GOVERNMENT OF TONGA

TONGA LEDS

LOW EMISSION DEVELOPMENT STRATEGY 2021-2050

NOVEMBER 2021

FOREWORD

As a series of low lying islands the Kingdom of Tonga is particularly vulnerable to the effects of climate change, and with a population of just over 100,000 people our greenhouse gas emissions are negligible compared to larger, more developed economies.

Nonetheless, Tonga is demonstrating strong ambition and leadership by communicating a long-term, low emission development strategy (LT-LEDS) that not only considers mitigation but also resilience and adaptation, as well the country's broader development objectives.

This LT-LEDS reaffirms Tonga's commitments to the Paris Agreement which Tonga ratified on the 21st September 2016. It also complements the Government of Tonga's adaptation and mitigation efforts as articulated in Tonga's Climate Change Policy, Tonga's Joint National Action Plan 2 on Climate Change and Disaster Risk Management and Tonga's Second Nationally Determined Contribution to the Paris Agreement.

By developing Tonga's Second Nationally Determined Contribution and LT-LEDS in unison, Tonga has already demonstrated visionary thinking and planning that will support alignment between the long-term vision and pathways, and planning and investments in the nearer term. LT-LEDS was developed in a participatory manner, grounded in our culture and values. Drawing on Talanga, an 'interactive dialogue or interactive talking with a purpose' between two individuals or groups or communities, the process and workshops wove together principles of traditional culture and knowledge, family, community and religion, autonomy and independence.

As a result, the LT-LEDS vision is well aligned to Tonga Strategic Development Framework 2015 -2025 (TSDF II): *A low emissions Tonga, where all sectors work together to create resilience, autonomy and self-reliance.*

I would like to extend my sincere thanks to the team from the Department of Climate Change, MEIDECC for their efforts in developing Tonga's LT-LEDS and to all national and international stakeholders who have contributed to its development.

As the Minister for the Ministry of Meteorology, Energy, Information, Disaster Management, Environment, Climate Change and Communications (MEIDECC), it is indeed an honour and a privilege to submit Tonga's Low Emission Development Strategy 2021-2050 to the United Nations Framework Convention on Climate Change (UNFCCC).

Honourable Poasi Mataele Tei

Image: Port of Refuge (Taulanga Puatalefusi) as viewed from Mt. Talau, Vava'u. Taken in 2020.

CONTENTS

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Front & back cover image: Aerial view of Nuku’alofa, Tongatapu. Taken in 2021.

All images are credited to the Mitigation Division, Department of Climate Change, Tonga.

Image (opposite page): Women laying out ngatu at a local residence in Fasi, Tongatapu. Taken in 2020.

Acronyms

ADB	Asian Development Bank
AFOLU	Agriculture, Forestry and Other Land Use
AGC	Agricultural Growth Committee
BAU	Business as Usual
CAD	Civil Aviation Division
CBOs	Community Based Organisations
CDPs	Community Development Plans
COP	UNFCCC Conference of Parties
CSO	Civil Society Organisation
DCC	Department of Climate Change
DOE	Department of Energy
E&S	Environmental and Social
EAP	Education Awareness Plan
EE	Energy Efficiency
EEZ	Exclusive Economic Zone
EU	European Union
EVs	Electric Vehicles
FAO	Food and Agricultural Organisation
FBO	Faith-based Organisation
FMP	Forest Management Plan (Management Plan for the Forests and Tree Resources of Tonga)
GCF	Green Climate Fund
GDP	Gross Domestic Product
Gg	Gigagram
GHG	Greenhouse Gas
GoT	Government of Tonga
ICT	Information and Communications Technology
IPCC	Intergovernmental Panel on Climate Change
JNAP2	Joint National Action Plan 2 on Climate Change & Disaster Risk Management 2018-2028
J-PRISM II	Japanese Technical Cooperation Project for Promotion of Regional Initiative on Solid Waste Management, Phase II
LED	Light Emitting Diode
LT-LEDS	Long-term, low-emission development strategy
MAFF	Ministry of Agriculture, Food, & Forests
MEIDECC	Meteorology, Energy, Information, Disaster Management, Environment, Climate Change and Communications
MFAT	New Zealand Ministry of Foreign Affairs and Trade
MIA	Ministry of Internal Affairs
MLNR	Ministry of Lands and Natural Resources
MOF	Ministry of Finance
MOI	Ministry of Infrastructure
MORC	Ministry of Revenue and Customs
MOT	Ministry of Tourism
MPAs	Marine Protected Areas
MPD	Marine Ports Division
MTED	Ministry of Trade and Economic Development
NCCCC	National Climate Change Coordination Committee
NDC	Nationally Determined Contribution
NEMO	National Emergency Management Office
NGHGI	National Greenhouse Gas Inventory
NGOs	Non-Government Organisations
NIIP II	National Infrastructure Investment Plan 2, 2013-2023
NIIP-3	Tonga National Infrastructure Investment Plan 2020-2030
NSPAO	National Spatial Planning Agency Office
PAT	Ports Authority Tonga
PMO	Prime Minister's Office
RE	Renewable Energy
SCADA	Supervisory Control and Data Acquisition
SDG	Sustainable Development Goal
SMAs	Special Management Areas
SOE	State-owned enterprise
SPREP	Secretariat of the Regional Environment Programme
TASF	Tonga Agriculture Sector Plan 2016-2020
TC	Tropical Cyclone
TCCP	Tonga Climate Change Policy (2016)
TEEMP	Tonga Energy Efficiency Masterplan
TERM	Tonga Energy Road Map
TERMPLUS	Tonga Energy Road Map, 2021 - 2035
TNC	Third National Communication (2019)
TNFP	Tonga National Forest Policy 2009
TMPI	Tonga Maritime Polytechnic Institute
TPL	Tonga Power Limited
TSD	Tonga Statistics Department
TSDF II	Tonga Strategic Development Framework 2015-2025
TVET	Technical and Vocational Education and Training
UNFCCC	United Nations Framework Convention on Climate Change
UNCTCN	United Nations Climate Technology Centre and Network
WAL	Waste Authority Limited

EXECUTIVE SUMMARY

The Intergovernmental Panel on Climate Change (IPCC) Working Group I Sixth Assessment Report (2021) shows that the world will probably reach or exceed 1.5 degrees Celsius of warming within the next two decades. Tonga is already experiencing the impacts of climate change and this warming world, including increased intensity of climate and weather extremes. An international solution is needed to address this international challenge. While respecting common but differentiated responsibility and respective capabilities, the Kingdom of Tonga will play its part in supporting the reduction of Greenhouse Gas (GHG) emissions in support of the long-term temperature goal of the Paris Agreement.

The Government of Tonga puts forth a long-term low-emission development strategy (LT-LEDS) that aspires to: A low emissions Tonga, where all sectors work together to create resilience, autonomy and self-reliance.

This will require concerted and comprehensive efforts from all facets of society: government, public enterprise, private sector, and civil society. Tonga will also continue to work actively in international forums to strengthen consensus among countries to tackle climate change, and collaborate actively with international partners to build capabilities and share experiences.

Tonga will pursue the sectoral pathways and actions outlined in this document, while also pursuing climate-resilience and adaptation efforts. In addition to the stated vision, Tonga's LT-LEDS is guided by 5 sector pathways, each with a series of actions:

- **Energy:** A Tonga that promotes standards that establish renewable energy, energy efficient infrastructure and battery storage facilities.
- **Transport:** A Tonga with low emissions in the Transport sector, achieved through sustainable maintenance of transport, knowledge production, enforced regulation and decentralisation of services.
- **Agriculture, Forestry and Other Land Use (AFOLU) and Fisheries:** A resilient Fisheries and Agriculture, Forestry and Land Use Tonga through low emissions, low costs and sustainable systems.
- **Waste:** A resilient, sustainable and educated Tonga, achieved through effective education and sustainable waste management.
- **Human Settlements:** Building a resilient and autonomous Tonga through transformation and strengthening of all sectors.

These sector pathways, their related actions and steps were guided by seven principles important to the Tongan people: For the purposes of the LT-LEDS, these were defined by stakeholders as environment, inclusivity, autonomy, culture, traditional knowledge, education and core values.

The implementation of the LT-LEDS, its sector pathways and actions will start straight away with the initiation of nine first steps that will advance Tonga towards its vision. In doing so, climate-resilience and adaptation co-benefits will be integrated with pathways, actions and steps.

Finally, Tonga is committed to coordinating processes for its LT-LEDS and future NDCs, with the aim of creating alignment between long- and short-term actions. This will avoid duplication of efforts and allow for regular exchange of information between the two documents. Alignment will occur under institutional arrangements, systems for monitoring and assessing progress, and revisions or review cycles.

While Tonga's efforts alone may seem modest, efforts in delivering this LT-LEDS will be substantial and demonstrate leadership in helping to achieve a long-term, low-carbon future for all.

A LOW EMISSIONS TONGA, WHERE ALL SECTORS WORK TOGETHER TO CREATE RESILIENCE, AUTONOMY AND SELF-RELIANCE.

TONGA LEDS 2021-2050

A DEMONSTRATED COMMITMENT TO ACHIEVING A RESILIENT TONGA BY 2035

TSDF II | TCCP 2016 | JNAP2 | TNC 2019

THE TONGA 2050 VISION

A LOW EMISSIONS TONGA, WHERE ALL SECTORS WORK TOGETHER TO CREATE RESILIENCE, AUTONOMY & SELF-RELIANCE.

DRIVEN BY

- Traditional knowledge & culture
- Health & wellbeing of all Tongans (& every household)
- Education
- Communities, individuals & government push for change

KEY NDC TARGETS

13% reduction in GHG emissions by 2030 compared to 2006 through 70% renewable electricity

Establishment of a forest inventory & planting

ONE MILLION TREES

by 2023

Expansion of the formal

WASTE COLLECTION SYSTEM

VISIONS
FOR LONG-TERM SECTOR PATHWAYS TO LOW EMISSIONS

ENERGY
A Tonga that promotes standards that establish renewable energy, energy efficient infrastructure, & battery storage facilities.

AUTONOMY

TRANSPORT
A Tonga with low emissions in the Transport sector, achieved through sustainable maintenance of transport, knowledge production, enforced regulation & decentralisation of services.

CORE VALUES

AFOLU
A resilient Fisheries & Agriculture, Forestry & Land Use Tonga through low emissions, low costs & sustainable systems.

CULTURE

WASTE
A resilient, sustainable & educated Tonga, achieved through effective education & sustainable waste management.

HUMAN SETTLEMENTS
Building a resilient & autonomous Tonga through transformation & strengthening of all sectors.

EDUCATION

ACTIONS
FOR LONG-TERM SECTOR PATHWAYS TO LOW EMISSIONS

- 100% renewable electricity by 2035
- High standards for technologies, infrastructure & retrofitting
- Education to support jobs in energy
- Private sector fund RE projects
- Upgrades to electricty grids

ENVIRONMENT

- GHG emissions reduced 28% by 2030
- Improve data collection & waste management
- Strengthened road & vehicle maintenance
- 100% EV government fleet & 50% long-term public adoption
- Expansion of non-motorised & cycling transport

INCLUSIVITY

- Strengthen public-private partnerships
- Data collection, management & accessibility
- Expansion of MPAs & SMAs
- Enhancing agro-forestry & home gardening

- Develop & implement national waste strategy
- Improve waste infrastructure & management
- Education, awareness raising, traditional knowledge & use of local/recycled goods
- Establish biogas plant by 2030

TRADITIONAL KNOWLEDGE

- Community access to climate resilient infrastructure
- Enhance stormwater management, water security & coastal protection
- Improve resilience of housing
- Promote sustainable tourism

MAJOR FIRST STEPS
TO ADVANCE TONGA'S LOW EMISSIONS FUTURE

1. Loan program for low energy buildings
2. Standardising lighting power consumption for buildings by 2025
3. Low emission vehicles: government to pilot electric vehicles
4. Develop a waste communication strategy
5. Strengthen existing transport policies
6. Mainstreaming important low emission policy elements into relevant ministries
7. Promote best practices in agriculture, forestry and fisheries
8. Develop and implement a national waste policy for Tonga
9. Pedestrianising Nuku'alofa by 2022

SYNERGIES BETWEEN MITIGATION & ADAPTATION ACROSS SECTORS

- Improve productivity & diversity of agroforestry
- Expansion of MPAs & SMAs
- Reforestation as part of promoting best practices in agroforestry
- Enhance home gardening
- Co-benefits of energy interventions
- Impacts of EV uptake on transport & waste
- Reduced waste production & sustainable waste disposal
- Resilient community infrastructure in human settlements across Tonga

1 NATIONAL CONTEXT

1.1 COUNTRY PROFILE

The Kingdom of Tonga is an archipelago located in the South Pacific Ocean with a total land area of 718km^2, consisting of four main island groups: Tongatapu, Ha'apai, Vava'u and the two Niuas. Nuku'alofa is the capital of Tonga, which is located on the main island of Tongatapu.

Climate

Tonga's climate is tropical, with two distinct seasons: dry season (May-October) and wet season (November-April). The mean annual temperature in Tonga varies from 23°C to 26°C. Climate in Tonga is governed by a number of factors which include the trade winds and the movement of the South Pacific Convergence Zone. Year-to-year variability in climate is also strongly influenced by the El Niño Southern Oscillation, which can bring prolonged drought conditions and tropical cyclones that occur during the wet season.

Tonga faces near and long-term exposure to the negative impacts of climate change and natural disasters. Tonga was ranked the second highest disaster risk country globally, according to the World Risk Report in 2020 (Bündnis Entwicklung Hilft, 2020). Impacts include seismic activity with earthquakes and tsunamis; frequent tropical cyclones with damaging winds (often between 22-65 knots), rain and storm surges; droughts, and sea level rise.

Population

The total population of Tonga is approximately 100,651 people as of 2016, split into 50,255 males and 50,396 females (Tonga Statistics Department, 2016). More updated population figures will come through the planned November 2021 Census. According to the 2016 census, the majority of this population (74%) lives on Tongatapu with population density being 286 people per km^2 compared to only 17 people per km^2 in the Niuas.

Economy

Tonga is a small, open economy, with a Gross Domestic Product (GDP) estimated at USD 512 million in 2019 (World Bank, 2021). It has a strong position as a lower middle-income country, in part due to its high migration and remittance culture, which represent approximately 50–60% of gross national domestic income (Tonga Statistics Department, 2016). In 2019, remittances from Tonga's diaspora contributed USD 193.6 million or 37% of GDP (World Bank, 2021).

Tonga's largest export sectors are tourism, agriculture and fisheries. In 2015–16 the service sector contribution to GDP (including tourism trade, and hospitality) was 54.5%, while agriculture contributed 14.7% to GDP in current prices (Census 2016).

Tonga's productive sectors are vulnerable to the impacts of climate change. Intense cyclones, as experienced in Tropical Cyclone (TC) Gita and TC Harold, substantially impact these sectors and the economy. In April 2020, TC Harold is estimated to have caused economic damage totalling 12% of GDP (World Bank, 2020), in addition to lives and livelihoods lost.

