



# **Tuvalu's NDC Implementation Roadmap and Investment Plan**



# Tuvalu's NDC Implementation Roadmap and Investment Plan

IMPLEMENTING PARTNERS



REGIONAL  
PACIFIC  
NDC HUB



GGGI

WITH FINANCIAL SUPPORT FROM



IN CONTRIBUTION TO



# Table of Contents

<b>Abbreviations and Acronyms</b>	<b>4</b>
<b>Executive Summary</b>	<b>6</b>
<b>1 Introduction</b>	<b>13</b>
<b>2 National circumstances, including NDC targets and GHG emissions profile</b>	<b>15</b>
2.1 National circumstances	15
2.2 Existing sectoral strategies, plans, and policies relevant to GHG mitigation projects	16
2.3 GHG emissions profile	18
2.4 NDC targets	19
<b>3 Institutional Context</b>	<b>21</b>
<b>4 Sector Context</b>	<b>24</b>
4.1 Land transport	24
4.2 Maritime transport	29
4.3 Energy efficiency	34
<b>5 Opportunities to help Tuvalu achieve its NDC targets</b>	<b>40</b>
<b>6 Financing Plan</b>	<b>44</b>
<b>7 Implementation Plan</b>	<b>50</b>
7.1 Timing and costs of project implementation	50
7.2 Monitoring and evaluation framework	53
7.3 Guidelines for promoting gender and social inclusion and environmental and social safeguards	55
A.1 Land transport	58
A.2 Maritime transport	64
A.3 Energy efficiency	68
B.1 Additional NDC projects in focus sectors	73
B.2 Additional NDC projects in agricultural sector	73

## Appendices

<b>Appendix A Project Concept Notes</b>	<b>58</b>
A.1 Land transport	58
A.2 Maritime transport	64
A.3 Energy efficiency	68
<b>Appendix B Ideas for additional NDC Projects</b>	<b>73</b>
B.1 Additional NDC projects in focus sectors	73
B.2 Additional NDC projects in agricultural sector	73
<b>Appendix C Terminologies and assumptions used in Section 5</b>	<b>75</b>
<b>Appendix D Existing and planned projects and initiatives in Tuvalu</b>	<b>76</b>

## Tables

Table 0.1: GHG mitigation opportunities in Tuvalu	8
Table 0.2: Sources of funding available in Tuvalu	9
Table 0.3: Potential sources of finance for GHG mitigation projects in Tuvalu	10
Table 0.4: Timing and duration of pipeline projects	11



Table 1.1: Cumulative GHG emissions reduction by 2030 and indicative investment need to 2030 for priority sectors	14
Table 2.1: Key documents relevant to GHG mitigation projects	16
Table 2.2: Summary of Tuvalu's energy sector GHG emissions by sub-sector (2014 and 2002)	18
Table 3.1: Key institutions, their capacity, and constraints to NDC implementation	22
Table 4.1: Registered land transport vehicles	24
Table 4.2: Number of imported vehicles between 2015 and 2020	25
Table 4.3: Key national stakeholders in land transport	26
Table 4.4: Key national stakeholders in maritime transport	31
Table 4.5: Key national stakeholders in energy efficiency	37
Table 5.1: GHG mitigation opportunities in the land transport sector	42
Table 5.2: GHG mitigation opportunities in the maritime transport sector	42
Table 5.3: GHG mitigation opportunities in the energy efficiency sector	43
Table 6.1: GHG emissions reduction potential, investment needs, cost effectiveness, likely funding sources, need for finance, and type of finance for pipeline projects	47
Table 6.2: Sources of funding available in Tuvalu	48
Table 6.3: Sources of finance available in Tuvalu	49
Table 7.1: Timing and duration of pipeline projects	51
Table 7.2: Timing of costs associated with pipeline projects (US\$)	52
Table 7.3: Existing and planned projects and initiatives in Tuvalu	76

## Figures

Figure 5.1: Cumulative GHG emissions reductions 2022-2030 from pipeline projects in Tuvalu	41
Figure 7.1: NDC Supervisor, Sector Leaders, and Executors for implementing Tuvalu's NDC	54



# Abbreviations and Acronyms

<b>ADB</b>	Asian Development Bank
<b>ADO</b>	Automotive diesel
<b>BAU</b>	Business as usual
<b>cc</b>	Cubic capacity
<b>CO<sub>2</sub>e</b>	Carbon dioxide equivalent
<b>CCD</b>	Department of Climate Change and Disaster
<b>DBT</b>	Development Bank of Tuvalu
<b>DOE</b>	Department of Energy
<b>EE</b>	Energy efficiency
<b>EEZ</b>	Exclusive economic zone
<b>EPC</b>	Engineering, Procurement, and Construction
<b>ESS</b>	Environmental and Social Safeguards
<b>EVs</b>	Electric vehicle
<b>FTE</b>	Full-time staff equivalent
<b>GG</b>	Gigagram
<b>GGGI</b>	Global Green Growth Institute
<b>GHG</b>	Greenhouse gas
<b>GIZ</b>	Deutsche Gesellschaft für Internationale Zusammenarbeit
<b>GoT</b>	Government of Tuvalu
<b>IAE4LCR TV</b>	Integrated Agro-ecosystem approach for enhancing Livelihoods and Climate Resilience in Tuvalu
<b>ICE</b>	Internal combustion engine
<b>IPP</b>	Independent power producer
<b>kW</b>	Kilowatt
<b>LCT</b>	Landing craft tank
<b>MCT</b>	Ministry of Communication and Transport
<b>MEYS</b>	Ministry of Education, Youth & Sports
<b>MFT</b>	Ministry of Fisheries and Trade
<b>MHA</b>	Ministry of Home Affairs and Rural Development
<b>MLGA</b>	Ministry of Local Government and Agriculture
<b>MoF</b>	Ministry of Finance
<b>MTET</b>	Ministry of Transport, Energy and Tourism
<b>MW</b>	Megawatt

<b>MWh</b>	Megawatt-hour
<b>NBT</b>	National Bank of Tuvalu
<b>NDC</b>	Nationally Determined Contribution
<b>ODA</b>	Official Development Assistance
<b>PPA</b>	Power purchase agreement
<b>PV</b>	Photovoltaics
<b>RE</b>	Renewable energy
<b>REDD+</b>	Reducing Emissions from Deforestation and Forest Degradation
<b>SNC</b>	Second National Communication
<b>t</b>	Ton
<b>TA</b>	Technical assistance
<b>TEC</b>	Tuvalu Energy Corporation
<b>TNPSO</b>	Tuvalu National Private Sector Organization
<b>TPF</b>	Tuvalu Police Force
<b>ULP</b>	Unleaded petroleum
<b>UNFCCC</b>	United Nations Framework Convention on Climate Change
<b>UNDP</b>	United Nations Development Programme
<b>USP</b>	University of the South Pacific
<b>WB</b>	World Bank

# Executive Summary

## Context

Tuvalu seeks to accelerate the implementation of its Nationally Determined Contribution (NDC) to global climate change mitigation efforts. In this context, and as a member of the Regional Pacific NDC Hub (the NDC Hub), the Government of Tuvalu (GoT) requested the NDC Hub to support the GoT in its effort to develop an NDC Implementation Roadmap and NDC Investment Plan (NDC Roadmap and Plan) for the land transport, maritime transport, and energy efficiency sectors<sup>1</sup>. The Global Green Growth Institute (GGGI), as part of its role as an implementation partner of the NDC Hub, has engaged Castalia to assist GoT in developing Tuvalu's NDC Roadmap and Plan.

This strategic document provides a plan for the GoT to achieve its NDC using GHG mitigation actions in the land transport, maritime transport, and electricity energy efficiency sectors<sup>2</sup>. This document 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.

## Tuvalu's GHG emissions profile

Tuvalu's GHG emissions profile is dominated by GHG emissions from the energy sector (including electricity generation and transport). According to Tuvalu's Second National Communication (NC), Tuvalu's total GHG emissions in 2014 were 18,467 tCO<sub>2</sub>e<sup>3</sup>. Of this total, 11,161 tCO<sub>2</sub>e comes from the energy sector. Within the energy sector, electricity generation is the largest source of GHG emissions, contributing 5,430 tCO<sub>2</sub>e (49 percent of the total energy sector emissions). Maritime transport produces the second-largest share of energy sector emissions (30 percent), while land transport contributes only 5 percent of Tuvalu's energy sector emissions<sup>4</sup>.

## Tuvalu's First NDC

In an effort to reduce its GHG emissions, Tuvalu published its First NDC in 2015<sup>5</sup>. Tuvalu's 2015 NDC focuses primarily on reducing GHG emissions from the energy sector (specifically electricity generation and transport). Tuvalu included the following targets in its 2015 NDC:

---

<sup>1</sup> The Global Green Growth Institute (GGGI), as part of its role as an implementation partner of the Regional Pacific NDC Hub, engaged Castalia to assist Tuvalu in developing its NDC Roadmap and Plan.

<sup>2</sup> This document focuses on demand-side energy efficiency in the electricity sector to avoid overlaps with existing efforts to reduce supply-side GHG emissions in Tuvalu's electricity sector.

<sup>3</sup> The 2014 GHG emissions estimate combines data on emissions from electricity generation in 2014 with data on emissions from all other sectors recorded in 2002. Second National Communication of Tuvalu (2015), available at: [https://www4.unfccc.int/sites/SubmissionsStaging/NationalReports/Documents/7190452\\_Tuvalu-NC2-1-Tuvalu%20%20SNC%20Final%20Report.pdf](https://www4.unfccc.int/sites/SubmissionsStaging/NationalReports/Documents/7190452_Tuvalu-NC2-1-Tuvalu%20%20SNC%20Final%20Report.pdf)

<sup>4</sup> See Table 2.2 for the full breakdown of GHG emission sources within the energy sector.

<sup>5</sup> The Government is considering submitting a second NDC.

- Reduce GHG emissions from the electricity generation (power) sector by 100 percent, by 2025;
- Reduce total GHG emissions from the entire energy sector to 60 percent below 2010 levels by 2025; and
- Pursue a zero-carbon development pathway by 2050 (dependent on availability of finance and technology)<sup>6</sup>.

A significant effort has been made to achieve the NDC targets, particularly in the energy sector and electricity sub-sector. To date, around 20 percent of Tuvalu's NDC mitigation target has been achieved. In addition, two large renewable energy projects, funded by the World Bank and the Asian Development Bank (ADB), will see the installation of an additional 2 MW of solar PV, 2 MWh of battery storage, and a small wind turbine on Funafuti. Following the completion of these projects, Tuvalu will generate approximately 90 percent of its electricity through renewable sources. These projects will reduce GHG emissions from electricity generation by 80 percent relative to 2015<sup>7</sup>. This would reduce total GHG emissions from the entire energy sector by 39 percent.

There is scope to further reduce GHG emissions in the land transport, maritime transport, and energy efficiency in electricity sectors in Tuvalu. This NDC Roadmap and Plan identifies these opportunities and lays out the steps needed to achieve greater GHG emission reductions in Tuvalu.

#### *Constraints to NDC implementation*

This NDC Roadmap and Plan considers several key constraints to implementing GHG mitigation projects in Tuvalu. Constraints include budget limitations, human capacity (including the number of staff 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 six GHG mitigation opportunities—two in the land transport sector, two in the maritime transport sector, and two in the electricity energy efficiency sector. 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, Tuvalu could consider proposing the establishment of donor funded Project Management Units (PMUs) to account for a proportion of the additional administrative burden on government agencies.

Table 0.1 details the GHG mitigation opportunities for each sector, along with indicative investments needs to 2030, the annual GHG mitigation potential in 2030, and the

<sup>6</sup> <https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Tuvalu%20First/TUVALU%20INDC.pdf>

<sup>7</sup> According to Tuvalu's 2015 NDC, 50 percent of Tuvalu's electricity was derived from renewables in 2015.



cumulative GHG mitigation potential by 2030. The information detailed in this table provides summary information about each project<sup>8</sup>.

**Table 0.1: GHG mitigation opportunities in Tuvalu**

Opportunity	Indicative investment needs to 2030 (US\$) <sup>9</sup>	Annual emissions reduction in 2030 (tCO <sub>2</sub> e)	GHG emissions reduction by 2030 (tCO <sub>2</sub> e) <sup>10</sup>
<b>Land transport</b>			
E-bike initiative	3,444,000	198	1,089
Electrification of Tuvalu's light vehicle fleet	13,470,000	537	2,417
<b>Maritime transport</b>			
Outboard motor transition from 2-stroke petrol outboards to 4-stroke	2,619,000	764	3,820
Shore side electrical supply for at berth vessels	50,000	144	1,080
<b>Energy efficiency</b>			
Retrofitting of major hotels and commercial and government buildings	140,000	86	516
Cold storage energy efficiency	125,000	48	336

*Note: GHG mitigation figures (tCO<sub>2</sub>e) are rounded to the nearest ton; indicative investment needs are rounded to the nearest US\$1,000.*

*Note: 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.*

These opportunities have the potential to reduce 9,258 tCO<sub>2</sub>e GHG emissions by 2030, with an annual GHG mitigation potential of 1,777 tCO<sub>2</sub>e once projects are implemented. Combined with planned renewable energy and storage projects, these primary GHG mitigation actions would reduce Tuvalu's GHG emissions from the energy sector by 55 percent<sup>11</sup> relative to Tuvalu's most recent GHG emissions profile (2014 for electricity and 2002 for all other sectors)<sup>12</sup>. The opportunities are estimated to have an investment need of US\$19,850,000 by 2030.

<sup>8</sup> The information detailed in this table provides summary information about each project.

<sup>9</sup> 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.

<sup>10</sup> The GHG emissions reduction estimate calculations are explained in the concept notes in Appendix A.

<sup>11</sup> The large proportion of GHG emissions reduction is from the two planned renewable energy and storage projects.

<sup>12</sup> While the target to reduce energy sector GHG emissions by 60 percent was defined relative to 2010 levels, Tuvalu's NDC does not provide GHG emissions estimates of energy sector emissions. Therefore, the total GHG emissions reduction potential pipeline projects are estimated relative to the GHG emissions estimates from Tuvalu's Second National Communication to the

The NDC projects included in this NDC Roadmap and Plan should be seen as a provisional list of GHG mitigation opportunities. Tuvalu will continue to add to these projects as new opportunities arise, and new opportunities should be analysed (and prioritised if required) similarly to those included in this NDC Roadmap and Plan<sup>13</sup>. Ministries and Implementing Agencies in each sector should be encouraged to continue innovating and to contribute to subsequent versions of this work.

#### *Financing GHG mitigation opportunities*

Each of the GHG mitigation opportunities included in the project pipeline requires funding arrangements that meet their full costs, indicated in Table 0.1. Some of the projects included in the pipeline will require financing<sup>14</sup>. 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: Sources of funding available in Tuvalu**

Donor Funding	
Name of Donor	Type of Funding Support
World Bank (International Development Association)	Grants, Technical Assistance (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 <sup>15</sup>	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

UNFCCC (based on 2014 data for electricity and 2002 data for all other sectors). See section 2.3 for Tuvalu's GHG emissions profile.

<sup>13</sup> A methodology for prioritizing projects in Tuvalu's pipeline in the accompanying document 'Guidelines on Development NDC Implementation Roadmaps and Investment Plans'. Prioritizing projects may be required if Tuvalu adds additional projects to its pipeline.

<sup>14</sup> 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).

<sup>15</sup> UNDP provides financial and technical support to projects through Global Environment Facility (GEF) and Green Climate Fund (GCF).

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
<b>Sources of Government Funding</b>	
Ministry of Finance	
Ministry of Fisheries and Trade	
Ministry of Health, Social Welfare and Gender Affairs	
Ministry of Local Government and Agriculture	
Ministry of Public Works, Infrastructure, Environment, Labour, Meteorology and Disaster	
Ministry of Transport, Energy and Tourism	
<b>Types of User Fees</b>	
Revenue from user tariffs	
Avoided costs <sup>16</sup>	

Potential sources of finance are shown in Table 0.3.

**Table 0.3: Potential sources of finance for GHG mitigation projects in Tuvalu**

Concessional Finance	Commercial Finance
<ul style="list-style-type: none"> <li>• World Bank</li> <li>• Asian Development Bank</li> <li>• European Investment Bank</li> <li>• Australian Aid</li> <li>• European Union</li> <li>• Green Climate Fund</li> <li>• Global Environment Facility</li> </ul>	<ul style="list-style-type: none"> <li>• National Bank of Tuvalu</li> </ul>

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, Tuvalu 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 Tuvalu in the future.

#### *Implementation plan*

Implementation of GHG mitigation projects will occur between 2022 and 2030. The two projects in each sector can be implemented at the same time. This approach is in line with

<sup>16</sup> 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.

advice provided by stakeholders in Tuvalu, who stated that no more than two projects should be implemented concurrently in the land and maritime transport sectors and no more than four projects should be implemented concurrently in the energy efficiency sector. The timeline and duration of implementing GHG mitigation opportunities is shown in Table 0.4, below<sup>17</sup>.

**Table 0.4: Timing and duration of pipeline projects**

	2022	2023	2024	2025	2026	2027	2028	2029	2030
<b>Project</b>									
<b>Land Transport Sector</b>									
E-bike initiative									
Electrification of Tuvalu's light vehicle fleet									
<b>Maritime Transport Sector</b>									
Outboard motor transition from 2-stroke petrol outboards to 4-stroke									
Shore side electrical supply for at berth vessels									
<b>Energy efficiency sector</b>									
Retrofitting of major hotels and commercial and government buildings									
Cold storage energy efficiency									

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

Implementation of this plan will be 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 Tuvalu's NDC
- Sector Leaders—Individuals from government ministries responsible for implementing specific actions each of the three sub-sectors of this Implementation Roadmap 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.

<sup>17</sup> Stakeholders in Tuvalu stated that no more than two projects should happen concurrently in the land transport and maritime transport sectors, and no more than four projects should happen concurrently in the energy efficiency sector. This insight will be important to consider if Tuvalu adds additional projects to the pipeline.

Sector Leaders should meet weekly with their Executors to track day-to-day tasks and liaise with the external consultants<sup>18</sup>. Sector leaders should give quarterly briefings to the NDC Supervisor, updating them on progress on the GHG 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 Tuvalu should promote gender and social inclusion in these projects by implementing 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 Tuvalu in managing key environmental and social risks.

---

<sup>18</sup> External consultants may be used by GoT to implement projects, for example if specialty skills are required.



# 1 Introduction

Tuvalu submitted its First NDC (First NDC) to the United Nations Framework Convention on Climate Change (UNFCCC) in November 2015,<sup>19</sup> which aimed to reduce GHG emissions from electricity generation by 100 percent by 2025 and reduce GHG emissions from the energy sector (specifically electricity and transport) to 60 percent below 2010 levels by 2025. This commitment was conditional on external support.

Tuvalu seeks to accelerate the implementation of its NDC to assist global climate change mitigation efforts. As a member of the NDC Hub, GoT asked the NDC Hub to support the GoT in developing an NDC Roadmap and Plan for the land transport, maritime transport, and electricity energy efficiency sectors<sup>20</sup>. GGGI engaged Castalia to assist with this objective.

