell of the landfill is complete, the cell is covered with an interim soil cover and is left to settle. Once stable, a geomembrane cover is installed, which can also be topped with a soil cover. Captured gas is then flared. A methane flare is then used to burn the landfill gas[252].

A geomembrane is made from a low permeability synthetic material, such as a high-density-polyethylene (HDPE)[253]. Due to its low permeability, a geomembrane traps surface methane emissions, which increases landfill gas (LFG) collection efficiency[254]. In addition, the cover prevents rainfall from infiltrating the landfill which reduces leachate and erosion. A simple gas collection and flaring system includes a collection of perforated pipe wells that are drilled into the waste (about one per acre), which are connected to a header pipe, and a blower places a vacuum on the header pipe to withdraw the gas[255]. A flare system is then used for safe destruction of the extracted gas (usually one flare per 100 acres of landfill)[256].

Samoa currently has a semi-aerobic landfill system (Fukuoka method), which was implemented in 2004. The method introduces air back into the waste layers via pipes, which promotes aerobic microbial degradation with heat generation[257]. A semi-aerobic landfill can reduce the emissions of greenhouse gases from the landfill by 50 percent, compared to an anaerobic landfill[258]. However, heavy rainfall in tropical countries may reduce air penetration into the landfill cell and increase anaerobic microbial activity[259]. Lifespan of the landfill is 10 years from now and the government is planning to extend the landfill further—the landfill is a long-term asset.

Future opportunities once the geomembrane cover is installed:

Solar Geomembrane

There is also possibility of implementing a geomembrane cover system with solar cells fused onto the geomembrane cover. Solar geomembranes provide the same GHG emission reductions as a standard geomembrane cover, but generate energy through solar. However, this technology is relatively new, the cost is higher than a standard cover, and it is recommended for a site that has an active LFG-to-energy system, which Samoa does not[260]. The figures below apply to the standard geomembrane only.

[252] https://www.epa.gov/sites/default/files/2017-05/documents/lfgcost_webv3.2manual_052617.pdf

[253] https://www.atarfil.com/cat/geomembranas/

[254] British Columbia: Ministry of Environment (2011). Technologies and Best Management Practices for Reducing GHG Emissions from Landfills Guidelines

[255] https://www.eesi.org/files/042613_Daniel_LeFevers.pdf

[256] https://www.mswmanagement.com/landfills/article/13036124/day-to-day

[257] WasteMINZ (n.d.), Meeting the Challenge—Landfill in Samoa (https://www.wasteminz.org.nz/wp-content/uploads/Ellen-Blake.pdf)

[258] WasteMINZ (n.d.), Meeting the Challenge—Landfill in Samoa (https://www.wasteminz.org.nz/wp-content/uploads/Ellen-Blake.pdf)

[259] EER (2014). Comparison of Solid Waste Stabilization and Methane Emission from Anaerobic and Semi-Aerobic Landfills Operated in Tropical Condition (http://eeer.org/journal/view.php?number=650)

[260] British Columbia: Ministry of Environment (2011). Technologies and Best Management Practices for Reducing GHG Emissions from Landfills Guidelines

LFG/waste-to-energy system

A landfill gas (LFG) system or waste-to-energy project could be considered once the geomembrane is installed[261]. LFG systems work with a geomembrane cover—tapped gas is converted as electricity onsite at the landfill, which is a reliable local source of energy. The three most used technologies to generate electricity from LFG are internal combustion engines (most common), gas turbines, and microturbines[262]. An LFG or waste-to-energy system is not being suggested at this stage, because stakeholders in Samoa stated a similar project has been proposed in the past, but it never came to fruition.

Estimated GHG emissions reduction potential

A geomembrane can increase the GHG recovery efficiency of a semi-aerobic landfill system by 85 percent[263].

GHG emissions from Samoa's landfill was 2,856t CO_2-e in 2007[264]. Based on this figure, a geomembrane covering half of Samoa's landfill area could reduce Samoa's GHG emissions from its landfill by 1,214 t CO_2-e per year.

Assuming that the project starts in 2022, and GHG emissions reductions increase at a linear rate to reach 1,214 tCO_2-e/year in 2024, the cumulative GHG emissions reduction potential of this project between now and 2030 would be 9,712 tCO_2-e.

Cost Estimates	*Estimated time scale*
Geomembranes Geomembranes cost between US$13,000-US$52,000 per acre (including average shipping cost), depending on the material used, and costs approximately US$4,300 per acre to install[265]. Based on these figures, it would cost US$1,509,000 to cover and install a geomembrane on 50 percent of Samoa's landfill area[266]. **Flaring system**	Geomembranes and gas flaring systems are readily available and quick to install, and therefore be done installed within a year. However, stakeholders in Samoa estimated this project to take 3 years to implement.

[261] The cost of an LFG project depends on a few factors, including the size, location, and layout of the landfill. Below are some indicative costs:

- Internal combustion engine (>800 kW):
  - Typical capital costs ($/kW) = US$1,800
  - Typical annual Operation and maintenance costs ($/kW) = US$250
- Gas turbine (>3 MW):
  - Typical capital costs ($/kW) = US$1,500
  - Typical annual Operation and maintenance costs ($/kW) = US$160
- Microturbine (<1 MW):
  - Typical capital costs ($/kW) = US$3,000
  - Typical annual Operation and maintenance costs ($/kW) = US$28

[262] EPA (2016). LFG Energy Project Development Handbook. https://www.epa.gov/sites/production/files/2016-07/documents/pdh_chapter1.pdf

[263] Xiaojun Wang, Mingsheng Jia, Xiangyu Lin, Ying Xu, Xin Ye, Chih Ming Kao & Shaohua Chen (2017). A comparison of CH4, N2O and CO_2 emissions from three different cover types in a municipal solid waste landfill. https://www.tandfonline.com/doi/pdf/10.1080/10962247.2016.1268547

[264] Government of Samoa (2007). Second National Greenhouse Gas Inventory. https://unfccc.int/resource/docs/natc/samnc2nir.pdf

[265] https://www.xrgeomembranes.com/blog/the-initial-cost-of-a-geomembrane-is-not-the-lifetime-cost

[266] Samoa's landfill is 950 meters by 350 meters (82 acres); therefore 50 percent would equal 41 acres. The cost of the cover would be approximately US$1,332,500 on average (average of 13,000 x 41 = 533,000; 52,000 x 41 = 2,132,000) and would cost approximately US$176,300 to install (4,300*41). https://www.adb.org/sites/default/files/publication/42663/solid-waste-management-samoa.pdf

Samoa would require approximately 41 pipes and one flaring systems for 50 percent of its landfill. The total capital cost per acre of the landfill gas management system would be approximately US$30,000. Based on this figure, it would cost approximately US$1,230,000 to install the system[267]. Annual maintenance of the flaring system is approximately US$50 per acre, totally US$2,100 per year for Samoa[268]. The total cost of this project to 2030 is US$2,752,000 (US$2,739,000 capital cost plus US$12,600 for maintenance over six years).	
Affordability	***Likely co-benefits***
This project is likely to be affordable. It would cost approximately US$ 8 per person to cover half of Samoa's landfill with a geomembrane. While people in Samoa may not benefit materially from the GHG emissions reductions, the other benefits of installing a geomembrane (including reduced leachates and odor) may help to justify this cost.	▪ Improve site surface water management and prevent rainfall infiltration, contributing to SDG 6 (clean water and sanitation) ▪ Improved management of the landfill, contributing to SDG 12 (responsible consumption and production) ▪ Reduced odor and pollution from the landfill contributing to SDG 3 (good health and well-being) and SDG 11 (sustainable cities and communities) ▪ Development of technical skills in staffs contributing to SDG 9 (industry, innovation, and infrastructure) ▪ Opportunities to expand this project to include solar panels and/or LFG system, contributing to SDG 7 (affordable and clean energy), SDG 11 (sustainable cities and communities), and SDG 9 (industry, innovation, and infrastructure).
Potential environmental or social impacts	
Negative ▪ The costs of the landfill gas collection system may be passed on to households in Samoa. If this occurs through a service fee, people may be less inclined to use waste services ▪ The flaring of LFG may impact local environmental amenity values, and may increase safety concerns Positive ▪ Installation of the geomembrane and the collection and flaring of LFG may reduce odor from the landfill site, and may improve visual amenity in the vicinity of the landfill	
Procurement method	***Likelihood of attracting private or donor funding (high, medium, low)***
Grant from international donors and government funding are likely sources of funding for this project. Given that the geomembrane would provide little discernible improvement for landfill users, it may be difficult to justify recovering costs through user fees. During consultation, 12 out of 22 stakeholders in Samoa thought that grants from international donors was the most appropriate funding source for this project, whereas four out of 22 stakeholders thought the project should be funded by the government.	***Low*** Private funding is unlikely to be available because there is no clear revenue stream from capturing landfill gas. Donors may be reluctant to fund further improvements to the landfill beyond the semi-aerobic system already constructed.

[267] https://www.mswmanagement.com/landfills/article/13036124/day-to-day

[268] https://www.mswmanagement.com/landfills/article/13036124/day-to-day

While six stakeholders also thought that the project can also be funded by user fees, this may be difficult to justify given that the geomembrane would provide little discernible improvement for landfill users.	
Capacity requirement to implement (high, medium, or low)	***Potential barriers***
Medium ▪ A specialized skill set is required to install and maintain the geomembrane and flaring system, which requires training staff ▪ Some ongoing maintenance of the geomembrane and flaring system is required.	This project may encounter the following barriers: ▪ The agencies managing Samoa's waste experience human capacity constraints because there are less than 10 staff ▪ Moreover, these organizations face significant cost and funding constraints ▪ Expertise required to install the geomembrane may require external expertise ▪ Increased fire risk.