COVID-19

The government of Tonga has successfully quarantined its population from COVID-19, with no cases recorded as of August 2021. However, the pandemic continues to threaten Tonga's population, health and economic fortunes. The recovery of Tonga's tourism sector, a substantial contributor to the economy before COVID-19, will be protracted as a consequence of border closures. Despite these challenges and uncertainties, Tonga continues to demonstrate ambitious mitigation commitments and action.

Image (opposite page): The tourist hotspot Friends Cafe and Tourist Center (white with red roof wooden building) on the main street of Taufaáhau Road in downtown Nuku'alofa, Tongatapu. Taken in 2021.

1.2 GHG EMISSIONS PROFILE

Tonga emitted 310.4 Gigagrams (Gg) of CO_2-equivalent in 2006, according to the Third National Communication submitted in 2019. Nearly all emissions are derived from the Energy sector (39%) and AFOLU (61%), with waste accounting for 0.3% of total GHG emissions. While energy emissions are mostly driven by a dependency on imported petroleum for electricity generation and transportation, the increase in AFOLU emissions is a result of the steady growth in commercial forest harvesting and wood utilisation, increased clearance of forested land and grasslands for commercial farming, and increased clearance of secondary growth for social uses especially firewood, wood carving and construction. The 2006 emissions represent an increase of 21.56 percent from GHG emissions of 2000, as reported in the Second National Communication. Nonetheless, Tonga accounts for just 0.0037 percent of global CO_2 emissions.

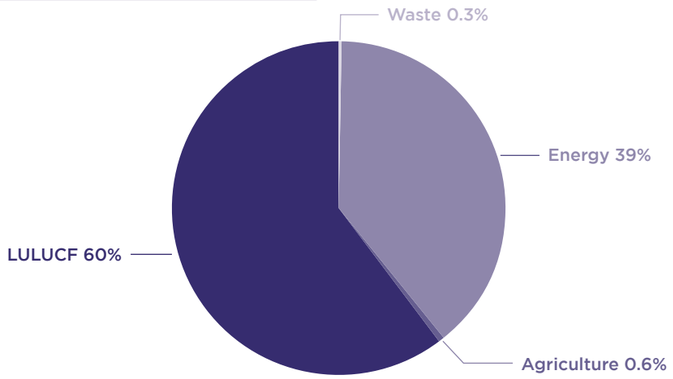
The Second NDC acknowledges the challenges that data accessibility and quality bring to Tonga's recording and reporting of emissions. In particular, uncertainty in land use data, combined with paucity of information regarding assumptions and methodologies used to calculate GHG emissions and carbon sequestration from living biomass, undermines the reliability of the estimate for the AFOLU sector.

This LT-LEDS is organised into Tonga's key GHG emitting sectors: AFOLU, Energy, Transport, Waste and Human Settlements. Transport has been identified as its own sector, with a focus on land transport as the largest emission sub-sector for transport, within data currently available. Human Settlements was selected as a cross-cutting sector with significant contributions to GHG emissions and broader development objectives.

Figure 1. Estimated greenhouse gas emissions by sector (2006)[1]

	GHG Emissions (in Gg)	Share in total GHG emissions
Energy	120.4	39%
Agriculture	1.8	0.6%
LULUCF	187.4	60%
Waste	0.9	0.3%
TOTAL	**310.2**	**100%**

Source: Government of Tonga (2019)



1 The Government of Tonga's Third National Communication to the UNFCCC distinguishes between (1) agriculture and (2) land use, land-use change and forestry (LULUCF) as separate sectors for GHG emissions (Government of Tonga, 2019)

1.3 NARRATIVE DESCRIPTION OF RELEVANT LEGAL AND INSTITUTIONAL FRAMEWORKS

The Government of Tonga is a global leader in developing a suite of policies and plans that integrate climate change and sustainable development.

The LT-LEDS is no different; drawing on and aligning with the following key executive and legislative mandates, laws, and publications[2]:

Tonga Strategic Development Framework 2015-2025 (TSDF II) provides an overarching framework for Tonga's development including the LT-LEDS. It seeks 'A more progressive Tonga supporting a higher quality of life for all' through seven national outcomes: knowledge-based economy; balanced urban and rural development across island groups; empowering human development with gender equality; responsive good-governance with law and order; successful provision and maintenance of infrastructure and technology; effective land administration, environment management, and resilience to climate and risk; and consistent advancement of our external interests, security and sovereignty.

Tonga Climate Change Policy (TCCP, 2016) intends to make Tonga climate-resilient by 2035 and enhance mitigation efforts. Its vision is for 'A Tonga that is resilient to the impacts of climate change and climate-related disaster risks, and is able to protect and safeguard its present and future citizens.' It seeks to achieve this through three strategic goals: strengthened integrated risk management to enhance climate and disaster resilience; low carbon development; and strengthened disaster preparedness, response and recovery specific targets.

Joint National Action Plan 2 Climate Change and Disaster Risk Management (JNAP2) 2018-2028 provides the strategic action plan for both the TSDF II and TCCP. Its mission is 'To develop a resilient Tonga through an inclusive, participatory approach that is based on good governance, builds knowledgeable, proactive communications and supports a strong, sustainable development pathway.' Its guiding principles were replicated in the LT-LEDS process, including 'A holistic, multi-faceted, multi-sectoral approach' and an 'Integrated approach to adaptation and mitigation'. The JNAP Technical Working Groups provided oversight to the LT-LEDS process (see Annex B for more detail).

Third National Communication on Climate Change Report (TNC, 2019) updates the information and inventory of Tonga's Second National Communication. It captures Tonga's national circumstances and National Greenhouse Gas Inventory (NGHGI), provides mitigation analysis, vulnerability and adaptation assessments, and details constraints, gaps, financial, technical and capacity needs.

2 This document acknowledges that at time of publication a number of new legislations had just been approved including the Disaster Risk Management Bill 2021; Tonga Climate Change Fund Bill 2021 and Tonga Energy Bill 2021

Tonga's Second National Determined Contribution (NDC, 2020) is ambitious and reflects the urgency of the Paris Agreement, with mitigation targets for Energy (a 13% (16 Gg) reduction in GHG emissions by 2030 compared to 2006), AFOLU (establishment of a forest inventory and planting one million trees by 2023) and Waste (expansion of the formal waste collection system). Tonga's Second NDC sought alignment with the LT-LEDS, with the recommendations and commitments of the former being included in the sector pathways development. Many of the stakeholders who participated in the 2015 NDC Review and Second NDC Validation were actively engaged in the workshops under the LT-LEDS.

Tonga has a goal of Gender Equity by 2025 and the Government recognises that sustainable development can only be achieved if gender considerations (i.e. the respective issues, concerns, and priorities of women and men) are factored into the work of the government. This approach is espoused in the TSDF II, of which the third National Outcome envisions 'a more inclusive, sustainable and empowering human development with gender equality'. Further, the **National Women's Empowerment and Gender Equality Tonga Policy and Strategic Plan of Action 2019–2025** includes specific national priorities to address gender issues that the Government and national stakeholders have agreed require urgent attention. Two of these priorities are particularly relevant for the LT-LEDS: 'Enabling environment for mainstreaming gender across government policies, programmes, services, corporate budgeting and monitoring and evaluation'; and 'Equitable access to economic assets and employment'.

Image (opposite page): Churchgoers after a church service at the Immaculate Heart of Mary Cathedral, Ma'ufanga, Tongatapu. Taken in 2019.

1.4 WHY A LT-LEDS FOR TONGA?

Purpose

Developing a LT-LEDS achieves multiple purposes for Tonga:

Fulfilling commitments under the Paris Agreement which under Article 4, paragraph 19, states that 'All Parties should strive to formulate and communicate long-term low greenhouse gas emission development strategies, mindful of Article 2 taking into account their common but differentiated responsibilities and respective capabilities, in the light of different national circumstances.' The related COP Decision 1/CP 21, paragraph 35, 'invites' Parties to communicate by 2020, to the secretariat, 'mid-century' long-term low greenhouse gas emission development strategies in accordance with Article 4, paragraph 19.

Support and complement existing planning and policy processes by bringing a longer term, more integrated view. This will result in improved socio-economic outcomes and contribute to meeting Sustainable Development Goals (SDGs). Tonga has already demonstrated visionary thinking and successful planning to identify low-carbon development, adaptation, mitigation and climate resilience actions and policies that simultaneously deliver socio-economic benefits in line with national priorities (see Section 1.3 for relevant policies).

Enhance dialogue and governance capability. By strengthening and extending existing processes of dialogue and governance, particularly those established for the JNAP2, Tonga can further enhance its capability for strategic planning in areas of infrastructure, social, economic and environmental development.

Provide a framework for more integrated and strategic investment and development aid coordination, towards a more resource-efficient, secure and resilient Tonga. The LT-LEDS provides an opportunity for the Tongan government to coordinate strategically with development partners on the transformational investments needed to mitigate GHG emissions and adapt to climate change.

Images: Mapping activities undertaken by stakeholders in participatory design workshops.

1.5 PROCESS, PRINCIPLES, AND MACROTRENDS

Process

Tonga's LT-LEDS was developed through a series of facilitated strategic dialogues with key Tongan stakeholders, supported by technical expertise and analysis. This participatory process was designed to reflect Tonga's culture of Talanga, an 'interactive dialogue or interactive talking with a purpose' between two individuals or groups or communities. Cultural metaphors and motifs were also used throughout to act as visual storytelling aids and carry dialogue activities. These dialogues took place over three workshops:

- **Window Workshop 1 (October 2020)** focused on exploring Tonga's past, present, and future, considering global and regional macrotrends and possible implications for Tonga. The result was three main visions that represent recurring themes of education and training, autonomy and independence, resilience & self-reliance and returning to tradition.
- **Window Workshop 2 (February 2021)** focused on iterating the visions from Workshop 1. Stakeholders outlined preferred pathways for each sector, identifying actions needed to achieve each vision and mapped these actions to different scales of change (village/ community, government/business, and global) and timelines (2025, 2030 and 2050).
- **Window Workshop 3 (July 2021)** focused on converging on and confirming a single shared vision. Based on this, stakeholders finalised sector pathways with priority intervention actions and outlined major first-step actions which would support implementation of the intervention actions identified.

The participatory design also enabled the LT-LEDS process to overcome challenges around access to strong quantitative data, particularly GHG emissions data (see section 1.2). The workshops provided decision-makers with qualitative information and took them through multiple rounds of divergent thinking (open, creative, playful, non-judgmental) to create choices and convergent thinking (analytical, decisive, and strategic) to refine those choices. This was informed by qualitative knowledge gathered from numerous sources: government policies and plans, external reports, additional technical analysis by the consulting team and sense checking with the local steering committee and technical experts.

Workshops included participants from all government ministries, public enterprise, private sector and civil society (see full Consultation list in Annex A). By maintaining a broad scope (beyond just low-carbon development), decision makers were encouraged to consider trade-offs, benefits and sequencing of Tonga's future pathways. The process intended to strengthen and extend existing processes of dialogue and governance so that Tonga can further enhance its capability for long-term, strategic planning.

Due to time and resource constraints, the following elements were deemed out of scope for the process: a quantified long-term emissions reduction target, quantified financial needs for proposed interventions, international cooperation needed to implement the LT-LEDS.

For more information on methodology and governance see Annex B.

Principles and Macrotrends

The LT-LEDS process was informed by a number of guiding principles, macrotrends and elements.

Cross-cutting development objectives and principles for Tonga are expressed in several existing documents including the TSDF II, the TCCP, the JNAP2 and the Tonga Energy Road Map (TERM). From these documents, seven principles were identified and used by stakeholders throughout Workshops 1, 2 and 3:

Environment
Sustainable environmental development.

Inclusivity
With participatory & inclusive governance and empowered communities.

Traditional Knowledge
Valuing Tongan traditional culture and knowledge.

Culture
Valuing community, family and religion.

Autonomy
With a resilient economy and reduced reliance on imported energy.

Education
Quality education for all Tongan's, guided by the latest science.

Core Values
Of sharing, cooperating and fulfillment of mutual obligations; humility and generosity; maintain relationships; and loyalty and commitment.

All actions and steps have been assessed against these principles.

Concurrently, stakeholders considered macrotrends that may influence Tonga's futures. These trends were grouped into economy, society, environment, politics and technology. Economic and societal macrotrends were equally high priorities for stakeholders. Examples include:

- **Climate migration:**
  'In the future, Tonga will experience increases in average temperatures which will result in a rise in the number of hot days and warm nights and a decline in cooler weather. This may drive more and more Tongans to migrate in search of livelihoods and more comfortable living conditions'.
- **Remittances:**
  'An important source of income for most Tongans, the Governor of Tonga's Reserve Bank cautions that remittances have been on the decline since the 2007-08 global financial crisis. Remittance may not be a sustainable form of investment for Tonga and the government needs to consider alternatives to generate local income and consumption'.
- **Health**:
  'Changing diets, the decline in fresh fish consumption and increase in intake of imported canned foods is directly linked to high rates of non-communicable diseases in Tonga'.

As part of the visioning process, stakeholders were asked to consider the following elements as they thought about ways forward:

Technical: Technical solutions and interventions.

Policy: Key policy and institutional changes.

Workforce: Future workforce needs and education strategies.

Investments: Key investments needed to start Tonga moving on agreed pathways in the short to medium term.

Financing: Approaches to financing including working with development partners, and enhancing private sector participation where feasible.

Technical and Workforce were most commonly identified among stakeholders as critical elements, followed by financing.

2 COMMITMENT STATEMENT

2.1 THE VISION

Taking into account Tonga's national circumstances, the urgency of global climate change, inputs from the participatory process and considering Tonga's Second NDC, the vision developed for the LT-LEDS is:

A low emissions Tonga, where all sectors work together to create resilience, autonomy and self-reliance.

The Tonga of 2050 is driven by:

- Traditional knowledge and culture;
- The health and wellbeing of all Tongans (and every household);
- Education;
- Communities, individuals and government push for change

This vision is supported by sub-visions and pathways for each emitting sector.

This vision aligns with and supports the visions outlined in key Tongan strategic policy documents (more in Chapter 5).

2.2 SECTOR VISIONS

The following summaries describe sector-specific visions developed by LT-LEDS stakeholders:

Energy: A Tonga that promotes standards that establish renewable energy, energy efficient infrastructure and battery storage facilities.

Transport: A Tonga with low emissions in the Transport sector, achieved through sustainable maintenance of transport, knowledge production, enforced regulation and decentralisation of services.

AFOLU: A resilient Fisheries and Agriculture, Forestry and Land Use Tonga through low emissions, low costs and sustainable systems.

Waste: A resilient, sustainable and educated Tonga, achieved through effective education and sustainable waste management.

Human Settlements: Building a resilient and autonomous Tonga through transformation and strengthening of all sectors.

Image (opposite page): Mala'ekula, the Royal Tombs for Tonga's Royal Family in central Nuku'alofa, Tongatapu. Taken in 2021.