The NDC Roadmap and Plan comprises two key strategic documents:

- An **Implementation Roadmap**, including information about Tuvalu's specific context, such as Tuvalu's GHG emissions profile, targets in Tuvalu's First NDC, 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**<sup>21</sup> of promising GHG mitigation projects across Tuvalu's priority sectors, outlining potential emissions reductions, costs, co-benefits, capacity requirements, and potential to attract funding. The project pipeline is outlined in Appendix A. It also shows 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 GoT 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. Successful implementation of the projects included in the NDC Roadmap and Plan will contribute to GHG emissions reductions and help Tuvalu achieve

---

<sup>19</sup> Tuvalu's First NDC is available here:  
<https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Tuvalu%20First/TUVALU%20INDC.pdf>

<sup>20</sup> This document focuses on demand-side energy efficiency in the electricity sector to avoid overlaps with existing efforts to reduce supply-side GHG emissions in Tuvalu's electricity sector.

<sup>21</sup> Tuvalu'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.

the mitigation targets set out in its First NDC. Total GHG mitigation potential and investment need for each sector is included in Table 1.1<sup>22</sup>.

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

Sector	Cumulative GHG emissions reduction by 2030 (tCO <sub>2</sub> e) <sup>23</sup>	Indicative investment need to 2030 (US\$)
Land transport	3,506	16,914,000
Maritime transport	4,900	2,671,000
Energy efficiency	852	256,000

Tuvalu's NDC Roadmap and Plan has been developed in close collaboration with stakeholders in Tuvalu. 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 GoT, the NDC Hub, and the management consulting company Castalia; virtual meetings with sector champions<sup>24</sup>; and a Cross-sector Workshop, during which participants from various ministries gathered to discuss opportunities in each focus sector. This consultation phase informed the draft NDC Roadmap and Plan
- **Phase two** involved two main parts: feedback from GGGI and the GoT 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.

<sup>22</sup> Further detail about the investment need and GHG mitigation potential in each sector is included in section 5.

<sup>23</sup> The emissions reduction estimate calculations are explained in the concept notes in Appendix A.

<sup>24</sup> Sector champions are stakeholders located in Tuvalu. The GoT 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.

## 2 National circumstances, including NDC targets and GHG emissions profile

### 2.1 National circumstances

Tuvalu is made up of nine inhabited islands in the west-central Pacific Ocean, and has a total land area of approximately 26 square kilometres. It is the fourth-smallest country in the world by total land area. The average height above sea level is less than 3 metres, with the highest point above sea level being 4.6 m in Niulakita<sup>25</sup>.

Funafuti Atoll<sup>26</sup> is the capital of Tuvalu and consists of two main islands: Fongafale, where the majority of the population lives, and the government administration and the international airport are located; and Amatuku, where the Tuvalu Maritime Training Institute is located<sup>27</sup>. Tuvalu has a population of approximately 10,600<sup>28</sup>. 63 percent (6,700 people) of the population lives in the capital Funafuti<sup>29</sup>. The rest of the population (4,000 people) live on eight outer islands<sup>30</sup>.

Tuvalu has an estimated Gross Domestic Product (GDP) of US\$42 million and a per capita GDP of US\$3,800 (2017 estimates)<sup>31</sup>. Tuvalu's exports total approximately US\$30 million (2018 estimate), the majority of which is frozen fish and agricultural products<sup>32</sup>. More recently, Tuvalu has made significant income (approximately 8 percent of its annual gross national income) from licensing its internet domain (.tv) to technology companies<sup>33</sup>.

Due to its small population, Tuvalu relies heavily on imports for food, other goods, and skilled services. A large proportion of Government income comes from Official Development Assistance. Tuvalu's annual imports total US\$48 million (2018 estimate), chiefly made up of refined petroleum (US\$14 million), fishing ships (US\$11.4 million), tug boats (US\$9 million), passenger and cargo ships (US\$6.3 million) and iron structures

---

<sup>25</sup> [https://www4.unfccc.int/sites/SubmissionsStaging/NationalReports/Documents/7190452\\_Tuvalu-NC2-1-Tuvalu%20%20SNC%20Final%20Report.pdf](https://www4.unfccc.int/sites/SubmissionsStaging/NationalReports/Documents/7190452_Tuvalu-NC2-1-Tuvalu%20%20SNC%20Final%20Report.pdf)

<sup>26</sup> Funafuti Atoll made up of at least 29 inlets <https://www.theguardian.com/global-development/2019/may/16/one-day-disappear-tuvalu-sinking-islands-rising-seas-climate-change>

<sup>27</sup> [https://www4.unfccc.int/sites/SubmissionsStaging/NationalReports/Documents/7190452\\_Tuvalu-NC2-1-Tuvalu%20%20SNC%20Final%20Report.pdf](https://www4.unfccc.int/sites/SubmissionsStaging/NationalReports/Documents/7190452_Tuvalu-NC2-1-Tuvalu%20%20SNC%20Final%20Report.pdf)

<sup>28</sup> Tuvalu Population & Housing Mini-Census 2017, Preliminary Report

<sup>29</sup> Tuvalu Population & Housing Mini-Census 2017, Preliminary Report

<sup>30</sup> Tuvalu Population & Housing Mini-Census 2017, Preliminary Report

<sup>31</sup> <https://www.cia.gov/the-world-factbook/static/a61cc1edf7701ed2e99a2c03f8e11691/TV-summary.pdf>

<sup>32</sup> <https://oec.world/en/profile/country/tuv>

<sup>33</sup> [https://unctad.org/system/files/official-document/dtlstict2019d13\\_en.pdf](https://unctad.org/system/files/official-document/dtlstict2019d13_en.pdf)

(US\$4.6 million). Imports are predominantly from Fiji, China, Japan, New Zealand, and Australia<sup>34</sup>.

Tuvalu is one of the most vulnerable countries in the world to the impacts of climate change. The majority of Tuvaluans live in low-lying coastal areas, which are vulnerable to storm surges, tropical cyclones, and sea level rise. In addition, the country is economically dependent on ocean resources and has limited adaptive capacity<sup>35</sup>. Climate change is already impacting Tuvalu—beaches are being eroded, coral reefs are being damaged, and crops are dying from salt-water intrusion<sup>36</sup>.

Resettlement has been put forward as an option to help Tuvaluans impacted by climate change. However, this would have significant impact on the language, culture, heritage, and the overall wellbeing of the citizens of Tuvalu. Tuvalu will have to build its resilience to the impacts of climate change through significant investment in adaptation.

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

There are several national and sectoral strategies, plans, and policies that are relevant to climate change mitigation efforts in Tuvalu, and which 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 GHG mitigation projects**

Document title	Description
<b>Overarching documents</b>	
<b>Te Kakeega III, Tuvalu's National Strategy for Sustainable Development 2016-2020 (TKIII) (2016)</b>	TKIII aims to align Tuvalu's development plans and strategies with the UN Sustainable Development Goals. TK III highlights priority areas as climate change, environment, migration and urbanization, and oceans and seas.
<b>Infrastructure Strategy and Investment Plan 2016–2025 (TISIP) (2017)</b>	This plan provides a country-led and prioritised investment plan for Tuvalu's economic infrastructure between 2016-2025. It identifies the investment needs and priorities for economic infrastructure and assesses the financial resources essential to support implementation. It covers multiple sectors, including: maritime transport, land transport, water and sanitation, waste management, energy, and coastal protection.
<b>Infrastructure Strategy and Investment Plan 2016-2020 (TISIP) (2016)</b>	This Plan identifies twelve strategic areas for policy development, including climate change, infrastructure, and support services (which includes energy and renewable energy, maritime transport, and roads).

<sup>34</sup> <https://oec.world/en/profile/country/tuv>

<sup>35</sup> <https://www.adb.org/sites/default/files/linked-documents/48484-004-sd-02.pdf>

<sup>36</sup> <https://www.un.org/en/chronicle/article/threat-our-human-rights-tuvalu-perspective-climate-change>

Document title	Description
<b>Tuvalu's Nationally Determined Contribution (NDC) (2015)</b>	This document is Tuvalu's committed contribution under the Paris Agreement of the United Nations Framework Convention on Climate Change (UNFCCC). The mitigation component of the NDC focuses on the broader energy sector (specifically power and transport) and the maritime and coastal sector.
<b>Second National Communication to the UNFCCC (SNC) (2015)</b>	This document provides information on the progress made by Tuvalu in implementing the United Nations Framework Convention on Climate Change (UNFCCC) and includes the national inventory of anthropogenic GHG emissions.
<b>Recovery and Vulnerability Reduction Plan (2015)</b>	This document addresses the investment needs to recover from Tropical Cyclone Pam and outlines long-term infrastructure rehabilitation needs.
<b>Te Kaniva: Tuvalu National Climate Change Policy 2012-2021 (2012)</b>	This document prescribes the GoT's strategic policies for responding to climate change impacts and related disaster risks over the next 10 years (2012-2021). The Policy is directly linked to the National Strategic Action Plan for Climate Change and Disaster Risk Management (NSAP).
<b>The National Strategic Action Plan (NSAP) 2012-2016</b>	This document provides a prioritised programme of action for the GoT to implement, in collaboration with the private sector and wider society, between 2012-2016.
<b>Land transport sector</b>	
<b>Traffic Act 2008</b>	This Act provides for the control of traffic and licensing of motor vehicles, bicycles, and drivers.
<b>Police Powers and Duties Act 2009</b>	This Act provides for the powers and responsibilities of the Tuvalu Police Force, including for vehicle and traffic offences
<b>Maritime transport sector</b>	
<b>Tuvalu Merchant Shipping Act 2008</b>	This Act provides for the registration of ships, the control and regulation of merchant shipping, and qualification of sailors.
<b>Tuvalu Marine Pollution Act 2008</b>	This Act provides for preventing and dealing with pollution of the sea, the prevention of marine pollution, and the protection of the marine environment.
<b>Energy efficiency sector</b>	
<b>Energy Efficiency Act 2016</b>	This Act promotes energy efficiency and legislates control of the importation, use and scale of inefficient electrical appliances.
<b>Renewable Electricity and Energy Efficiency Master Plan (2012)</b>	This is the GoT's plan to develop renewable energy and energy efficiency. The strategy's goal is to convert Tuvalu's electricity generation from 100 percent diesel to 100 percent renewable, particularly focusing on solar and wind generation and demand management and grid stability.
<b>National Energy Policy Tuvalu (2009)</b>	This policy identifies strategic areas (including petroleum, renewable energy and energy efficiency, transport, and environment) where action is required to achieve the overall goal of promoting the use of renewable energy and ensuring Tuvaluans have cost effective, reliable, accessible, secure, and environmentally sustainable energy.



## 2.3 GHG emissions profile

Tuvalu's last comprehensive national GHG inventory was prepared in 2002. Data on electricity sector GHG emissions were updated in 2014. According to Tuvalu's draft Second National Communication (SNC), Tuvalu's total GHG emissions in 2014 were 18,467 tCO<sub>2</sub>e<sup>37</sup>. Of this total, 11,161<sup>38</sup> tCO<sub>2</sub>e comes from the energy sector. Tuvalu's 2015 NDC focuses on reducing GHG emissions from the energy sector.

Within the energy sector, electricity generation is the largest source of GHG emissions, contributing 5,430 tCO<sub>2</sub>e (49 percent of the total energy sector GHG emissions). The total installed generation capacity in Funafuti is 2,550 kW, of which 1,800 kW (74 percent) is diesel. Off-grid generators and solar photovoltaic (PV) installations make up the additional electricity capacity. Maritime transport produces the second-largest share of energy sector GHG emissions (30 percent), while road transport contributes only 5 percent of Tuvalu's energy sector GHG emissions. Table 2.2 presents a summary of Tuvalu's GHG emissions by sector.

**Table 2.2: Summary of Tuvalu's energy sector GHG emissions by sub-sector (2014 and 2002)**

Sector	GHG emissions (tCO <sub>2</sub> e)	Percent of total GHG emissions (%)
Electricity	5,430	49
Road transport	570	5
Maritime transport	3,350	30
Residential energy generated <sup>39</sup>	1,560	14
Agriculture, forestry, and fishing <sup>40</sup>	240	2
<b>Total</b>	<b>11,161</b>	<b>100</b>

Source: Second National Communication of Tuvalu (2015)

Note: Electricity data is based on 2014 electricity generation data. All other sectors are based on 2002 data

Note: GHG emissions figures (GG CO<sub>2</sub>e) are rounded to the nearest two decimal places

<sup>37</sup> The 2014 GHG emissions estimate combines data on GHG emissions from electricity generation in 2014 with data on GHG emissions from all other sectors recorded in 2002. Second National Communication of Tuvalu (2015), available at: [https://www4.unfccc.int/sites/SubmissionsStaging/NationalReports/Documents/7190452\\_Tuvalu-NC2-1-Tuvalu%20%20SNC%20Final%20Report.pdf](https://www4.unfccc.int/sites/SubmissionsStaging/NationalReports/Documents/7190452_Tuvalu-NC2-1-Tuvalu%20%20SNC%20Final%20Report.pdf)

<sup>38</sup> Tuvalu's SNC reports two figures for GHG emissions from the energy sector—11,161 and 11,214 tCO<sub>2</sub>e. 11,161 tCO<sub>2</sub>e is used throughout this document.

<sup>39</sup> For example, fuel combustion for cooking.

<sup>40</sup> For example, GHG emissions from outboard motors.

## 2.4 NDC targets

GHG emissions in Tuvalu are very small on a global scale. Despite this, as an island nation at particular risk of the adverse impacts of climate change, Tuvalu is keen to play its part in global climate change mitigation efforts. Tuvalu's First NDC (published in 2015) outlines how the country aims to mitigate its GHG emissions.

*Tuvalu's NDC focuses primarily on reducing GHG emissions from the energy sector (specifically electricity and transport)*

Tuvalu included the following targets in its 2015 NDC:

- Reduce emissions of GHGs from the electricity generation (power) sector by 100 percent, i.e., almost zero emissions by 2025;
- Reduce total emissions of GHGs from the entire energy sector to 60 percent below 2010 levels by 2025; and
- Pursue a zero-carbon development pathway by 2050 (dependent on the availability of finance and technology)<sup>41</sup>.

Tuvalu's GHG emissions reduction targets are conditional on availability of necessary technology and access to finance.

*Tuvalu has achieved approximately 20 percent of its 100 percent renewable energy target, but new solar PV installations are set to increase the renewable share*

The outer islands of Tuvalu are already generating 80 to 90 percent of their electricity from renewable sources. Diesel is used for the remaining 10 to 20 percent of generation on these outer islands.

The GoT is committed to increasing the use of renewables for electricity generation to strengthen Tuvalu's energy security, particularly on the country's main island of Funafuti. Tuvalu, with funding from New Zealand's Ministry of Foreign Affairs and Trade, is developing a new solar PV plant (with battery storage) in Funafuti. The US\$6 million project will include 770 kW of Solar PV and at least 1 MWh of battery storage<sup>42</sup>. The plant will help replace diesel on the island, where about 85 percent of electricity is currently generated from diesel. The plant was expected to be completed by the end of 2020 but has been delayed due to COVID-19 travel restrictions.

In addition, two large renewable energy projects, funded by the World Bank and the Asian Development Bank (ADB), will see the installation of an additional 2 MW of solar PV, 2 MWh of battery storage, and a small wind turbine on Funafuti<sup>43</sup>. Following the completion of these projects, Funafuti is expected to achieve a renewable energy contribution of approximately 90 percent. This will mean that nationwide, Tuvalu will generate approximately 90 percent of its electricity through renewable sources.

<sup>41</sup> <https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Tuvalu%20First/TUVALU%20INDC.pdf>

<sup>42</sup> <https://www.infratec.co.nz/projects/first-solar-battery-project-completed-for-tuvalu>

<sup>43</sup> See Appendix D for more information about existing and planned projects in the electricity sector.

*Tuvalu is currently highly dependent on the import of energy in the form of expensive fossil fuels*

Maritime vessels running on imported fossil fuels are critical to providing services to remote islands and transporting goods and people long distances between them. Tuvalu's distance from mature economies, as well as lack of economies of scale, and limited bargaining power, results in high import prices for fuel (and other commodities). Tuvalu is also highly exposed to fluctuating global fuel prices. Reducing the use of fossil fuels would help Tuvalu to reduce expenditure on fuel imports (which cost the country approximately US\$14 million per year)<sup>44</sup>.

*GoT has identified scope to reduce GHG emissions in the land transport and maritime transport sectors*

There are opportunities to reduce fossil fuel consumption in both the maritime and land transport sector by increasing efficiency and considering alternative fuel sources and technologies. Despite new opportunities in the land and maritime transport sectors, limited financial capability is hindering the ability to make faster progress in reducing GHG emissions. This NDC Roadmap and Plan seeks to help generate interest from potential implementation partners, including donors and private investors.

---

<sup>44</sup> <https://oec.world/en/profile/country/tuv>

### 3 Institutional Context

This Section provides a general overview of the government agencies in Tuvalu 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 Tuvalu's GHG mitigation targets.

Table 3.1 details the key government agencies and other organisations, their capacity for NDC implementation (in terms of the number of full-time staff equivalent (FTE)), and constraints to NDC implementation. This information was gathered through project research, as well as consultations with, and a survey completed by, participants at the Consultation Workshop (24 March 2021).

All institutions have some capacity to implement and manage climate change mitigation projects. However, each institution also faces some combination of the following constraints to NDC implementation:

- Lack of budget for new projects
- Limited human capacity to implement and manage projects
- Capacity building required to advance technical skills, understandings of technological changes, and knowledge of projects, and to improve project implementation, management, and monitoring skills
- Minimal experience managing large investment projects and environmental and social safeguards
- Coordination challenges with other ministries.

Constraints on NDC implementation in each sector (including institutional constraints), and solutions to overcome these constraints, are discussed in Sections 4.1.3, 4.2.3, and 4.3.3.

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

Institution	Roles and relationship to NDC implementation	Number of FTE available for NDC implementation <sup>45</sup>
Island Councils (Kaupule)	Island Councils (Kaupule), in coordination with the Ministry of Local Government and Agriculture, manage the land transport infrastructure and other infrastructure of the outer islands. Kaupule are also responsible for vehicle registrations outside of Funafuti	0.16
Ministry of Communication and Transport (MCT)	MCT is responsible for the provision of strategic policy direction in Tuvalu's transport and communications infrastructure and aims to provide high quality and cost-effective transport and communication services	0.4
Ministry of Finance (MoF)	MoF has oversight of the Department of Climate Change and Disaster (CCD), which is responsible for implementing and coordinating Tuvalu's NDC goals. MoF also has an overarching role in guiding the development of the land transport sector towards sustainable operations	1
Ministry of Fisheries and Trade (MFT)	MFT coordinates Tuvalu's fishing and trade industries. Department of Trade (DOT) is responsible for trade promotion and development, trade negotiations, trade facilitation, and policy formulation. MFT is responsible for developing Tuvalu's agriculture and fisheries sectors and securing the value chain	1.6
Ministry of Home Affairs and Rural Development (MHA)	MHA is responsible for waste levies and programmes in Tuvalu. The Department of Rural Development is responsible for local government	0.06
Ministry of Local Government and Agriculture (MLGA)	MLGA coordinates the outer islands, including their community governance structures and management of public resources	0.06
Ministry of Public Works, Infrastructure, Environment, Labour, Meteorology and Disaster	This ministry has a range of responsibilities, including: <ul style="list-style-type: none"> <li>Providing infrastructure for government assets, public buildings, roads, and sea walls</li> <li>Assessing damage to civil infrastructure, properties, and water storage</li> </ul>	1.6

<sup>45</sup> Number of FTE is based on the 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. These figures were reported by stakeholders who participated in the Consultation Workshop on 24 March 2021.