A.5 Tourism Sector

A.5.1 Energy efficient appliances

Project name: Energy efficient appliances		
Sector: Tourism	**Sub-sector: Energy Efficiency**	**Project type: Investment**
Project description		
This project aims to develop a comprehensive program to adopt energy efficient appliances in the Samoa's tourism industry. There is significant scope for the tourism industry to use energy efficient appliances to reduce energy use in hotels and hospitality venues. This program would involve: ▪ Undertaking an energy audit of the tourism industry (including hotels and hospitality venues). No formal energy audit programs have been done since 2012, and the 2012 audit focused on air conditioners in the hospitality sector. Stakeholders in Samoa suggested that energy audits should be a priority ▪ Engaging key stakeholders in the tourism industry to increase awareness and to promote energy efficient appliances—Surveys conducted by tourism websites, airlines, and the hotel industry have revealed that tourists are becoming increasingly eco-friendly and are increasingly concerned about their impacts on the environment especially during travel ▪ Introducing energy efficiency standards for tourism industry—Stakeholders suggested that some of the larger hotels have already introduced some energy efficiency measures. These measures could be used (and improved on) and then implemented Stakeholders in Samoa stated that if awareness raising campaigns and energy audit programs can be provided, hotels would be quite likely to invest in energy efficient appliances due to energy savings available. Stakeholders are unsure of percentage savings available using energy efficient appliances but agreed that there are savings to be made. MOF does not have ongoing projects with tourism sector, but MOF has asked for finance opportunities related to energy that they could tap into.		
Estimated GHG emissions reduction potential		

<table>
<tr><td colspan="2">According to an ADB report, Samoa has annual electricity savings potential of 8,600 MWh per year through energy efficiency, of which 1,297 MWh per year can be saved from implementing energy efficiency projects in the 'hotel sector' (comprising hotels, motels, and resorts, many of which include restaurants)[269].
Multiplying this annual energy saving by the grid emission factor in Samoa (0.42 tCO2/MWh), suggests that the total estimated potential GHG emissions reduction potential of an energy efficiency program in the tourism sector would be 545 tCO_2-e/ year once fully implemented.
Given that establishments refurbish appliances every 7-10 years[270], it can be estimated that appliances in 12 percent of the tourism industry would be updated on average each year over eight years. Assuming that the program starts in 2022, and GHG emissions reductions increase in a linear fashion over eight years to reach 545 tCO_2-e/year in 2029, cumulative GHG emissions reduction potential of this project by 2030 would be 2,998 tCO_2-e.</td></tr>
<tr><td>Cost Estimates</td><td>Estimated time scale</td></tr>
<tr><td>The cost of running this education and audit project is estimated to be US$250,000. This assumes US$100,000 for a TA to provide detailed training to staff in Samoa and support auditing over the first year, plus US$150,000 to develop training programs for each sector and support ongoing audit and education staff.
It is assumed that the capital costs of investing in building energy efficiency are accounted for by energy cost savings. Whole-of-life cost of energy efficient appliances are generally negative. A Carbon Trust Survey states that payback period of energy efficient investments in the hospitality industry range between 1 and 2 years[271].</td><td>Most professional establishments refurbish appliances every 7–10 years. Therefore, it is reasonable to assume that a well-managed energy efficiency program in Samoa's tourism sector could achieve almost total conversion to energy efficient appliances by 2029.</td></tr>
<tr><td>Affordability</td><td>Likely co-benefits</td></tr>
<tr><td>The costs of the education and audit program are likely to be affordable, and represent only one tenth of one percent of Samoa's fiscal budget[272].
Given the short payback periods for energy efficiency investments in the hospitality sector, this project is likely to be affordable for business owners within the hospitality sector.</td><td>▪ Water savings in case of washing machines and dishwashers, and lower operating and running costs—ADB estimates that the savings potential for energy efficient appliances in Samoa's hotel sector is US$0.41 million[273]. This will contribute to SDG 7 (affordable and clean energy) and SDG 12 (responsible consumption and production)
▪ Demonstrates environmentally conscious investment decisions to tourists, contributing to SDG 11 (sustainable cities and communities)
▪ New appliances result in increased comfort levels and optimized operating conditions, contributing to SDG 9 (industry, innovation, and infrastructure).</td></tr>
<tr><td colspan="2">Potential environmental or social impacts</td></tr>
<tr><td colspan="2">Negative
▪ Upgrading appliances may increase streams of appliance and construction waste and cause localized disturbance while work is ongoing
Positive
▪ Increased energy efficiency can lower operating costs for the businesses partaking in upgrades</td></tr>
</table>

[269] Appendix C, p. 27 https://www.adb.org/sites/default/files/project-document/74740/42078-012-reg-tacr.pdf

[270] https://prod-drupal-files.storage.googleapis.com/documents/resource/restricted/Hospitality%20sector%20guide%20-%20GBF.pdf

[271] https://prod-drupal-files.storage.googleapis.com/documents/resource/restricted/Hospitality%20sector%20guide%20-%20GBF.pdf

[272] Samoa's fiscal budget was estimated to be US$182 million in 2016-17. Budget documents are available at: https://www.mof.gov.ws/wp-content/uploads/2019/09/Statement-on-the-Foward-Estimate-2014-2015-to-2016-2017-1.pdf

[273] Appendix C, p. 27 https://www.adb.org/sites/default/files/project-document/74740/42078-012-reg-tacr.pdf

▪ Lower operating costs for businesses may lead to a more competitive tourism sector in Samoa and increased tourist numbers leading to higher revenues	
Procurement method	***Likelihood of attracting private or donor funding (high, medium, low)***
This project can be funded through user fees and financed using commercial finance. While 12 out of 25 stakeholders in Samoa thought that grants from international donors was the most appropriate funding source for this project, and six out of 25 stakeholders thought the project should be funded by the government, international donors and government agencies are unlikely to be interested in funding energy efficiency work that is already commercially viable for resort owners.	***High*** Implementation of this program would likely attract private funding because lower operating costs mean that the energy efficient appliances are already commercially viable in the hospitality sector. Donors including the ADB have funded other energy efficiency projects across the Pacific including in Samoa (E.g., PEEP project).
Capacity requirement to implement (high, medium, or low)	***Potential barriers***
Low Support is needed to overcome initial barriers, but installation of energy efficient appliances is generally straightforward, and makes use of skills and technologies that already exist in Samoa.	This project may encounter the following barriers: ▪ Lack of awareness of benefits and co-benefits might limit uptake of energy efficient appliances ▪ High upfront costs may deter industry from purchasing energy efficient appliances.

A.6 Marine sector

A.6.1 Mangrove restoration and planting

Project Name: Mangrove restoration and planting		
Sector: Marine	**Sub-sector: Coastal wetlands**	**Project type: Mitigation and Adaptation**
Project description		
This project aims to implement a large-scale program to plant or restore mangrove forests in Samoa's coastal wetlands. Planting or restoring mangrove forests removes significant amounts of carbon from the atmosphere and stores it as biomass or in coastal soils and sediments. Mangroves sequester carbon at similar rates to tropical humid forests, and		

are among the most carbon-rich biomes, containing more than 900 tons of carbon per hectare (ha), on average[274]. Samoa currently has only three large mangrove stands, and a total mangrove area of 374 ha[275]. A large coastal mangrove area is proposed to be removed for the construction of a new wharf development. This development provides an opportunity to increase mangroves elsewhere in Samoa. There are about 14 acres in one village of wetland with no mangroves, which could provide a good opportunity to plant mangroves. There are likely to be other similar opportunities in other villages. Stakeholders in Samoa suggested that the area of mangroves could be increased by 5 percent (an increase of 18.7 ha).

Planting mangroves aligns well with work MNRE is currently undertaking, such as restoration projects (particularly to increase forest cover) and tree planting through a national tree planting campaign. This project can be implemented as part of this work—the Ministry can start from surveys to identify areas of degradation, and then move on to restoration.

During our consultation, the participants were interested to know whether this project could involve low-carbon seagrass. Although seagrass can support climate change mitigation and adaptation, only 10 countries explicitly include reference to seagrass in their NDCs, and in many cases these do not include a measurable target[276]. Seagrasses have therefore been deemed out of scope for Samoa's NDC.

Estimated GHG emissions reduction potential	
New mangroves sequester 900 tCO_2 per ha over approximately 6–20 years[277]. On average, therefore, new mangroves can be expected to sequester carbon at a rate of 90 tCO_2-e per hectare (assuming that mangroves take three years to start sequestering carbon at a meaningful rate). If Samoa were to increase the area of mangroves in Samoa by 5 percent (18.7 ha), Samoa's GHG emissions could be reduced by an additional 1,683 tCO_2-e/year. Assuming that Samoa increases its mangrove area by 5 percent through a replanting campaign in 2022, and that it takes three years for new mangroves to start sequestering carbon at a meaningful rate, this project has the potential to sequester 8,415 tCO_2-e by 2030.	
Cost Estimates	*Estimated time scale*
It costs approximately US$50,000 per hectare to plant or restore mangroves[278]. It would therefore cost US$ 935,000 to increase Samoa's total mangrove area by 18.7 hectares (5 percent).	It would take two years year to increase Samoa's mangrove area by 5 percent. Assuming mangroves start sequestering carbon at meaningful rates 3 years after planting, GHG emissions reduction benefits would be realized from 2026[279].
Affordability	*Likely co-benefits*
It would cost less than US$5 per head of population to implement this project in Samoa. While the impact of the GHG emissions reductions from this project are unlikely to meaningfully affect people in Samoa, the	▪ Mangrove forests are a valuable ecological and economic resource, providing food and fuel resources; nursery grounds for fish, mammals, and other fauna; depocenters for sediment and other elements. This will contribute to SDG 13 (climate action), SDG 14 (life below water), and SDG 15 (life on land)

[274] Alongi, D.M. (2014). Carbon Sequestration in Mangrove Forests. In Carbon Management (https://www.researchgate.net/publication/274116107_Carbon_sequestration_in_mangrove_forests)

[275] Percival, J.E.H. (2018). The Importance of Seascape Structure on Fish Communities in the Mangroves of Samoa. Graduate School of Global Environmental Studies Kyoto University, Japan. In Samoa Ocean Strategy (https://www.mnre.gov.ws/wp-content/uploads/2018/11/Samoa-Ocean-Strategy_2020-2030.pdf)

[276] https://www.grida.no/resources/13589

[277] Alongi, D.M, p.316. Mangroves can sequester carbon effectively over a period of 100 years. Alongi, D.M, p.316.