3 KEY SHORT, MEDIUM AND LONG TERM CLIMATE ACTIONS

3.1 INTRODUCTION

This chapter provides pathways to low emissions development for Tonga that align with overall vision and priority sector visions established in the preceding chapter. These pathways were developed in the form of a prioritised set of actions for the mitigation sectors of AFOLU and Fisheries, Energy (focused on electricity), Transport (focused on land transport), Waste and Human Settlements.

The pathways build on existing policies and strategies to develop pathways to cut GHG emissions in the short term (by 2025), medium term (by 2030) and long term (by 2050). While these updated pathways address emission reductions by individual sectors, working across sectors will also be crucial to achieving the vision of the LT-LEDS. We will therefore need multidisciplinary initiatives that work across multiple sectors in key areas. They include data collection, management and sharing, mainstreaming and development of future sectoral low emissions policies and plans and community empowerment. Multi-sector initiatives have been highlighted where possible.

While the sectoral sub-chapters below lay out high level pathways and actions, overall reduction in emissions will be achieved primarily through managing energy demand and continuing renewable energy expansion, establishing a low emissions Transport sector, expanding agroforestry and forestry and protecting the marine environment. These key areas will be supported by restoring mangrove forests, improving the urban planning process and transforming the AFOLU sector towards low emissions through agro-ecosystems, land management and technological advancement. Waste management is collectively seen as having a lower contribution to GHG reduction but is laying important foundations for environmental sustainability.

All sector-based pathways and the actions they comprise must support national economic development as well as seven principles important to the Tongan people: for the purposes of the LT-LEDS, these were defined by stakeholders as environment, inclusivity, autonomy, culture, traditional knowledge, education and core values (see Chapter 1.5). Each of the actions in the pathways below has been assessed through the lens of these seven principles. Overall, autonomy and the use of traditional knowledge are important considerations for all sectors. Therefore, all actions in the sector pathways are framed wherever possible to identify, support and use local and traditional knowledge and to highlight local actions that can be taken autonomously.

Image (opposite page): People getting on a small raft in Fafa Island, a small atoll located 7km north of Tongatapu. Taken in 2020.

3.2 ENERGY

3.2.1 Context

Introduction

Energy in this LT-LEDS context refers to the working fluid that runs modern-day Tonga, with imported fuel accounting for 21 percent of all imports in 2014 (World Bank, 2021) and fuel imports for electricity accounting for 10 percent of GDP (Government of Tonga, 2010). The need to import fuel weighs heavily on Tongan businesses' operating expenses and residents' disposable income. Tonga, like every other Pacific Island, has relied mainly on petroleum fuels for decades to power its electricity system. Further, Tonga is dependent on petroleum fuels for all economic activities of agriculture, fisheries, forestry, industry, and especially, transportation. In 2008, Tonga committed to transforming half of all power generation to renewable sources in record time. Since then, development partners have provided both financial and technical assistance to support this ambition. With such a dramatic transition needed to upgrade the electrical system, Tonga's institutions and policies were reformed alongside the progress of these renewable aspirations.

Addressing the interwoven challenges of energy security, climate-change and energy access, Tonga's energy transformation began with bold policies in the Renewable Energy Act (2008). In 2009, the Government of Tonga (GoT) approved a goal of 50 percent of electricity to be generated from renewable energy sources by 2020, which became the centerpiece of the ground-breaking Tonga Energy Road Map 2010–2020 (TERM). Subsequently, Tonga followed TERM strategies from 2010 to 2020 resulting in a series of renewable electricity and network upgrade projects moving from total dependence on fossil-fuels to an increasing share of renewable electricity. Remarkably, alongside this transition, Tonga electrified its remote populations resulting in over 95 percent of the total population now with access to electricity country-wide. Today however, Tonga continues to rely significantly on non-renewable diesel generation and due to COVID-19, the 50 percent renewable target has been reset for 2021-22.

Tonga's electricity sector has been undergoing a transformation with the integration of renewable electricity at an increasing rate. The last five years have shown remarkable progress, achieving 13.5 percent renewable electricity for 2020 with this figure set to double in a year's time to 30 percent, then up to 50 percent by fiscal year 2022 (TPL 2021).

Tonga's energy transformation was recently accelerated by new and comprehensive policies from the Energy Bill (passed in Parliament) and poised to become an Act in 2022 (by royal assent). This Bill provides robust policy to establish coherent institutional and regulatory frameworks for coordination of the Energy sector. It establishes clear national objectives and promotes private sector incentives and research initiatives. When passed as an Act, the Energy Bill will begin the development and adoption of a National Energy Policy to include Tonga's ambitious targets of 70 percent and 100 percent renewable electricity in 2030 and 2035, respectively.

With massive transformations underway in renewable energy generation, distribution and policy, Tonga's future electricity system will perform with ever-increasing complexity. Operating, maintaining and controlling the renewable electricity system of the future will require technology upgrades across almost every area, with significant capacity building needed to develop skills in those who manage Tonga's increasingly dynamic network.

Relevant national policies, sectoral policies and links with the LT-LEDS

The Renewable Energy Act (2008) regulates Tonga's use of renewable energy. It seeks to promote renewable resources by researching and developing opportunities around renewable energy, encouraging the use of commercially sustainable renewable energy technology for both grid connected and standalone power supply systems and also supporting the engagement of the private sector in renewable energy projects in the country. The Electricity Act (2007) provides rules that apply to the Energy sector and establishes the Electricity Commission as a body corporate. The Petroleum Act (1959) regulates petroleum imports/exports to and from Tonga.

At the National policy level, the Tonga Strategic Development Framework 2015-2025 (TSDF II) includes an 'Infrastructure and Technology Inputs Organisational Outcome' (under Outcome 4.1.5) to have more reliable, safe, affordable and widely available energy services built on an appropriate energy mix, moving towards increased use of renewable energy. The National Infrastructure Investment Plan 2, 2013-2023 (NIIP II) outlines plans for major initiatives in economic infrastructure (energy, telecommunications, water, solid waste management, and transport) over the next five to 10 years. It responds to the need for a longer term view and sector-wide approach to infrastructure planning and management, with systematic approaches to identifying future priorities.

From a climate change perspective, the JNAP2 declares that 'Tonga is committed to reducing its greenhouse gas emissions from the Energy sector principally by increasing its utilisation of renewable sources of energy such as solar and energy efficient technologies'. It also includes Guiding Principle (9): 'Long-term sustainability - Initiatives and programs' that will be designed to deliver long term, positive, environmental, social, and economic benefits founded on ensuring self-sufficiency at all levels of Tongan society. The Tonga Climate Change Policy (2016) (TCCP) lays out Tonga's extreme vulnerability to the adverse effects of climate change and disaster risks because of its geographical, geological and socio-economic features, while the Second NDC has a mitigation target of a 13 percent (16 Gg) reduction in GHG emissions from the Energy sector (including transport) by 2030. One of the key measures to reach this target will be achieving 70 percent renewable electricity by 2030.

In terms of sectoral policy, the TERM is the main governing document for the Energy sector. It lays out a strategic plan to reduce Tonga's vulnerability to high prices and the volatility of imported fuels and has, at its centerpiece, the target of 50 percent renewable electricity by 2020. The Tonga Energy Road Map, 2021 - 2035 (TERMPLUS) Framework provides analysis of the TERM to provide a foundation for and build the next 15 year energy strategy document, which will govern the Energy sector in years to come. The Tonga Energy Efficiency Master Plan (TEEMP) provides strategies for the most cost-effective and most reliable initiatives for saving energy and reducing costs and GHG emissions. TEEMP EE and GHG targets are achievable, to ensure feasibility of transition to an energy efficient future.

Responsible Ministries and Sector Stakeholders

The Department of Energy (DOE) within the Ministry of Meteorology, Energy, Information, Disaster Management, Environment, Climate Change and Communications (MEIDECC) is largely responsible for Energy sector policy in Tonga. State-owned electric utility Tonga Power Limited (TPL) is the main implementer of energy projects on its 4 major networks. Both the DOE and TPL develop and maintain projects that are on-grid (connected to TPL grid) and off-grid. The new Energy Bill once given approval by the royal assent (2022) will create a new Ministry of Energy. Under this Ministry will be responsibilities for all sectors of energy including electricity, gas, petroleum, renewable energy and other energy sources. Further a new Energy Commission will be responsible for regulation of the Energy sector.

Historical and current GHG emissions

The Third National Communication on Climate Change report (2019) states that the Tonga Energy sector (including transportation) emitted 39 percent of Tonga's GHG emissions, for a total of 121 Gg CO_2-equivalent in 2006.

Current initiatives

Over the last 10 years many significant renewable energy and network projects have been implemented, with the help of over USD $100 million in donor funding. This has included funding from the Australian Government, New Zealand's MFAT, Asian Development Bank (ADB), Green Climate Fund (GCF), European Union (EU) and Global Environment Facility (GEF). Projects have included solar, wind, battery and network upgrade initiatives. Current projects that have made a big impact over the last several years and will remain ongoing for the next few years include the Tonga Renewable Energy Project (TREP), the Outer Island Renewable Energy Project (OIREP) and Network Upgrade Programs. EU initiatives supporting energy bill research, writing and adoption are also currently active.

3.2.2 Sector Pathway

The Energy sector vision is:

'A Tonga that promotes standards that establishes renewable energy, energy efficient infrastructure, and battery storage facility.'

This sectoral pathway focuses on electricity generation and consumption as the main source of GHG emissions. Building an Energy sector that promotes high standards of renewable energy systems and energy efficiency measures will require each project to be delivered as an integrated solution. As a priority, demand-side (consumer-side) efficiency measures should be deployed wherever possible on a country-wide basis. Further, optimising incentives through electricity rate structures and renewable energy financing will ensure that government, businesses and residences are aligned and assist in the co-creation of the future power generation system.

Community awareness, knowledge and capacity building are essential to gaining country-wide support for the ambitious trajectory of Tonga's electricity system. Education around energy consumption, energy supply and renewable energy projects will help consumers support changing technology and systems. A new model will be required so the electric utility can collaborate with consumers, businesses and government. Higher standards, regulations and enforcement will be needed for building green infrastructure, retrofitting existing structures and purchasing interior energy efficient equipment.

ENERGY

Sector Pathway Actions Over Time

1 **Implement Standards and Regulations for renewable energy and energy efficiency technologies imported into the country**
PRINCIPLES
Environment, Education & Traditional Knowledge

2 **Draft regulation and policy paper for Infrastructure developed using green infrastructure standards**
PRINCIPLES
Environment & Education

3 **Renewable Energy and Energy Efficiency to become part of standard education curriculum**
PRINCIPLES
Education

4 **Draft regulation and policy paper to support roll out of LED Street and Interior LED Lamps**
PRINCIPLES
Core Values, Autonomy & Traditional Knowledge

5 **Increase access to finance for the private sector to fund demand-side renewable energy, projects and green initiatives**
PRINCIPLES
Autonomy, Culture, Core Values & Environment

6 **Increase access to finance for the private sector to fund supply-side renewable energy, projects and green infrastructure**
PRINCIPLES
Autonomy, Core Values, Traditional Knowledge, Education & Environment

7 **Technologies like battery storage to upgrade, maintain and operate a renewable energy network**
PRINCIPLES
Autonomy & Environment

8 **Government to provide a loan program to private sector for Low Energy Buildings**
PRINCIPLES
Autonomy, Education & Environment

ENERGY ACTION 1

Implement Standards and Regulations for renewable energy and energy efficiency technologies imported into the country.

GHG Reduction potential: High.

Description: Implementing standards and regulations will provide for more complete and optimal solutions. It will ensure that any project developed or equipment procured is of the highest quality available to continue to move Tonga toward a clean, sustainable energy pathway. The TEEMP will provide high energy efficiency equipment standards adopted from neighboring countries of Australia and New Zealand. The Energy Bill poised to become an Act in 2022 will provide broad powers to enact standards and regulations with the DOE.

Supporting asset and capacity measures: The DOE will need to train, deploy and set-up proper inspections at airports and wharves to ensure high-standard compliance for the import of renewable energy components and energy efficiency equipment.

Location: Starting in Tongatapu with some remote inspections in Vava'u and Ha'apai.

Timeline: Implementation of standards and regulations will begin by 2022 when the Energy Bill becomes an Act.

Principles: Environment, Education and Traditional Knowledge.

Links to Second NDC: Renewable Energy (RE) & Energy Efficiency (EE) Mitigation Measures.

Links to other mitigation sectors: All sectors.

ENERGY ACTION 2

Draft regulation and policy paper for infrastructure developed using green infrastructure standards.

GHG Reduction potential: Medium.

Description: All public infrastructure should be developed using latest principles of clean energy, energy efficiency, and resilience as well as integrating with local natural resources and reducing waste of all types. This will ensure the planning and development of infrastructure for Tonga incorporates the latest green standards that focus on improving local environments. All future development policy should look to build on the Waste Management Act and Tonga Housing Recovery and Resilience policies. Although costs in the beginning may be higher due to higher infrastructure standards, life-cycle cost and improvement to the environment is projected to outweigh initial added expenses. New standards for green infrastructure are to become part of NIIP II and upcoming NIIP 3.

Supporting asset and capacity measures: Green infrastructure projects including waste infrastructure to be deployed on existing assets and upcoming refurbishments as well as in new builds.

Location: Commence with pilots and projects in Tongatapu and apply lessons to outer islands.

Timeline: 2025 and beyond.

Principles: Environment and Education.

Links to Second NDC: RE & EE Mitigation Measures.

Links to other mitigation sectors: All sectors.

ENERGY ACTION 3

Renewable Energy and Energy Efficiency to become part of standard education curriculum.

GHG Reduction potential: Low.

Description: Including renewable energy and energy efficiency as standard in the education curriculum will assist in providing jobs and careers for Tonga's people. Building wide knowledge of renewable energy and energy efficiency technologies and systems will enable capacity building for Tonga's future experts to support a green growth future.

Supporting asset and capacity measures: Educational institutes to provide programs for energy efficiency education and practical technical vocational training as well as on-site labs for testing equipment. Radio and television ads can support interest and knowledge building by touting the benefits of energy efficiency solutions for home and businesses.

Location: All of Tonga.

Timeline: 2022 just after Energy Bill becomes an Act.

Principles: Not provided, but would at least include Education.

Links to Second NDC: None.

Links to other mitigation sectors: All sectors.

ENERGY ACTION 4

Draft regulation and policy paper to support roll out of light emitting diode (LED) street lamps and interior LED lamps.

GHG Reduction Potential: High.

Description: A complete LED Street Lamp Retrofit Program for all outdoor roadway and outdoor lights. Also includes an Interior Light retrofit to LT-LEDS in existing Government Buildings and as part of new building codes. Once existing lights have been retrofitted, all future street lamps and interior lights should automatically specify LED as standard. Due to the issue of wide variation in LED lamp technologies, this project should include local 'pilot-testing' to cover lamps of different manufacture. Some testing of optimum lights for exterior & interior spaces is also needed. Additionally, information about efficiency in lumens-per-watt should be verified by an independent testing lab. All findings to be made available to update the TEEMP and to place country and island-wide projects in the upcoming NIIP II update. Projects can (and should) be developed as public-private-partnerships, with the GoT providing up to 50 percent of funding on high-return efficiency projects (return on investment of 3-5-years is normal).