Institution	Roles and relationship to NDC implementation	Number of FTE available for NDC implementation <sup>4,5</sup>
<b>Ministry of Transport, Energy and Tourism (MTET)</b>	<ul style="list-style-type: none"> <li>Managing the six major water storage facilities on Funafuti and six on the outer islands</li> <li>Approving septic tank designs and providing backup sanitation services</li> <li>The Public Works Department has oversight over land transport infrastructure in Funafuti and other infrastructure developments across Tuvalu</li> </ul> <p>MTET has a range of responsibilities, including:</p> <ul style="list-style-type: none"> <li>Overseeing the Tuvalu Electricity Corporation (TEC)</li> <li>Maintaining and expanding the electricity grid, and accommodating renewable energy</li> <li>Managing maritime transport issues and fuel imports</li> </ul>	0.4
<b>Tuvalu Energy Corporation (TEC)</b>	TEC is a state-owned enterprise and is the sole provider of electricity services in Tuvalu. TEC is working towards achieving the country's goal of using 100 percent renewable energy by 2025	0.15
<b>Tuvalu Police Force (TPF)</b>	TPF maintains data on traffic-related accidents and infringements and also enforces compliance issues	0.06

*Note: The institutional roles and relationship to NDC implementation is modified from the GGGI Tuvalu Scoping Mission Report*

The following institutions may also be relevant for NDC implementation: Funafuti Town Council, Tuvalu National Private Sector Organization (TNPSO), Ministry of Health, Social Welfare and Gender Affairs, and Ministry of Education, Youth & Sports (MEYS). The National Bank of Tuvalu (NBT) and the Development Bank of Tuvalu (DBT) are also likely to be important financial institutions. The role of these financial institutions is explored in detail in the Financing Plan (Section 6).

## 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 Land transport

*Tuvalu has a limited and underdeveloped road network*

The Tuvalu Infrastructure Strategy and Investment Plan 2016–2025 indicates Funafuti has the only sealed road infrastructure in Tuvalu, with 15.5 kilometres of sealed roads constructed. There are currently no plans to seal roads on the outer islands, and no bridges exist.

*Land transport in Tuvalu lacks the market diversity seen elsewhere in the world*

According to available data, there are approximately 3,799 registered land vehicles in Tuvalu, mostly located in Funafuti<sup>46</sup>. Table 4.1 details the breakdown of registered land transport vehicles in Tuvalu. Motorbikes (ranging largely from 110-250cc) represent approximately 90 percent of the currently registered vehicle fleet in Funafuti (approximately 3,440 motorbikes). Other forms of transport in Tuvalu are limited. For example, bicycle use in Tuvalu is minimal, particularly on the main islands, and although stakeholders suggest that the number of cars in Tuvalu has increased recently (particularly in the last year), cars make up only six percent of registered vehicles<sup>47</sup>. There are approximately 10 buses in Tuvalu, mainly used to pick up and drop off primary and secondary school students<sup>48</sup>.

**Table 4.1: Registered land transport vehicles**

Vehicle type	Quantity
Motorbikes	3,440
Cars	211
3-wheeled vehicles	27
4-wheeled vehicles	7
Scooter	26
Trucks	47

<sup>46</sup> Consultation with stakeholders in Tuvalu, and data collected from the Funafuti Town Council, Island Councils (Kaupule), and ASYCUDA Project.

<sup>47</sup> [https://openresearch-repository.anu.edu.au/bitstream/1885/157782/1/202\\_motorisation.pdf](https://openresearch-repository.anu.edu.au/bitstream/1885/157782/1/202_motorisation.pdf); Consultation Workshop, 24 March 2021.

<sup>48</sup> Consultation Workshop, 24 March 2021.

Vehicle type	Quantity
Buses	10 <sup>49</sup>
Vans	4
Other (including vehicles listed without vehicle type)	18
<b>Total</b>	<b>3,799<sup>50</sup></b>

Source: Consultation with stakeholders in Tuvalu, and data collected from the Funafuti Town Council, Island Councils (Kaupule), ASYCUDA Project

The actual number of vehicles on the road in Tuvalu is likely to be higher than those listed in Table 4.1 because, although vehicle owners must annually renew registration, Funafuti Town Council records suggest that only around 10 per cent (or even less) do so<sup>51</sup>. Discrepancy between registered and actual vehicles is evidenced by stakeholders, who suggested that there are approximately 1,000 light vehicles in Tuvalu, which is much higher than the recorded 250 registered light vehicles<sup>52</sup>. The rate of turnover of Tuvalu's land transport fleet is approximately 7.5 years<sup>53</sup>.

#### *Electric vehicles are subject to the same tariffs as other vehicles*

All vehicles in Tuvalu are imported, predominantly from Japan. Table 4.2 details the number of motorbikes and other vehicles imported to Tuvalu between 2015 and 2020. The import duty varies depending on the size of the vehicle (either engine size or number of people the vehicle can transport) and whether the vehicle is new or used. On average, new Internal Combustion Engine (ICE), hybrid, and electric light vehicles have a 9 percent import duty rate, and used vehicles have an import duty rate of US\$1,340 per vehicle or 9 percent (whichever is greater). New and used motorbikes are subject to 15 and 20 percent import duty, respectively<sup>54</sup>.

**Table 4.2: Number of imported vehicles between 2015 and 2020**

Vehicle type	2015	2016	2017	2018	2019	2020	Total
<b>Motorbikes</b>	29	507	557	752	912	755	4210
<b>Other vehicles</b>	29	40	64	50	53	61	297

Source: Tuvalu Customs Department

<sup>49</sup> Data provided by the Funafuti Town Council and Island Councils (Kaupule) stated there is one bus in Tuvalu. However, stakeholders during the consultation workshop stated there are approximately 10 busses in Tuvalu. Given that data provided by central or local government is limited due a large majority of vehicles being unregistered, it is assumed that Tuvalu has 10 buses.

<sup>50</sup> The total number of vehicles is not a sum of the quantity of vehicles listed in Table 4.1. The total number of vehicles was provided by stakeholders in Tuvalu.

<sup>51</sup> Mellor, C. S. (2005). Motorisation in paradise: the economics of land transport in Tuvalu.

<sup>52</sup> Data used in the land transport concept notes in Appendix A was provided by stakeholders in Tuvalu, rather than data collected by central and/or local Government which does not include data on non-registered vehicles.

<sup>53</sup> Castalia analysis for the present report.

<sup>54</sup> Tuvalu Customers and Border Protection Services, Customs Tariff Schedule, 2017.

#### *Land transport across Tuvalu is overseen by both national and local government bodies*

The sector is underpinned by the Traffic Act 2008 and the Police Powers and Duties Act 2009. A Land-use Management Plan (LUM), titled National Action Plan to Combat Land Degradation and Drought (2006), has been developed, but it has not been implemented<sup>55</sup>. Stakeholders in Tuvalu stated the plan cannot be finalised until the Biodiversity Rapid Assessment Report (BIORAP), from the Ridge to Reef team, is finalised. This BIORAP report is currently in progress<sup>56</sup>.

Road network infrastructure is managed by the Ministry of Public Works, Infrastructure, Environment, Labour, Meteorology and Disaster, specifically the Public Works Department. The Tuvalu Police Force enforces road transport legislation, and maintains data on traffic-related accidents and infringements. The Funafuti Town Council, a local government body, is responsible for vehicle registration in Funafuti and handles active and expired vehicle details in the capital, while the Island Councils (Kaupule), in coordination with the Ministry of Local Government and Agriculture, are responsible for the land transport infrastructure of the outer islands. The country has not established a Land Transport Authority and the Ministry of Transport, Energy and Tourism (MTET) chiefly focuses on maritime transport.

#### **4.1.1 Key national stakeholders in land transport**

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

**Table 4.3: Key national stakeholders in land transport**

Key stakeholder	Roles within the sector
<b>Funafuti Town Council</b>	The Funafuti Town Council is responsible for vehicle registration in Funafuti, and handles active and expired vehicle details
<b>Island Councils (Kaupule)</b>	Island Councils (Kaupule), in coordination with the Ministry of Local Government and Agriculture, manage the land transport infrastructure and other infrastructure of the outer islands. Kaupule are also responsible for vehicle registrations outside of Funafuti
<b>Ministry of Communication and Transport (MCT)</b>	MCT is responsible for the provision of strategic policy direction in Tuvalu's transport and communications infrastructure, and aims to provide high quality and cost-effective transport and communication services
<b>Ministry of Finance (MoF)</b>	MoF has oversight of the Department of Climate Change, which is responsible for implementing and coordinating Tuvalu's NDC goals. MoF also has an overarching role in guiding the development of the land transport sector towards sustainable operations
<b>Ministry of Local Government and Agriculture (MLGA)</b>	MLGA coordinates the outer islands, including their community governance structures and management of public resources
<b>Ministry of Public Works, Infrastructure, Environment,</b>	The ministry provides infrastructure for government assets, public buildings, roads, and sea walls. The Public Works Department has

<sup>55</sup> <https://www.adb.org/sites/default/files/linked-documents/cobp-tuv-2017-2019-ld-02.pdf>

<sup>56</sup> Consultation with stakeholders in Tuvalu.

Key stakeholder	Roles within the sector
Labour, Meteorology and Disaster	oversight over land transport infrastructure in Funafuti and other infrastructure developments across Tuvalu
Private sector	There are a range of retailers of new motorbikes, automobiles, and bicycles in Tuvalu (predominantly in Funafuti), however these have decreased over the past few years due to retail and service constraints across the market
Tuvalu Police Force (TPF)	TPF maintains data on traffic-related accidents and infringements and also enforces compliance issues

*Note: Modified from the GGGI Tuvalu Scoping Mission Report*

### 4.1.2 Specific NDC targets for land transport

Tuvalu's First NDC does not include a specific quantitative target for reducing land transport GHG emissions, which account for about 5 percent of the country's total GHG emissions. However, reducing GHG emissions from land transport could play an important part of Tuvalu's goal to reduce total GHG emissions of GHGs from the entire energy sector to 60 percent below 2010 levels by 2025. In the long term, GHG emissions from land transport will need to be either eliminated or offset in order to reach Tuvalu's 100 percent renewable electricity target and the country's overall energy sector target.

### 4.1.3 Constraints on land transport sector

Eight overarching constraints limit the implementation of GHG mitigation projects in the land transport sector. These constraints were identified during research on the land transport sector, research on potential GHG mitigation opportunities, as well as by stakeholders during the Consultation Workshop (held on 24 March 2021). 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 budget to implement and manage new projects. Private sector involvement to implement GHG mitigation opportunities could help with budget constraints. However, funding GHG mitigation opportunities necessary to achieve Tuvalu's NDC is likely to be beyond the ability of the GoT and the private sector<sup>57</sup>. Significant international climate finance is likely to be needed<sup>58</sup>. Each project concept note includes a procurement method, which details how the GHG mitigation opportunity could be funded and financed. This will help the GoT find viable sources of funding to implement GHG mitigation opportunities.

#### Institutional capacity

Institutions involved in NDC implementation do not have sufficient capacity (including personnel and staff time) to implement projects. For example, the Ministry of Public Works, Infrastructure, Environment, Labour, Meteorology and Disaster has only 1.6 FTE available for NDC implementation projects. Participants also suggested that no more than two projects should be run in the land transport sector at one time. To account for limited

<sup>57</sup> Identified by stakeholders who participated in the Consultation Workshop on 24 March 2021.

<sup>58</sup> Identified by stakeholders who participated in the Consultation Workshop on 24 March 2021.



institutional capacity, stakeholders in Tuvalu stated that no more than two projects are being managed by the land transport sector institutions concurrently.

### Experience

Stakeholders in Tuvalu 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 due to new technologies and regulatory and legislative changes that may need to be introduced<sup>59</sup>. Projects included in the pipeline have been designed to incorporate capacity building programs and technical assistance activities when needed.

### Data

Data on land transport in Tuvalu is limited. For example, data on traffic surveys, traffic volumes, vehicle imports, or vehicle registrations is often inaccurate, incomplete, or inaccessible<sup>60</sup>. Without accurate data on demand and current usage, it is 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 Tuvalu's land transport sector.

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

### Coordination

Activities in the sector can be better coordinated between ministries, agencies, development partners, financial entities, private businesses, and individuals<sup>61</sup>. This is likely because the land transport sector has minimal reporting requirements, there is no Land Transport Authority to oversee developments, and there is no underpinning regulatory framework or strategy<sup>62</sup>.

As stated above, regulatory requirements (such as annual vehicle registrations) are not well enforced, which makes it difficult to understand characteristics of the fleet and the market. Funafuti Town Council records suggest that although vehicle owners must annually renew registration, only around 10 percent (or even less) do so<sup>63</sup>.

The responsible ministry to lead projects in the land transport sector has yet to be defined by the GoT. A sector leader of each project will also need to be identified, as outlined in Section 7). Having one executor for each project will enable project ownership and enforcement (particularly in absence of an overarching Land Transport Authority), and will also facilitate coordination between ministries.

---

<sup>59</sup> These views were reported by stakeholders in a survey distributed during the consultation workshop.

<sup>60</sup> Mellor, C. S. (2005). *Motorisation in paradise: the economics of land transport in Tuvalu*.

<sup>61</sup> Identified by stakeholders during the Inception Mission.

<sup>62</sup> <https://www.adb.org/sites/default/files/linked-documents/cobp-tuv-2017-2019-ld-02.pdf>

A Land-use Management Plan (LUM) has been developed, but not implemented. The LUM is titled National Action Plan to Combat Land Degradation and Drought (2006). Stakeholders in Tuvalu stated the plan cannot be finalised until the BIORAP assessment report, from the Ridge to Reef team, is finalised. This report is currently in progress.

<sup>63</sup> Mellor, C. S. (2005). *Motorisation in paradise: the economics of land transport in Tuvalu*

### 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 Tuvalu run on unleaded petroleum (ULP) or automotive diesel oil (ADO). Currently, there are few alternatives to fossil-fuelled vehicles in Tuvalu. Furthermore, there are no financial incentives to encourage the import or purchase of low-carbon vehicles in Tuvalu.

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

### 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<sup>64</sup>. This is likely due to the lack of low carbon and electric vehicles available in Tuvalu. In addition, stakeholders suggested that people may be resistant to change from BAU—for example, Tuvaluan's are used to the speed and size of motorbikes and cars and therefore may not be open to electric alternatives that are perceived as less powerful and/or capable. Where relevant, awareness-raising programs have been included as a part of the design of the GHG mitigation project to demonstrate the capabilities of new vehicles and encourage their uptake. Awareness-raising programs will be important to encourage behavioural changes.

### Land space

Stakeholders in Tuvalu stated that land space is limited and improving existing roads will be challenging. This constraint is particularly important for NDC projects in the land transport sector, which require Tuvalu's roads to be in good condition. Stakeholders did not state that the pipeline projects were unable to go ahead with the current condition of the roads and limited land space. Limited land space and poor road condition has been added to barriers section of the concept notes for the land transport sector projects. In addition, future projects could consider upgrading main roads<sup>65</sup>.

## 4.2 Maritime transport

*Maritime transport is crucial to Tuvalu's economy and the livelihoods of Tuvaluans*

Tuvalu is a maritime nation with 6 atolls and 3 islands spread over an exclusive economic zone (EEZ) of 700,000 square kilometres (km<sup>2</sup>). Tuvalu is characterized by small, remote

---

<sup>64</sup> Concerns raised by stakeholders during the Inception Mission.

<sup>65</sup> The project 'active transport infrastructure upgrade' was proposed early in the consultation and aimed to improve to public walkways, develop pathways for bikes and micro mobility, and increase safe road spaces by introducing space between motorised vehicle traffic lanes and non-motorised lanes. This project was removed from the pipeline because stakeholders stated that the project would likely require land reclamation. Land reclamations would increase the cost for this project substantially and this was already an extremely expensive project with only very modest emissions reduction potential. In future, Tuvalu could integrate aspects of the 'active transport infrastructure upgrade' with a road upgrade project.

communities on small islands separated by long distances. These communities rely on sea transport for their connectivity, and access to food, health, and education services. The only port in Tuvalu is on Funafuti, and there is also a deep-water berth in the lagoon at Nukufetau.

*The government provides interisland passenger and cargo services*

Funafuti receives a large cargo vessel (110 meters with 8,000 tons of capacity) of supplies from Fiji once a month. Some goods are transhipped to the outer islands on the Government's inter-island passenger and freight vessels—the government has five maritime vessels: MV Nivaga III, MV Manu Folau, Moeiteava, Mataili and Manau. These vessels can carry approximately 200 passengers as well as freight<sup>66</sup>. The interisland service is heavily subsidised—annual operations cost approximately US\$23 million, while revenue from passengers and freight total approximately US\$0.39 million annually<sup>67</sup>. The service visits each island every 2-3 weeks, and can be used for supplies and medical evacuation or other emergencies. The service is sometimes interrupted or delayed due to rough weather. GoT has two additional vessels which are used for maritime patrol and fishing. GoT is also currently procuring a landing craft tank (LCT) barge.

*Small private boats are predominantly used for fishing*

There are approximately 2,000 small private boats in Tuvalu<sup>68</sup>. Fisheries is an important industry in Tuvalu. Domestic fishing is for personal consumption or is sold in local fisheries centres<sup>69</sup>. Approximately 67 percent of the population is involved in the fishing industry<sup>70</sup>. Commercial fishing in Tuvalu is mainly done by foreign vessels operating under access agreements. Commercial fisheries are a major source of income for the GoT – the fishing license fee contributes about 40 percent of government revenue<sup>71</sup>, the commercial fishing industry also provides employment to Tuvaluans<sup>70</sup>.

*Both national and local government bodies oversee maritime transport across Tuvalu*

The key ministry in the maritime transport sector is the Ministry of Transport, Energy and Tourism (MTET), which manages maritime transport projects and policy development, and has oversight of the Marine and Port Services units. The Marine Unit operates government vessels, while the Port Services Unit operates Funafuti Port. Island Councils (Kaupule) have oversight of projects on the outer islands, and also conduct surveys of small boats and outboard motor use on the outer islands. The sector is underpinned by the Merchant Shipping Act 2008 and the Marine Pollution Act 2008.

---

66 Identified by stakeholders who participated in the Consultation Workshop on 24 March 2021 and from other consultation with stakeholders in Tuvalu.

67 <https://www.sprep.org/att/IRC/eCOPIES/Countries/Tuvalu/41.pdf>

68 This estimate is based on information from stakeholders who stated there are 1,886 2-stroke motors and 16 4-stroke motors.

69 [https://spccfpstore1.blob.core.windows.net/digitallibrary-docs/files/54/5429a3d095d46de8cfc7878883ac94dd.pdf?sv=2015-12-11&sr=b&sig=js6W4bR5JqP9%2B52oqLS0Pb2GoErpHFEcbgoMG4Cn33M%3D&se=2022-03-15T03%3A25%3A18Z&sp=r&rsc=public%2C%20max-age%3D864000%2C%20max-stale%3D86400&rsc=application%2Fpdf&rscd=inline%3B%20filename%3D%22FishNews150\\_19\\_Preston.pdf%22](https://spccfpstore1.blob.core.windows.net/digitallibrary-docs/files/54/5429a3d095d46de8cfc7878883ac94dd.pdf?sv=2015-12-11&sr=b&sig=js6W4bR5JqP9%2B52oqLS0Pb2GoErpHFEcbgoMG4Cn33M%3D&se=2022-03-15T03%3A25%3A18Z&sp=r&rsc=public%2C%20max-age%3D864000%2C%20max-stale%3D86400&rsc=application%2Fpdf&rscd=inline%3B%20filename%3D%22FishNews150_19_Preston.pdf%22)

70 <http://www.fao.org/fi/oldsite/FCP/en/TUV/profile.htm#:~:text=From%20census%20data%20it%20has,are%20quite%20important%20in%20Tuvalu.>

71 <https://pubdocs.worldbank.org/en/256961563917598074/mpo-cpi.pdf>

### 4.2.1 Key national stakeholders in maritime transport

Table 4.4 details the key national stakeholders in the maritime transport sector.