[278] 2,500 mangroves can be planted in approximately 1 hectare (based on a study in the Philippines which planted 190,000 mangroves over 76 hectares – 190,000/76 = 2,500) (https://news.mongabay.com/2020/09/missing-mangroves-are-root-of-contention-over-philippine-airport-project/). USAID funded US$49,500 to plant 2,500 mangroves in Samoa. Increasing Samoa's mangrove area by 20%, 75 hectares, would cost (75 x 49500) = 3,750,000.

[279] Alongi, D.M., p.316.

significant co-benefits from increased ecosystem services such as storm surge protection are likely to be significant. Therefore, this project is likely to be affordable for Samoa.	▪ Mangroves provide protection from coastal flooding, tsunamis, storm surges, and sea-level rise, and can reduce coastal erosion[280]. Mangrove forests can actively raise the forest floor in response to sea-level rise, as their presence enables accumulation of sediment above the tidal range[281]. This will contribute to SDG 11 (sustainable cities and communities), SDG 13 (climate action), SDG 14 (life below water), and SDG 15 (life on land) ▪ Mangroves are resilient to environmental changes, such as water and oxygen deficiency, changes in salinity, wave effects, and tidal shifts[282]. This will contribute to SDG 3 (good health and well-being), SDG 15 (life on land), and SDG 13 (climate action) ▪ The annual economic value of mangroves has been estimated to be US$200,000—$900,000 per hectare[283]. This will contribute to SDG 8 (decent work and economic growth).
Potential environmental or social impacts	
Negative ▪ Planting and restoring mangroves may impact local communities by inhibiting access to the sea or between access between households in estuarine areas ▪ Mangroves can be breeding grounds for mosquitos and may be associated with an increase in mosquito-borne diseases Positive ▪ Community replanting and community ownership of mangrove areas can contribute to community cohesion ▪ Mangroves contribute significantly to healthy ecosystem function, and can act as nurseries for fish, and habitat for invertebrates and birds	
Procurement method	***Likelihood of attracting private or donor funding (high, medium, low)***
Government funding and donor funding from international grants and are likely funding sources for this project. 13 out of 24 stakeholders in Samoa thought that grants from international donors was the most appropriate funding source for this project, whereas seven out of 24 stakeholders thought the project should be funded by the government.	**High** ▪ Funding and support for mangrove restoration in Samoa is currently being provided by the World Bank and USAID ▪ The significant co-benefits of mangroves are likely to make mangrove restoration and planting particularly attractive to donors.
Capacity requirement to implement (high, medium, or low)	***Potential barriers***
Low Planting and maintaining mangrove forests is not technically difficult.	There may be barriers to this project, such as: ▪ Locating suitable coastal wetlands in Samoa ▪ Land ownership issues ▪ Maintaining planted mangroves.

[280] Alongi, D.M.

[281] UNEP. (2010). Building Resilience to Climate Change: Making the Case for Ecosystem-based Adaptation. https://wedocs.unep.org/bitstream/handle/20.500.11822/13737/2010%20Mt%20EbA%20Making%20the%20case%20for%20EbA.pdf?sequence=1&isAllowed=y

[282] Ministry of Natural Resources, Environment and Meteorology (2006). Mangroves of Samoa (https://www.sprep.org/att/IRC/eCOPIES/Countries/Samoa/83.pdf)

[283] IUCN. (2006). Managing Mangroves for Resilience to Climate Change (https://portals.iucn.org/library/sites/library/files/documents/2006-041.pdf)

A.7 AFOLU sector

A.7.1 Agroforestry support program

Project Name: Agroforestry support program		
Sector: Agriculture	**Sub-sector: Agroforestry**	**Project type: Investment**

Project description

This project would support the expansion of agroforestry in Samoa to an additional 5 percent of agricultural land through awareness raising activities and targeted support. This project would focus primarily on planting coconut palms which can contribute to the production of copra and coconut oil, and coconut cream. This project would leverage traditional knowledge of agroforestry systems in Samoa, combined with the following components:

- Samoa's Ministry of Agriculture and Fisheries would promote the planning of agricultural trees such as coconut through enhanced awareness raising activities and extension services. This would include efforts to better quantify and publish evidence on the effects of trees on agricultural productivity.
- MNRE's Forestry Division would build on existing work to further promote agroforestry on community lands. MNRE's Forestry Division would also lead efforts to distribute seedlings to landholders, building on its work under the Community Forestry Program.

This project builds on previous work to encourage agroforestry in Samoa. Samoa's Ministry for Agriculture and Fisheries is implementing an ongoing project to provide coconut and cocoa seedlings to landholders. Agroforestry was also promoted under Samoa's Two Million Trees planting campaign, which ran from 2015-2020. One of the target outputs of the program was that "farmers and communities benefited from pursuing forest plantations and agroforestry", and the key activity under this deliverable was to "raise 550,000 native resilience trees"[284].

Promoting agroforestry aligns well with Samoa's strategic objectives in the agriculture sector. Agroforestry was promoted and supported under the Samoa Agriculture Sector Plan End of Sector Plan Outcome 4 (ESPO4)[285]. Specifically, the sector plan states that:

> *"The continued appropriate and well-managed use of trees in agricultural systems can serve as an effective component of sustainable economic development and environmental protection in Samoa. Agroforestry practices can diversify farm outputs, improve productivity, and reduce inputs, while mitigating some of the environmental damage caused by the past processes of deforestation and the removal of trees from the landscape. Agroforestry can also be a useful land management approach in buffer zones to Protected Areas of conservation and watersheds. It is also a land management practice that has much to offer in terms of nutrient cycling and ecosystem services required in organic farming."*

Similar plans to encourage the expansion of agroforestry by replanting coconut palms have been formulated in Tonga. The Tonga Forest Management Plan (2017) included a program to support re-planting of coconut palms at a density of 60 stems per hectare.

Estimated GHG emissions reduction potential

This project would aim to increase the land area under agroforestry in Samoa by 3,785 ha (5 percent of the current agricultural land in Samoa)[286]. According to IPCC Guidelines for National Greenhouse Gas Inventories (2006), coconut palms in cropland, grassland, and shrubland sequester carbon at between 2.80 and 8.40 tCO_2-e/ha/year[287]. Taking the mid-point of this range (5.6 tCO_2-e/ha/year), and multiplying this by the target area (3,785 ha) indicates that this project would be capable of reducing emissions by 21,196 tCO_2-e/year once fully implemented.

[284] Government of Samoa (2015). 2 Million Tree Planting Campaign 2015-2020. National Strategy and Action Plan. April 2015-April 2020. MNRE.

[285] Government of Samoa. 2015. Agriculture Sector Plan 2016-2020. Available at:https://www.maf.gov.ws/images/Downloads/ASP%20Vol%202%20Implementation%20Plan--Final%202016%2005%2018%20(2).pdf

[286] According to the FAO, the area of land used for agriculture in Samoa in 2018 was approximately 75,700 hectares. Data on land use is recorded on the FAO's FAOSTAT database. Available at: http://www.fao.org/faostat/en/#data/RL Accessed on 26/5/2021

[287] Calculated using the default factor for annual above-ground net-biomass growth and the ratio of below to above ground biomass reported in Tonga's NDC Review Report.

<table>
<tr><td colspan="2">Assuming that this project starts in 2022, and GHG emissions reductions increase in a linear fashion over the first seven years of the project to reach 21,196 tCO_2-e/year in 2028, the cumulative GHG emissions reduction potential between now and 2030 would be 127,014 tCO_2-e.</td></tr>
<tr><td>Cost Estimates</td><td>Estimated time scale</td></tr>
<tr><td>The estimated cost of the support program for agroforestry in Samoa's Two Million Trees initiative was US$38,073 comprising:
US$25,695 for managing the program and promoting agroforestry on community lands
US$5,191 for awareness raising and extension services to support planting of agricultural trees
US$7,187 for distributing seedlings to landholders
The NDC project aims to plant approximately 454,200 coconut palms (7,570 ha at a density of 60 stems per ha). MAF buys mature coconut seedlings from farmers at US$ 0.2. Therefore, the cost of distributing 454,200 seedlings under this NDC project would be US$ 90,840. Assuming that the awareness raising, and promotion program costs are the same as those estimated for the Two Million Trees project, the total cost of this NDC project would be US$ 122,000.</td><td>During consultation on this project in June 2021, agricultural sector stakeholders estimated that this project would likely take seven years to implement. The long timeframe is due to the complexity of changing land use on land that is held in communal or customary title.</td></tr>
<tr><td>Affordability</td><td>Likely co-benefits</td></tr>
<tr><td>This project is likely to be affordable for Samoa and within the means of Samoa's agriculture and fisheries budget. This project would cost less than 1 percent of the annual agriculture sector funding required to implement Samoa's Agriculture Sector Plan.[288]</td><td>Potential co-benefits of expanding agroforestry in Samoa include:
Reduced flood risk as forested catchments act like sponges and reduce flood peaks when there are heavy downpours. This will contribute to SDG 3 (good health and well -being), SDG 11 (sustainable cities and communities), SDG 13 (climate action), and SDG 15 (life on land)
The expansion of habitat for native wildlife would contribute to SDG 15 (life on land)
Increased production of coconuts, copra, and coconut cream will contribute to SDG 8 (decent work and economic growth).</td></tr>
<tr><td colspan="2">Potential environmental or social impacts</td></tr>
<tr><td colspan="2">Negative
Where agroforestry reduces agricultural productivity, it could lead to greater reliance on imported food
Trees planted on or near property borders may cause disputes over rights and responsibilities
Positive
Agroforestry systems provide significant habitat and ecosystem benefits relative to pure agricultural systems
Agroforestry systems may increase visual amenity value in agricultural areas
Relative to pure agriculture, agroforestry also provides resilience benefits by reducing windspeeds and moderating runoff</td></tr>
<tr><td>Procurement method</td><td>Likelihood of attracting private or donor funding (high, medium, low)</td></tr>
<tr><td>This project could be funded by the GoS through the Agriculture and Fisheries budget. In principle, there would be potential to collect user fees from farmers who see commercial benefits from</td><td>Medium
As a relatively small project that is well within the fiscal means of the GoS, this project may struggle to attract funding from international donors. Furthermore, there is a good general case</td></tr>
</table>

[288] https://pafpnet.spc.int/resources/560-samoa-agriculture-sector-plan-2016-2020-vol-1

coconut palms. However, in practice, developing a scheme to collect user fees from farmers would be complex and costly, and it is not likely to be justified in Samoa.	for funding this project from Samoa's fiscal budget. Expanding the area under agroforestry can increase the productivity of Samoa's agricultural sector and increase resilience to weather-related disasters in Samoa.
Capacity requirement to implement (high, medium, or low)	***Potential barriers***
Low This project would be very straightforward to implement. It leverages traditional knowledge and builds on an existing agroforestry project.	This project may encounter the following barriers: ▪ There has been an increase in livestock farming in Samoa, and many landowners are currently applying to expand their farms to accommodate greater livestock numbers. This may reduce the land available for agroforestry ▪ A lack of interest from landholders and a lack of demand for coconut seedlings ▪ Competing demands on the time of staff from MNRE and the Ministry of Agriculture and Fisheries ▪ Difficulty changing land use on land that is held in communal or customary title.