Supporting asset and capacity measures: Existing lighting infrastructure to be used where possible - and replaced only where needed. Start training a workforce to undertake this rollout, with collaboration from GoT and TPL.

Location: Phase 1 - starts with the major villages of Tongatapu, moving to Phase 2 - more populous outer islands and Phase 3 - remote inhabited islands.

Timeline: 2021-2025 - education and capacity building; 2025-2030 - implementation; 2030-2050 - operation, maintenance and enforcement of new lighting standards / ordinance.

Principles: Core Values, Autonomy, Traditional Knowledge and Environment.

Links to Second NDC: EE Mitigation Measures.

Links to other mitigation sectors: Human Settlements and Transport.

ENERGY ACTION 5

Increase access to finance for the private sector to fund demand-side renewable energy, projects and green initiatives.

GHG Reduction Potential: High.

Description: An electricity system serving large customers or an aggregation of customers can perform more efficiently if it can be switched on-or-off according to demand. Supporting asset and capacity measures: Existing network of Tongatapu to be upgraded to a 'smart-grid' that can allow two-way flow of electricity. Capacity-building will be needed for a new generation of electric utility control-room specialists. Automated controls are needed for shedding (reducing) load on large customers like water pumps or large industries. Aggregating loads (where individual energy users band together to reduce costs) will need an expert system, such as Supervisory Control and Data Acquisition (SCADA), which can also turn off-and-on systems like air-conditioners, water heaters, lights, etc. Electricity & energy regulators should work with electricity concessionaires to drive incentives for large customers or large aggregators through policy. TEEMP should include updates on these policies and technology platforms and the TERMPLUS should include these measures. The parallel development of a smart network with centralised control is needed as a foundation for these programs.

Location: Tongatapu.

Timeline: 2025.

Principles: Autonomy, Culture, Core Values, Environment.

Links to Second NDC: RE Mitigation Measures (allows more RE to flow on grid).

Links to other mitigation sectors: Transportation (electric vehicle (EV) charging/discharging), Human Settlements and Waste, Agriculture (water-pumping).

ENERGY ACTION 6

Increase access to finance for the private sector to fund supply-side renewable energy, projects and green infrastructure.

GHG Reduction Potential: High.

Description: Tonga's stated goals are to achieve 70 percent then 100 percent renewable electricity by 2030 and 2035, respectively. To achieve this, many inputs must be coordinated, including applying the best technologies for a Tonga-context setting, from the Pacific and around the world.

Supporting asset and capacity measures: Existing land-sites that can add storage systems and additional renewable equipment are ideal. New ideal land-sites (typically, royal-lands) for renewable energy resources need to be obtained as soon as practical. Capacity development needed from external consultants that analyse for renewable resources needs to be funded and applied. Development partner funding for specific RE projects in sequence can be determined from TERMPLUS documents and investment plans. Feasibility studies will be needed on pushing the limits of renewable energies from solar and wind plus smart networks with appropriate storage. Capacity-building is needed for TPL technicians that will implement and operate advanced RE systems. Strengthened and close coordination as well as common understanding of RE goals among major energy stakeholders; especially the GoT Ministries and TPL. RE goals should also be codified in national and sectoral plans like NIIP II, TERMPLUS as well as TPL Business Plans.

Location: All inhabited lands need to be addressed, starting with the largest grid of Tongatapu. Certain renewable resources like biomass from plants and animals may only be feasible on the larger islands. Certain renewable resources like biomass from plants and animals and renewable fuels like hydrogen may only be feasible on the larger islands. Geothermal resources would need to be located near large populations.

Timeline: 2021-2030–feasibility studies; 2023 - ongoing capacity building; 2023 - ongoing on the job training; 2025-2030 - implementation of projects.

Principles: Autonomy, Core Values, Traditional Knowledge, Education, Environment.

Links to Second NDC: RE Mitigation Measures.

Links to other mitigation sectors: All sectors.

ENERGY ACTION 7

Technologies like battery storage to upgrade, maintain and operate a renewable energy network.

GHG Reduction Potential: Medium.

Description: To support a renewable energy network, upgrades are needed on Tonga's electricity grids.

Supporting asset and capacity measures: Existing network in Tongatapu to receive network upgrades to allow the penetration of renewable electricity to rise to 70-100 percent. Most network upgrade equipment and capacity building will come from development partner countries like Australia, New Zealand and the United States. Appropriate battery storage, centralised SCADA, Controls and advanced transmission and distribution infrastructure will allow maximum capabilities for storing, transmitting and distributing renewable electricity when penetration levels hit above 50 percent RE. Significant development partner funding and capacity building will be needed for the network projects in tandem with the large funding for pure RE projects. The TERMPLUS should address these network issues. Funding needs to be provided by development partners for capacity building for new skills in operating, maintaining and managing a complex smart-grid.

Location: Tongatapu.

Timeline: 2025-2030.

Principles: Not provided, but should at least include Autonomy and Environment.

Links to Second NDC: RE Mitigation Measure.

Links to other mitigation sectors: Transportation, Human Settlements, Waste.

ENERGY ACTION 8

Government to provide a loan program to private sector for low energy buildings.

GHG Reduction Potential: High.

Description: Update building codes for energy efficiency and resilience as well as enforce compliance for government, business and residential buildings. New codes for green infrastructure projects will also require significant capacity building.

Supporting asset and capacity measures: New buildings planned and designed using the latest building codes in the Pacific. Existing buildings to be retrofitted. This needs highly-skilled and knowledgeable technicians to provide both resiliency- and energy efficiency-measures. Provide education and training to tradespeople working on these structures and develop programs to educate construction industry businesses and the workforce about latest materials and equipment used for new buildings and upgrades to existing building stock. Upgrade important structures to Category 5 to be resilient to the strongest cyclones. Government to provide loans to make these structures more resilient and able to withstand the new normal of climate change events..Learn from other countries like the islands of Japan (Okinawa) about building cost-effective and climate-resilient structures.

Location: All islands (however, most buildings are in Tongatapu).

Timeline: 2022-2023 - update building codes; 2022-2050 - enforce codes and provide skills and training.

Principles: Not provided, but should at least include Autonomy, Education, Environment.

Links to Second NDC: EE Mitigation Measures.

Links to other mitigation sectors: Human Settlements.

3.2.3 Socio-economic and environmental considerations

Skills and capacity building needed

Education, training and capacity building are fundamental to the transformation of Tonga's traditional fossil-fuel based electricity system to a new, renewable electricity system. Currently however, there is a shortage of skills and experience in the technical and regulatory areas needed to implement Tonga's ambition to achieve 70 percent then 100 percent renewable electricity by 2030 and 2035, respectively.

Over the recent time period leading up to COVID-19, external consultants were flown in to do much of the technical planning and implementation. Now, with development partners keenly aware of the need to train Tonga nationals to continue this work, funding for capacity development has just started. Intensive technical training of electric utility workers will be needed for Tonga's new renewable electricity system/s. Trained workers also need incentives to stay in Tonga and deploy their skills. New building codes for green infrastructure projects will require significant capacity building. Outer-islands communities will require capacity building for new off-grid projects remote locations. Legal & regulatory training will be needed for the energy regulator that will be established from the Energy Bill/Act (2022).

Cross-sectoral considerations

Energy touches on all other sectors including Transport, Human Settlements, Waste and AFOLU. Energy system transformation requires significant education and capacity building for all of Tonga, so that ambitious initiatives can work to benefit all. However, there might also be short term pain with price increases, before price reductions are experienced - and this is also where a strong educational and marketing programs can be best deployed.

Increasing renewable energy sources will produce dramatic positive impacts for long term green growth and could also spur economic development in new areas where renewable energy can be best deployed, for instance, integrating transportation systems and microgrids for disaster management purposes.

Gender and social inclusion considerations

The role of men and women, including behavioural change around purchasing energy efficient household appliances, should be examined. Specific communication and awareness campaigns may be needed for specific groups. Measures should be implemented to ensure that low-income and vulnerable groups are not excluded from benefits or penalised by higher prices of more efficient appliances.

With regard to renewable energy implementation for homeowners, it should be stressed that low-income groups need to be made aware of and given some subsidy to equalise access to the benefits of renewable energy (solar photovoltaics) on the home.

The role of men and women in the buildings sector and construction industry should be examined to ensure women can also participate in learning and skill development/job creation. Differences between urban and rural areas should also be taken into consideration to ensure that low-income and vulnerable groups are not excluded from benefits or penalised by higher costs of a new building code. Specific communication and awareness campaigns may be needed for specific groups.

Importantly, all Tongans should enjoy the benefits of sustainable renewable electricity. All strata of stakeholders must be supported in receiving information and taking action to implement beneficial cost-effective home appliances and home solar systems. Therefore, training and capacity building programs should be inclusive across all of society.

Environmental and social safeguards considerations

Renewable energy system upgrades and projects should be informed by comprehensive environmental impact assessments, in order to understand whether such projects would have wider impacts on local environments. This is especially true in the case of battery energy storage systems, given that some customers have objected to the use of smart equipment in their homes, specifically smart meters. It is important to address such concerns through public educational bulletins and other outreach resources, before deploying equipment island-wide.

Key data gaps and solutions

Tonga's success in the Energy sector relies heavily on obtaining, managing and disseminating data that supports the march to its 70 percent and 100 percent renewable electricity goals. Importantly, development partners and donors require appropriate and accurate data to unlock funding sources for upcoming projects and monitor their implementation.

Renewable resource optimisation will be ever more important to the ongoing implementation of further renewable electricity as penetration levels reach higher percentages. Added resources will need to be identified, and intensive analysis will also be needed to determine the most appropriate sequence for project implementation. Tonga Power Limited (TPL) will need to optimise its control of a more complex electricity grid (one that flows two-ways) and will necessarily need to incorporate a much more sophisticated system. This will require audits of TPL's business structure, alongside comparisons with other electric utilities achieving high-penetrations of renewable energy.

With Tonga's Energy Bill poised to become an Act in 2022, the major responsibility for proper data collection and dissemination will reside in the new Ministry of Energy. It will be essential for the Ministry of Energy to model and adapt ideas from other country governments which have been successful in collecting, storing and disseminating such intensive energy information.

Surveys of other electricity networks that are pushing the boundaries of renewable electricity integration will be needed, in order to determine the most appropriate renewable solutions for a Tongan network.

Image: Maama Mai Solar Facility at the Tonga Power Limited's Power Station in Popua, Tongatapu. 'Maama Mai' means 'let there be light'. Taken in 2021.

3.3 TRANSPORT

3.3.1 Context

Introduction

Tonga's Transport sector depends exclusively on imported petroleum products (GoT 2015) and accounts for approximately 90 percent of end-use petroleum oil demand in Tonga. Road transport is the dominant mode of transport, while domestic shipping (for transportation of people and goods and fishing) is also important. Domestic aviation plays a small role.

For land transport, the 2016 vehicle stock was estimated at 6,031 cars, 7,103 light trucks, vans and SUVs, 2,099 heavy duty vehicles, 953 taxis and rentals, 306 motorcycles and 225 buses (TEEMP, 2020). There are currently no vehicle standards in place but the government is seeking to restrict importation to newer vehicles and has put in place a 10 year age limit for imported vehicles.

Vehicle ownership is high. There are approximately 18,200 households in the country, owning a total of 16,000 vehicles (Tonga Statistics Department (TSD), 2016) with 59 percent of households owning at least one car (TSD, 2019). Based on vehicle stock figures, the country has an estimated motorisation rate of approximately 160-170 vehicles per 1,000 people (United Nations Climate Technology Centre and Network (UNCTCN),2018; TSD, 2016) which is relatively high compared to other countries in the Asia-Pacific region. Road transportation is concentrated on Tongatapu, with 85 percent of fuel for road transportation being used on the island (TEEMP, 2020). Estimates suggest a total of approximately 200 million vehicle kilometres travelled per year, which translates into almost 2,300 vehicle kilometres travelled per capita (GoT and UNCTCN, 2018). Under a business as usual scenario, an average annual growth rate of 2.4 percent for vehicle kilometres travelled during the period 2016-2050 is projected, translating into an equal growth in fuel consumption from road transport (TEEMP, 2020; UNCTCN, 2018). In general there is a preference for car usage over motorbike, cycling and walking and a lack of infrastructure for non-motorised transport. Congestion on the main roads of Nuku'alofa is a concern.

Due to the isolated nature and relatively small size and population of a number of Tonga's islands, inter-island shipping forms a vital part of the supply chain. Many of the smaller islands have neither docking capability for larger vessels nor airstrips, making them reliant on supply by small boats for commerce, social, educational and medical needs. Domestic shipping is provided by the government-owned Friendly Islands Shipping Agency and a variety of private sector parties including private shipping companies, churches, small vessel operators and a community cooperative (World Bank, 2015). Service to major islands in each of Tonga's main island groups is reliable (World Bank, 2015) but services are weather affected and may be cancelled due to windy and/or rough water conditions, particularly during the cyclone season (World Food Programme (WFP), Undated). As of 2014, there were 250 seafarers in Tonga (World Bank, 2015). The Government has stated its highest priority for the maritime sector is increasing the safety and resilience of all maritime activities, especially in relation to inter-island shipping (LCA, WFP, Undated). The current available data does not allow for a breakdown between diesel used in road and maritime transport. However, domestic maritime transport likely represents a considerable share of diesel consumption. In future, expansion of cruise passenger arrivals as part of tourism may have implications for increased fuel use, GHG emissions and other environmental impacts.

Freight transport via aviation in Tonga is limited. Domestic planes are small and mostly serve for passenger travel. There are no dedicated cargo planes. From 2008-2012 less than 5 percent of jet fuel was reported as being used for domestic aviation (IRENA, 2013). In addition, assuming that the vast majority of aviation gasoline is used for local travel (generally used in small, short-distance airplanes), domestic aviation represents approximately a quarter of fuel consumption in aviation.

Relevant national policies, sectoral policies and links with the LT-LEDS

One of the goals defined in the TSDF II is the provision of safer, more reliable, and more affordable transport infrastructure and services to achieve dynamic and inclusive growth across the country.

The NIIP II outlines these priorities for the maritime space: (i) reduce the cost of services to reduce transport costs and improve Tonga's international competitiveness; (ii) improve the sustainability of maritime infrastructure by ensuring adequate maintenance, so as to minimise long term costs and maximise availability; (iii) enhance inter-island shipping services to help improve socioeconomic conditions; (iv) increase the safety of the transport system, and its resilience to climate change and natural disasters, to minimise disruptions; (v) strengthen and reform the institutional framework that governs the management, maintenance, and financing of maritime infrastructure and services; and (vi) promote and better use a competitive private sector. The Ports Authority Tonga (PAT) Business Plan 2019–2024, also has, amongst its aims, the promotion of sustainable growth and a sustainable environment. Industry, Innovation and Infrastructure - SDG9, calls on the global community to build resilient infrastructure, promote inclusive and sustainable industrialisation, and foster innovation. The pathways laid out in this LT-LEDS will therefore contribute towards this, as well as to the sustainability aims of the NIIP and PAT Business Plan 2019-2024.