**Table 4.4: Key national stakeholders in maritime transport**

Key stakeholder	Roles within the sector
Island Councils (Kaupule)	Island Councils (Kaupule), in coordination with the Ministry of Local Government and Agriculture, manage the land transport infrastructure and other infrastructure of the outer islands. Kaupule are responsible for vehicle registrations outside of Funafuti, and conduct surveys of small boats and outboard motor use on the outer islands
Ministry of Communication and Transport (MCT)	MCT is responsible for the provision of strategic policy direction in Tuvalu's transport and communications infrastructure, and aims to provide high quality and cost-effective transport and communication services
Ministry of Finance (MoF)	MoF has oversight of the Department of Climate Change, which is responsible for implementing and coordinating Tuvalu's NDC goals. MoF also has an overarching role in guiding the development of the maritime transport sector towards sustainable operations
Ministry of Fisheries and Trade (MFT)	MFT coordinates Tuvalu's fishing and trade industries. Department of Trade (DOT) is responsible for trade promotion and development, trade negotiations, trade facilitation, and policy formulation. MFT is responsible for developing Tuvalu's agriculture and fisheries sectors and securing the value chain
Ministry of Home Affairs and Rural Development (MHA)	MHA is responsible for waste levies and programmes in Tuvalu. The Department of Rural Development is responsible for local government
Ministry of Local Government and Agriculture (MLGA)	MLGA coordinates the outer islands, including their community governance structures and management of public resources
Ministry of Transport, Energy and Tourism (MTET)	MTET has a range of responsibilities, including: <ul style="list-style-type: none"> <li>▪ Overseeing the Tuvalu Electricity Corporation (TEC)</li> <li>▪ Maintaining and expanding the electricity grid, and accommodating renewable energy</li> <li>▪ Managing maritime transport issues and fuel imports</li> <li>▪ The Marine Unit operates Government vessels</li> </ul>
Private Fisheries Companies	Vessel owners and operators
Tuvalu Maritime Training Institute	The institute provides maritime and seafarers training, automotive training, and other Technical and Vocational Education and Training (TVET) related to boat operations
University of the South Pacific (USP)	USP provides tertiary and TVET training, research partnerships, technical support on International Maritime Organisation (IMO) and shipping emission through Micronesian Centre for Sustainable Transport (MCST)

*Modified from the GGGI Tuvalu Scoping Mission Report*

#### 4.2.2 Specific NDC targets for maritime transport

Tuvalu's First NDC does not include a specific quantitative target for reducing maritime transport GHG emissions. However, maritime transport currently contributes approximately 30 percent of Tuvalu's overall GHG emissions,<sup>72</sup> so reducing GHG emissions from maritime transport is likely to be essential for achieving Tuvalu's NDC goal to reduce total GHG emissions to 60 percent below 2010 levels by 2025. In the long term, GHG emissions from maritime transport will need to be either eliminated or offset in order to shift to a net zero-carbon development pathway by 2050.

#### 4.2.3 Constraints on the maritime transport sector

Seven overarching constraints limit the implementation of GHG mitigation projects in the maritime transport sector. These constraints were identified during research on the maritime transport sector, research on potential GHG mitigation opportunities, as well as by stakeholders during the Consultation Workshop (held on 24 March 2021). 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 budget to implement and manage new projects. Private sector involvement in NDC implementation projects could help with budget constraints. However, financing GHG mitigation opportunities necessary to achieve Tuvalu's NDC is likely to be beyond the ability of the GoT and the private sector<sup>73</sup>. Significant international climate finance is likely to be needed<sup>74</sup>. Each project concept note includes a procurement method, which details how the GHG mitigation opportunity could be funded and, if need be, financed. This will help the GoT find viable sources of funding and finance to implement GHG mitigation opportunities.

##### **Institutional capacity**

Institutions involved in NDC implementation have limited capacity (including personnel and staff time) to implement projects. For example, stakeholders in Tuvalu estimated that MTET has only 0.4 FTE available for NDC implementation projects. Participants also suggested that institutions in the maritime transport sector are capable of running between one and two GHG emissions reduction projects at one time. To account for limited institutional capacity, stakeholders in Tuvalu stated that no more than two projects are run by maritime sector institutions concurrently.

##### **Experience**

Stakeholders in Tuvalu 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 due to new technologies and regulatory and legislative changes that may need to be introduced. Projects included in the pipeline

---

<sup>72</sup> Second National Communication of Tuvalu (2015).

<sup>73</sup> Identified by stakeholders who participated in the Consultation Workshop on 24 March 2021.

<sup>74</sup> Identified by stakeholders who participated in the Consultation Workshop on 24 March 2021.

have been designed to incorporate capacity-building programs and technical assistance activities when needed.

### **Data**

MTET manages maritime transport issues and fuel imports. However, data collected on activities in the maritime transport sector, such as fuel use, vessels numbers, a vessel types, is limited, likely due to lack of reporting infrastructure and limited institutional capacity to collect information. Without accurate data, it is challenging to understand the impacts that projects (such as transitioning from 2-stroke to 4-stroke outboard motors) would have on the GHG emissions in Tuvalu's maritime transport sector. In addition, data deficiencies make it difficult to estimate possible funding sources and financing requirements for GHG mitigation projects in the land transport sector. Data about Tuvalu's maritime transport sector has been provided by stakeholders to assist with developing this Roadmap and Plan. This data has been used when formal data is not available.

### **Coordination**

Activities in the maritime transport sector are not well coordinated between ministries, agencies, development partners, financial entities, private businesses, and individuals<sup>75</sup>. This is likely because the maritime transport sector does not have an overarching regulation, policy, or strategy that guides the sector.

Stakeholders suggested that the Director of Marine lead projects in the maritime transport sector<sup>76</sup>. Having one executor for each project enables project ownership and enforcement (particularly in the absence of an overarching sector strategy) and will also facilitate coordination between ministries.

### **Market structure**

Market structure constraints can limit the transition to low-emissions maritime transport. Almost all boats in Tuvalu run on unleaded petroleum (ULP) or automotive diesel (ADO), and fuel quality is often poor. Commercial lending is not provided at affordable rates for the purchase, import, or construction of energy-efficient vessels. Financial support for the construction of fishing boats has previously been covered by standard loans (with interest rates now being at nine percent) with about five loans per year being granted<sup>77</sup>. There are also no incentives in the market, such as tax deduction and low-interest loans for low-emissions vessels or motors<sup>78</sup>.

The GHG mitigation opportunities in the maritime transport sector provide alternatives to BAU, for example, transitioning from 2-stroke to 4-stroke outboard motors. In addition, each project concept note details ways in which the project could be incentivised, such as

---

<sup>75</sup> GGGI Tuvalu Scoping Mission Report.

<sup>76</sup> Identified by stakeholders who participated in the Consultation Workshop on 24 March 2021.

<sup>77</sup> GGGI Tuvalu Scoping Mission Report.

<sup>78</sup> GGGI Tuvalu Scoping Mission Report.

through low-interest loans for commercial and retail customers wanting to transition to low-emissions vessels.

#### **Public awareness**

Stakeholders suggested that Tuvaluans have limited knowledge of the options to reduce GHG emissions in the maritime transport sector, and are unaware of the co-benefits<sup>79</sup>. In addition, Tuvalu seafarers' qualification does not include courses on energy efficiency in maritime transport and trade. Lack of public awareness has resulted in the limited transition towards low-emission vessels because stakeholders do not know of options available to them. Where relevant, awareness-raising programs have been included as a part of the design of the GHG mitigation project in the project pipeline. Awareness-raising programs will be important to encourage behavioural changes.

### **4.3 Energy efficiency<sup>80</sup>**

The Tuvalu Electricity Corporation (TEC) is solely responsible for the generation and distribution of electricity in Tuvalu. There are no independent power producers (IPPs), and the current legislative framework does not allow generation by entities other than TEC. TEC provides 24-hour electricity supply to eight of Tuvalu's nine islands via electricity grids.

The total population of the eight outer islands is approximately 4,200 and each island has a population ranging from 30-1,000 people<sup>81</sup>. The outer islands have small, predominantly residential electrical loads. These islands, except for Niulakita, have solar hybrid mini-grid systems with battery storage. This provides almost 100 percent renewable electricity on four islands and up to 60 percent on the three other islands. Diesel is used as backup generation. Niulakita is a remote island with a population of fewer than 50 people, which has stand-alone solar home systems.

Tuvalu's annual electricity consumption is approximately 5,200 MWh per year<sup>82</sup>. The capital, Funafuti, is responsible for nearly 80 percent of total electricity consumption and hosts the only significant commercial and government loads. Funafuti is the site of the main diesel power station with capacity of 1,800 kW and several distributed solar PV systems with total capacity of approximately 750 kW, though not all are fully functional. In 2019, the peak load in Funafuti was approximately 1,400 kW (at about 7 pm) and the average load was around 850 kW<sup>83</sup>.

---

<sup>79</sup> Identified by stakeholders who participated in the Consultation Workshop on 24 March 2021.

<sup>80</sup> This document focuses on demand-side energy efficiency in the electricity sector to avoid overlaps with existing efforts to reduce supply-side GHG emissions in Tuvalu's electricity sector.

<sup>81</sup> Tuvalu Population & Housing Mini-Census 2017, Preliminary Report. The population of Funafuti is approximately 6,320.

<sup>82</sup> NZ MFAT Country Profiles – Tuvalu 2017.

<sup>83</sup> GGGI Tuvalu Scoping Mission Report.



#### *TEC experiences relatively high network losses*

According to Pacific Power Association (PPA) benchmarking data<sup>84</sup>, TEC's standard network delivery and distribution losses are around 12 percent. This is relatively high compared with a regional average of 6 percent<sup>85</sup>. Prepayment meters are currently being installed for all residential customers and small commercial customers, and this is expected to improve revenue collection and decrease network losses<sup>86</sup>.

#### *A tariff review was completed and approved in 2008*

Cabinet approves tariff changes. The current tariff consists of two components—base tariff and fuel tariff. The base tariff was designed to make changes on a yearly basis, and the fuel tariff was designed to make changes on a quarterly basis, depending on the market fuel price. The fuel tariff was approved at US\$1.00 per litre and, if the fuel price is above US\$1.00 per litre, the government pays for the additional cost. However, stakeholders in Tuvalu suggest that GoT does not always subsidise the fuel cost<sup>87</sup>. Renewable energy can help alleviate fuel cost risk for TEC.

#### *Tuvalu has previously introduced energy efficiency projects which have been successful*

Tuvalu has introduced the Pacific Appliance Labelling Scheme (PALS) for imported appliances. While this has resulted in some improvement in the energy efficiency of appliances, it has been difficult to enforce<sup>88</sup>. The Development Bank of Tuvalu started a subsidy scheme in 2016, called the Low Carbon Fund and Energy Efficiency Revolving Fund, through which Tuvaluans receive rebates or refunds of 25 percent of the purchase of energy efficient appliances and housing retrofits. The subsidy scheme has been popular<sup>89</sup>. The Development Bank of Tuvalu is working with other development partners to extend the scheme to provide loans for low carbon and energy efficient building materials. Limited funds and unavailability of building materials (much of which is imported) is constraining the development of this part of the scheme<sup>90</sup>.

A series of energy efficiency projects were proposed under a World Bank funded project in 2015-2016, called Energy Sector Development Project, targeting major electricity consumers on Funafuti<sup>91</sup>. Two small projects were implemented as a result (window tinting and prepayment meters)<sup>92</sup>. The Development Bank of Tuvalu has also been working with TEC and the Energy Department of MTET to implement the Facilitation of the Achievement of Sustainable National Energy Targets of Tuvalu (FASNETT) project, funded

---

<sup>84</sup> [https://www.ppa.org.fj/wp-content/uploads/2019/03/2017-FY-Benchmarking-Report\\_Publication\\_Final-1.pdf](https://www.ppa.org.fj/wp-content/uploads/2019/03/2017-FY-Benchmarking-Report_Publication_Final-1.pdf)

<sup>85</sup> [https://www.ppa.org.fj/wp-content/uploads/2019/03/2017-FY-Benchmarking-Report\\_Publication\\_Final-1.pdf](https://www.ppa.org.fj/wp-content/uploads/2019/03/2017-FY-Benchmarking-Report_Publication_Final-1.pdf)

<sup>86</sup> Consultation with stakeholders in Tuvalu.

<sup>87</sup> Consultation with stakeholders in Tuvalu.

<sup>88</sup> Consultation with stakeholders in Tuvalu.

<sup>89</sup> Consultation with stakeholders in Tuvalu.

<sup>90</sup> Consultation with stakeholders in Tuvalu.

<sup>91</sup> <https://projects.worldbank.org/en/projects-operations/project-detail/P144573>

<sup>92</sup> <http://documents1.worldbank.org/curated/en/281471588730371569/text/Tuvalu-EAST-ASIA-AND-PACIFIC-P144573-Energy-Sector-Development-Project-Procurement-Plan.txt>

by Global Environment Facility (GEF). In November 2020, the FASNETT project provided the Bank with financial assistance of US\$38,600 to underwrite the existing program<sup>93</sup>.

The Energy Department also runs a quarterly education programme via the radio, on household energy efficiency<sup>94</sup>. This programme is ongoing, and will be completed by the end of 2022. Radio is an effective medium of education for a wide range of Tuvalu's population to be educated<sup>95</sup>.

*The focus of future energy efficiency work will be on Funafuti*

The largest electricity users in Tuvalu are government organisations on Funafuti, with the main government building being the single largest user. There are also several private businesses with relatively high electricity consumption. Notably, the wharf is a major electricity user due to refrigerated containers used by private businesses for food storage.

*The government is committed to increasing the use of renewables for electricity generation to strengthen the Tuvalu's energy security*

Tuvalu, with funding from New Zealand's Ministry of Foreign Affairs and Trade (MFAT), is developing a new solar PV plant (with battery storage) on the country's main island of Funafuti. The US\$6.1 million project will include 770 kW of Solar PV and at least 1 MWh of battery storage<sup>96</sup>. The plant will help replace diesel on the island, where about 85 percent of electricity is currently generated from diesel. The plant was expected to be completed by the end of 2020 but has been delayed due to COVID-19 travel restrictions.

In addition, two large renewable energy projects, funded by the World Bank and the Asian Development Bank (ADB), will see the installation of an additional 2 MW of solar PV, 2 MWh of battery storage, and a small wind turbine on Funafuti. Currently, ADB is in the process of contract signing with the developer. Construction of the World Bank project has been delayed due to border closures related to COVID-19 and land issues for installation. However, most materials required have been procured, and some materials, such as batteries and aggregates, have already arrived in Tuvalu. TEC is confident that construction of both projects will begin once the borders open<sup>97</sup>.

Following the completion of these two projects, Funafuti is expected to achieve a renewable energy contribution of approximately 90 percent. This will mean that nationwide, Tuvalu will generate approximately 90 percent of its electricity through renewable sources.

*The energy sector is managed by multiple government institutions*

The Department of Energy (DOE) within the Ministry of Transport, Energy and Tourism (MTET), is responsible for the overall energy sector planning, as well fuel imports and the import of appliances. MTET has oversight over the Tuvalu Electricity Corporation (TEC) and is also responsible for maintaining and expanding the electricity grid and

---

<sup>93</sup> Consultation with stakeholders in Tuvalu.

<sup>94</sup> Personal communication, 2015; [http://prdrse4all.spc.int/system/files/master\\_plan\\_for\\_renewable\\_electricity.pdf](http://prdrse4all.spc.int/system/files/master_plan_for_renewable_electricity.pdf); Consultation with stakeholders in Tuvalu.

<sup>95</sup> Sector focal points suggested that often only a few community members attend the workshop. Radio is used in Tuvalu for public awareness. Consultation with stakeholders in Tuvalu, including TEC and DBT.

<sup>96</sup> <https://www.infratec.co.nz/projects/first-solar-battery-project-completed-for-tuvalu>

<sup>97</sup> Consultation with stakeholders in Tuvalu.

accommodating the inclusion of renewable energy. The sector is underpinned by the Energy Efficiency Act 2016, and is led by the Energy Efficiency Master Plan (2012) and the National Energy Policy 2009-2023.

#### 4.3.1 Key national stakeholders in energy efficiency

Table 4.5 details the key national stakeholders in the energy efficiency sector.

**Table 4.5: Key national stakeholders in energy efficiency**

Key stakeholder	Roles within the sector
Department of Energy (DOE)	DOE is responsible for the overall energy sector planning, as well as fuel imports and the import of appliances
Island Councils (Kaupule)	Island Councils (Kaupule), in coordination with the Ministry of Local Government and Agriculture, manage the land transport infrastructure and other infrastructure of the outer islands. Kaupule are also responsible for vehicle registrations outside of Funafuti
Ministry of Finance (MoF)	MoF has oversight of the Department of Climate Change, which is responsible for implementing and coordinating Tuvalu's NDC goals.
Ministry of Public Works, Infrastructure, Environment, Labour, Meteorology and Disaster	<p>This ministry has a range of responsibilities, including:</p> <ul style="list-style-type: none"> <li>Providing infrastructure for government assets, public buildings, roads, and sea walls</li> <li>Assessing damage to civil infrastructure, properties, and water storage</li> <li>Managing the six major water storage facilities on Funafuti and six on the outer islands</li> <li>Approving septic tank designs and providing back up sanitation services</li> </ul> <p>The Public Works Department has oversight over infrastructure developments across Tuvalu</p>
Ministry of Transport, Energy and Tourism (MTET)	<p>MTET has a range of responsibilities, including:</p> <ul style="list-style-type: none"> <li>Overseeing the Tuvalu Electricity Corporation (TEC)</li> <li>Maintaining and expanding the electricity grid, and accommodating renewable energy</li> <li>Managing maritime transport issues and fuel imports—Tuvalu does not have a Land Transport Authority, and therefore MTET focuses on maritime transport</li> </ul>
Pacific Energy	The primary fuel importer for Tuvalu, supplying TEC and the nine gas stations in Tuvalu
Pacific Power Association	Inter-governmental agency and member of the CROP to promote the direct cooperation of the Pacific Island power utilities in technical training and exchange of information
Tuvalu Energy Corporation (TEC)	TEC is a state-owned enterprise and is the sole provider of electricity services in Tuvalu. TEC is working towards achieving the country's goal of using 100 percent renewable energy by 2025.

*Modified from the GGGI Tuvalu Scoping Mission Report*

### 4.3.2 Specific NDC targets for energy efficiency

Tuvalu's First NDC does not include a specific quantitative target for energy efficiency. However, the NDC does focus on reducing GHG emissions in the energy sector more broadly, specifying the following targets (which are conditional on necessary technology and finance):

- Reduce emissions of GHGs from the electricity generation (power) sector, by 100 percent, i.e., almost zero emissions by 2025;
- Reduce total emissions of GHGs from the entire energy sector to 60 percent below 2010 levels by 2025; and
- Pursue a zero-carbon development pathway by 2050 (dependent on availability of finance and technology)<sup>98</sup>.