A.7.1 National forestry plan

Project name: National forestry plan		
Sector: Forestry	**Sub-sector: Permanent Forests**	**Project type: Investment**
Project description		
This project would attempt to encourage tree planting and attempt to manage forests sustainably by: ▪ Developing a national forestry plan that extends the planting work started under the 2 million trees program ▪ Exploring other mechanisms to encourage reforestation. **Developing a national forestry plan that extends the planting work started under the 2 million trees program** Samoa has a division within the Ministry of Agriculture, Forestry and Fisheries undertaking restoration projects (particularly to increase forest cover) and the division is continuing with tree planting through a national tree planting campaign[289]. The division ran the 2 Million Trees program which ran for five years and finished in December 2020. The proposed National forestry plan would aim to plant a further 2 million trees in Samoa between 2022 and 2027. **Exploring other mechanisms to encourage reforestation** MNRE could develop a program for reforestation and forest restoration supported by incentive payments under the 'Reducing Emissions from Deforestation and Forest Degradation' and the enhancement of forest carbon stocks (REDD+) framework[290]. Stakeholders in Samoa stated that 'Reforestation and forest restoration under REDD+' project would fit well with the division's mandate. Developing a REDD+ program in Samoa would involve: ▪ Developing a national REDD+ policy and a REDD+ strategic action plan ▪ Setting up national forest monitoring system maintaining ▪ Awareness and training programs for ministry staff and other stakeholders[291]—awareness programs will ensure social and ecological safeguards are met		

[289] The Green Climate Fund is also undertaking a project in this space in Samoa.

[290] https://www.pacificclimatechange.net/sites/default/files/documents/SPC%20-%20FRAMEWORK%20FOR%20REDD%2B%20Booklet%20Final.pdf

[291] Recommendations based on consultation with Samoa stakeholders

- Sustainable management of forestry by increasing the area of protected forests to match the area of primary forests listed in the World Data Base on Protected Areas (WDPA)[292]
- Increasing Samoa's forest cover by five percent by tree planting.

There has been considerable interest in REDD+ in the Pacific recently. The Secretariat of the Pacific Community (SPC) has published a policy framework for REDD+ in the Pacific Islands, that notes benefit from REDD+ projects even in countries with small land areas. In October 2019, the Pacific Week of Agriculture took place in Apia, Samoa. Several presentations were made on the implementation of the REDD+ projects in other Pacific countries, and they received great interest.

Estimated GHG emissions reduction potential

Reducing deforestation

Average emissions in Samoa over the past 10 years from net forest conversion was 105 tCO_2-e per year[293]. Therefore, if the National Forestry Plan were able to reduce net deforestation in Samoa by 50 percent, it could save 52.5 tCO_2-e per annum relative to business as usual.

Planting two million more trees

It is assumed that the additional trees planted under the National Forestry Plan are planted at a density of 80 stems her hectare,[294] and they help to convert 25,000 ha of tropical shrubland to tropical dry forest. According to the IPCC 2006 guidelines for National Greenhouse Gas Inventories, converting tropical shrubland to tropical dry forest sequesters carbon at a rate of 3.22 tCO_2-e /year[295]. Therefore, planting 2 million more trees would reduce net emissions by 80,500 tCO_2-e /year once the project is fully implemented.

Total GHG emissions reduction potential

Combining emissions GHG emissions reductions from reducing deforestation, and carbon sequestration from planting two million more trees, this project has the potential to reduce net emissions in Samoa by 80,553 tCO_2-e per year once fully implemented. Assuming that this project starts in 2022, and emission reductions increase at a linear rate over the next five years to reach 80,553 tCO_2-e per year in 2026, the cumulative emissions reduction potential would be 563,871 tCO_2-e by 2030.

Cost Estimates	*Estimated time scale*
This project would cost approximately US$3,877,000 to implement. **Cost of planting two million more trees** It is assumed that the cost of panting two million trees between 2022 and 2026 would be similar to the costs of the initial two million trees project (US$277,000)[296]. While there would be cost savings in repeating some of the same exercises and using established structures, it is assumed that many of the easy-to plant areas have already	This project would take approximately five years to implement It is expected that a program to plant two million more trees would take five years, equivalent to the initial two million trees project. In parallel with this, the program to developing a national REDD+ policy, a REDD+ strategic action plan, setting up national forest monitoring system, maintaining social and ecological safeguards is also expected to take five years. It took five years, to successfully test and implement the REDD+ activities in three local forest carbon projects in Fiji and Vanuatu. A similar project in Samoa may take a similar length of time to implement.

[292] https://www.iucn.org/theme/protected-areas/our-work/quality-and-effectiveness/world-database-protected-areas-wdpa#:~:text=The%20World%20Database%20on%20Protected,in%20conserving%20species%20and%20ecosystems.

[293] http://www.fao.org/faostat/en/#data/GF/metadata

[294] For the purposes of estimating project cost, it is estimated that trees are planted at a density of 80 stems per ha. This is consistent with tree density found in young successional tropical dry forest by Chapman, C. A., and Chapman, L. J. (1990). Density and growth rate of some tropical dry forest trees: Comparisons between successional forest types. Bulletin of the Torrey Botanical Club. 117 (3). P. 226-231.

[295] According to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Tropical shrubland in Asia (insular) that is less than 20 years old has above-ground biomass growth of 2.0 tonnes of dry matter per hectare per year, while tropical dry forest in Asia (insular) that is less than 20 years old has above-ground biomass growth of 7.0 tonnes of dry matter per hectare per year. Multiplying these values by the default value for the carbon fraction of above ground forest biomass (0.47 tonnes of carbon per tonne of dry matter), and by one plus the default value for the ratio of below-ground to above-ground biomass (1 + 0.37 = 1.37) indicates that tropical shrubland sequesters carbon at 1.29 tCO_2-e/ha, while tropical dry forest sequesters carbon at 4.51 tCO_2-e/ha. Therefore, replanting unused shrubland would lead to a net increase in carbon sequestration of 3.22 tCO_2-e/ha.

[296] The total budgeted cost of the initial 2 million trees program was reported as US$277,000 by the Government of Samoa (2015). 2 Million Tree Planting Campaign 2015-2020. National Strategy and Action Plan. April 2015-April 2020. MNRE.

been planted, so the tree planting itself would cost more on a per-stem basis. **Cost of reforestation and forest restoration support program** The cost of developing a program for reforestation and forest restoration supported by incentive payments under REDD+ is based on a similar REDD+ project in Vanuatu. In March 2013, the FCPF Participants Committee approved Grant Funding of US$3.6 million to prepare Vanuatu for engaging and get benefits from the future performance-based system from REDD+. The Grant was mainly for strengthening the existing institutions and stakeholder's engagement process for the REDD+ at the national and decentralized level. It is also for funding the operational activities of the REDD+ Unit, setting up of REDD+ Technical Committee, Provincial REDD+ Committee, conducting Analytical Studies, setting up Feedback and Grievance Redress Mechanism, and preparation of national REDD+ Strategy[297]. Samoa's REDD+ program implementation plan should be comparable and would have similar components to Vanuatu's program and is likely cost a similar amount (US$3.6 million) to implement.	
Affordability	***Likely co-benefits***
This project is likely to be affordable for Samoa. It would cost approximately US$20 per head of population to implement this project in Samoa. While the impact of the emissions reductions from this project are unlikely to meaningfully affect people in Samoa, the significant co-benefits from increased ecosystem services such as flood protection are likely to be significant.	▪ This project will enable Samoa to provide other ecosystem services provided by the forests, such as nursery businesses, value chain processes, eco-tourism, and non-timber forest products. This will contribute to SDG 8 (decent work and economic growth), SDG 13 (climate action), and SDG 15 (life on land) ▪ Reduced deforestation and forest restoration can also mitigate flood risk as forested catchments act like sponges and reduce flood peaks when there are heavy downpours. This will contribute to SDG 3 (good health and well-being), SDG 11 (sustainable cities and communities), SDG 13 (climate action), and SDG 15 (life on land).
Potential environmental or social impacts	
Negative ▪ Reforestation may compete with agricultural production and lead to greater demand for imported food ▪ Trees planted on or near property borders may cause disputes over rights and responsibilities Positive ▪ Forests and trees provide significant habitat and ecosystem benefits, and can contribute to human health and wellbeing ▪ Trees and forests can increase visual amenity in many areas ▪ Trees and forests also provides resilience benefits by reducing windspeeds, stabilizing soils, and moderating runoff	
Procurement method	***Likelihood of attracting private or donor funding (high, medium, low)***
Given the substantial cost of this project, the majority of its funding would need to come from	Medium