The Tonga Climate Change Policy sets the targets of 'a transport system that is not reliant on fossil fuels' and '100 per cent renewable energy'. This LT-LEDS aligns with this aim as well as with the aims of Tonga's Second NDC which states a target of reducing GHG emissions from the combustion of fossil fuels by 13 percent (16 Gg) by 2030, compared to 2006. The NDC specifies a Transport sector measure of 2 percent efficiency gain per year for newly purchased light duty vehicles to contribute to the NDC emission reduction target. The LT-LEDS pathway for transport supports this NDC aim through either establishing mandatory vehicle standards and/or incentives for purchasing more efficient vehicles through taxes, fees, or import tariffs.

Responsible Ministries and sector Stakeholders

All transport responsibilities come under the Ministry of Infrastructure (MOI), under which sit a number of entities managing land, maritime and aviation sub-sectors. The main actor in land transport is the Land Transport Division of MOI. The main actors in the maritime sector in Tonga are the Marine and Ports Division (MPD) of the MOI, Ports Authority Tonga (PAT), Ministry of Education, Tonga Maritime Polytechnic Institute (TMPI) and a number of private sector actors. The MPD is responsible for oversight of the maritime sector (policy, regulation of domestic shipping, ship registry operation, port and flag state control, auditing of PAT and TMPI). MPD also manages and operates six domestic ports (World Bank, 2015). The MOI also collects data on domestic shipping, including the number of ferries, the number of passengers, and the volume of cargo delivered to various wharves (GoT and UNCTCN, 2018). PAT is responsible for the management and operations of Nuku'alofa Port. It is a government-owned enterprise overseen by the Ministry of Public Enterprises. The aviation sector is overseen by the Civil Aviation Division of MOI. The Ministry of Trade and Economic Development (MTED) is responsible for importation, and this ministry and the customs service have a role to play in implementation and enforcement of vehicle standards. The MTED also manages standards, including fuel standards.

Historical and current GHG emissions

The Transport sector is the second largest source of greenhouse gas emissions in Tonga (GoT, 2019).. One-third (37%) of fossil fuel supply is used for electricity generation, while approximately two thirds (63%) are used for direct final consumption (Department of Energy, 2020). The Transport sector accounts for approximately 80% of total final consumption, dominated by road transport, representing 70% of total final consumption.

GHG emissions from the Transport sector primarily reflect emissions from land transport which accounts for 60 percent of Energy sector emissions according to the Third National Communication (GoT, 2019). Hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride, ozone and aerosol precursors are not covered in the GHG inventory. Emissions based on liquid fuels sold to aircrafts and ships engaged in international transport are not covered in the national emissions totals. There is no data available regarding share of emissions from the maritime and aviation sectors. According to TEEMP, emissions from land transport will grow by an average of 2.4 percent per year under a business as usual (BAU) scenario (GoT and UNCTCN, 2018).

Current initiatives

The Tonga Climate Resilient Transport Sector Project 2019–2024 (USD 27 million), supported by the World Bank, aims to facilitate the safe, efficient and sustainable movement of people and goods in Tonga while strengthening resiliency of the Transport sector. It has four components. The first; Sectoral and Spatial Planning Tools, involves technical assistance that will improve the way climate change is addressed in Tonga's Transport sectors and allows for the financing of updates to analytical and sector planning tools to enable policymakers to make informed decisions based on the most accurate and up-to-date information available. The second component; Climate Resilient Infrastructure Solutions, involves feasibility studies, design and physical works of identified road, aviation and maritime assets to improve their resilience to climate related hazards and/or events. The third component; Strengthening the Enabling Environment, will provide funding to support institutional and regulatory reforms for Transport sector asset management and maintenance, including measures to strengthen local capacity and to increase the sustainability of climate resilient investments under the project; and the fourth component; Contingency Emergency Response is designed to provide a swift response in the event of an eligible crisis or emergency, by enabling the GoT to ask the World Bank to reallocate project funds to support emergency response and reconstruction.

The Fanga'uta Lagoon bridge project in Nuku'alofa aims to relieve congestion and connect communities. It will also provide an evacuation route to higher areas in the event of a tsunami and extreme weather events, and facilitate long term climate change-induced relocation of communities currently living in low-lying areas, to higher areas (ADB 2021).

The ongoing Nuku'alofa Port Upgrade Project will rehabilitate, renew and expand existing infrastructure. And it will improve management and operations practices with the aim of achieving safer, more reliable, and more affordable transport infrastructure and services in Tonga (ADB 2020).

The Green Pacific Port initiative integrates applicable global approaches and promotes more efficient port infrastructure and operations, in a regional project implemented by The Pacific Community. The Green Pacific Port approach explores port development that enables holistic - operational, energy-conscious, and environmental - management of ports. The initiative's benefits extend to reduced environmental impacts, better quality of working and living in port areas, and greater commercial benefits (ADB 2020). PAT joined the initiative in 2018.

3.3.2 Sector Pathways

The Transport sector vision is:

'A Tonga with low emissions in the Transport sector, achieved through sustainable maintenance of transport, knowledge production, enforced regulation and decentralisation of services.'

The sector focuses on land transport as the largest emission sub-sector within transport, according to data currently available. Given domestic aviation's small contribution to transport GHG emissions, it is not a focus of the LT-LEDS.

Targets to reduce GHG emissions from maritime transport and aviation were not examined in this LT-LEDS due to the lack of commercially viable alternatives, at least in the short term. This may, however, change in the medium-term and this sub-sector can be revisited once more data and information is available, along with commercially viable alternatives.

Priority areas for the transport pathway were identified as improved data collection and waste management of vehicles, sustainable maintenance and overhaul and services for vehicles and improved road maintenance. These are already set policies and plans for these interventions and the LT-LEDS will align closely to existing policies for the short term while enabling future revision of policies to take low emissions measures into account. The next five years (short term) are planned for, but the door remains open for transformative change over the subsequent 40 years. This is where the LT-LEDS supports new policies, introduction of technologies and accompanying measures to reduce GHG emissions. Some of the medium term priorities identified for the pathway were low emissions vehicles, including mandatory vehicle standards, and a 100 percent electric government fleet and non-motorised/cycling options. In the long term, the aim is for public adoption of electric vehicles.

A combination of mode shifts, improvements in vehicle efficiency and use of alternative fuels (e.g. renewable electricity) as mentioned in this pathway, would reduce GHG emissions from road transport by 28 percent by 2030, compared to a BAU scenario (TEEMP, 2020). As actions in this pathway are transformative, awareness raising and clear communication strategies for different actions will be very important, and should include promoting transparency and information availability to the public.

TRANSPORT

Sector Pathway Actions Over Time

1

Improved transport data collection and waste management

PRINCIPLES

Environment, Education, Autonomy, Culture & Core Values

2

Mandatory vehicle standards and incentives for more efficient vehicles through tax, fees and import tariffs

PRINCIPLES

Education, Environment, Inclusivity, Culture & Traditional Knowledge

3

Strengthening Road maintenance—Tanu Hala

PRINCIPLES

Environment

4

Decentralization of services from urban to rural areas to decrease traffic congestion

PRINCIPLES

Inclusivity, Environment, Education, Autonomy & Core Values

5

Low Emissions Vehicles

PRINCIPLES

Autonomy, Environment & Inclusivity

6

Introducing Electric Vehicles (EVs) in the municipal government fleet

PRINCIPLES

Environment, Education & Culture

7

Strengthen Sustainable Maintenance of all vehicles

PRINCIPLES

Environment

8

Implementation of Non-motorised and cycling transport options

PRINCIPLES

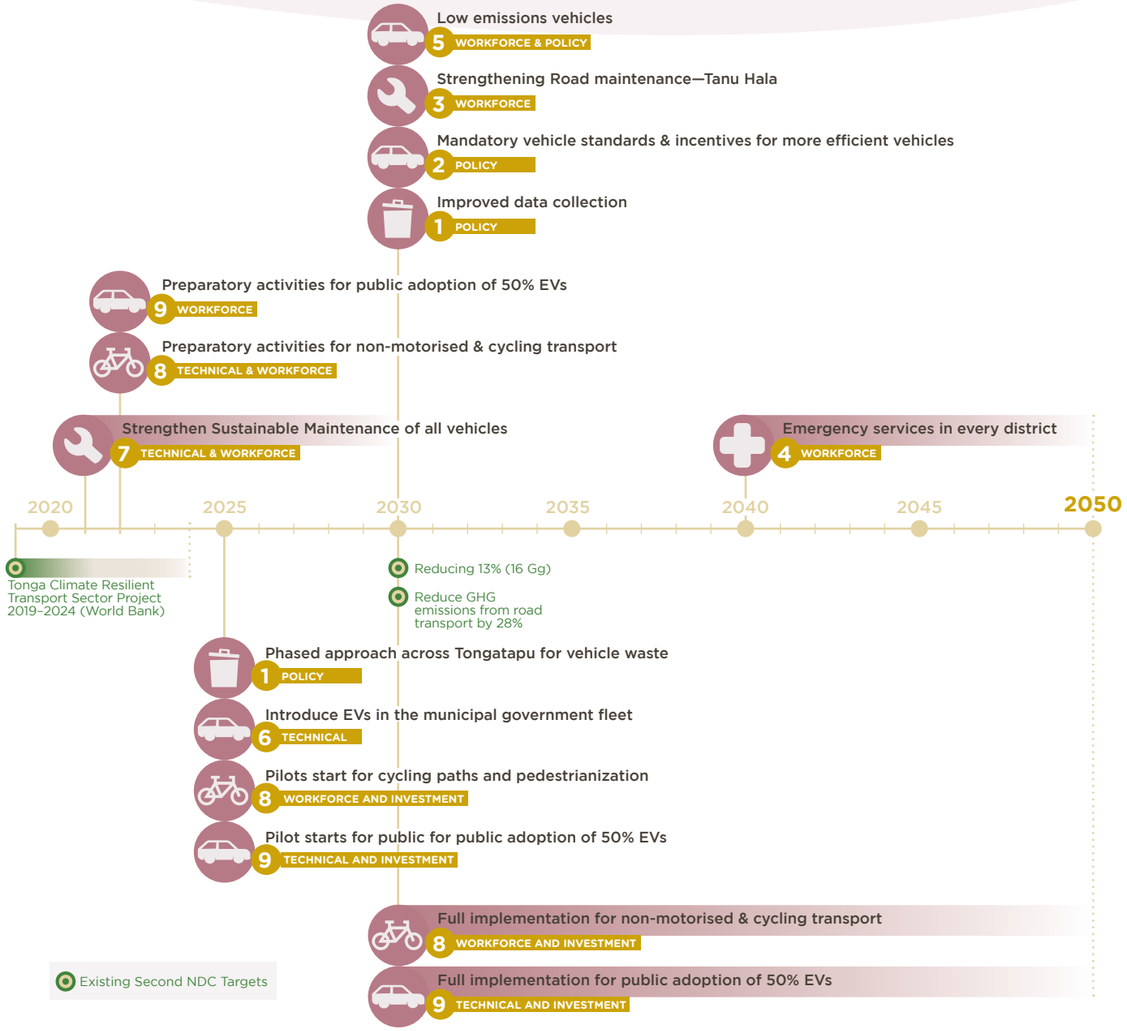
Environment, Traditional Knowledge and Culture and well aligned to Inclusivity, Autonomy, Education & Core Values

9

Public adoption of 50% Electric Vehicles (EVs)

PRINCIPLES

Environment, Education, Inclusivity, Autonomy & Core Values



Pathways Description

TRANSPORT ACTION 1

Improved transport data collection and waste management.

GHG emission reduction potential: Low and mostly indirect.

Description: This action involves improved data collection across all areas of the Transport sector, including consumption behaviour and transport preferences, breakdown of fuel use for land, maritime and aviation, and separation and classification of transport waste. Mandatory data collection systems and procedures will be put in place with awareness raising and training provided. At the policy level this includes policies on abandoned vehicles, vehicle and boat collection and scrappage, and data collection for transport energy consumption (aligned with the new Energy Bill). Policies for all new vehicles will be considered to allocate responsibility to the importer or exporter, for vehicles' end of life removal, before replacements can be brought in.

Supporting asset and capacity measures: For vehicle waste - a central facility for collection and disposal or preparation for export of scrapped vehicles. For data collection - laptops, tablets, drones and mobile apps.

Location: For vehicle waste - Tongatapu only. For data collection - across the whole Kingdom of Tonga. However, consideration needs to be given for constraints around data collection in the outer islands, though this could, in part, be overcome by technologies that facilitate remote data collection.

Timeline: 2025 with a phased approach across all of Tongatapu only for vehicle waste; 2030 for improving data collection.

Principles: This action is highly aligned to Environment and is also well aligned to Education, Autonomy, Culture and Core Values.

Links to Second NDC: None.

Links to other mitigation sectors: Waste for disposal of vehicles and boats, including setting up of a central facility for collection and vehicle disposal.

Image: Traffic congestion at Veitongo, Tongatapu as vehicles are headed to the eastern side of the island in the evening. Taken in 2021.

TRANSPORT
ACTION 2

Mandatory vehicle standards and incentives for more efficient vehicles through tax, fees and import tariffs.

GHG emission reduction potential: Medium.

Description: This action involves policy, regulations and/or incentives to increase uptake of more energy efficient, lower emissions conventional vehicle technologies.

Policies to operationalise this will include bans on certains types of vehicles, regulations on imported vehicles to meet low sulfur standards (e.g. Euro 4), high import tariffs on inefficient vehicles and lower tariffs for efficient vehicles, and a maximum age of imported vehicles of 5 years. This will be accompanied by enforcement with penalties. An awareness raising campaign will support behavioural change and promote the benefits of this approach, as well as raise awareness of enforcement and penalties.

Supporting asset and capacity measures: Inspection equipment and buildings, or specific areas for tests and inspections. Capacity measures will need to involve a broad range of stakeholders. General awareness raising with the public in the short and medium , to provide everyone with good access to information, particularly on enforcement and penalties. Delivery of this action will also need short courses for government officials, technicians and mechanics, customs officers, transport civil servants, owners of large commercial fleets and other private sector professionals. And these capacity building measures will need to continue periodically for the medium term, to embed behaviour change.

Location: All of Tonga.

Timeline: 2030.

Principles: This action is highly aligned to Education and well aligned to Environment, Inclusivity, Culture and Traditional Knowledge.

Link to Second NDC: This action supports the NDC target of a 2 percent efficiency gain per year for newly purchased light duty vehicles through either establishing mandatory vehicle standards and/or incentives for purchasing more efficient vehicles through taxes, fees, or import tariffs.

Links to other mitigation sectors: Waste for disposal of old and inefficient vehicles including setting up of a central facility for vehicle disposal.