Encouraging energy efficiency will be an important strategy for reducing overall electricity demand in Tuvalu, and increasing the proportion of that demand met by existing and planned renewable energy generation.

### 4.3.3 Constraints on energy efficiency sector

Six overarching constraints limit the implementation of GHG mitigation projects in the energy efficiency sector. These constraints were identified during research on the energy sector, research on potential GHG mitigation opportunities, and stakeholders during the Consultation Workshop (held on 24 March 2021). Specific barriers to each of the energy efficiency sector pipeline projects are also outlined in the project concept notes in Appendix A.

#### **Budget**

Institutions involved in NDC implementation do not have sufficient budget to implement and manage new projects. Private sector involvement in NDC implementation projects could help with budget constraints. However, financing GHG mitigation opportunities necessary to achieve Tuvalu's NDC is likely to be beyond the ability of the GoT and the private sector<sup>99</sup>. Significant international climate finance is likely to be needed. Each project concept note includes a procurement method, which details how the GHG mitigation opportunity could be funded and, if need be, financed. This will help the GoT find viable sources of funding and finance to implement GHG mitigation opportunities.

#### **Institutional capacity**

Institutions involved in NDC implementation have limited capacity (including personnel and staff time) to implement projects. Participants at the Consultation Workshop suggested that institutions in the energy efficiency sector can run between three and four GHG emissions reduction projects at one time. However, stakeholders estimated that MTET has only 0.4 FTE available for NDC implementation projects, and TEC has only 0.15

<sup>98</sup> <https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Tuvalu%20First/TUVALU%20INDC.pdf>

<sup>99</sup> Identified by stakeholders who participated in the Consultation Workshop on 24 March 2021.

FTE. To account for limited institutional capacity, stakeholders in Tuvalu stated that no more than four projects are run by energy sector institutions concurrently.

### **Experience**

Stakeholders in Tuvalu reported that staff members of institutions involved in the energy efficiency 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.

### **Coordination**

Activities in the sector are not well coordinated between ministries, agencies, development partners, financial entities, private businesses, and individuals<sup>100</sup>. This is largely due to split responsibilities and because there is no recent overarching energy planning strategy – the most recent strategy is the Renewable Electricity and Energy Efficiency Master Plan was published in 2012. There is also limited capacity to implement energy efficiency projects. In addition, there is a lack of integration and coordination between the electricity sector and petroleum sector, particularly with sector planning<sup>101</sup>.

Stakeholders suggested that the Director of Energy lead projects in the energy efficiency sector<sup>102</sup>. Having one executor for each project enables project ownership and enforcement and will also facilitate coordination between ministries.

### **Market structure**

Financing energy-efficient technologies in Tuvalu has been challenging because energy efficiency investment is considered risky, and the small size of the market in Tuvalu limits its appeal for large financial institutions<sup>103</sup>. Although financial incentives have been introduced into the market to encourage uptake of energy-efficient appliances and other energy-efficient projects, Tuvalu has experienced limited momentum. To overcome barriers relating to market structure, each pipeline project concept note details ways in which the project could be incentivised, such as through low-interest loans for commercial and retail customers.

### **Public awareness**

Stakeholders suggested that Government ministries and the general population are unaware of all the environmental and co-benefits of energy-efficient technologies<sup>104</sup>. Where relevant, awareness-raising programs have been included as a part of the design of the GHG mitigation projects included in the project pipeline. Awareness-raising programs will be important to encourage behavioural changes.

---

<sup>100</sup> Identified by stakeholders who participated in the Consultation Workshop on 24 March 2021.

<sup>101</sup> GGGI Tuvalu Scoping Mission Report.

<sup>102</sup> Identified by stakeholders who participated in the Consultation Workshop on 24 March 2021.

<sup>103</sup> GGGI Tuvalu Scoping Mission Report.

<sup>104</sup> Identified by stakeholders who participated in the Consultation Workshop on 24 March 2021.

## 5 Opportunities to help Tuvalu achieve its NDC targets

This NDC Roadmap and Plan identifies six GHG mitigation opportunities—two in the land transport sector, two in the maritime transport sector, and two in the energy efficiency sector. A summary of the GHG mitigation potential and investment needs of the mitigation opportunities is provided below.

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 C<sup>105</sup>.

The mitigation opportunities in this NDC Roadmap and Plan have:

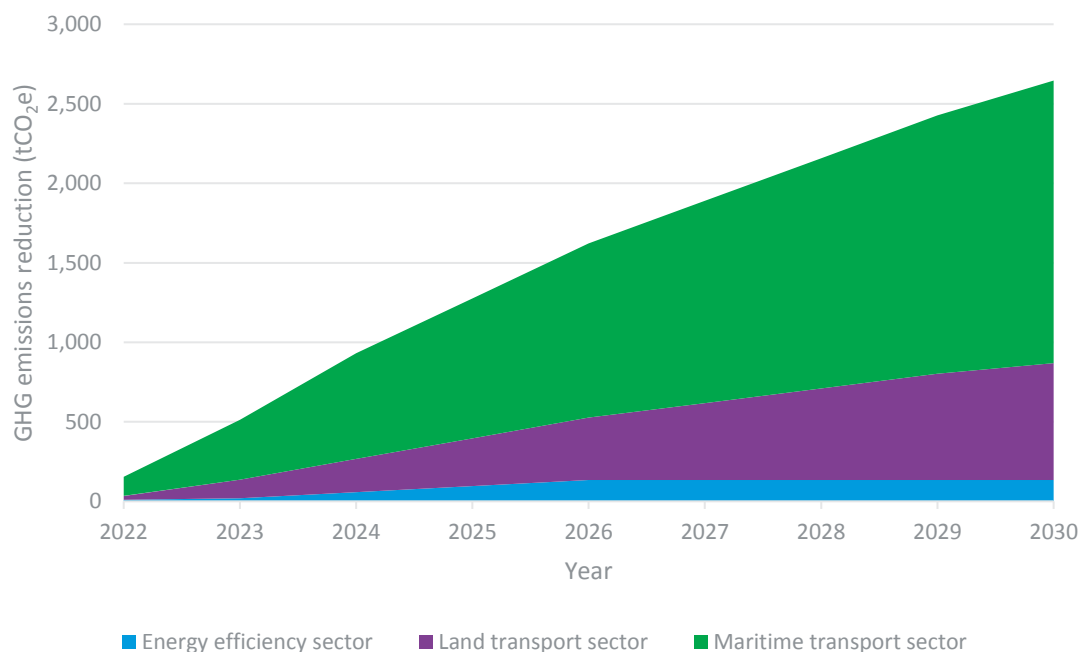
- Potential to reduce GHG emissions by 9,258 tCO<sub>2e</sub> by 2030
- An annual GHG mitigation potential of 1,777 tCO<sub>2e</sub> in 2030
- An indicative investment need of US\$19,850,000 by 2030.

Figure 5.1 details the cumulative GHG emissions reductions per sector from projects in the pipeline between 2022-2030. Emission reductions are dominated by the maritime transport sector project to transition from 2-stroke to 4-stroke outboard engines, and the land transport sector project to electrify Tuvalu's light vehicle fleet.

---

<sup>105</sup> A methodology for prioritizing projects in Tuvalu's pipeline in the accompanying document 'Guidelines on Development NDC Implementation Roadmaps and Investment Plans'. Prioritizing projects may be required if Tuvalu adds additional projects to its pipeline.

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



The NDC projects included in this Roadmap and Plan should be seen as a provisional list of mitigation opportunities. Tuvalu will continue to add to these projects as new opportunities arise, and new opportunities should be given equal attention to 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.

### 5.1.1 Land transport

There are two mitigation opportunities which focus on land transport. These are outlined in Table 5.1 below. The mitigation opportunities have:

- Potential to reduce GHG emissions by 3,506 tCO<sub>2</sub>e by 2030
- An annual GHG mitigation potential of 735 tCO<sub>2</sub>e in 2030
- An indicative investment need of US\$16,914,000 by 2030.



**Table 5.1: GHG mitigation opportunities in the land transport sector**

Opportunity	Indicative investment need to 2030 (US\$)	Annual emissions reduction in 2030 (tCO <sub>2</sub> e)	Cumulative emissions reduction by 2030 (tCO <sub>2</sub> e) <sup>106</sup>
E-bike initiative	3,444,000	198	1,089
Electrification of Tuvalu's light vehicle fleet	13,470,000	537	2,417

Note: Mitigation figures (tCO<sub>2</sub>e) are rounded to the nearest ton and indicative investment needs are rounded to the nearest US\$1,000

### 5.1.2 Maritime transport

There are two mitigation opportunities which focus on maritime transport. These are outlined in Table 5.2 below. The mitigation opportunities have:

- Potential to reduce GHG emissions by 4,900 tCO<sub>2</sub>e by 2030
- An annual GHG mitigation potential of 908 tCO<sub>2</sub>e in 2030
- An indicative investment need of US\$2,671,000 by 2030

**Table 5.2: GHG mitigation opportunities in the maritime transport sector**

Opportunity	Indicative investment need to 2030 (US\$)	Annual emissions reduction in 2030 (tCO <sub>2</sub> e)	Cumulative emissions reduction by 2030 (tCO <sub>2</sub> e) <sup>107</sup>
Outboard motor transition from 2-stroke petrol outboards to 4-stroke	2,619,000	764	3,820
Shore side electrical supply for at berth vessels	50,000	144	1,080

Note: Mitigation figures (tCO<sub>2</sub>e) are rounded to the nearest ton and indicative investment needs are rounded to the nearest US\$1,000

### 5.1.3 Energy efficiency

There are two mitigation opportunities which focus on energy efficiency. These are outlined in Table 5.3 below. The mitigation opportunities have:

- Potential to reduce GHG emissions by 852 tCO<sub>2</sub>e by 2030
- An annual GHG mitigation potential of 134 tCO<sub>2</sub>e in 2030
- An indicative investment need of US\$265,000 by 2030.

<sup>106</sup> The GHG emissions reduction estimate calculations are explained in the concept notes in Appendix A.

<sup>107</sup> The GHG emissions reduction estimate calculations are explained in the concept notes in Appendix A.

**Table 5.3: GHG mitigation opportunities in the energy efficiency sector**

Opportunity	Indicative investment need to 2030 (US\$)	Annual emissions reduction in 2030 (tCO <sub>2</sub> e)	Cumulative emissions reduction by 2030 (tCO <sub>2</sub> e) <sup>108</sup>
Retrofitting of major hotels and commercial and government buildings	140,000	86	516
Cold storage energy efficiency	125,000	48	336

*Note: Mitigation figures (tCO<sub>2</sub>e) are rounded to the nearest ton and indicative investment needs are rounded to the nearest US\$1,000*

<sup>108</sup> The GHG emissions reduction estimate calculations are explained in the concept notes in Appendix A.

## 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
- 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 sources of funding for mitigation projects in Tuvalu*

The costs of GHG 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 the land transport, maritime transport, and energy efficiency sectors have different funding potential. Some projects are likely to be commercially viable—that is, they should be funded by users. Users may either be willing to pay more due to better service, or because the project delivers cost savings to them. Other projects are unlikely to lead to revenues that cover their costs, so they may need either government or international grant funding to proceed. In practice, many mitigation projects in Tuvalu will need to be funded using international grant funding. The GoT is currently in debt distress, and stakeholders stressed the need to carefully manage the domestic budget to maintain the capacity to deal with increasingly frequent natural disasters.

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<sup>109</sup> 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, Tuvalu'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.

A potential challenge of financing NDC projects is that some may be too small to warrant engagement in the complex procurement and approval systems that international financing institutions and concessional financing institutions have. Tuvalu should think about how individual projects could be aggregated with other projects across sectors. This will allow organisations to support a single, coherent programme in Tuvalu or the Pacific more broadly. It will be easier for Tuvalu to get financing and concessional support for larger programmes 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, Tuvalu 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 Tuvalu 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 identifies the most appropriate 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 Tuvalu. 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

---

<sup>109</sup> 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.

for many of the projects in the pipeline, it would often be employed to leverage donor 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 Tuvalu with climate change mitigation projects.

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

Mitigation project	Cumulative GHG emissions reduction by 2030 (tCO <sub>2</sub> e)	Indicative investment needs (US\$) <sup>110</sup>	Cost effectiveness (kgCO <sub>2</sub> /US\$) <sup>111</sup>	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		
E-bike initiative	1,089	3,444,000	7.16	✓	✓	✓	Yes	✓	✓	Medium	Low
Electrification of Tuvalu's light vehicle fleet	2,417	13,470,000	0.18	✓	✓	✓	Yes	✓	✓	Medium	Medium
Outboard motor transition from 2-stroke petrol outboards to 4-stroke	3,820	2,619,000	Infinite	✓	✓	✓	Yes	✓		Medium	High
Shore side electrical supply for at berth vessels	1,080	50,000	21.60		✓	✓	Yes	✓		Medium	Medium
Retrofitting of major hotels and commercial and government buildings	516	140,000	Infinite	✓	✓	✓	Yes	✓	✓	High	Medium
Cold storage energy efficiency	336	125,000	2.69			✓	Yes	✓		Low	Medium

Note: Cost effectiveness is rounded to 2 decimal places

<sup>110</sup> 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.

<sup>111</sup> Cost effectiveness is based on total economic costs and total cumulative GHG emissions reduction of each project. Projects with 'infinite' cost effectiveness means the projects deliver cost savings.

Potential sources of funding under the three categories described above are listed in Table 6.2. Tuvalu is one of 74 low-income countries eligible to receive support under the World Bank's International Development Association. Tuvalu'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 Tuvalu**

<b>Donor Funding</b>	
<b>Name of Donor</b>	<b>Type of Funding Support</b>
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 <sup>112</sup>	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
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
<b>Sources of Government Funding</b>	
Ministry of Finance	
Ministry of Fisheries and Trade	
Ministry of Health, Social Welfare and Gender Affairs	
Ministry of Local Government and Agriculture	
Ministry of Public Works, Infrastructure, Environment, Labour, Meteorology and Disaster	
Ministry of Transport, Energy and Tourism	
<b>Types of User Fees</b>	
Revenue from user tariffs	
Avoided costs <sup>113</sup>	

Potential sources of finance under the two categories described above are listed in Table 6.3. Tuvalu's private financial sector is small and experience with lending to businesses and

<sup>112</sup> UNDP provides financial and technical support to projects through Global Environment Facility (GEF) and Green Climate Fund (GCF).

<sup>113</sup> 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.



households is limited. The National Bank of Tuvalu, which is a joint venture between the GoT and the Australian-owned Westpac Banking Corporation, is Tuvalu's only bank. Tuvalu does not have a sovereign credit rating. This makes it difficult for Tuvalu to access funding in international bond markets, because investors cannot see the level of risk associated with investing in the debt of Tuvalu.

**Table 6.3: Sources of finance available in Tuvalu**

Concessional Finance	Commercial Finance
<ul style="list-style-type: none"> <li>▪ World Bank</li> <li>▪ Asian Development Bank</li> <li>▪ European Investment Bank</li> <li>▪ Australian Aid</li> <li>▪ European Union</li> <li>▪ Green Climate Fund</li> <li>▪ Global Environment Facility</li> </ul>	<ul style="list-style-type: none"> <li>▪ National Bank of Tuvalu</li> </ul>

## 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 Tuvalu's NDC. This monitoring and evaluation framework identifies the reporting, monitoring, 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

Implementation of GHG mitigation projects in the pipeline will occur between 2022 and 2030. Due to institutional capacity constraints (discussed in Section 3), stakeholders in Tuvalu stated that no more than two projects should happen concurrently in the land transport and maritime transport sectors, and no more than four projects should happen concurrently in the energy efficiency sector. This insight will be important to consider if Tuvalu adds additional projects to the pipeline.

The timings and durations of each of the mitigation projects included in Tuvalu's project pipeline are shown in Table 7.1.



Table 7.2 shows the timings of costs (including capital and implementation costs) associated with each of the pipeline projects.

**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
<b>Land Transport Sector</b>										
E-bike initiative	\$383,000	\$383,000	\$383,000	\$383,000	\$383,000	\$383,000	\$383,000	\$383,000	\$383,000	\$3,447,000
Electrification of Tuvalu's light vehicle fleet	\$2,470,000	\$1,375,000	\$1,375,000	\$1,375,000	\$1,375,000	\$1,375,000	\$1,375,000	\$1,375,000	\$1,375,000	\$13,470,000
<b>Maritime Transport Sector</b>										
Outboard motor transition from 2-stroke petrol outboards to 4-stroke	\$291,000	\$291,000	\$291,000	\$291,000	\$291,000	\$291,000	\$291,000	\$291,000	\$291,000	\$2,619,000
Shore side electrical supply for at berth vessels	\$25,000	\$25,000								\$50,000
<b>Energy efficiency sector</b>										
Retrofitting of major hotels and commercial and government buildings		\$35,000	\$35,000	\$35,000	\$35,000					\$140,000
Cold storage energy efficiency	\$25,000	\$25,000	\$25,000	\$25,000	\$25,000					\$125,000

## 7.2 Monitoring and evaluation framework

This Section outlines a high-level monitoring and evaluation framework for Tuvalu's Department of Climate Change and Disaster (CCD) to keep track of progress towards implementing its 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:

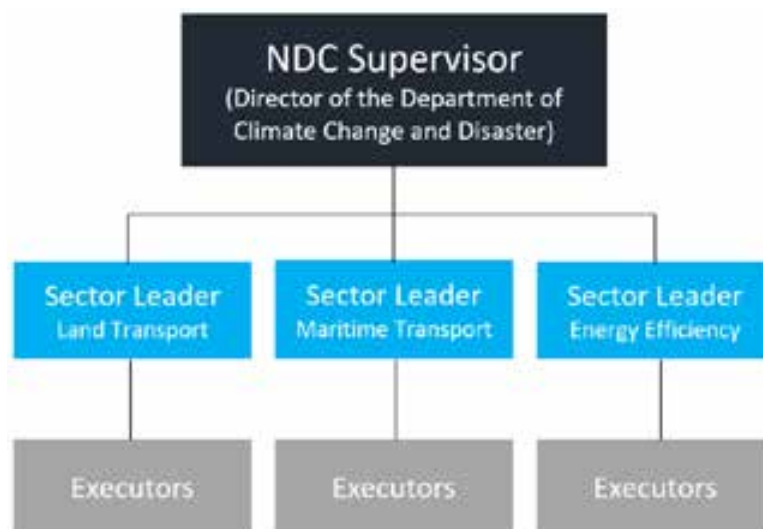
- A reporting structure that assigns responsibility for actions to specific government employees
- A monitoring structure that tracks progress in a transparent manner
- An evaluation structure that outlines the consequences for completing—or not completing—actions in time.

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 Tuvalu's NDC. In this case, stakeholders in Tuvalu have agreed that the Director of the CCD, should make up the top tier of the reporting structure. The NDC Supervisor should report to a more senior official (for example the Minister of Finance), or someone else that the GoT determines.
- **Sector Leaders**—Individuals from government ministries responsible for implementing specific actions each of the three sub-sectors of this NDC Implementation Roadmap and Investment Plan and reporting on progress to the NDC Supervisor. In this case, the Director for Marine and the Director for Energy should lead projects in the maritime transport and energy sectors, respectively. There is currently no director of land transport in Tuvalu. Therefore, Tuvalu should appoint a senior staff member from the CCD, with a firm grasp of land transport issues.
- **Executors**—Individuals from government ministries responsible for carrying out the day-to-day tasks required to manage and implement the 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 GoT. This reporting structure was discussed during consultations on 24 March 2021. Stakeholders approved of the structure and gave direction on the appropriate people to fulfil each position.