[297] http://reddplus.vu/wp-content/uploads/2016/05/Progress-Report-for-REDD-Project-Vanuatu-April-to-August-2016.pdf

international donors. There may also be a case for the GoS to part-fund a REDD+ implementation plan. However, careful consideration should be given to whether this project would be a good use of Samoa's limited fiscal budget. 13 out of 23 stakeholders in Samoa thought that grants from international donors was the most appropriate funding source for this project, whereas eight out of 23 stakeholders thought the project should be funded by the government.	▪ Donors may be attracted by the multiple co-benefits of reducing deforestation and restoring forests ▪ Stakeholder in Samoa have indicated that the Global Environment Facility may be a possible source of funding for this project ▪ GIZ is providing US$6 million in grant funding for a REDD+ support program across Fiji, Papua New Guinea, Solomon Islands, and Vanuatu. The grant is funded by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (Germany)[298]
Capacity requirement to implement (high, medium, or low)	***Potential barriers***
Medium ▪ Samoa already has experience with mass tree planting under the original two million trees program ▪ The institutional structures required to implement REDD+ projects are complex. Land tenure and land ownership issues may also complicate REDD+ projects in Samoa.	▪ Samoa may struggle to find enough land on which to plant an additional two million trees following the success of the original two million trees program ▪ REDD+ is not implemented in Samoa and is not well-recognized. Staff in the Ministry are quite new, so knowledge is limited—capacity building activities to support REDD+ is required ▪ Land issues and disputes—majority of land owned is customary, and landowners are incentivized to partner with the agricultural sector due to opportunities to earn income. Incentive payments will be an important mechanism to shift landowners' behavior and encourage partnership with forest restoration projects. ▪ Data about forest cover is out of date and more recent data is limited. The group stated it can send over a report about increase in agricultural clearance ▪ Stakeholders suggested that planted trees are sometimes not maintained due to limited resources ▪ Samoa is trying to increase agricultural production and food security while also increasing forest restoration. These two goals contradict each other.

[298] https://www.spc.int/events/pacific-week-of-agriculture-pwa-2019

A.7.2 Manure management using anaerobic digesters

Project Name: Manure management using anaerobic digesters		
Sector: Agriculture	**Sub-sector: Livestock**	**Project type: Investment**

Project description

This project would lower emissions from livestock manure by expanding the use of anaerobic digesters for stored manure in Samoa. The focus would be on managing manure from commercial piggeries which provide concentrated sources of manure slurry suitable as a feedstock for anaerobic biodigesters. The biogas collected from the digesters would be used for direct heating and electricity generation, displacing emissions from electricity generation in Samoa.

This project would build on previous work the sector. Samoa has already commissioned five anaerobic digesters to produce biogas under the IMPRESS project. These anaerobic digesters capture methane from manure slurry for direct heating applications or electricity production. Currently, one of these biogas digesters (at Sa'asa'ai village) is complete and operational, and a second digester (at the Faleula Methodist community Piggery) is 90 percent complete. Progress on the other three digesters has been delayed due to COVID-19. Samoa's Ministry of Agriculture and Fisheries has also been working with China on developing an anaerobic digester at another commercial piggery.

The goal of using anaerobic digesters to manage livestock manure aligns well with Samoa's strategic objectives in the agriculture sector. Production of biogas from livestock manure was promoted as a strategic priority action in Samoa's draft Greenhouse Gas Abatement Strategy 2020-2030. According to Samoa's Draft National Greenhouse Gas Abatement Strategy (2020-2030),[299] emissions from livestock account for 20 percent of Samoa's total emissions, including 74 percent of Samoa's methane emissions. Livestock manure and urine account for roughly one quarter of direct agricultural GHG emissions in Samoa (65,687 tCO_2-e in 2007 according to the FAO)[300].

Estimated GHG emissions reduction potential

Anaerobic digesters have the potential to reduce biogenic GHG emissions from piggeries in tropical areas by roughly 55 percent.301 According to the FAO's FAOSTAT database, emissions from pig manure management in Samoa were 54,800 tCO_2-e from a total national herd of 170,391 pigs in 2018[302].

Biogenic GHG Emissions Reduction

Samoa's national pig herd fell substantially to 91,725 in 2019.303 Assuming that 10 percent of pigs in Samoa in 2019 (9,173) live in piggeries amenable to anaerobic digesters for manure slurry, equipping all suitable piggeries with anaerobic digesters would reduce emissions by 1,622 tCO_2-e per year.

GHG emissions reduction from electricity production

According to the International Energy Agency (IEA), a 100kWe combined heat and electricity facility would require a daily feedstock of 68.4 tons of pig slurry, which would be produced by approximately 6,240 pigs.[304] Therefore, it would take manure slurry from roughly 62.4 pigs to produce 1 kWe of electricity from an anaerobic biodigester system. The manure slurry from 10 percent of Samoa's herd (9,173 pigs) could therefore produce 147 kWe of electricity. Assuming these biogas generation facilities are constructed and operate 80 percent of the time, the total annual electricity output would be 1,030 MWh. Using Samoa's grid emissions factor of 0.42tCO_2-e/MWh,[305] this would equate to GHG emissions reductions of 433 tCO_2-e per year.

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[299] Government of Samoa. 2021. National Greenhouse Gas Abatement Strategy 2020-2030. (Draft provided by MNRE)

[300] Using data on emissions from manure management from all animal types in 2007 recorded on the FAO's FAOSTAT database. Available at: http://www.fao.org/faostat/en/#data/GM. Accessed on 26/5/2021

[301] Inoue, K.R.A., Souza. D. D. F., et al. 2016. Potential of reduction in the missions of methane and nitrous oxide from swine wastewater after treated by two different systems. Engenharia Agrícola 36 (06), Nov-Dec 2016

[302] Using data on emissions from manure management from all animal types in 2007 recorded on the FAO's FAOSTAT database. Available at: http://www.fao.org/faostat/en/#data/GM. Accessed on 26/5/2021

[303] Total pig numbers are reported in Samoa's 2019 agricultural survey, due to be published in 2021.

[304] Lukehurst, C., Bywater, A. 2015. Exploring the viability of small-scale anaerobic digesters in livestock farming. IEA Bioenergy.

[305] This grid emissions factor for Samoa was calculated based on IPCC values for the carbon content per GJ for diesel fuel, assuming a thermal efficiency factor (for a diesel genset) of 30%, and assuming that diesel accounts for 50 percent of Samoa's electricity generation (as reported by stakeholders during the consultation workshop).

<table>
<tr><td colspan="2">Total GHG emissions reduction potential
Establishing anaerobic biodigester systems for 10 percent of Samoa's total pig herd has the potential to reduce emissions by 2,055 tCO_2-e/year[306] by 2030. Assuming that this project starts in 2022, and GHG emissions reductions increase in a linear fashion over the first five years of the project to reach 2,055 tCO_2-e/year in 2026, the cumulative GHG emissions reduction between now and 2030 would be 14,385 tCO_2-e.</td></tr>
<tr><td>Cost Estimates</td><td>Estimated time scale</td></tr>
<tr><td>The NPV of this project is estimated to be US$ 60,000.
The IEA estimate the capital cost of anaerobic digestion and combined heat and electricity systems in Germany range between US$1,855 and US$ 7,448/kWe[307]. Assuming that the average cost of constructing anaerobic biodigesters in Samoa is at the extreme high end of this range, the capital costs of anaerobic digestion facilities capable of processing manure slurry from 10 percent of Samoa's herd (9,137 pigs) would be US$ 1,095,000.
Assuming that these systems produce 1,030 MWh of electricity each year, they would lead to energy cost savings of US$ 195,700 per year[308]. Assuming that the project starts in 2022, and the project capital costs and energy cost savings both increase at a linear rate over the first five years of the project, to reach US$ 1,095,000 and US$ 195,700/year, respectively, in 2026, the NPV of the project would be US$ 60,000 under a 6 percent discount rate.
This suggests that the development of anaerobic digestion and biogas electricity systems is likely to be commercially viable in Samoa. However, the commercial viability of these systems will likely vary significantly between different facilities, and more detailed feasibility assessments would need to be done in each case.</td><td>This anaerobic biodigester project would be implemented over five years, in line with the time scale of the IMPRESS project.</td></tr>
<tr><td>Affordability</td><td>Likely co-benefits</td></tr>
<tr><td>This project is likely to be affordable in Samoa given the high energy cost savings outlined in the cell above. However, the commercial viability of these systems will likely vary significantly between different facilities, and more detailed feasibility assessments would need to be done in each case. In some cases, anaerobic digesters may not be commercially viable, and therefore they</td><td>Potential co-benefits of using anaerobic digesters to manage manure from piggeries in Samoa include:
▪ Reduced odor from manure slurry (which might otherwise be stored dry or in open-air holding ponds), contributing to SDG 11 (sustainable cities and communities) and SDG 3 (good health and well-being)</td></tr>
</table>

[306] This is a combination of the biogenic GHG emissions reduction potential and the GHG emissions reduction potential from electricity production.

[307] Lukehurst, C., Bywater, A. 2015. Exploring the viability of small-scale anaerobic digesters in livestock farming. IEA Bioenergy.

[308] This is calculated by multiplying the total electricity savings by the energy charge component of the electricity sector tariffs published by the Office of the Regulator in Samoa (0.48 WST = 0.19 USD). https://www.regulator.gov.ws/images/ORDERS/Electricity/2019/ORDER2019-E68-FinalDetermination.pdf. This includes the cost of fuel plus payments made to IPPs and should reflect the value to EPC of reduced losses. 0.48 WST = 0.19 USD on the current exchange rate. Note: as explained in Section 4.1, Samoa updated its electricity tariffs in September 2021. Samoa's new electricity tariffs are 5-10 US cents per kWh more expensive than those used in the calculations in this concept note. Therefore, cost savings from this project are likely to be greater than the estimate provided in this concept note.