TRANSPORT
ACTION 3

Strengthening road maintenance—Tanu Hala.

GHG emission reduction potential: Low.

Description: This action refers to improved road maintenance focusing on pothole repair and road resurfacing. This will reduce travel costs, including movement of agricultural produce to markets, and support introduction of newer vehicles, e-vehicles, as well as cycling and walking where road resurfacing can be combined with introduction of dedicated cycle paths and pavements. To implement this action, standards (tanu Hala) with regular reporting and greater transparency will be introduced, and weight limits for trucks will be put in place. A road asset management system will be implemented to support this action.

Supporting asset and capacity measures: Infrastructure - road repairs and resurfacing will be needed as well as road maintenance trucks. For capacity building, a range of short term and medium term measures are needed, including on the job training and short courses for road repair contractors, truck owners and drivers and government employees, particularly those involved in roads and transport work.

Location: All of Tonga.

Timeline: 2030.

Principles: This action is well aligned to Environment.

Links to Second NDC: None.

Links to other mitigation sectors: Human Settlements for road planning.

TRANSPORT
ACTION 4

Decentralization of services from urban to rural areas to decrease traffic congestion.

GHG emission reduction potential: Low.

Description: This action involves focusing on decentralisation of services from urban to rural areas in order to decrease traffic congestion around Tongatapu, but it is also applicable to the centre of island districts. This action includes a strategic plan for decentralising services, incentives to locate or relocate key utility services/agencies offices outside of Nuku'alofa CBD so that people can reach services locally, expansion of internet services through the development of apps and digitised services, incentives for employees to move/ work in decentralised offices, and recruitment of staff based in decentralised locations. This action may also involve encouraging private companies to decentralise services and operations over a certain size, and to provide minibus services for employee pick-up and drop-off in mornings and afternoons.

Supporting asset and capacity measures: Infrastructure - parking and road maintenance (linked to Action 3), Internet access and digitisation of services and buildings for decentralised services. Capacity building measures will need to continue from medium to long term, including awareness raising for the general public, short courses for government employees and professionals and vocational training for technicians.

Location: This action would start with Nuku'alofa and the Tongatapu districts, then also be implemented for the centre of each island district. Locations would be further defined by the strategic plan for decentralising services.

Timeline: 2040, with emergency services available in every district by 2050.

Principles: This action is highly aligned to inclusivity and is well aligned to Environment, Education, Autonomy and Core Values.

Links to Second NDC: None.

Links to other mitigation sectors: Urban Planning and Energy (particularly energy efficiency).

TRANSPORT
ACTION 5

Low emissions vehicles.

GHG emission reduction potential: Medium.

Description: Mandatory vehicle standards for newly purchased light duty vehicles (private cars, taxis, minivans, etc.) with incentives through taxes, fees and import tariffs. The action would include policies favouring low emissions vehicles, the introduction of regulations and standards, enforcement of penalties for non-compliant vehicles (this could be enforced at the border, with the importer), incentives for compliant vehicles (both for importers and consumers, to encourage purchase).

Supporting asset and capacity measures: Infrastructure - new inspection buildings and equipment for testing vehicles. Short courses and vocational training would be implemented for enforcement agency staff, government employees, technicians and professionals. In the medium term tertiary studies could also support this action as standards evolve. A communications strategy would be needed to support effective implementation of this action. Capacity building in the short term would focus on awareness raising for the general public, including multiple rounds of awareness raising and outreach programs to communities.

Location: All of Tonga.

Timeline: 2030.

Principles: This action is highly aligned with Autonomy and well aligned with Environment and Inclusivity.

Link to Second NDC: This action supports the NDC target of a 2 percent efficiency gain per year for newly purchased light duty vehicles through either establishing mandatory vehicle standards and/or incentives for purchasing more efficient vehicles through taxes, fees, or import tariffs.

Links to other mitigation sectors: Energy (energy efficiency).

TRANSPORT
ACTION 6

Introducing electric vehicles (EVs) in the municipal government fleet.

GHG emission reduction potential: Low, but the potential to grow significantly beyond the government fleet as EVs are implemented.

Description: This action focuses on making the municipal government fleet 100 percent electric. The government would lead by example to implement a pilot project for e-vehicles in the municipal fleet.

Supporting asset and capacity measures: The action requires procurement of EVs for the government municipal fleet and charging stations at government buildings. It would need changes to policies around vehicle procurement, and awareness raising among civil servants and the general public. It also requires piloting the introduction of new regulations and standards for electric vehicles. As a pilot, the action will need to include Information and Communications Technology (ICT) for monitoring, collection and storage of EV operational data - this will be very important to enabling planning around future EV applications. There will also be close cooperation and exchange of data on electricity with TPL. Capacity building for the pilot will be needed in the short term, including short courses and ongoing training for Ministry drivers and mechanics and government employees, with Ministries involved in the EV fleet pilot being fully engaged in maintenance, management and data collection. Awareness raising among all Ministry staff as well as the general public would be undertaken.

Location: Nuku'alofa.

Timeline: 2025.

Principles: This action is highly aligned to Environment and Education and well aligned to Culture.

Links to Second NDC: None.

Links to other mitigation sectors: Energy and particularly renewable electricity generation.

TRANSPORT
ACTION 7

Strengthen sustainable maintenance of all vehicles.

GHG emission reduction potential: Low.

Description: This action focuses on overhaul and maintenance services for all types of vehicles, and enforcement of related regulations for both public and government vehicle fleets.

Supporting asset and capacity measures: This action would involve the introduction of safety inspections to assist with enforcement of maintenance every 3 years. Inspection equipment and new inspection buildings attached to current garages would be needed. The action would also support implementation of ISO14000 and ISO 9001:2015 and other international best practice and standards, as well as insurance policies for fleets, maintenance and inspection programs, and green procurement policies.

Implementation within ministries from top to bottom of management would encourage fleet management programs to be put in place. As significant changes in attitudes towards vehicle maintenance will be needed, behavioural change would also be supported through various measures. This capacity building will be mainly short term and include awareness raising and short courses for the general public and government employees.

Location: All four main island groups.

Timeline: 2030 in incremental phases.

Principles: This action has good alignment to the Environment principle.

Links to Second NDC: None.

Links to other mitigation sectors: None.

TRANSPORT
ACTION 8

Implementation of non-motorised and cycling transport options.

GHG emission reduction potential: Unknown.

Description: This action focuses on the expansion and creation of new cycling and pedestrian pathways/sidewalks both within and outside the central business district of Nuku'alofa. It includes the development of an integrated urban planning program (homes, employment, transport), dedicated cycle lanes, pedestrians-only city centre areas (cyclist and pedestrians only paths /roads) and permanent removal of import duties for bicycles. This will be brought together under a green cities program with a sustained 5-year awareness raising campaign on health benefits of cycling and walking.

In the past, Tongans walked a lot, so there are strong linkages to culture which can be reactivated, making this a matter of learning from the past and building it into the future of sustainable transport and community health. Given that it offers many all-round benefits and fits well into traditional Tongan life, non-motorised transport is a high priority.

Supporting asset and capacity measures: Infrastructure - adapting road layouts and creating safe separation between different modes of transport, adding cycle lanes and space and infrastructure for parking bikes safely, adding pavements /sidewalks and creating new dedicated paths for cycles and pedestrians. Creating green spaces and pathways which make it pleasant to cycle or walk in pedestrianised or exclusively cycling areas.

This action will require a broad range of capacity building (awareness raising, short courses, tertiary and vocational training well as integrating information into lessons in primary and secondary schools (e.g. about the environmental and health benefits of cycling and walking) amongst target groups. These groups include the general public, women and youth, government employees, primary and secondary school teachers and students and professionals in urban planning and transport. Capacity building needs to start immediately and continue into the medium and long term as the action is envisioned to be implemented all the way to 2050.

Behavioural change and community and individual participation will also be important and will form a significant component of this action. Studies will be carried out to determine how to influence behaviour through enforcement and incentives, and to uncover which initiatives might work best with different target groups. A communications strategy will be developed and a long term awareness campaign implemented. Incentives and requirements for ministries and larger companies to provide facilities to encourage cycling by employees like showers, changing rooms, personal lockers and secure bike parking will also be implemented.

Location: Nuku'alofa.

Timeline: 2022 - preparatory activities and some actions (such as sidewalk construction underway); 2025 - pilots start for cycling paths and pedestrianisation; 2030 - 2050 - full implementation.

Principles: This action is highly aligned to Environment, Traditional Knowledge and Culture and well aligned to Inclusivity, Autonomy, Education and Core Values.

Links to Second NDC: None.

Links to other mitigation sectors: Human Settlements for urban planning.

TRANSPORT
ACTION 9

Public adoption of 50 percent electric vehicles (EVs).

GHG emission reduction potential: Medium to high, depending on percentage of electricity derived from renewables to charge EVs.

Description: Tongatapu is a very well suited location for EVs, it has the population, it is flat, only 60 and 30km in each direction. TPL are engaged in the discussion on EVs and have started research to look into a transition to EVs and what this means for electricity generation. This action would follow-on from the piloting of EVs within the government municipal fleet (Action 6). It involves expanded adoption of EVs to the public, including different types of light duty EVs (cars, bikes, minivans, etc.).

Supporting asset and capacity measures: Introduction of national EV regulations and standards - to ensure safety and good quality, introduction of regulations and standards for battery management and disposal, alignment of incentives for tax/duties/tariffs with the different stakeholders (car dealers, consumers and TPL), provide rebates for EV purchasers and for charging station set-up, create special parking spaces reserved for EVs and the option of a shared EV scheme may also be explored. These initiatives would start with studies to determine which EV and charging technologies to focus on and the optimal design and implementation of incentives schemes.

Infrastructure - EV charging stations and parking spaces as well as safer roads for electric bikes. Introduction of a variety of EV technology including private vehicles (bikes, cars, minivans), electric buses and taxis and electric motors for small boats.

A broad range of capacity building (awareness raising, on-the-job training, short courses, tertiary and vocational training) will also be needed. This would need to start in 2022 and continue into the medium and long term, as the action is envisioned to be implemented all the way to 2050. Target groups for capacity building are the general public, youth, car dealers, government employees, car mechanics, TPL staff and professionals in urban planning and transport.

Location: Phase 1 - Nuku'alofa; Phase 2 - all of Tongatapu.

Timeline: 2022 - preparatory activities start; 2025 - pilots start; 2030 to 2050 - full implementation.

Principles: This action is highly aligned to Environment and well aligned to Education, Inclusivity, Autonomy and Core Values.

Links to Second NDC: None.

Links to other mitigation sectors: Energy, particularly renewable electricity generation. Note that renewable energy generation would need to increase significantly to cater for demand from EVs, in order to achieve emission reductions.

An additional action arising which has not been prioritised but is currently underway is the completion of a maritime transport low GHG emissions strategy.

This strategy will be ready as a first draft in November 2021 and will inform interventions for low emission development in the maritime sector. It can therefore complement actions focused on the land Transport sector, as laid out in this LT-LEDS.

A further specific action for maritime transport is the implementation of ferry transportation across the Fanga'uta Lagoon. This would involve the public leaving their vehicles behind and using the lagoon ferry to travel to Nuku'alofa instead of driving. The ferry could be electric - an option that could be explored in future.

Additionally, the option of an electric bus network was explored but not prioritised, though this may be revisited in future as E-Buses are being studied as a potential pilot for the TERM-PLUS which is being completed in 2021. To date, biofuel has not offered a cost effective option. It also conflicts with food security and thus has not been considered in this LT-LEDS. Further exploration of biofuels as an alternative fuel for both land and maritime transport may be revisited in future, although potential conflict with food security will again need to be carefully examined, as food security would always be a priority.

Image: View of Taufa'ahau Road from the Tungi Colonnade Building in Nuku'alofa, Tongatapu. Taken in 2021.

3.3.3 Socio-economic and environmental considerations

Skills and capacity strengthening needed

Sustainable transportation is a new field of work with limited experience on the ground in Tonga. A broad range of capacity building measures (awareness raising, on-the-job training, short courses, tertiary and vocational training) would therefore be needed. Additionally, integrating information into lessons in primary and secondary schools (e.g. about the environmental and health benefits of cycling and walking, how EVs work, etc.) will need to be implemented, starting as soon as possible to begin building knowledge. The acquisition of knowledge, skills and experience will be a long term undertaking, all the way to 2050. Target groups for capacity building also range widely, from the general public, to women and youth and government employees (particularly those involved in energy, transport, road construction and urban planning), to primary and secondary school teachers and students at the vocational and tertiary level, private sector car dealers, mechanics, technicians and professionals in energy, transport, civil engineering and urban planning.

Overseas training/courses will be helpful in expanding local experience by integrating innovative and new technologies from countries where EVs are already implemented. This will apply to a broad range of areas such as policy-making, regulations and standards for EVs, as well as technologies, maintenance and implementation. To complement this, capacity strengthening for data collection, management and storage is needed. This can also be facilitated through increased availability and use of electronic equipment such as laptops, tablets, storage devices/servers as well as drones and mobile apps which could enable remote data collection.

Cross-sectoral considerations

There are strong linkages between the land Transport sector and energy efficiency and urban planning. For example, action on pedestrianisation of Nuku'alofa and appropriate road and pathway design for e-vehicles, cycling and walking will need to be coordinated with urban planning entities and undergo broad consultation across communities involved.

ICT can play an important role in supporting decentralisation of services. In this respect, reliable internet could be a major factor alongside key infrastructure investment. The latter not only refers to the decentralisation of physical infrastructure, but also the human resource needed to operate and maintain it. It would, therefore, also involve the management of human resources potentially across a number of ministries and the civil service. This could be assisted by short courses and vocational training to be provided for staff who are recruited to decentralised posts.

The sector also has close linkages with health and healthier lifestyle choices, such as cycling and walking, which could deliver added benefits such as reduced obesity and incidence of non-communicable diseases in Tonga.

Gender and social inclusion considerations

The actions needed in this pathway include significant communication and awareness raising among the general public and other groups. In order to be as effective and efficient as possible, this awareness raising must take into account gender and the roles of different groups within the Transport sector, and be tailored to reach all audiences. Where behaviour change is desired, incentives should also take into account different characteristics among gender and society groups.

Development of policies should include a gender-sensitive approach. Changes in transportation regulations, standards and other issues need to be as transparent as possible, with information available to the public in a timely and effective manner.

Actions to improve non-motorised transport (walking, cycling), decentralisation of services and improvements in public transport would offer major benefits around social inclusion, making services more easily available to all segments of the population. This is likely to boost access to services and facilitate improved transport options for low-income families, families without cars / access to private transport, women, the elderly and vulnerable groups.

There is a risk to social inclusion if vehicles and compliance become too expensive for lower-income households. Further studies are therefore needed, to ensure cost distribution is right, with measures put in place to ensure equity in the transition to low emission vehicles.

For capacity building and training it should be taken into consideration that vehicle technicians and government drivers, as well as the maintenance and inspection sector for transport, etc. can be male dominated. Ways to also involve women across Transport sector actions will therefore need to be studied with an action plan developed, so that men and women are learning from new projects and experiences and skills development, with the creation of potential jobs available to all.