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



Communication is a vital part of the monitoring framework—the NDC Supervisor, Sector Leaders, and Executors should frequently discuss progress on the projects under their supervision. Sector Leaders should meet monthly to track day-to-day tasks and liaise with the external consultants<sup>114</sup>. Sector Leaders are responsible for monitoring progress on implementing the NDC in a centralized monitoring spreadsheet (held by CCD). This centralised 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.

Sector Leaders should give quarterly 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 be responsible for reporting annually on NDC implementation progress. This report should include an evaluation of progress on each of the pipeline projects against the chart shown in Section 7.1, and it should clearly mention

<sup>114</sup> External consultants maybe be used by GoT to implement projects, for example if specialty skills are required.

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 Implementation Roadmap). 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.

CCD 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 Tuvalu 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 Tuvalu.

### **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)<sup>115</sup>. 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 labour market opportunities in infrastructure. International evidence also suggests that safety can constitute a significant concern for women considering jobs in infrastructure.

---

<sup>115</sup> 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.



Promoting gender and social inclusion in capacity building and employment in NDC projects will allow developers to maximize their opportunity to employ local labour, to contribute to local development, and to foster social acceptance for their projects. The NDC Supervisor, and Sector Leaders overseeing NDC projects in Tuvalu 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<sup>116</sup>. 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

---

<sup>116</sup> World Bank (2017). *Getting to Gender Equality in Energy Infrastructure: Lessons from Electricity Generation, Transmission, and Distribution Projects*. Available at: <https://documents1.worldbank.org/curated/en/930771499888717016/pdf/117350-ACS.pdf>; World Bank (2018). Good Practice Note: Addressing Gender Based Violence in Investment Project Financing Involving Major Civil Works. Available at: <https://documents1.worldbank.org/curated/en/399881538336159607/Environment-and-Social-Framework-ESF-Good-Practice-Note-on-Gender-based-Violence-English.pdf>

- 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<sup>117</sup>. The Standards help ensure commitment to sustainable development. Projects in Tuvalu's NDC Roadmap and Plan should use IFC's E&S Performance Standards. Utilising this resource will assist Tuvalu in identifying and managing environmental and social risks.

<sup>117</sup> [https://www.ifc.org/wps/wcm/connect/24e6bfc3-5de3-444d-be9b-226188c95454/PS\\_English\\_2012\\_Full-Documents.pdf?MOD=AJPERES&CVID=jkV-X6h](https://www.ifc.org/wps/wcm/connect/24e6bfc3-5de3-444d-be9b-226188c95454/PS_English_2012_Full-Documents.pdf?MOD=AJPERES&CVID=jkV-X6h)

# Appendix A Project Concept Notes

## A.1 Land transport

### E-bike initiative

Project name: E-bike initiative			
Sector: Land transport	Sub-sector: Micro mobility, MaaS	Project type: Investment	Information
<b>Project description</b>			
<p>This project would encourage the uptake of electric bikes (e-bikes) for personal use through awareness-raising campaigns and supporting services. Mode shift from Internal Combustion Engines (ICE) motorbikes to e-bikes represents a significant opportunity for emission reductions in Tuvalu over the 2021-2030 period. In addition, increasing the uptake of e-bikes can reduce the number of cars and motorbikes on the road, thereby reducing emissions from the land transport sector, lead to savings in household expenditure, and result in health benefits.</p> <p>E-bikes are growing in popularity across the globe. E-bikes are the most popular form of micro mobility available today, with more than 3 million e-bikes sold globally in 2019 alone for private and shared use. Recent data shows that there are currently over 2,900 e-bike sharing schemes operating in cities worldwide.</p> <p>E-bikes have a lower per-unit cost relative to motorcycles and other vehicles. This represents an opportunity for much of the national population to acquire their own independent land transportation without significant additional subsidies or other concessional finance. Many e-bikes can also fulfil similar functions to small motorbikes. New models travel approximately 25-35km an hour (depending on the road and limiters set on e-bikes) with a pedal-assisted range of up to 100 km on a single charge.</p> <p>Stakeholders in Tuvalu indicated that it is possible to replace 100 percent of motorbikes with e-bikes in seven to eight years. This project concept note assumes it will take eight years to replace 100 percent of motorbikes with e-bikes. This would involve importing approximately 1,000 e-bikes into Tuvalu between 2022 and 2029.</p>			
<b>Estimated emissions reduction potential</b>			
<p>Based on the data for 2002, there are 1,013 motorcycles in Tuvalu<sup>118</sup>. One motorcycle emits 0.196 CO<sub>2</sub>e per year, based on fuel consumption, distance travelled, and CO<sub>2</sub> emitted per litre of petrol. If 100 percent of the motorbikes can be replaced by e-bikes in the next eight years (replacing 126 motorbikes each year) this will reduce emissions by 25 tCO<sub>2</sub>e in the first year. Total emission reduction in Tuvalu would be 198 tCO<sub>2</sub>e annually after the fleet is fully replaced. The cumulative emissions reduction is 1,089 tCO<sub>2</sub>e between 2022 and 2030.</p>			
<b>Cost estimates</b>		<b>Estimated time scale</b>	
<p><b>Cost of awareness raising and support program</b></p> <p>The cost of awareness raising and supporting services would be approximately US\$152,000. This is based on a similar e-bike promotion project in Fiji,<sup>119</sup> which is expected to cost US\$1,521,000 to target 10,000 bikes (Tuvalu is targeting approximately 10 percent of this number).</p> <p><b>Cost of motorcycle replacement</b></p> <p>E-bikes cost between US\$1,750 and US\$4,750, with average prices of US\$3,250<sup>120</sup>. Therefore, the total capital cost of replacing 100 percent of</p>		<p>This project assumes that it will take eight years to replace Tuvalu's full motorcycle fleet with e-bikes. This transition will occur at a constant rate of roughly 126 bikes per year.</p> <p>This transition is in line with the background vehicle replacement rate in Tuvalu. Most motor vehicles in Tuvalu are second hand Japanese models, and the motorcycle fleet turns over roughly every seven years. In addition, stakeholders in Tuvalu stated that it is possible to replace 100 percent of motorbikes in 7-8 years.</p>	

<sup>118</sup> [https://openresearch-repository.anu.edu.au/bitstream/1885/157782/1/202\\_motorisation.pdf](https://openresearch-repository.anu.edu.au/bitstream/1885/157782/1/202_motorisation.pdf)

<sup>119</sup> While costs in Fiji are used as a proxy for costs in Tuvalu, it is likely that costs in Tuvalu will be somewhat higher than in Fiji due to Tuvalu's small market size, remote location, and limited negotiation power. There is, however, no robust way to estimate the overall cost premium attached to good and services in Tuvalu relative to Fiji in a way that materially reduces the uncertainty of the cost estimates included at this concept note stage. More detailed costing should be a priority at the pre-feasibility study stage for each of the pipeline projects.

<sup>120</sup> <https://electricbikereview.com/forums/threads/the-true-costs-of-owning-and-using-an-electric-bike.22739/>

<p>motorcycle fleet with e-bikes in Tuvalu would be US\$3,292,250. However, this expenditure would avoid US\$3,039,000 in expenditure on motorcycles over the same period (assuming the capital cost of a motorcycle is US\$3,000). The difference in the total cost of ownership is likely to be negligible because recharging an e-bike is much cheaper than refuelling a motorbike.</p> <p><b>Total investment need</b></p> <p>The total investment need of this project is therefore US\$3,444,000.</p>	
<b>Potential environmental or social impacts</b>	
<p>Negative</p> <ul style="list-style-type: none"> <li>Experience globally shows that e-bikes often cause tensions over mixed-use space, and may increase risk to pedestrians of ridden on pavements</li> </ul> <p>Positive</p> <ul style="list-style-type: none"> <li>This project would encourage active transport, which provides significant health benefits through increased physical exercise</li> <li>This project would reduce local air and noise pollution from ICE vehicles</li> <li>This project can reduce risks associated with oil spills and contamination of both the coastal marine environment and freshwater.</li> </ul>	
<b>Affordability</b>	<b>Likely co-benefits</b>
<p>The cost of awareness raising and supporting services (US\$152,000) equates to 14 percent of the Government's 2019 budget allocated to the Ministry of Communications and Transport<sup>121</sup>. This project would be affordable for the ministry. Awareness raising and supporting services would also have benefits for other land transport projects, therefore cost could be attributed to more than one project.</p>	<p>E-bikes can:</p> <ul style="list-style-type: none"> <li>Provide travel solutions for those who cannot/do not wish to drive or travel on public transport, contributing to SDG 11 (sustainable cities and communities)</li> <li>Promote physical exercise through active transport and reducing Non-Communicable Diseases, contributing to SDG 3 (good health and wellbeing)</li> <li>Reduce urban air pollution, contributing to SDG 3 (good health and wellbeing) and SDG 11 (sustainable cities and communities)</li> <li>Reduce congestion contributing to SDG 11 (sustainable cities and communities)</li> <li>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)</li> <li>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)</li> <li>Reduce household costs of fuel, contributing to SDG 8 (decent work and economic growth)</li> <li>Encourage tourism but reducing cars on the road, contributing to SDG 8 (decent work and economic growth).</li> </ul>
<b>Procurement method</b>	<b>Likelihood of attracting private or donor funding (high, medium, low)</b>
<p>Given e-bikes tend to cost less than motorcycles, people in Tuvalu are likely to be able to replace motorcycles with e-bikes when their motorcycles</p>	<p>Medium</p> <ul style="list-style-type: none"> <li>Donor funding is unlikely to be available to cover the capital costs of e-bikes because they are already cheaper than</li> </ul>

<sup>121</sup> [http://www.tuvaluaudit.tv/wp-content/uploads/2019/04/FINALE-2019-NATIONAL-BUDGET\\_approved-by-Parliament\\_17Dec.pdf](http://www.tuvaluaudit.tv/wp-content/uploads/2019/04/FINALE-2019-NATIONAL-BUDGET_approved-by-Parliament_17Dec.pdf)

<p>come to the end of their useful lives. People can purchase e-bikes from commercial e-bike retailers. Finance may be required in some instances. Where finance is required, this should be provided by commercial finance organizations given the investments are commercially viable.</p> <p>Awareness-raising and supporting services could be funded either by the GoT or by international donors. In the Consultation Workshop, six out of nine stakeholders thought international donor funding to be the most appropriate way to fund this project, while only two out of nine thought government funding was appropriate.</p>	<p>motorized alternatives. However, international donors may see value in supporting awareness-raising and supporting services projects, particularly if it is bundled with other transport projects in Tuvalu.</p>
<b>Capacity requirement to implement (high, medium, or low)</b>	<b>Potential barriers</b>
<p>Low</p> <ul style="list-style-type: none"> <li>• The maintenance requirements for e-bikes are generally lower than for motorcycles</li> <li>• Supporting services for e-bikes, such as bike stands and low-voltage public charging stations, are generally easy to install and maintain</li> <li>• An awareness-raising campaign promoting the benefits of e-bicycles is likely to be simple to execute.</li> </ul>	<ul style="list-style-type: none"> <li>• The use of bicycles for commuting and general transport is currently limited in Tuvalu, particularly as the popularity of private vehicles (especially cars) has grown over the last few years. This barrier can be overcome through a combination of awareness-raising campaigns (including promoting health benefits, savings potential of bicycles and e-bikes), and support services</li> <li>• Infrastructure barriers such as charging stations, would need to be provided. This barrier can be overcome because adequate charging stations will be included as part of this project</li> <li>• In the Consultation Workshop, stakeholders stated that until Tuvalu is using renewable energy, it may be counterproductive to promote e-bikes. However, the energy required to charge an e-bike is low—approximately 0.4-0.8 kWh, costing US\$0.05–0.08 per charge. The additional energy required to charge a fleet of 1,000 e-bikes is 400–800 kWh per charge. In addition, Tuvalu is close to its 100 percent renewable energy target</li> <li>• In the Consultation Workshop, stakeholders stated that the average weight and size of the population is large, which may limit the use of bikes. Standard bikes and e-bikes have an average load capacity limits of 130 kg. Some models also have higher load capacity; these models can also be considered for import if required</li> <li>• Stakeholders in Tuvalu stated that land space is limited and improving existing roads will be challenging. Poor condition of roads may limit the uptake of this project. Future projects could consider upgrading main roads<sup>122</sup>.</li> </ul>

<sup>122</sup> The project 'active transport infrastructure upgrade' was proposed early in the consultation and aimed to improve to public walkways, develop pathways for bikes and micro mobility, and increase safe road spaces by introducing space between motorised vehicle traffic lanes and non-motorised lanes. This project was removed from the pipeline because stakeholders stated that the project would likely require land reclamation. Land reclamations would increase the cost for this project substantially and this was already an extremely expensive project with only very modest GHG emissions reduction potential. In future, Tuvalu could integrate aspects of the 'active transport infrastructure upgrade' with a road upgrade project.

## Electrification of Tuvalu's light vehicle fleet

Project name: Electrification of Tuvalu's light vehicle fleet		
Sector: Land transport	Sub-sector: EVs	Project type: Investment
<b>Project description</b>		
<p>The project aims to encourage 100 percent electrification of the light vehicle fleet in the next 10 years by replacing the fleet with EVs and building infrastructure.</p> <p>There are approximately 1,000 light vehicles in Tuvalu<sup>123</sup>. If 100 percent of this fleet is electrified, charging infrastructure must be built. EV charging hubs are publicly available stations that are solely dedicated to charging electric vehicles. They provide charging solutions for different transport modes on a single site. This project envisages installing EV charging hubs that couple solar generation and onsite battery storage to ensure that new EVs are powered by 100 percent renewable energy. This will ensure that the increase in electricity demand does not lead to increases in GHG emissions from the electricity grid in Tuvalu. There are currently ten petrol service stations in Tuvalu, which suggests that ten small mixed-use hubs that support all the vehicle types in Tuvalu (EV and non-EV) should provide the required infrastructure to support the small number of vehicles. The strategic positioning of these sites can support the transition to electric vehicles.</p> <p>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 vehicle-to-everything (V2X) capabilities, where the vehicle can act as a storage entity to provide electricity back to the required location. Such technology can help deal with grid capacity issues, peak shaving, and matching renewable generation with vehicle charging patterns.</p> <p>Stakeholders in Tuvalu suggested that GoT could use policy tools to assist in the uptake of this project, for example banning or taxing ICEVs from a certain date, or incentivising EVs through tax rebates or subsidies.</p>		
<b>Estimated GHG emissions reduction potential</b>		
<p>Assuming that the average car in Tuvalu travels 10 km per day, the average GHG emissions from a car in Tuvalu would be 0.537 CO<sub>2</sub>e per year, based on fuel consumption, distance travelled (approximately 10 km per day), and CO<sub>2</sub> emitted per litre of petrol. Assuming that charging infrastructure is developed in 2022, and EV penetration increases at a linear rate over eight years from 2023 to 2030, approximately 125 cars would be replaced each year as cars in the current fleet gradually reach the end of their economic lives<sup>124</sup>. GHG emissions would be reduced by 67 tCO<sub>2</sub>e in the first year (from 2023, once the infrastructure is in place), which will ramp up progressively to 537 tCO<sub>2</sub>e when the project is fully implemented. The cumulative GHG emissions reduction between 2022 and 2030 is 2,417 tCO<sub>2</sub>e.</p>		
<b>Cost estimates</b>		<b>Estimated time scale</b>
<p><b>Cost of vehicles</b></p> <p>Based on modelling the capital and operating costs of ICEV and EVs in Tuvalu, the electrification of 100 percent of the light vehicle fleet in Tuvalu would cost US\$11,000,000. This modelling compared the lifetime costs (in net present value terms) of EVs vs ICVs in Tuvalu. At current prices, despite having US\$242 lower operating costs per year (annual mileage 3,650 km), EVs are still US\$11,000 more expensive over their lifetimes. Tuvalu would have to replace 1,000 ICEV cars with EVs to reach 100 percent electrification of</p>		<p>It would take nine years to electrify the whole fleet:</p> <ul style="list-style-type: none"> <li>It will take 12 months to install the first EV charging infrastructure in Tuvalu due to the country's distance to market which is likely to push procurement to the longer end of this scale</li> <li>EVs will replace the current fleet at a linear rate over eight years between 2023 and 2030.</li> </ul>

<sup>123</sup> Data provided by sector focal points in Tuvalu state that Tuvalu has approximately 250 registered light vehicles. However, stakeholders in Tuvalu suggest that there are approximately 1,000 cars in Tuvalu. Given the significant number of unregistered vehicles in Tuvalu (approximately only 10 percent of vehicles are registered), the number of vehicles in Tuvalu as estimated by stakeholders is used (1,000).

<sup>124</sup> We assume that investments and supporting charging infrastructure would lead to 100 percent electrification of the fleet over the next eight years.

<p>the light vehicle fleet, meaning the additional unfunded costs of this transition would be US\$11,000,000.</p> <p><b>Cost of charging infrastructure</b></p> <p>Tuvalu would require ten charging hubs to support the electric fleet, which would cost US\$2,470,000. A small charging hub with solar and storage would typically cost US\$220,000–US\$275,000 and can charge up to six vehicles at a time<sup>125</sup>.</p> <p><b>Total investment need</b></p> <p>The total investment need of this project is therefore US\$13,470,000.</p>	
<b>Potential environmental or social impacts</b>	
<p>Negative</p> <ul style="list-style-type: none"> <li>Construction of charging infrastructure can cause local disturbance including noise pollution, dust, sediment pollution, and increased streams of construction waste</li> <li>This project will lead to increases in EV batteries that require careful disposal/recycling at the end of their economic lives</li> </ul> <p>Positive</p> <ul style="list-style-type: none"> <li>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.</li> </ul>	
<b>Affordability</b>	<b>Likely co-benefits</b>
<p>The total additional lifetime cost of owning an EV rather than ICE vehicle in Tuvalu would be US\$11,000 per car. This is unaffordable for consumers in Tuvalu. Charging infrastructure will cost US\$2,470 per car, which is also unaffordable, if paid for through user fees alone. This project would require support from international donors.</p>	<ul style="list-style-type: none"> <li>Learning from best practice around the world, the availability of charging hubs is proving to be one of the biggest enablers for electrification of vehicles, contributing to SDG 13 (climate action), and SDG 11 (sustainable cities and communities)</li> <li>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)</li> <li>The decarbonization of transport would lead to a reduction in reliance on diesel and allow Tuvalu to use only on locally produced and stored electricity, contributing to SDG 8 (affordable and clean energy) and SDG 13 (climate action)</li> <li>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)</li> <li>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)</li> <li>Reduce household costs of fuel, contributing to SDG 8 (decent work and economic growth)</li> <li>Encourage tourism but reducing noise and physical pollution from ICEVs, contributing to SDG 8 (decent work and economic growth).</li> </ul>
<b>Procurement method</b>	<b>Likelihood of attracting private or donor funding (high, medium, low)</b>

<sup>125</sup> These figures have been extracted from the completed projects by Urban Foresight for Dundee City Council in Scotland.