<table>
<tr><td>would be considered unaffordable in the absence of additional government or donor funding.</td><td>▪ Residual sludge from anaerobic digesters could be used as a source of organic fertilizer, contributing to SDG 12 (responsible consumption and production)
▪ Electricity generation from biogas would reduce Samoa's use of imported fossil fuels for electricity generation, contributing to SDG 7 (affordable and clean energy).</td></tr>
<tr><td colspan="2">Potential environmental or social impacts</td></tr>
<tr><td colspan="2">Negative
▪ If not disposed of or used appropriately, the residual manure sludge from the anaerobic digesters could pollute local environments
▪ Digesters may be in competition with direct use of manure as an organic fertilizer
Positive
▪ Use of anaerobic digesters can reduce odor from manure slurry
▪ Diversification of electricity generation can increase the resilience of Samoa's grid, and provide more stable electricity to households and businesses</td></tr>
<tr><td>Procurement method</td><td>Likelihood of attracting private or donor funding (high, medium, low)</td></tr>
<tr><td>This project could be funded through user fees, as the operators of the biodigester facilities would use biogas combined heat and electricity facilities to save on electricity costs. However, the commercial case for anaerobic digesters will likely be stronger for some piggeries than for others, depending on factors like electricity requirements and distance to market. For anaerobic digester facilities that are economically beneficial but not commercially viable, there may be the potential to leverage viability gap funding from international donors.
The large upfront costs and gradual cost savings mean that anaerobic digester facilities are likely to require finance. Where this is the case, the Development Bank of Samoa will have to maintain the central role it has taken in financing agricultural investments in the past in Samoa. The Development Bank of Samoa may need to consider various concessional lending products to entice piggery operators to invest in anaerobic digester and biogas electricity systems.</td><td>High
Anaerobic digesters can lead to considerable energy cost savings for commercial facilities, meaning that there is a good case for funding these facilities privately. In cases where anaerobic digester facilities that are economically beneficial but not commercially viable, there may be potential to leverage viability gap funding from international donors.</td></tr>
<tr><td>Capacity requirement to implement (high, medium, or low)</td><td>Potential barriers</td></tr>
<tr><td>Medium
While anaerobic biodigesters and biogas combined heat and electricity facilities require specialized skills to establish, operate, and maintain, the ongoing IMPRESS project has already demonstrated the potential to implement similar projects in Samoa. These previous demonstration projects will have helped to develop construction, operation, and maintenance skills that could be used to expand the project in Samoa.</td><td>This project may encounter the following barriers:
▪ Difficulty estimating the commercial viability of anaerobic digesters and biogas electricity facilities for each commercial piggery
▪ Difficulty convincing commercial pig farmers of the commercial viability of anaerobic digesters and biogas electricity facilities. Agriculture sector stakeholders noted that commercial piggery owners may be reluctant to pay the upfront costs even if these investments are likely to lead to savings over time
▪ Commercial viability gaps requiring viability gap funding in some cases
▪ Some components of the digester and electricity systems would have to be imported from overseas.</td></tr>
</table>

	▪ If multiple anaerobic digester projects are implemented concurrently, there may be shortages of technical expertise and skilled labor ▪ The commercial piggery industry may experience fluctuations in size. Agriculture sector stakeholders noted that one commercial piggery closed down in 2020.

A.7.3 Improving the efficiency and precision of fertilizer use

Project Name: Improving the efficiency and precision of fertilizer use		
Sector: Agriculture	**Sub-sector: Agricultural Inputs**	**Project type: Capacity building and technical assistance**
Project description		
This project would improve the efficiency of nitrogen fertilizer use by better matching nitrogen application with crop nutrient needs. This would be done by training extension workers in Samoa to advise farmers on: ▪ Adoption of plants that have been bred to increase the uptake of nitrogen so that the same yields can be achieved using less fertilizer ▪ Increasing the use of organic fertilizers to substitute for imported synthetic fertilizers The project would include a training and awareness raising program for farmers, including efforts to build awareness of efficient nitrogen use and farming practices. This could build on the Ministry of Agriculture and Fisheries' existing working relationships with 'model farmers' in Samoa. Under this project, the Ministry of Agriculture and Fisheries would also undertake reginal-level soil testing, develop appropriate nutrient management plans, and disseminate the results to farmers. The goal of improving fertilizer use efficiency aligns well with Samoa's strategic objectives in the agriculture sector. Samoa's Agriculture Sector Plan[309] signals efforts to ensure that greater attention is paid to sustainable land use management, including matching cropping systems with land and soil capability based on soil testing and assessment. The agriculture sector plan has the following objectives: ▪ Strategy 4.1: Strengthen capability, resourcing, and effectiveness of extension providers (including NGOs and private sector providers) to promote sustainable resource management practices in agriculture and fisheries in close cooperation with MNRE, landowners and community within the framework of the National Environment Sector Plan (NESP). ▪ Strategy 4.2: Strengthen the management of agricultural chemical to ensure safe use, storage, and disposal to protect people's health and the environment. Samoa's draft Greenhouse Gas Abatement Strategy 2020-2030[310] also included the two following strategic priority actions relevant to fertilizer use: ▪ Build awareness about the efficient use of nitrogen in cropping ▪ Develop a framework and guidance information for regular soil testing to develop appropriate nutrient management plans.		
Estimated GHG emissions reduction potential		
The potential to reduce emissions through precision fertilizer use will vary greatly by farming systems, and there are few data on the potential for efficiency gains in the Pacific Islands. According to the International Fertilizer Association's submission to the UNFCCC's Subsidiary Body for Scientific and Technological Advice (SBSTA), most		

[309] Government of Samoa. 2015. Agriculture Sector Plan 2016-2020. Available at:https://www.maf.gov.ws/images/Downloads/ASP%20Vol%202%20Implementation%20Plan--Final%202016%2005%2018%20(2).pdf

[310] Government of Samoa. 2021. National Greenhouse Gas Abatement Strategy 2020-2030. (Draft provided by MNRE)

farming systems have the capacity to reduce GHG emissions from nitrogen fertilizer use by 15 to 25 percent[311]. During consultations with agricultural sector stakeholders in Samoa, it was decided that the potential for reducing emissions from fertilizers is probably at the low end of this range (15 percent).

In 2007, emissions from synthetic fertilizer use in Samoa were 103 tCO_2-e.[312] Assuming that this project can reduce GHG emissions from fertilizer use in Samoa by 15 percent, this project would reduce emissions in Samoa by 15 tCO_2-e per year in 2030.

Assuming that this project starts in 2022, and GHG emissions reductions increase in a linear fashion over the first four years of the project to reach 15 tCO_2-e/year in 2025, the cumulative GHG emissions reduction between now and 2030 would be 113 tCO_2-e.

Cost Estimates	*Estimated time scale*
The total estimated cost of this project is approximately US$ 546,000 comprising: ▪ US$ 126,464 for a training and awareness raising program (equivalent to US$ 31,616 per year budgeted for a training program on agricultural chemical use outlined in Samoa's Agricultural Sector Plan) ▪ US$158,080 for training of extension workers (equivalent to US$ 39,520 per year budgeted for a program to train extension workers on the principles of sustainable agricultural resource management outlined in Samoa's Agriculture Sector Plan) ▪ US$261,312 for soil fertility monitoring and regional nutrient management planning (equivalent to US$ 65,328 per year budgeted for a program strengthen data collection and reporting capacity outlined in Samoa's Agriculture Sector Plan).	During consultation on this project in June 2021, agricultural sector stakeholders estimated that this project would likely take between three and five years to implement. For the purposes of estimating GHG emissions reduction potential and cost, this concept note assumes that the project will take four years to implement.
Affordability	*Likely co-benefits*
This project is likely to be affordable for Samoa and within the means of Samoa's agriculture and fisheries budget. This project would cost less than 3 percent of the annual agriculture sector funding required to implement Samoa's Agriculture Sector Plan.	Potential co-benefits of increased nitrogen use efficiency include: ▪ Reduced nitrogen leaching leading to improvements in water quality and reduced risk of algae blooms, contributing to SDG 6 (clean water and sanitation), SDG 14 (life below water), and SDG 15 (life on land) ▪ Reduced demand for the manufacture and import of chemical fertilizers, contributing to SDG 12 (responsible consumption and production) ▪ Reduced expenditure on agricultural inputs, contributing to SDG 8 (decent work and economic growth).
Potential environmental or social impacts	
Negative ▪ In some cases, reduction in the use of fertilizers may lead to lower agricultural output. This may lead to greater demand for imported food Positive	

[311] the International Fertilizer Association's submission to the UNFCCC's Subsidiary Body for Scientific and Technological Advice (SBSTA). Available at: https://unfccc.int/files/documentation/submissions_from_non-party_stakeholders/application/pdf/598.pdf

[312] Using data on emissions from nutrient nitrogen fertilizers in 2007 recorded on the FAO's FAOSTAT database. Available at: http://www.fao.org/faostat/en/#data/GY accessed on 26/5/2021.

<table>
<tr><td colspan="2">

More efficient use of fertilizers will lead to reduced nutrient pollution, and improved freshwater and marine ecosystems
Efficient use of fertilizer can also lower the costs of agricultural production, leading to greater operating margins for farmers (initially) and lower prices for consumers (eventually)

</td></tr>
<tr><td>Procurement method</td><td>Likelihood of attracting private or donor funding (high, medium, low)</td></tr>
<tr><td>This project could be funded by the GoS through the Agriculture and Fisheries budget. In principle, there would be potential to collect user fees from farmers who see the benefit of using nitrogen fertilizers more efficiently. However, in practice, developing a scheme to collect user fees from farmers would be complex and costly, and it is not likely to be justified in Samoa.</td><td>Low
It is unlikely that this project would be able to attract private or donor funding because it is a relatively small project with only modest GHG emissions reduction benefits. Furthermore, there is a good general case for funding this project from Samoa's fiscal budget. Improvements in nitrogen use efficiency would improve the efficiency of Samoa's agricultural sector and provide benefits to the country as a whole.</td></tr>
<tr><td>Capacity requirement to implement (high, medium, or low)</td><td>Potential barriers</td></tr>
<tr><td>Medium
Expert advice would be needed to design and guide this project. However, many of the implementation tasks (such as agricultural extension work and soil fertility testing) are within the capacity of the Ministry of Agriculture and Fisheries.</td><td>This project may encounter the following barriers:
Difficulty engaging with the large number of people who would need to be involved to make this project successful
A lack of engagement from farmers who may be skeptical of the benefits of nutrient management planning
Competing demands on the time of agricultural extension workers and staff from the Ministry of Agriculture and Fisheries.</td></tr>
</table>

Appendix B: Ideas for additional NDC projects

This Appendix includes a table of additional NDC project ideas that were raised or revived by stakeholders during the final validation of the NDC Roadmap and Plan. These projects should be considered when Samoa updated its NDC Roadmap and Plan.