Environmental and social safeguards considerations

Where additional transport infrastructure is put in place the appropriate EIAs would need to be undertaken. For example, there may be some infrastructure such as e-mobility charging stations, cycle paths and sidewalks needing an EIA if in new areas. However, most infrastructure will already likely be built on existing roads and will not need EIA.

There are risks that as vehicles are replaced they are dumped instead of being scrapped properly and that as e-vehicle batteries need to be replaced they are dumped instead of disposed of safely. Both these risks must be managed through vehicle and battery collection, scrappage and disposal management systems put in place early. Another area of risk in terms of waste, is where there is an increase of electronic equipment for data collection and management for the e-waste which must be disposed of in a safe manner.

There will also be benefits: lower GHG emission vehicles will also reduce other pollutants such as sulfur and particles, so there will be co-benefits for the environment and there are also significant social co-benefits in terms of better health outcomes from increased walking and cycling which can contribute to reduced obesity and reduced non-communicable diseases.

Key gaps data and solutions

Data management is fragmented with responsibilities shared among the Ministry of Infrastructure (MOI), PAT, the Tonga Statistics Department (TSD), and the Ministry of Revenue and Customs (MORC). The private sector also collects important trade performance information, but this is not always publicly available due to confidentiality issues. As the Transport sector is one of Tonga's main GHG emitters, a coordinated effort is needed with a number of Ministries involved, including MEIDECC, MTED, the TSD, and development partners, in order to improve data collection and availability. This will enable planning to allow a future where the Transport sector makes a greater contribution to emission reductions, and allow for more detailed emission reduction targets to be set during the 2025 NDC revision process.

Improved data for the Transport sector is a top priority as identified in the pathway action 1. As well as improved data collection for the number of vehicles, and vessels, number of passengers, transport routes and length of journeys, improved data is also needed regarding vehicle stock and vehicle efficiency, passenger/traveller behaviour and preferences, cargo volumes by mode of transport (passenger and freight kilometres by mode of transport), marine and aviation data. For example, there is currently no breakdown between passenger and freight kilometres travelled. Given that it describes two different activities, namely the movement of people versus the movement of goods, such a breakdown would be useful for analysis and the development of projections.

Improved data collection is also needed in order to distinguish clearly between fuel consumption for international and domestic aviation and international and domestic shipping. Being able to distinguish between these is relevant, as only GHG emissions from domestic aviation and shipping are counted towards national emissions. This would require collection of petroleum product demand by type of end-use and mode of transport (e.g. diesel for road transport versus diesel for shipping; fuel for domestic versus international aviation/shipping).

There is no information on the relevance of non-motorised transportation in Tonga though high vehicle ownership rate could indicate limited use of non-motorised transportation. However, there are a number of assumptions and caveats behind this assessment. Firstly, the high ownership rate per household is based on the assumption that the large majority of households own more than one vehicle. Secondly, it assumes that vehicles owned by a household are shared by individual household members. Thirdly, it assumes that the vehicle is frequently used. These assumptions should be further investigated through surveys, interviews and other data collection such as adding questions to the census, to gather information on non-motorised transport.

Finally, there is no systematic collection of passenger and freight data in the aviation sector by the Civil Aviation Division (CAD), CAD can, however, request data on passenger numbers and freight from operators, which would improve data for domestic aviation for future analysis.

3.4 AGRICULTURE, FORESTRY AND OTHER LAND USE (AFOLU) AND FISHERIES

3.4.1 Context

Introduction

Agriculture, forestry and other land uses along with fisheries form an integral part of Tonga's economy and culture and are the leading productive sectors for Tonga (IFAD, 2017) as well as AFOLU being the largest source of GHG emissions.

Agriculture, fisheries, and forestry provide 30 percent-40 percent of employment, contributing 18 percent of total GDP (2013/14) and 44 percent of exports (MAFFF, 2015a). Agriculture, agroforestry, and fisheries are often the only sources of livelihoods in remote and isolated rural areas, therefore measures that reduce emissions without adversely affecting these livelihoods, will be key to climate resilience. Subsistence agriculture predominates: only 5 percent of Tonga's farmers are commercial producers who engage directly with formal markets. Key agricultural commodities are root crops (cassava, yam, sweet potatoes and swamp taro), squash, and vanilla (MAFFF, 2015a). Coconut-based agroforestry was commercially important in the past, including for export markets, and offers potential for future economic growth. Animal husbandry is locally important. In 2015 there were 100,000 pigs and 92,071 chickens in Tonga but few cattle, sheep, or horses. Commercial forestry is limited, but many Tongans depend on forest products for their subsistence, and more depend on the various forms of agroforestry (combinations of trees and other crops), including coconut woodlands, which cover much of Tonga's land mass.

There is considerable scope for boosting agricultural productivity, but there are also considerable challenges. More than half (51 percent) of agricultural land is left fallow due to land rights issues and the high population of Tongan landowners living overseas (IFAD, 2017). Droughts and cyclones have a severe impact on forestry and agriculture: for example, cyclone Ian and severe drought each caused extensive damage in 2014 and in 2016 respectively (FAO, n.d; MAFFF, 2015a).

The Food and Agricultural Organisation (FAO) has estimated that 4.3 percent of native forest cover for all of Tonga is threatened, hence, a national forestry inventory is needed. The forestry sector is mainly government managed with limited private sector initiatives other than nursery seedlings. The government runs forest nurseries and small-scale sawmilling, mainly as part of cyclone response and recovery works. Since the early 1970s, there has been a focus on developing timber plantations in 'Eua and promoting public tree planting via seedlings produced at forest nurseries run by the Ministry of Agriculture Food, & Forests (MAFF). The main timber species promoted include Caribbean pine (Paini), Red cedar (Sita kula), Mahogany (Makoni), Teak (Tiki) and Kauri (Kauli). While sandalwood is the prominent export forest product, its export is currently banned under "Tonga Sandalwood Regulation 2016" which seeks to promote replanting and safeguard unsustainable harvest of sandalwood. Invasive species such as the Tulip and Kotia have also been introduced. Sawmilling, including coconut palm wood utilisation is a declining industry. There is growing demand, especially from women, for multipurpose trees/plant varieties for landscaping and floriculture activities, hence a growing number of small, private tree nurseries operate in Tongatapu.

Fishing is among the most important economic activities of Tongans for subsistence, semi-subsistence, and commerce, providing food security and income (Kronen, 2004a & 2004b; FAO 2010) and contributing 3 percent of GDP (GCF, 2018). Fish (including live reef fish) dominated Tonga's exports in 2013-14, at 22 percent, followed by crustaceans and other aquatic invertebrates at 20 percent and other marine products such as seaweed and live hard coral (FAO, nd; MAFF, 2015a). Fisheries production continues to fluctuate substantially due to changes in policy, resource depletion, and climate change impacting the distribution of tuna. Barriers to further development of export markets are market access, unstable market prices, and growing local demand (GCF, 2018). Numerous reports indicated that coastal fishery resources are close to overfishing and degradation (Kronen & Bender, 2007; MAFF, 2015b). Fisheries infrastructure remains at a low level and requires further investment.

Image: Displays of local seafood at the annual Royal Agricultural Show at Neiafu, Vava'u. Taken in 2019.

Relevant national policies, sectoral policies and links with the LT-LEDS

At the national level, the AFOLU sector draws direction from three of TSDF II's outcomes: (i) urban and regional (island/rural) agriculture development; (ii) good governance through the MAFF and (iii) sustainable environment and climate resilience. With regard to adaptation and building resilience to climate change, the JNAP2 identifies as a priority the implementation of climate-smart agriculture, fisheries and aquaculture and water management approaches. Areas in common with the LT-LEDS include community engagement; data collection and management; operational monitoring systems for groundwater, soil health and coastal conditions; and involvement of civil society organisations in raising awareness on climate change. Key JNAP2 targets relevant to the AFOLU sector of the LT-LEDS are (1) resilient fisheries development and marine and coastal ecosystems conservation, including special management areas (SMAs); (2) resilient, low-chemical-input or organic farming systems; and (3) allocation of 30 percent of Tonga's land to be used for agroforestry or forestry.

At the sectoral level, the Tonga Agriculture Sector Plan (TASF) 2016-2020 identifies the vision and priorities for maximising contributions from the agriculture sector both to national economic growth and to sustain Tonga's food security in the face of a changing world economy, looming climate change, and natural disasters in the Pacific. The TASF's Programme 1, 'Climate-resilient environment and agricultural systems,' is relevant for the LT-LEDS, while programs 2, 3, and 4 emphasise an enabling environment and sustainability as well as linkages to livelihoods and healthy foods - elements which also form an important part of the LT-LEDS.

The Tonga Forestry Act 2016 has enabled the establishment of regulations for the protection, control, and management of forest reserves and has fostered and encouraged the growth of forest products. The Management Plan for the Forests and Tree Resources of Tonga (Forest Management Plan, or FMP) 2017, prescribes actions to enhance the sustainable management of forests and tree resources. Other key documents are the Tonga National Forest Policy (TNFP) 2009, which supports the sustainable management of

Tonga's forests and tree resources, and the Code of Practice for Sustainable Management of Forests 2010, which provides practical guidelines for the sustainable management of forest and tree resources of Tonga. The TNFP and FMP designate agroforestry as 'the preferred form of productive land use in Tonga.' The Tonga National Land use Policy is currently in its finalisation stage, led by the Ministry of Lands and Natural Resources (MLNR). LT-LEDS AFOLU matters, as well as other sectors, will make necessary links and affiliation to this national policy as needed.

The Tonga Fisheries Sector Plan 2016-2024 is a framework for achieving the overall sector objective of 'Increasing sustainable shared benefits for the Kingdom from optimal use of its living marine resources'. It includes four components: sustainable community fisheries, profitable commercial fisheries and aquaculture, public and private investment, and governance and capacity building. All four are reflected in the LT-LEDS.

In 2020, the Second NDC set two non-emission AFOLU mitigation sector targets: (1) to establish a forest inventory as a prerequisite to identifying a GHG emission target for the 2025 NDC and (2) planting one million trees by 2023. For adaptation, the NDC sets an AFOLU target of 30 percent of land in Tonga to be utilised for agroforestry or forestry by 2025 (aligned to the JNAP2), and a fisheries target of maintaining existing stocks of fish and other marine species through a commitment to expand the area covered by Marine Protected Areas (MPAs) and Special Management Areas (SMAs) to 30 percent of Tonga's exclusive economic zone (EEZ). The LT-LEDS is aligned to these NDC targets and integrates action towards implementing them. Overall, the AFOLU sector is cross-cutting across a number of SDGs, including: Good health and well-being (SDG 3), Decent work and economic growth (SDG 8), Sustainable cities and communities (SDG 11), Climate action (SDG 13), Life below water (SDG 14), Life on land (SDG 15), and Partnerships for the goals (SDG 17).

Responsible Ministries and Sector Stakeholders

The Ministry of Agriculture, Food and Forests (MAFF) is responsible for policy and implementation for agriculture and forestry and chairs the Agricultural Growth Committee (v). The Tonga Agriculture Sector Plan is implemented through the AGC, with the Minister of MAFF acting as chair of the AGC along with a member of the private sector acting as co-chair. Members are mostly from the private sector including MORDI Tonga Trust, Food and Agricultural Organisation, Bilateral Agencies (Australia, New Zealand etc.) and exporters, as well as MAFF's six divisions representatives. Reporting on the implementation of the TASP is made regularly to the AGC.

For forestry, the Forestry Division is mandated to take charge of forest management and development, including development of policies and legislation. The division also monitors the state of forests in Tonga and promotes awareness on forests and forestry initiatives. The Department of Environment also undertakes nursery and tree planting activities. There is limited private sector involvement apart from the Aotearoa Forest Co. which is managing the forestry plantations on 'Eua. Tonga Timber Limited has also been involved in plantation management. Some non-governmental organisations (NGOs) are undertaking awareness and tree planting programs with their local partner communities including MORDI Tonga Trust, the Tonga National Youth Congress and the Tonga Community Development Trust.

The Ministry of Fisheries is responsible for policy and implementation in the fisheries sector. The Tonga Meteorological Division plays an important role in providing weather information to the sectors. The Ministry of Lands and Natural Resources (MLNR) has the mandate on all land management and the Ministry of Internal Affairs (MIA) also plays important cross-cutting roles in the sector.

Historical and current GHG emissions

Activities in the AFOLU sector account for 61 percent of Tonga's GHG emissions (NDC, 2020). Emissions from agriculture fell between 2000 and 2006. The main greenhouse gasses released from the agricultural sector are CO, CH_4, NO_x, $N2_O$, and CO_2 (Third National Communication, 2019). GHG emissions sources by sub-categories are enteric fermentation, emissions from managed soils, prescribed burning of savanna, and urea fertilisation. Total GHG emissions were 1.75 Gg - a very small portion of the total GHG inventory. For land use, land use change, and forestry, CO_2 was the only GHG identified. CO_2 removals from forestry decreased from 1997.95 Gg in 2000 to 1879.37 Gg in 2006, and forestry emissions increased from 147.66 Gg in 2000 to 187.40 Gg in 2006. The main cause of this change was conversion of forest and grassland biomass. Changes in forest cover and other woody biomass and abandonment of managed lands also contributed to CO_2 removal. However, uncertainty in land-use data and in the assumptions used to calculate GHG emissions and carbon sequestration from living biomass, undermines the reliability of GHG emissions estimates for the AFOLU sector.

Current initiatives

Green Environment Facility-funded Ridge to Reef (R2R) projects have been ongoing for a number of years. The first component was completed recently and focussed on the rehabilitation of the mangrove ecosystems around Tongatapu. The second component, Integrated Land and Agro-ecosystems Management Systems, is ongoing. There are several success stories from these projects, including the adoption of biogas and organic/animal fertiliser as part of managing the roaming livestock that damages the environment etc; promoting community tree planting efforts via community nurseries and capacity buildings in related areas; introducing applicable and practical farming practices through women and youth e.g. keyhole gardening, farmer field demonstrations, and wicking systems for household-level activities; and others.

Tonga Community Development Trust is promoting aspects of conserving traditionally useful tree species and home gardening. Tonga National Youth Congress is promoting organic farming and certification targeting youth and is involved in a number of resilient farming activities nationwide. MORDI Tonga Trust has been carrying out the Tonga Rural Innovation Project since 2018, with 122 rural communities. MORDI Tonga engages rural, remote and isolated outer islands including in Tongatapu, 'Eua, Ha'apai islands, Vava'u islands, Niuafo'ou and Niuatoputapu. The government's future climate change pipeline includes the project 'Towards climate change resilient coastal fisheries and aquaculture in Tonga', which will address effects of climate change on coastal fisheries through integrated sustainable management to ensure food security. The project will cover ecosystems and ecosystem services, health, food and water security and livelihoods of vulnerable communities. This fits with targets under the Second NDC, JNAP2 and fisheries sector plans and will also contribute to the LT-LEDS aims and pathway for AFOLU, particularly in the fisheries sector. Another key project for agriculture involves climate smart agriculture (CSA) approaches for sustainable food and nutrition and secure livelihoods in Tonga, which aims to contribute to achievement of targets of the NDC, JNAP2 and the Agriculture Sector Plan (MEIDECC 2020).[3]

3 Please refer to the NDC Implementation Roadmap and Investment Plan with Project Pipeline, Appendix B, for more information on current and planned projects

3.4.2 Sector Pathways

This sector's vision is for:

'A resilient Fisheries and Agriculture, Forestry and Land Use Tonga through low emissions, low costs and sustainable systems.'