<p>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.</p> <p>At the Consultation Workshop, seven out of 11 stakeholders in Tuvalu thought international donor funding to be the most appropriate way to fund this project. Only three out of 11 stakeholders thought government funding to be the most appropriate way to fund this project.</p>	<p>Medium</p> <ul style="list-style-type: none"> <li>▪ An effort to completely electrify the light vehicle fleet in Tuvalu would be a highly visible project that demonstrates a commitment to GHG emissions reductions and may be attractive to donors</li> <li>▪ A commitment to the electrification of vehicles may attract commercial interest in installing and operating a charging network without any state funding required.</li> </ul>
<b>Capacity requirement to implement (high, medium, or low)</b>	<b>Potential barriers</b>
<p>Medium</p> <ul style="list-style-type: none"> <li>▪ If delivered by a private organization, charging hub providers may require support from the Tuvalu government to identify suitable locations and provide relevant permissions.</li> <li>▪ If the charging network is delivered by the government then a more technical knowledge is required to support the correct specifications in the most appropriate locations.</li> <li>▪ EVs typically have lower maintenance requirements than ICE vehicles.</li> </ul>	<ul style="list-style-type: none"> <li>▪ This project may face opposition from people and businesses servicing Tuvalu's current fleet of ICEV. For example, service station owners may be concerned about falling demand for fuel, and auto mechanics may be concerned about falling demand for engine maintenance. Stakeholders during the Consultation Workshop discussed the reliance of some families on fuel shops</li> <li>▪ EV models are new to the Tuvalu 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</li> <li>▪ The disparity in price points between second-hand ICE automobiles and new highly efficient vehicle will be a barrier to market acceptance</li> <li>▪ No import exemptions exist for EVs, which may hinder uptake</li> <li>▪ Stakeholders in Tuvalu stated that land space is limited and improving existing roads will be challenging. Poor condition of roads may limit the uptake of this project. Future projects could consider upgrading main roads<sup>126</sup>.</li> </ul>

<sup>126</sup> The project 'active transport infrastructure upgrade' was proposed early in the consultation and aimed to improve to public walkways, develop pathways for bikes and micro mobility, and increase safe road spaces by introducing space between motorised vehicle traffic lanes and non-motorised lanes. This project was removed from the pipeline because stakeholders stated that the project would likely require land reclamation. Land reclamations would increase the cost for this project substantially and this was already an extremely expensive project with only very modest GHG emissions reduction potential. In future, Tuvalu could integrate aspects of the 'active transport infrastructure upgrade' with a road upgrade project.



## A.2 Maritime transport

### Outboard motor transition from 2-stroke petrol outboards to 4-stroke

Project name: Outboard Motor Transition from 2-stroke petrol outboards to 4-stroke		
Sector: Maritime transport	Sub-sector: Energy efficiency	Project type: Investment
<b>Project description</b>		
<p>This project would encourage 50 percent of outboard motor vessel owners in Tuvalu to replace their 2-stroke outboard motors with more efficient 4-stroke outboard motors through awareness-raising campaigns and supporting services. This transition represents a significant opportunity to reduce emissions from the maritime transport sector in Tuvalu. Sixteen percent of households in Tuvalu own an outboard motor, and DOE's (2012) energy statistics suggest outboard motors are the single largest user of imported fossil fuels used in transport in Tuvalu. 4-stroke outboard motors are roughly 30 percent more efficient than 2-stroke outboards<sup>127</sup>.</p>		
<b>Estimated emissions reduction potential</b>		
<p>It is assumed for the purposes of these calculations that, on average, one 2-stroke outboard motor produces approximately 2.7 tCO<sub>2</sub>/year<sup>128</sup>. According to a recent FAO report on fuel efficiency for small fishing boats, the average 2-stroke motors consume fuel at 20 litres per hour, whereas the average 4-stroke engine consumes fuel at 14 litres per hour<sup>129</sup>. This means 4-stroke outboards are approximately 30 percent more fuel efficient than 2-stroke outboards.</p> <p>According to data from Tuvalu's Community Fishing Centre and Island Councils, there are 1,886 2-stroke outboard engines in Tuvalu. If 50 percent of these engines were replaced with more efficient 4-stroke engines, this would reduce emissions by 764 tCO<sub>2</sub>e.</p> <p>Assuming that this project starts in 2022, and engine replacement occurs at a linear rate over the next nine years to reach 50 percent in 2030, the total emission reduction in 2030 would be 764 tCO<sub>2</sub>e. The cumulative emissions reduction potential of this project would be 3,820 tCO<sub>2</sub>e by 2030.</p>		
<b>Cost estimates</b>		<b>Estimated time scale</b>
<p><b>Cost of support programme</b></p> <p>A similar 4-stroke outboard motor promotion project in Fiji estimated development costs as US\$30,000 and enabling capacity building and technical assistance needs as US\$325,000. The project aimed to replace 7,900 outboard motors. Scaling the technical assistance costs to the number of outboard engines in Tuvalu targeted for this project (approximately 943 outboard engines), the technical assistance costs in Tuvalu would be US\$39,000<sup>130</sup>. Therefore, assuming the development costs are the same as for the project</p>		<p>The transition away from 2-stroke outboard motors requires a phased approach and fiscal incentives, supported by capacity building, training and pilot trials. A phased transition from predominantly premix 2-stroke outboard to 4-stroke could take place over a nine-year period.</p>

<sup>127</sup> See calculations and references in the estimated GHG emissions reduction potential section of the concept note.

<sup>128</sup> Emissions calculations for RMI Government vessel tenders with outboards found annual GHG emissions from 8 outboard motors of 72.63 tons of CO<sub>2</sub> (averaging >9 tCO<sub>2</sub>/yr per motor) and used 23.06 tons of petrol in 2017 (outboard motors 6 x 45 HP and 2 x 25 HP Yanmar Enduros). R. Held (2018) Bachelor Thesis "Transitioning to Low Carbon Shipping: A Survey on the fleet within the inter-island shipping in the Republic of the Marshall Islands with special regard to CO<sub>2</sub> emissions and their reduction potential" submitted to Universities of Applied Sciences Flensburg and Emden-Leer and PRIF (ibid) calculated that total consumption of outboard motors in RMI was about 1,277,000 litres of petrol equivalent to 3,038 tCO<sub>2</sub> in 2017.

<sup>129</sup> <http://www.fao.org/3/i2461e/i2461e.pdf>

<sup>130</sup> While costs in Fiji are used as a proxy for costs in Tuvalu, it is likely that costs in Tuvalu will be somewhat higher than in Fiji due to Tuvalu's small market size, remote location, and limited negotiation power. There is, however, no robust way to estimate the overall cost premium attached to goods and services in Tuvalu relative to Fiji in a way that materially reduces the uncertainty of the cost estimates included at this concept note stage. More detailed costing should be a priority at the pre-feasibility study stage for each of the pipeline projects.

<p>in Fiji, the total cost of the support programme in Tuvalu would be US\$69,000.</p> <p><b>Capital cost estimates:</b> Based on a recent report in Fiji, new 2-stroke 40 horsepower motor costs US\$3,300, while a new 40 horsepower 4-stroke motor costs US\$6,000. Assuming 105 motors are replaced each year, the capital cost premium of shifting from 2-stroke to 4-stroke engines would be US\$283,500/year for each of the nine years of the replacement program</p> <p><b>Operating cost estimates:</b> A recent report by FAO concluded that the total annual cost of operating a two-stroke engine is US\$8,040 (assuming 4 hours per trip, 200 fishing trips per year and US\$0.80/litre<sup>131</sup>). This assumes that the operating cost is dominated by fuel costs only. Scaling the cost to reflect the price per litre of fuel in Tuvalu (US\$1.35), the total cost of operating a 2-stroke motor would be US\$13,567 per year. If 4-stroke motor is 30 percent more fuel efficient than a 2-stroke motor, the total costs of operating 4-stroke motor would be US\$9,497 per year. Therefore, assuming 105 motors are replaced each year, the operational cost savings would increase at a linear rate over the nine years of the replacement programme to reach US\$3,838,000 in 2030.</p> <p><b>Net present value</b> Assuming the project costs are incurred in 2022, and the capital costs and operational cost savings change as engines are replaced at a rate of 105 per year over the next nine years, the net present value of this project would be US\$10,743,000 between 2022 and 2030, assuming a 6 percent discount rate.</p>	
<p><b>Potential environmental or social impacts</b></p> <p>Negative</p> <ul style="list-style-type: none"> <li>Replacing simple 2-stroke engines with mechanically more complex 4-stroke engines may create new waste streams</li> </ul> <p>Positive</p> <ul style="list-style-type: none"> <li>Reduced demand for fuel reduces operating costs and risk of fuel spills</li> <li>Four stroke engines are both quieter, and cleaner than 2-stroke engines. Therefore, this project would lead to a reduction in noise pollution, and engine oil spills.</li> </ul>	
<p><b>Affordability</b></p> <p>Estimates suggest that 4 stroke outboard motors are commercially viable in Tuvalu. Therefore, with appropriate financial arrangements, this project should provide significant financial benefits to people in Tuvalu.</p>	<p><b>Likely co-benefits</b></p> <ul style="list-style-type: none"> <li>Potential employment opportunities associated with sale, maintenance, installation, recharging and recycling for 2-stroke outboard motors. This contributes to SDG 8 (decent work and economic growth)</li> <li>Traditional knowledge of small canoe building and sailing becomes more appropriate, contributing to SDG 4 (quality education)</li> <li>Reduced operating costs over time would reduce pressure on local fisheries, contributing to SDG 8 (decent work and</li> </ul>

<sup>131</sup> <http://www.fao.org/3/i2461e/i2461e.pdf>

	economic growth) and SDG 11 (sustainable cities and communities).
<b>Procurement method</b>	<b>Likelihood of attracting private or donor funding (high, medium, low)</b>
<p>Given the short investment payback period, the capital costs of transitioning from 2-stroke to 4-stroke outboard engines should be funded by users and financed by commercial banks.</p> <p>Awareness raising campaigns and supporting services could be funded by one or a combination of donor grants of government budget. Four out of eight stakeholders in Tuvalu thought international donor funding to be the most appropriate way to fund this project. Only three out of eight stakeholders in Tuvalu thought government funding to be the most appropriate way to fund this project.</p>	<p>Medium</p> <ul style="list-style-type: none"> <li>Such projects have been considered viable for funding in island countries.</li> </ul>
<b>Capacity requirement to implement (high, medium, or low)</b>	<b>Potential barriers</b>
<p>High</p> <ul style="list-style-type: none"> <li>High upfront costs and capacity building and training requirements</li> <li>A key constraint is the maintenance of the motors and the cost of parts</li> <li>According to stakeholders, most people will replace their motor when the boat needs to be replaced. Regular fishermen will replace their motors more often.</li> </ul>	<ul style="list-style-type: none"> <li>Cost is a major barrier and likely to be borne by users if fiscal incentives are not provided. Hence, without compensating current users of 2-stroke outboards, the uptake may be slow</li> <li>2-stroke outboard motors are relatively lighter compared to 4-stroke motors, hence consumers in Tuvalu may still prefer 2-stroke motors despite the energy-efficiency potential of 4-stroke motors</li> <li>Appropriate training needs to be provided to mechanics to be able to service the 4-stroke engines for which maintenance is slightly more complex than the 2-stroke.</li> </ul>

### Shore side electrical supply for at berth vessels

<b>Project name: Shore Side electrical supply for at berth vessels</b>		
<b>Sector: Maritime transport</b>	<b>Sub-sector: Energy efficiency</b>	<b>Project type: Investment</b>
<b>Project description</b>		
<p>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.</p> <p>Shoreside electricity connections provide electricity to vessels while at berth, enabling the vessels to turn off other power sources operated by hydrocarbon fuels (HFO). Vessels that operate on diesel or other marine fuels such as HFO typically need to have some power to operate onboard services while at berth. Running diesel generators, auxiliary engines or main engines at berth emits contaminants that impact air quality at berth and contribute to carbon emissions.</p> <p>Tuvalu has one passenger ferry which carries 200 passengers, and the country receives a large cargo vessel once a month (110 meters with 8,000 tons of capacity). The Government is currently procuring a landing craft tank (LCT) barge, which is smaller than the ferry. There are four registered commercial vehicles longer than 15 meters in Tuvalu—mainly police patrol/maritime patrol, and fisheries boats. Many large vessels do not currently have capacity for shoreside electricity plug-ins, but smaller vessels may have this capacity.</p> <p>Where grid capacity is insufficient to accommodate connection, local generation should be considered. For large cargo ships visiting Tuvalu that operate on HFO, a local diesel generation shoreside electricity 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 electricity requirements.</p> <p>Consultation with stakeholders who are extremely familiar with the layout and functionality of the port will be crucial to ensure that the best location(s) of the electrical supply is chosen</p>		

<p>Ports of Auckland (POAL) has undertaken several feasibility studies for shore electricity 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. POAL's 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 electricity, but many of these had high repeat calls, meaning approximately 30 percent of cruise vessel calls would be shore electricity capable.</p>	
<b>Estimated emissions reduction potential</b>	
<p>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 (three medium-sized vessels) each have average annual emissions of 1,370 tCO<sub>2e</sub>,<sup>132</sup> the total emissions reduction potential of this project would be 144 tCO<sub>2e</sub> in 2030.</p> <p>Assuming that this project starts in 2022, and emissions reductions increase at a linear rate from 2023 to reach 144 tCO<sub>2e</sub> in 2024, this project would have an emission reduction potential of 1,080 tCO<sub>2e</sub> between now and 2030.</p>	
<b>Cost estimates</b>	<b>Estimated time scale</b>
<p>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.</p> <p>It is assumed that electricity costs roughly equal the fuel savings under this project.</p>	<p>Shoreside electricity supply infrastructure would take approximately three years to develop and reach full usage.</p>
<b>Potential environmental or social impacts</b>	
<p>Negative</p> <ul style="list-style-type: none"> <li>Shore side infrastructure upgrades can cause localized disturbance and impact local amenity values</li> <li>This project would increase demand for electricity, which may make it more difficult for Tuvalu to reach 100 percent renewable generation</li> </ul> <p>Positive</p> <ul style="list-style-type: none"> <li>Reduced demand for marine diesel reduces operating costs and risk of fuel spills</li> <li>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.</li> </ul>	
<b>Affordability</b>	<b>Likely co-benefits</b>
<p>This project would cost less than US\$5 per capita per year in Tuvalu. Therefore, it may be possible to fund this project from Tuvalu's fiscal budget. However, given the Government of Tuvalu is in debt distress, and the primary benefit from this project is emissions reduction, there is likely to be a strong case for international donor support.</p>	<ul style="list-style-type: none"> <li>Health impacts from improved air quality and reduced noise levels of vessels at berth. This will directly contribute to SDG3 (Good health and well-being)</li> <li>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).</li> </ul>
<b>Procurement method</b>	<b>Likelihood of attracting private or donor funding (high, medium, low)</b>
<p>This project could be funded through a combination of user fees and donor funding. Finance could be sought either through commercial finance institutions, or through concessional finance, given how large the investment would be.</p> <p>Two thirds of stakeholders in Tuvalu thought international donor funding to be the most</p>	<p>Medium</p> <ul style="list-style-type: none"> <li>This project may be attractive to funders if a detailed business case assessment were able to show an economic case of the project with a clear commercial viability gap.</li> </ul>

<sup>132</sup> This estimate assumes that small passenger and cargo ships travel an average of 100 km per day, burn 14.01 litres of fuel per km, and that each litre of fuel burned emits 2.68 kg CO<sub>2e</sub>.

appropriate way to fund this project. While no stakeholders identified user fees as a possible funding source, there is a clear case to charge fees equivalent to the cost of running diesel generators, auxiliary engines, or main engines at berth.	
<b>Capacity requirement to implement (high, medium, or low)</b>	<b>Potential barriers</b>
<p>Medium</p> <p>Capacity constraints include:</p> <ul style="list-style-type: none"> <li>• The shoreside electricity supply would require specialised operation and maintenance</li> <li>• Vessel crew members would require training in the safe operation of electrical connections.</li> <li>• A feasibility study would likely be required to determine the capacity of the local grid to service at-berth vessels.</li> </ul>	<ul style="list-style-type: none"> <li>• Installing plug-in facilities on vessels may require them to be moved out of service temporarily while the necessary adjustments are made</li> <li>• Stakeholders in Tuvalu stated that there is no shelter and limited space for berthing. Special consideration about where the electrical supply is located will be important when designing this project. Consultation with stakeholders who are extremely familiar with the layout and functionality of the port will be crucial to ensure that the best location(s) of the electrical supply is chosen.</li> </ul>

## A.3 Energy efficiency

### *Retrofitting of major hotels and commercial and government buildings*

Project name: Retrofitting of major hotels and commercial and government buildings		
Sector: Energy efficiency	Sub-sector: Buildings and their facilities	Project type: Investment
<b>Project description</b>		
<p>This project would provide energy efficiency training and education and low-cost loans to hotels and shops for energy-efficient retrofits and appliances. It would also involve retrofitting government buildings (including schools), and provide energy efficiency training and education to government workers, school students, and teachers. There are about 10–15 commercial buildings and four hotels, which should participate in an energy efficiency retrofit project. There are also approximately 300 government buildings which should participate—107 government buildings are on Funafuti and 192 government buildings are on the outer islands<sup>133</sup>. Awareness programs are required to engage both the public and private sector, and civil society with energy efficiency projects.</p> <p>Significant energy savings can be realised through retrofits focusing on reducing heat load through shading and passive cooling, efficient appliances, and behaviour change in commercial buildings and hotels. Examples implemented in other countries include:</p> <ul style="list-style-type: none"> <li>• Awnings or other external shadings on large windows</li> <li>• Design for crossflow ventilation through rooms, via opening windows or louvres on both sides</li> <li>• Replace old air conditioners with efficient reverse-cycle units</li> <li>• Replace inefficient bar fridges and leave fridges switched off by default (mainly applicable in hotels)</li> <li>• Add signage reminding employees and guests to switch off lights and air conditioners when leaving</li> <li>• General employee energy awareness training.</li> </ul> <p>Efforts to retrofit buildings to improve their energy efficiency have been successful in Samoa, Tonga, Cook Islands, and Fiji (particularly in the hotel sector).</p>		
<b>Estimated GHG emissions reduction potential</b>		

<sup>133</sup> The number of government buildings include schools, which are included in this project.

## Hotels and commercial buildings

The commercial sector accounts for approximately 32 percent of Tuvalu's energy consumption (based on billing data ITP obtained from TEC in 2014-2015) with the top 20 large customers accounting for about 20 percent. Studies of the hotel and commercial sectors across the Pacific show savings of 5-20 percent per building after energy efficiency measures are implemented<sup>134</sup>. Conservatively, it is assumed that 20 buildings achieve a 5 percent saving to get a total energy savings of 50 MWh/year. When multiplied by Tuvalu's grid emission factor (0.51),<sup>135</sup> this project would lead to 26 tCO<sub>2</sub>e reduction per year once fully implemented in 2026.

## Government buildings

The annual energy consumption for government buildings on Funafuti is 2,185 MWh and for outer islands is 187 MWh (totalling 2,372 MWh per year)<sup>136</sup>. It is assumed that government buildings in Tuvalu achieve similar percentage energy savings to hotels and commercial buildings after energy efficiency measures are implemented. It is therefore conservatively assumed that government buildings achieve a 5 percent saving to get a total energy savings of 119 MWh/year. When multiplied by Tuvalu's grid emission factor (0.51), this would lead to 60 tCO<sub>2</sub>e reduction per year once fully implemented in 2026.