Table 7.4: Additional NDC projects mentioned during the validation workshop

Project	Sector
Low emissions vehicles (fuel efficiency/hybrid vehicles)	Land transport
Woodlots for commercial forestry	AFOLU

Appendix C: Terminologies and assumptions used in Section 5

Determination of GHG Mitigation

GHG (expressed as CO_2) mitigation potentials outlined in this paper are determined based on the available information gained from stakeholders in Samoa, government documents, and other sources, which take into account IPCC 2006 guidance.

Determination of investment requirement and costs

Investment needs and costs are determined in US dollars (US$) and are based on estimated costs as incurred in the Pacific region up through 2030. These values are rounded to the nearest thousand US$. Cost estimates in this report should be seen as suggestive due to the high degree of uncertainty caused by external factors, such as the economic downturn caused by the COVID-19 pandemic, and energy and commodity price swings.

Data

When data was not available or may be inaccurate or outdated, mitigation potentials and other conclusions (such as estimated cost of the project) were estimated based on various informed assumptions. Any assumptions are included in footnotes.

To achieve more accurate data, additional research or an updated GHG inventory is required. In addition, capacity building and technical assistance activities (associated with the mitigation opportunities) could focus on improving data availability and accuracy – we have suggested where this is promising. Updated data is likely to improve the accuracy of the mitigation potential opportunities, cost estimates, and other conclusions outlined in this paper.

Despite limitations in data, the data informing this paper is sufficient to make decisions as to which opportunities shall be prioritized for Samoa.

Appendix D: Existing and planned projects and initiatives in Samoa

Table 7.5 outlines the existing projects or initiatives (either in development or recently implemented) to reduce GHG emissions in the priority sectors. Many projects have been delayed due to travel restrictions implemented during the COVID-19 pandemic.

Table 7.5: Existing and planned projects and initiatives in Samoa

Project	Project type (infrastructure, equipment upgrade, study, training, public awareness)	Description	Project completion expectation[313]	Organization responsible
		Electricity sector		
Geothermal feasibility in Savai'i	Study	Feasibility, technical, financial, and economic, and environmental study of Geothermal power in Savaii and drilling of exploratory holes[314].	After 2022	EPC
Tiapapata hydro power plant	Infrastructure	750-kilowatt Tiapapata Hydro Power Station[315]. The project is self-funded by EPC. Completion will depend on borders being opened as this project will require an overseas-based contractor with experience in construction hydropower stations.	After 2022	EPC

[313] Project completion expectation is informed by participants at Consultation Workshop (19 March 2021). Many projects are delayed due to travel restriction implemented during the COVID-19 pandemic.

[314] EPC Proposed Future Projects

[315] EPC Proposed Future Projects

Project	Project type (infrastructure, equipment upgrade, study, training, public awareness)	Description	Project completion expectation[313]	Organization responsible
Transmission line from wind farm	Infrastructure	33KV line from a new Mt. Le Pue 20MW Wind Farm to Tanugamanono Substation[316]. This project was part of a wish list sent to the Asian Development Bank (ADB).	After 2022	EPC
Backup transmission line	Infrastructure	33KV Backup Transmission Line from Fuluasou Substation to Tanugamanono Substation[317]. This project was part of a wish list sent to the ADB.	After 2022—this project was submitted as part of a 'wish list' to ADB in 2020. However, no funding has been allocated to this project	EPC
Transmission line to airport	Infrastructure	33KV Transmission Line from Fiaga Substation to Faleolo International Airport 33/22 KV Substation[318]. This project was part of a wish list sent to the ADB	After 2022—this project was submitted as part of a 'wish list' to ADB in 2020. However, no funding has been allocated to this project	EPC
Feasibility study for submarine transmission line	Study	Feasibility, technical and ocean study for submarine transmission line to connect Savaii and Upolu Grids[319].	After 2022—this project was submitted as part of a 'wish list' to ADB in 2020. However, no funding has been allocated to this project	EPC
Submarine transmission line	Infrastructure	Construction of submarine transmission line from Upolu to Savaii. Dependent on the feasibility study[320]. This project was part of a wish list sent to the ADB	After 2022—this project was submitted as part of a 'wish list' to ADB in 2020. However, no funding has been allocated to this project	EPC

[316] EPC Proposed Future Projects

[317] EPC Proposed Future Projects

[318] EPC Proposed Future Projects

[319] EPC Proposed Future Projects

[320] EPC Proposed Future Projects

Project	Project type (infrastructure, equipment upgrade, study, training, public awareness)	Description	Project completion expectation[313]	Organization responsible
National control center upgrade	Training, Equipment upgrade	Upgrade staff capacity and equipment of the National Control Centre[321].	End of 2022	EPC
Power flow study	Study	Power flow analysis and voltage reticulation study[322].	End of 2022	EPC
Vaipu Pumped Hydro Storage Station[323]	Infrastructure	Vaipu Pumping Scheme was tendered out, but no bids were received. EPC is now looking at completing this project itself. However, there are some land issues—Vaipu Pumping Scheme is on hold while land issues are being settled with Fagaloa district.	After 2022	EPC
Geothermal Power Plant in Savai'i	Infrastructure	EPC went to tender with the geothermal power plant in Savai'i, but there was no interest.	Will not be completed—this project was submitted as part of a 'wish list' to ADB in 2020. However, no funding has been allocated to this project. Stakeholders in Samoa stated the project will not be completed	EPC
Biogas systems under IMPRESS project	Infrastructure	As part of the IMPRESS project, the Saasaai Biogas System has been launched (750 kW biomass plant), and four more are in progress	End of 2021	MNRE
SCADA and telecommunication system expansion	Equipment upgrade	Adding communication and monitoring/control equipment to the network. SCADA allows a high level of remote monitoring and control which helps with integrating more renewable energy (RE)[324].	After 2022—this project was submitted as part of a 'wish list' to ADB in 2020. However, no funding has been allocated to this project	EPC
Grid stability study	Study	Stability study and installation of devices connected to grid to provide fault currents.[325] This study is ongoing. EPC needs to collect data to give to JICA, who will then develop a model that can help	End of 2022	EPC

[321] EPC Proposed Future Projects

[322] EPC Proposed Future Projects

[323] EPC Proposed Future Projects

[324] EPC Proposed Future Projects

[325] EPC Proposed Future Projects

Project	Project type (infrastructure, equipment upgrade, study, training, public awareness)	Description	Project completion expectation[313]	Organization responsible
		increase stability. Grid stability is EPC's biggest challenge at the moment		
Solar and storage IPPs	Infrastructure	EPC, with the help of a US based company called Grid Market, is currently in negotiations with a number of Independent Power Producers (IPPs) to build a RE generation source that will hopefully replace a significant portion of diesel. Four companies have been shortlisted from a tender that was held earlier this year. All four IPPs are proposing solar with storage. For the RE generation plant, the timeframe depends on the following: ▪ EPC and the selected IPP agreeing on the commercial and technical terms ▪ Signing of the Power Purchase Agreement ▪ IPP securing a generation license from the Office of the Regulator ▪ Opening up of the borders so the IPP can mobilize to start construction. The RE IPP being evaluated is intended to place Samoa very close to achieving its RE target. EPC's engineers are focusing on projects that will enhance its system protection and ability of the grid to absorb fluctuations caused by a very high solar penetration.	After 2022	EPC
		Land transport sector		
EPC EVs	Infrastructure	This project is listed under EPC proposed future projects[326]. A tender for the procurement of 10 EVs and 10 charging stations is currently being advertised. These EVs are part of a study endorsed by the	After 2022	EPC

[326] EPC Proposed Future Projects

Project	Project type (infrastructure, equipment upgrade, study, training, public awareness)	Description	Project completion expectation[313]	Organization responsible
		National Energy Coordination Committee to collect and analyze data on the operation and maintenance of EVs. A team of EPC engineers will be doing the analysis. The project is self-funded. EPC intends to have its EVs before the end of the current Financial Year.		
Electric taxis and buses	Infrastructure	Pilot project listed in the Energy Sector Plan 2017-2022[327].	After 2022—this project needs to be approved with funding to commence	LTA
Bio-diesel and bio-ethanol research trial	Study	The Second National Communication to the UNFCCC states that the Research and Development Institute of Samoa planned to explore the viability of producing ethanol from breadfruit, cassava and other food crops that are readily available in Samoa[328] The Scientific Research Organization of Samoa (SROS) on behalf of the GoS implemented bio-diesel research trials utilizing a production pilot plant (SIP200M) in mid-2009. Coconut oil was sourced as feedstock for the trials. Findings of the trial include: ▪ Unblended (B100) and blended forms (B10 and B20) of biodiesel were successfully trailed in 2 diesel engine vehicles and one generator over 6 months. Performance and engine checks found both vehicle engines and generator performance was maintained throughout the trial period. No technical problems were encountered. In summary: – No modifications in engines of new diesel vehicles or generators are required prior to running on biodiesel, whether as blend or unblended	After 2022	MNRE

[327] Energy Sector Plan 2017-2022
[328] The Second National Communication to the UNFCCC

Project	Project type (infrastructure, equipment upgrade, study, training, public awareness)	Description	Project completion expectation[313]	Organization responsible
		– Old diesel engine motors can also run-on biodiesel (blend or unblended) after gradual increase of biodiesel blend in each subsequent tank-filling episode over a certain time period, until the motor is run entirely on unblended (100 percent) biodiesel.[329] SROS recommend that: ▪ GoS seeks funding to proceed to the next phase of biodiesel production (i.e., up scaling of project to a commercial scale) ▪ GoS, through MAF, actively promotes and intensifies national coconut replanting programs to guarantee sustainability of feedstock supply.		
ERAP – Enhanced Road Access Project	Infrastructure	ERAP includes restoration and improvements to key roads and sector assets damaged by extreme weather events and enhancing the climate resilience of critical roads and bridges in Samoa. The project provides funding to repair roads and bridges damaged by TCE and to upgrade, rehabilitate and/or reconstruct existing road sector assets to higher standards to strengthen their resilience to climate change and extreme weather events. Grant disbursements as of March 2021 amounted to US$15.09 million (81 percent) of the IDA Grant and US$9.63 million (100 percent) of the APIP Grant[330].	Nearing completion—expected completion date October 2021	
Climate Resilience Project (SCRTP)	Infrastructure	This project, in partnership with IDA and World Bank, seeks to identify: planning tools being used to improve climate resilience of	In progress—expected completion date 2024	

[329] SROS, Bio-diesel and Bio-ethanol Research Trial Findings Summary as shared to the Energy Sector in updating of Samoa's NDCs 2021

[330] https://documents1.worldbank.org/curated/en/955081618929252469/pdf/Disclosable-Restructuring-Paper-Enhanced-Road-Access-Project-P145545.pdf; https://documents.worldbank.org/en/publication/documents-reports/documentdetail/650711468107049669/samoa-enhanced-road-access-project

Project	Project type (infrastructure, equipment upgrade, study, training, public awareness)	Description	Project completion expectation[313]	Organization responsible
		roads; climate resilient investments constructed and in use; an enabling environment solution implemented. It also aims to construct or rehabilitate roads with climate resilience measures.		
Enhancing Climate Resilience of the West Coast Road Project (CRWCR)	Infrastructure	This project includes improving the climate resilience of the West Coast Road (WCR), reduce percentage of WCR that is vulnerable to climate change (areas along the WCR susceptible to coastal flooding, i.e., less than two meters above mean sea level), rehabilitate non-rural roads rehabilitated (km), and enhance local capacity to develop Climate-resilient policies, codes, and more climate resilient road network[331].	Completed	
CCIRUP – Central Cross Island Road Upgrading Project	Infrastructure	This project, in partnership with ADB, involves upgrading about 20 km of national road, incorporating climate-proofing considerations, innovative technologies, road safety measures, and gender-inclusive elements[332].	Preparatory phase	
		Maritime transport sector		
Solar panel installation, phase I	Infrastructure	Solar panels have been installed on Lady Samoa III.	Completed—however, solar panels are not currently working. In addition, batteries had been installed but have since been removed[333]	MWTI

[331] https://documents1.worldbank.org/curated/en/241461468306860242/pdf/NonAsciiFileName0.pdf

[332] https://www.adb.org/sites/default/files/project-documents/51268/51268-001-rrp-en.pdf

[333] Insight from participants at Consultation Workshop (19 March 2021).

Project	Project type (infrastructure, equipment upgrade, study, training, public awareness)	Description	Project completion expectation[313]	Organization responsible
Solar panel installation, phase II	Infrastructure	There is a second phase planned for the project installing solar panels on large vessels in Samoa. In the long run, the aim is to install solar panels on all the inter-island vessels. There have been some delays due to COVID-19. In addition to the solar panels, the projects will include installing other technologies that can reduce fossil fuels like a propeller that can produce energy as well as special pumps.	After 2022—this phase is fully funded by MTCC-Pacific however it has yet to be completed. All equipment has been delivered to SSC and stored at their warehouse.	MWTI
		Waste sector		
Recycling plastics	Infrastructure and public awareness	Project by MNRE waste unit to enhance recycling of plastics which will decrease CO_2 emissions by 40 percent relative to single-use. Planned to take place over 12 months[334]. Although this project may help reduce global emissions, plastics are imported into Samoa, so GHG emissions reductions from more efficient plastic use are unlikely to be counted into Samoa's inventory.	After 2022	MNRE
Promotion of re-usable water bottles	Public awareness	MNRE waste unit program to promote re-useable water bottles. This would decrease emissions related to plastic water bottles by 60 percent relative to a single-use scenario. There is regional consultation on this project happening[335].	After 2022—MNRE will commence with plastic recycling pilot project soon under J-PRISM II and UNDP CERO waste projects	MNRE
		Tourism sector		
Technical support to the tourism	Study and Infrastructure	Joint initiative led by Samoa Tourism Authority (STA) in collaboration with Samoa Hotel Association (SHA). Phase 1 includes	After 2022	STA

[334] Meeting with Waste sector Champion at MNRE on the 4th of November 2020

[335] Meeting with Waste sector Champion at MNRE on the 4th of November 2020

Project	Project type (infrastructure, equipment upgrade, study, training, public awareness)	Description	Project completion expectation[313]	Organization responsible
industry with renewable energy technologies		an energy consumption assessment and developing five pilot sites for biomass or solar for tourism accommodation.		
Funding the Solarization of Samoa's Hotels	Infrastructure and Training	As part of the International Solar Alliance (ISA) project[336], STA, SHA, and Savai'i Samoa Tourism Association (SSTA) will jointly demonstrate this proposed Solar Power Pilot Project at 8-20 hotels. ISA will fund the: ▪ installation of the 120kW of pilot solar systems, ▪ commissioning of these systems, ▪ provision of technical advice and training, ▪ delivery of Power Saving Workshops, ▪ publication of a Power Saving Guidebook, ▪ provision of Monitoring and Evaluation (M&E) component, and ▪ implementation of a 5-Year Operations and Maintenance (O&M) Contract by STA[337].	Project proposal submitted to ISA	STA, SHA, SSTA
Solar power survey	Study	The Solar Power Survey, undertaken by STA and SHA. This survey seeks to is a first step towards a large renewable energy and energy efficiency program for the tourism industry. The survey also seeks to inform ISA for a 5-Year Operations and Maintenance (O&M) Contract (mentioned in project 'Funding the solarization of Samoa's Hotels')[338].	Ongoing	

[336] ISA support for up to USD 50,000 for funding innovative pilot solar projects in LDC and SIDS Member Countries.

[337] International Solar Alliance (ISA) - Funding the Solarization of Samoa's Hotels – a Tourism Industry Initiative.

[338] STA and SHA, Solar Power Survey, Solarizing Samoa's Tourism Industry.

Project	Project type (infrastructure, equipment upgrade, study, training, public awareness)	Description	Project completion expectation[313]	Organization responsible
		Marine sector		
Strengthening mangrove conservation areas	Infrastructure	This World Bank project involves working with the community to strengthen mangrove conservation areas[339].	After 2022	EPC
USAID mangrove restoration	Infrastructure	USAID has also given another US$49,500 for the restoration of 2,500 mangroves. The project will start at the beginning 2021[340]. The project does not mention carbon or social protection credits.	End of 2022	MNRE
		AFOLU sector		
Biogas Digesters under the Improving the Performance and Reliability of RE Power Systems in Samoa (IMPRESS)	Samoa has already commissioned five anaerobic digesters to produce biogas under the IMPRESS project. These anaerobic digesters capture methane from manure slurry for direct heating applications or electricity production. MAF has also been working with China on developing an anaerobic digester at another commercial piggery.	Currently, one of these biogas digesters (at Sa'asa'ai village) is complete and operational, and a second digester (at the Faleula Methodist community Piggery) is 90 percent complete. Progress on the other three digesters has been delayed due to COVID-19.		MNRE

[339] Meeting with Waste sector Champion at MNRE on the 4th of November 2020

[340] Cross sector workshop

Project	Project type (infrastructure, equipment upgrade, study, training, public awareness)	Description	Project completion expectation[313]	Organization responsible
Tree replanting	Infrastructure	Tree planting with funding from New Zealand and Australia with the intention of offsetting the carbon from travel of seasonal workers.	Concept phase	
National parks restoration	Infrastructure	Working with community to restore national parks. Including replanting and conservation. This is an ongoing effort between Samoa Conservation and MNRE. MNRE is also working with community to restore areas that have been degraded through invasive species or unsustainable practice[341].	Ongoing	MNRE
2 million tree program	Infrastructure	Samoa's 2 Million Trees campaign began in 2015. MNRE is leading this national effort. Seedlings are provided free of charge for planting to any groups, organizations, companies, or individuals who want to aid the campaign's efforts by providing their time and free labor. The 2 million tree program has just reached its target of planting 2 million trees, but the program will continue with NGOs and schools planting more trees[342].	Core projected complete (2020). Additional tree planting work is ongoing.	MNRE
Agroforestry support	Infrastructure	Samoa's Ministry for Agriculture and Fisheries is implementing an ongoing project to provide coconut and cocoa seedlings to landholders. Agroforestry was also promoted under Samoa's Two Million Trees planting campaign, which ran from 2015-2020. One of the target outputs of the program was that "farmers and communities benefited from pursuing forest plantations and agroforestry", and the key activity under this deliverable was to "raise 550,000 native resilience trees".	Ongoing	
Upscaling Samoa's carbon offsets project: sustainable support for	Infrastructure and Training	The Samoa Conservation Society just received US$48,500 from USAID for their carbon offsetting project for 2021-2022. The purpose of the project is to: ▪ Investigate the feasibility of getting international certification for our carbon offsets project	2016—2021	

[341] Meeting with Waste sector Champion at MNRE on the 4th of November 2020.

[342] Cross Sector Workshop

Project	Project type (infrastructure, equipment upgrade, study, training, public awareness)	Description	Project completion expectation[313]	Organization responsible
restoration of degraded ecosystems in Samoa		▪ Train youth in forest restoration and tree planting ▪ Restore at least 4 ha of the highly degraded OLPP National Park and other sites to restore biodiversity and improve resilience to threats such as climate change as well as to absorb more than 2,300 tonnes of carbon dioxide.		
Global Research Alliance on Agricultural Greenhouse Gases (GRA),	Training	Samoa has joined the Global Research Alliance on Agricultural Greenhouse Gases (GRA), and is planning to use technical assistance provided by the GRA to build capacity in the sector, monitor GHG emissions, and identify potential cost-effective mitigation measures.	Ongoing	


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