This project would result in a combined energy savings of 169 MWh/year between hotels, commercial buildings, and government buildings, once fully implemented. It is assumed that 80 buildings can be retrofitted each year (320 buildings over four years). GHG emissions reduction potential would be realised from year two, equating to 29 tCO<sub>2</sub>e (2024), which will ramp up progressively to 86 tCO<sub>2</sub>e per year once fully implemented in 2026. The cumulative GHG emissions reduction between 2023 and 2030 is 516 tCO<sub>2</sub>e.

Cost estimates	Estimated time scale
<p><b>Capital costs</b></p> <p>This project is expected to cost US\$35,000 per year. Therefore, the total capital cost of the project is US\$140,000.</p> <p><b>Energy cost savings</b></p> <p>Once fully implemented, this project would lead to energy cost savings of US\$145,340 per year once fully implemented, based on electricity costs in Tuvalu of US\$ 0.86/kWh<sup>137</sup>.</p> <p><b>Net present value</b></p> <p>If the project starts in 2023, the project capital costs are spread evenly over four years of the project, and the energy cost savings are partially realised from 2024 (one year after the first year of implementation), the net present value of the project between 2023 and 2030 would be US\$524,000 under a 6 percent discount rate.</p>	<p>Energy efficiency measures can be phased in over four years.</p>
Potential environmental or social impacts	
<p>Negative</p> <ul style="list-style-type: none"> <li>It is possible that energy efficiency work could increase appliance and building waste streams in Tuvalu</li> <li>Energy efficiency investments can worsen social inequality by delivering savings to those hotels and businesses able to afford upgrade work, and raising barriers to entry for new businesses</li> </ul> <p>Positive</p> <ul style="list-style-type: none"> <li>Energy and cost savings for businesses through energy efficiency improvements</li> <li>Energy efficiency work can lead to job creation.</li> </ul>	

<sup>134</sup> ITP research.

<sup>135</sup> Tuvalu's grid emissions factor is reported on the UN's U4E website. Available at: <https://united4efficiency.org/country-assessments/tuvalu/>

<sup>136</sup> Provided by the GoT from latest available data (2020).

<sup>137</sup> Cost of electricity in Tuvalu reported in: <https://documents1.worldbank.org/curated/en/912921468309257890/pdf/PID-Appraisal-Print-P144573-11-17-2014-1416286688727.pdf>

<b>Affordability</b>	<b>Likely co-benefits</b>
<p>The average cost of implementing this project is approximately US\$3.00 per capita per year. Therefore, implementing this project should be affordable to consumers in Tuvalu.</p> <p>Furthermore, energy efficiency retrofits often save businesses money by reducing energy bills. This project should target retrofits that have high net present values.</p>	<ul style="list-style-type: none"> <li>Improved services for commercial facilities and potential job creation for energy efficiency retrofits, contributing to SDG 8 (decent work and economic growth)</li> <li>Potential cost savings through energy efficiency improvements, contributing to SDG 7 (affordable and clean energy)</li> <li>Potential for business productivity improvements through energy-efficiency improvements, contributing to SDG 7 (affordable and clean energy).</li> </ul>
<b>Procurement method</b>	<b>Likelihood of attracting private or donor funding (high, medium, low)</b>
<p>This project could be funded by the GoT, or by user fees generated from this project.</p> <p>Seven out of 11 stakeholders in Tuvalu thought international donor funding to be the most appropriate way to fund this project.</p> <p>There may also be potential for government funding to fund this project. However, only three out of 11 stakeholders in Tuvalu thought government funding to be the most appropriate way to fund this project.</p> <p>Many retrofitting projects will require finance. This could be either commercial finance (provided by commercial banks) or concessional finance (provided to the GoT and disbursed via the Development Bank of Tuvalu).</p> <p>Residential and business customers are concerned about interest rates—soft loans should assist with cost issues, but additional awareness programmes are needed. The Development Bank is offering soft loans of up to \$80,000 for upgrades related to building code improvements energy efficiency. Uptake has been low, and most loans are very small.</p>	<p>High</p> <ul style="list-style-type: none"> <li>Energy efficiency has been financed by development banks around the Pacific. In many cases, investments in energy efficiency retrofits will be profitable, meaning that the case for donor funding is weak. However, individual retrofit projects may be too small to warrant donor funding.</li> <li>Tuvalu National Bank may also fund the project, particularly due to the potential for pay back through user fees and because energy efficiency in buildings has been financed in other PICs.</li> </ul>
<b>Capacity requirement to implement (high, medium, or low)</b>	<b>Potential barriers</b>
<p>Medium</p> <ul style="list-style-type: none"> <li>Requires skilled labour to conduct energy efficiency retrofits and maintain energy-efficient appliances.</li> </ul>	<ul style="list-style-type: none"> <li>Lack of awareness from private and public sector and civil society</li> <li>Upfront costs of retrofits</li> <li>Lack of availability of energy-efficient appliances and materials needed for retrofits.</li> </ul>



## Cold storage energy efficiency

Project name: Cold storage energy efficiency				
Sector: Energy efficiency		Sub-sector: Energy efficiency	Project type: regulation	Investment,
Project description				
<p>This project aims to replace reefers at the wharf with purpose-built cool rooms for shops. This is a very simple and cost-effective project leading to large energy savings. Stakeholders stated that this is a very useful project for Tuvalu because Tuvalu’s wharf has limited space for containers, and this project would help with this issue of land space.</p> <p>At least five shops currently use refrigerated containers (reefers), stored at the wharf in Funafuti, for cold food storage. These containers are a major contributor to electricity demand and operate very inefficiently compared with purpose-built cold storage facilities. Food quality is also affected by inconsistent temperatures due to reefers sitting in the sun and being opened and closed repeatedly throughout the day.</p> <p>TEC and the Energy Department indicated strong interest in this project during consultations in March 2021. Some officials were concerned that installing new cool rooms could overload distribution transformers and cables in Funafuti. Transformer monitoring was undertaken in 2015/2016, and this research showed that transformers would not be overloaded if new cool rooms were installed. Stakeholders in Tuvalu suggested that this study is now out of date. The first step in this project would be to cross-check the 2015/2016 study with existing distribution infrastructure in Funafuti.</p>				
Estimated GHG emissions reduction potential				
<p>According to a World Bank feasibility study undertaken in 2016, replacing reefers in Tuvalu with purpose-built cool rooms could save a total of 93.334 MWh/year<sup>138</sup>. Multiplying these energy savings by Tuvalu’s grid emissions factor (0.51 tCO<sub>2</sub>e/MWh)<sup>139</sup> shows that this project could reduce GHG emissions in Tuvalu by 48 tCO<sub>2</sub>e per year once fully implemented. Assuming that one replacement is made every year beginning 2022 and five replacements are achieved by year 2026, the cumulative emission reduction between 2022 and 2030 would be 336 tCO<sub>2</sub>e by 2030.</p>				
Cost estimates		Estimated time scale		
<p>Cool room capital costs estimated at US\$25,000 per shop, or US\$125,000 for all five major shops.</p>		<p>5 years—This project can be implemented quickly and will have immediate benefits including cost savings to shop owners.</p>		
Potential environmental or social impacts				
<p>Negative</p> <ul style="list-style-type: none"><li>Upgrading refrigeration equipment may increase streams of appliance and construction waste and cause localized disturbance while work is ongoing</li></ul> <p>Positive</p> <ul style="list-style-type: none"><li>Increased refrigeration energy efficiency can lower operating costs for the businesses partaking in upgrades</li><li>Lower operating costs for businesses should lead to lower prices for consumers.</li></ul>				
Affordability		Likely co-benefits		
<p>This project is likely to lead to significant savings for businesses in Tuvalu over time. According to a World Bank feasibility study undertaken in 2016, cool rooms typically have operating costs approximately half those of reefers. Replacing reefers in Tuvalu with purpose-built cool rooms was found to have a very low simple payback period in Tuvalu, ranging from 1.74 to 0.57 years<sup>140</sup>.</p>		<ul style="list-style-type: none"><li>Reduced wharf congestion</li><li>Better security and accessibility for shop owners, contributing to SDG 8 (decent work and economic growth)</li><li>Health benefits to the community through better food quality. Supermarket owners noted that food sometimes spoiled due to poor temperature control. This will contribute to SDG 3 (good health and wellbeing).</li></ul>		

<sup>138</sup> ITP "Reefer replacement" feasibility study for the World Bank in 2016.

<sup>139</sup> Tuvalu's grid emissions factor is reported on the UN's U4E website. Available at: <https://united4efficiency.org/country-assessments/tuvalu/>

<sup>140</sup> ITP "Reefer replacement" feasibility study for the World Bank in 2016.



<i>Procurement method</i>	<i>Likelihood of attracting private or donor funding (high, medium, low)</i>
<p>Given the change is likely to be a profitable investment for business in Tuvalu, changing reefers can be paid for through cost savings for business, and potentially financed by commercial banks.</p> <p>It may be beneficial to coordinate procurement between businesses in Tuvalu, so that the procurement contracts can reach an efficient scale.</p> <p>Six out of ten stakeholders in Tuvalu thought international donor funding to be the most appropriate way to fund this project. There may also be potential for government funding to fund this project. Three out of ten stakeholders in Tuvalu thought government funding to be the most appropriate way to fund this project. One stakeholder thought that user fees from projects would be adequate to fund this project.</p>	<p>Low</p> <ul style="list-style-type: none"> <li>▪ This project was previously proposed through a World Bank study, but it was difficult to secure funding due to perceived equity risks around grant funding to the private sector. A program run through the development bank may help with this.</li> </ul>
<i>Capacity requirement to implement (high, medium, or low)</i>	<i>Potential barriers</i>
<p>Medium</p> <ul style="list-style-type: none"> <li>▪ Implementation requires commitment from shop owners and incentives from the government, including the wharf authority</li> <li>▪ Support for technician training may help to reduce technical barriers.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Despite clear benefits to shop owners, very few have built their own cool rooms. This appears to be due to convenience (continuing with the status quo), concerns about maintenance, and upfront cost. Support from the development bank may help reduce cashflow barriers</li> <li>▪ Five major shop owners have capital available to install cool rooms. However, it is likely that they will ask for a grant another incentive to change the status quo</li> <li>▪ Shop owners were concerned about their ability to maintain their own cool rooms. Training and support would assist with this</li> <li>▪ Some stakeholders in Tuvalu are concerned that distribution transformers and cables may be overloaded if shops installed cool rooms. The 2016 feasibility study found that this is unlikely to be a problem, however this risk may change over time and will require continual monitoring</li> <li>▪ Stakeholders in Tuvalu stated that shop owners may have limited land space and space in shops for cool rooms—more consultation with shop owners would be needed when further developing this project to confirm which shops have space and how space could be accommodated.</li> </ul>

## Appendix B Ideas for additional NDC Projects

This Appendix details ideas for additional NDC projects in energy efficiency, land transport, and maritime transport sectors. It also provides ideas for projects in the agriculture sector.

### B.1 Additional NDC projects in focus sectors

NDC Roadmap and Plan considered additional projects in each of the focus sectors (listed below). These projects were removed from the project pipeline, at the request of the GoT. The GoT may want to revisit these projects in the future<sup>141</sup>.

Land transport sector:

- Shared electric cars/vans
- Electrification of commercial fleets
- Whole-of-lifecycle vehicle programme

Maritime transport sector:

- Biodiesel ferry

Energy efficiency sector:

- Development and implementation of the Energy Efficiency Building Code
- Capacity building for integrated energy planning and energy statistics
- Strengthening and expanding the standards and labelling programme for appliances and lighting
- Grid straightening projects.

### B.2 Additional NDC projects in agricultural sector

While agriculture was not included in this NDC Implementation Roadmap and Investment Plan, stakeholders noted that there are climate change mitigation and adaptation projects being planned in the agricultural sector. Specifically, Tuvalu will soon commence the Integrated Agro-ecosystem approach for enhancing Livelihoods and Climate Resilience in Tuvalu (IAE4LCR TV) programme, funded by the GEF.

The IAE4LCR TV programme includes both natural and assisted regeneration and replanting of degraded lands, and the expansion of dry litter technology and biodigesters for managing piggery waste. The programme's proposal document<sup>142</sup> estimates that these

<sup>141</sup> A concept note has been developed for each of these projects.

<sup>142</sup> [https://publicpartnershipdata.azureedge.net/gef/GEFProjectVersions/086620eb-6964-ea11-a811-000d3a337c9e\\_PIF.pdf](https://publicpartnershipdata.azureedge.net/gef/GEFProjectVersions/086620eb-6964-ea11-a811-000d3a337c9e_PIF.pdf)

activities will reduce net GHG emissions by 160,000 tCO<sub>2</sub>e between 2022 and 2042, and lead to indirect emissions reductions of 189,000 tCO<sub>2</sub>e over the same period. The IAE4LCR TV programme is also expected to deliver substantial adaptation benefits, including increased food security, improvements in coastal resilience, and greater economic resilience. The total cost of the programme has been estimated at US\$8,731,000.

Relevant agricultural sector projects, including those covered by the IAE4LCR TV programme, should be considered when Tuvalu develops its enhanced NDC and updates its NDC Implementation Roadmap and Investment Plan.

## Appendix C Terminologies and assumptions used in Section 5

### **Determination of GHG mitigation**

GHG (expressed as CO<sub>2</sub>e) mitigation potentials outlined in this paper are determined based on the available information gained from stakeholders in Tuvalu, Government documents, and other sources, which take into account IPCC 2006 guidance. Mitigation values are rounded to the nearest ton.

### **Determination of investment and support needs**

Costs for investment and support needs are determined in United States (US) dollar and are based on estimated costs as incurred in the Pacific region up through 2030. These values are rounded to the nearest thousand US dollar. Cost estimates in this paper 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, energy and commodity price swings, and other geopolitical events.

### **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. All 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—promising opportunities have been identified. 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 prioritised for Tuvalu.

## Appendix D Existing and planned projects and initiatives in Tuvalu

Table 7.3 outlines the existing projects or initiatives (either in development or recently implemented) to reduce GHG emissions the priority sectors. Many projects have been delayed due to travel restrictions implemented during the COVID-19 pandemic. There are no current or planned projects in Tuvalu's land transport sector.

**Table 7.3: Existing and planned projects and initiatives in Tuvalu**

Project	Project type (infrastructure, equipment upgrade, study, training, public awareness, incentive)	Description	Project completion expectation <sup>143</sup>	Organization responsible
<b>Maritime transport sector</b>				
Outer Island Maritime Infrastructure Project <sup>144</sup>	Infrastructure and training	<p>This project involves:</p> <ul style="list-style-type: none"> <li>▪ Building and rehabilitating boat harbours on the island of Nukulaelae (original project), Niutao (first additional financing) and Nui (second additional financing)</li> <li>▪ Building better maritime facilities in the outer islands in order to expedite cargo handling and improve the safety and security of vessel and passenger traffic</li> <li>▪ Building capacity to maintain maritime infrastructure; and</li> </ul>	<p>The construction of the boat harbour in Nukulaelae is 90 percent completed, and the civil works contract to construct the boat harbour in Niutao was awarded in November 2020.</p> <p>The contract award for the Nui project is scheduled for late 2022. This project is particularly important to accommodate for the government's procurement of the new LCT barge.</p>	MTET

<sup>143</sup> 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.

<sup>144</sup> <https://www.adb.org/sites/default/files/project-documents/48484/48484-005-rrp-en.pdf>

Project	Project type (infrastructure, equipment upgrade, study, training, public awareness, incentive)	Description	Project completion expectation <sup>143</sup>	Organization responsible
<p>Developing a master plan for future harbour developments.<sup>145</sup></p> <p>This project is expected to cost US\$13.3 million. An ADB grant will fund \$1.1.3 million of the project, a Global Environment Facility grant will fund \$500,000 and the remaining \$1.5 million will be provided by the Government of Tuvalu<sup>146</sup>.</p>				
<b>Energy efficiency sector</b>				
The Facilitation of the Achievement of Sustainable National Energy Targets of Tuvalu (FASNETT)	Infrastructure	FASNETT is funded by the Global Environment Facility (GEF) and seeks to facilitate the development and utilisation of feasible renewable energy resources and the application of energy efficiency technologies for achieving Tuvalu's 100 percent renewable energy targets <sup>147</sup> .	Expected to be completed by July 2021. Updated completion date by the end of 2022 (including the Low Carbon Fund and Energy Efficiency Revolving Fund)	MTET (DOE)
Low Carbon Fund and Energy Efficiency Revolving Fund for energy-efficient	Public awareness and Incentive	The Development Bank of Tuvalu started a subsidy scheme for energy-efficient appliances and housing retrofits in 2016. In November 2020, the bank was given financial assistance of US\$38,600 through the FASNETT programme to buffer the bank's existing energy efficiency program <sup>148</sup> .	Expected to be completed by the end of 2020. Updated completion date by the end of 2022	DBT

<sup>145</sup> Identified by a stakeholder in the Consultation Survey, which was part of the Consultation Workshop on 24 March 2021.

This project could lead to indirect GHG emissions reductions (rather than direct GHG emissions). For example, building better maritime facilities and harbours could reduce boat idling which would reduce diesel consumption of at-berth vessels.

<sup>146</sup> <https://www.rnz.co.nz/international/pacific-news/318864/improved-maritime-facilities-for-tuvalu-outer-islands>

<sup>147</sup> <https://www.thegef.org/project/facilitation-achievement-sustainable-national-energy-targets-tuvalu-fasnett>

<sup>148</sup> Consultation with stakeholders in Tuvalu.

Project	Project type (infrastructure, equipment upgrade, study, training, public awareness, incentive)	Description	Project completion expectation <sup>143</sup>	Organization responsible
appliances and housing retrofits		The programme will now be enhanced and implemented as part of the FASNETT project <sup>149</sup> .		
770 kW solar PV plant (with battery storage) on Funafuti	Infrastructure	This US\$6.1 million MFAT funded project will include 770 kW of Solar PV and at least 1 MWh of battery storage <sup>150</sup> . The plant will help replace diesel on the island, where about 85 percent of electricity is currently generated from diesel.	The plant was expected to be completed by the end of 2020 but has been delayed due to COVID-19 travel restrictions. Construction is expected to begin as soon as the borders open	MTET
2 MW of solar PV, 2 MWh of battery storage, and a small wind turbine on Funafuti	Infrastructure	Funded by the World Bank and the Asian Development Bank (ADB). This project involved implementing a 2 MW of solar PV, 2 MWh of battery storage, and a small wind turbine on Funafuti.	Project delayed due to COVID-19 travel restrictions. Construction is expected to begin after October 2021 (once borders open) <ul style="list-style-type: none"> <li>• ADB is in the process of contract signing with the developer</li> <li>• Materials required for the project have been procured and some delivered to Tuvalu</li> </ul>	MTET
Radio programme on household energy efficiency	education Public awareness	The Department of Energy runs a quarterly education programme via the radio, on household energy efficiency	Project will be completed at the end of 2022 <sup>151</sup> .	MTET (DOE)

<sup>149</sup> <https://info.undp.org/docs/pdc/Documents/TUV/PIMS%205613%20TUV%20FASNETT%20Project%20Document%20Final.pdf>

<sup>150</sup> <https://www.infratec.co.nz/projects/first-solar-battery-project-completed-for-tuvalu>

<sup>151</sup> Consultation with stakeholders in Tuvalu.