For the AFOLU and Fisheries sector, promotion of best practices in agriculture, forestry and fisheries is the highest priority. This includes the need to strengthen public-private partnerships among government agencies, NGOs, village communities, church groups, farmer and fisher groups, and others, to enable sharing of responsibilities among stakeholders to meet their objectives as organisations and jointly contribute to low emissions actions. Data collection, management and accessibility is also a key part of agriculture, forestry, fisheries and land use work. Establishment of a forestry inventory and a digital library of information including traditional knowledge, are two key initiatives.

This pathway also focuses on the expansion of MPAs and SMAs and of sustainable, low emissions, low cost, high productivity and sustainable agriculture, forest and land use systems. A holistic and participatory approach is envisioned. At the larger scale, this is with improvements in agro-forestry and at the smaller scale, enhancing home gardening. Training and capacity building will be extended to all stakeholders from village groups and NGOs, to farmers, fishers, forestry workers, government officials and private sector actors.

Image: Tree Planting Activity at the Mango Tree Respite Center during the Department of Climate Change's annual National Climate Change Awareness Week. The Tree Planting Activity focused on inclusive tree planting activities to include people living with disabilities. Taken in 2020.

AFOLU

Sector Pathway Actions Over Time

1

Strengthen Public Private Partnership to drive requirements of organisations with the aim of sharing responsibility to promote best practices in agriculture and forestry

PRINCIPLES

Environment, Education, Inclusivity, Autonomy & Core Values

2

Improve coordination of public and private sectors to strengthen and harmonise existing data collections for improved data monitoring and information management

PRINCIPLES

Environment

3

Support Community Nurseries to improve the productivity and diversity of agroforestry

PRINCIPLES

Environment, Inclusivity, Traditional Knowledge, Culture & Core Values

4

A proposal for low emissions, low cost, high productivity and sustainable AFOLU approach to be submitted to the Green Climate Fund for the next funding cycle

PRINCIPLES

Environment, Autonomy & Inclusivity

5

Establish SMA association and ensure its maintenance through financial support and capacity, in order to support the expansion of MPAs and SMAs

PRINCIPLES

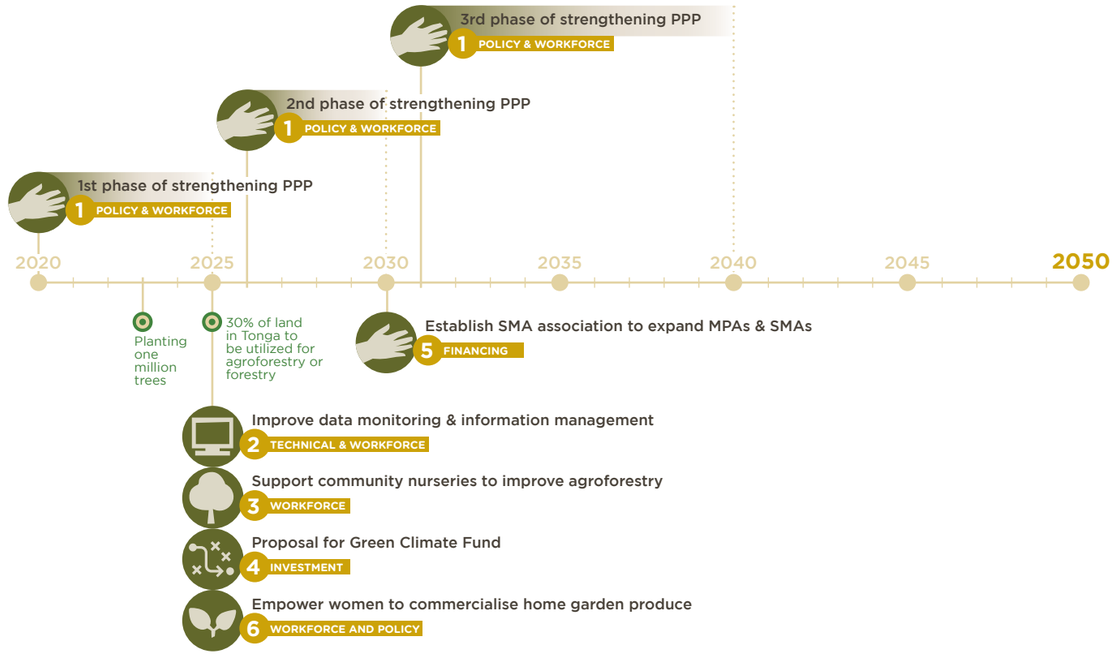
Environment, Culture, Traditional Knowledge, Core Values, Autonomy, Inclusivity & Education

6

Empower women to sustain and enhance home gardening through commercialising their produce

PRINCIPLES

Inclusivity, Autonomy, Core Values, Culture & Environment



AFOLU ACTION 1

Strengthen public private partnership to drive requirements of organisations with the aim of sharing responsibility to promote best practices in agriculture and forestry.

GHG emissions reduction potential: GHG emission potential is difficult to estimate for this action. Emissions reductions will be mainly indirect.

Description: This action will implement outreach campaigns to promote integrated agroforestry, with minimum tillage and free from fire, in areas designated for agriculture. It will promote agroforestry as 'the preferred form of productive land use in Tonga' (TNFP 2009, FMP 2017). The action includes the promotion of best available, socially appropriate practices in all AFOLU sectors through agricultural, agroforestry and forestry extension services, supported by public outreach.

An important element of this work is to involve all stakeholders in planning and implementation, including foresters, agriculturalists and grassroots implementers, such as local NGOs and church groups, as well as ensuring the involvement of women and youth. As part of the planning for this action, environmental policies, sector plans and traditional practices will be reviewed and documented as a basis for making improvements, and this information will be disseminated to stakeholders. New enabling policy will also be required. Options include subsidies to farmers to encourage adoption of agroforestry, inter-cropping and other practices to retain and enrich soil organic matter (an important carbon stock). The AGC will drive these developments and promote partnership-building through enabling policy changes. This action will contribute to the following SDGs: Sustainable cities and communities (SDG11), Life on land (SDG15) and Partnerships for the goals (SDG17); and Tonga's JNAP2 and Second NDC target for 30 percent of land to be used for agroforestry or forestry as well as the NDC target to plant one million trees by 2023.

Supporting asset and capacity measures: This action requires computer and software supplies, procurement of agricultural and forestry materials, machines and tools, and marketing and partnership tools. Capacity strengthening areas are to train program managers in government, private sector and NGOs and provide on the job training in the short term. In the medium term short courses and mentoring, as well as peer-to-peer learning would be useful among government agencies and private sector/NGOs.

Location: All of Tonga including households, communities, districts, outer islands, schools, royal estates and government land.

Timeline: This action is split into three phases: present-2025 first phase, 2026-2030 second phase and 2031-2040 third phase.

Principles: This action is highly aligned to Environment and Education and also has good alignment with Inclusivity, Autonomy and Core Values.

Links to Second NDC: This action will contribute to the mitigation target to plant one million trees by 2023 and the adaptation target of 30 percent of land in Tonga to be utilised for agroforestry or forestry by 2025.

Links to other mitigation sectors: Waste and Energy for management and use of any increase in biomass waste (e.g. agricultural waste, woodchips/off-cuts).

AFOLU ACTION 2

Improve coordination of public and private sectors to strengthen and harmonise existing data collections for improved data monitoring and information management.

GHG emissions reduction potential: This action, while not directly reducing GHG emissions, will improve clarity and transparency for the AFOLU sector, providing a basis for the calculation of GHG emissions and carbon sequestration from forests and other woody biomass. Such an inventory will serve as the foundation for quantifying GHG emissions from the sector and identifying a GHG emission target for the 2025 NDC.

Description: This action will establish the National Forest Inventory with carbon-stock assessment and monitoring of all forests and woodlands (including agro-forestry) as called for in the TNFP (2009) and the Management Plan for the Forests and Tree Resources of Tonga (FMP 2017). This action will utilise high resolution satellite imagery where available, combined with airborne light detection and ranging and ground truthing, supported by long term ground based observations. The data will be used for land use planning and a broad range of other information needs. This action includes improving coordination between public and private sectors and harmonising existing data collection through the AGC, mainstreaming necessary actions into Ministry Corporate Plans and annual budgets, and integrating relevant actions into the agricultural census. Market and crop surveys will also be implemented at regular intervals. A national data and information coordination and management group will be established, and data collection on outer islands will be enhanced through mobile phone applications and digitisation.

Supporting asset and capacity measures: This action requires computer hardware and software, mobile apps, tablets for entering data and services, including cloud data storage services. Templates to collect data and information for each sector and sub-sector will be developed. Drones will also increase ease of data collection and the geographic coverage that can be achieved, especially since some areas are inaccessible for humans. Significant short term capacity strengthening is needed including on the job training, short courses and survey and data collection training including using trial agro-forestry sites. The training will target government employees of relevant departments including ICT, technical and extension staff, responsible NGOs, as well as secondary, tertiary and vocational students. A training plan will be developed and some actions will continue in the medium term as needed.

Location: All of Tonga.

Timeline: 2025.

Principles: This action aligns well to Environment.

Links to Second NDC: The establishment of a national forestry inventory is one of the non-emission targets.

Links to other mitigation sectors: The data collected will also contribute to planning for Energy from biomass.

AFOLU
ACTION 3

Support community nurseries to improve the productivity and diversity of agroforestry.

GHG emissions reduction potential: This action has high GHG reduction potential through enhancing Tonga's carbon sinks.

Description: This action will focus on improving the productivity and diversity of agroforestry for food, fibre and timber. In addition to its direct economic benefits, this action will increase the standing stock (biomass) of multipurpose trees with productive and service functions in agroforestry systems, thus boosting carbon stocks.

Tree density and carbon stocks per ha are moderate in these ecosystems, but agroforestry (including coconut woodlands) covers around 75 percent of Tonga's total land area (FMP 2017), so the cumulative impact is potentially high. Field testing (trials and demonstrations) will be carried out to determine tree species that offer optimum potential to be part of agroforestry systems, types of agroforestry or mixed systems, trees for specific soil types and terrain, etc. This action includes creating incentives for community nurseries to grow and distribute tree seedlings of productive species as well as providing training through the private sector, NGOs, Civil Society Organisations (CSO), Community Based Organisations (CBO) and church groups. Nursery infrastructure, as well as planting materials and seeds, nursery tools and other support, will also be provided. A government financial mechanism to sustainably support government-run nurseries is proposed, while an increasing proportion of funding will also be allocated to support NGO, privately-run and community nurseries. To plan for implementation of the action, a cost-benefit analysis and market study will be carried out to determine the optimal selection of tree and non-tree species and to identify appropriate water, energy and other infrastructure needs.

Supporting asset and capacity measures: This action requires nursery infrastructure, supplies, tools and equipment, as well as fencing materials, composting machines and vehicles for transportation of supplies, and market access, seedlings, planting materials, etc. All community nursery initiatives shall link to community, regional and national tree planting programs whereby key targets will be set and timelines scheduled. Packing houses at each district will also support community crops sold locally and abroad. Capacity strengthening measures will focus on communities, women and youth leaders, CSOs, CBOs, NGOS and church groups, and will include a community-based training program, with on the job training, short courses, mentoring and transfer of traditional knowledge will be developed and implemented. NGOs and CSOs will also receive support from relevant regional organisations.

Location: All of Tonga.

Timeline: 2025, with different initiatives needing to take place in parallel to meet this timeline.

Principles: This action is highly aligned to Environment and Inclusivity and also well aligned to Traditional Knowledge, Culture and Core Values.

Links to Second NDC: This action will contribute to the mitigation target to plant one million trees by 2023 and the adaptation target of 30 percent of land in Tonga to be utilised for agroforestry or forestry by 2025.

Links to other mitigation sectors: Increased stock and improved management of biomass and agroforestry waste products may contribute to Energy production.

AFOLU
ACTION 4

A proposal for low emissions, low cost, high productivity and sustainable AFOLU approach to be submitted to the Green Climate Fund for the next funding cycle.

GHG emissions reduction potential: To be estimated during development of the proposal.

Description: This action includes mainstreaming low emissions development into MAFF policies, including the Tonga Agriculture Sector Plan and the National Forestry Policy and its Corporate plan, increasing private sector involvement, conducting bottom-up planning through the Community Development Plans (CDPs) and feasibility studies completed where needed. MAFF will be increasingly involved in low emissions planning and an AFOLU-based proposal will be developed and submitted for funding in the next GCF funding cycle.

Supporting asset and capacity measures: There are no immediate asset needs. These will be determined during the proposal development. Capacity strengthening will include short term on-the-job training and short courses on policy and planning as well as proposal development, particularly for staff in MAFF, MEIDECC and private sector actors (NGOS, etc.). Longer term capacity building needs will be determined during the proposal development.

Location: To be determined during the proposal design and development.

Timeline: 2025.

Principles: This action is highly aligned to Environment and well aligned to Autonomy and Inclusivity.

Links to Second NDC: This action links to the need to mobilise financing for the AFOLU sector as articulated in the NDC.

Links to other mitigation sectors: These will be identified during proposal design and development.

AFOLU
ACTION 5

Establish SMA association and ensure its maintenance through financial support and capacity, in order to support the expansion of MPAs and SMAs.

GHG emissions reduction potential: Low.

Description: This action aligns directly with the JNAP2 and Second NDC objectives to expand MPAs and SMAs to cover 30 percent of Tonga's EEZ. More broadly, it will also support resilient fisheries development and marine and coastal ecosystems conservation. At the policy level, the action includes developing a national consensus on the definition of MPAs and SMAs and aligning this to international and regional definitions, amendment of laws, establishment of a national SMA association, strengthening enforcement, and conducting feasibility studies to explore financial instruments (such as 'blue bonds'), dedicated funds, and other options for financing MPAs and SMAs.

An important part of this action is empowering and involving communities in all steps, to expand and strengthen MPAs and SMAs. Building relationships between communities and the national government, together with the devolution of some decision making to communities to manage their own resources, will foster community ownership and strengthen enforcement, particularly for SMAs. Links between national government and communities should be fostered through ongoing and reciprocal communication.

Supporting asset and capacity measures: Equipment for mapping, monitoring, marketing, and communications as well as small boats and safety equipment for coastal and maritime operations are also needed for this action. Capacity strengthening measures are continuously needed for

the long term including on the job training, short courses, mentoring and transfer of traditional knowledge. Capacity building and training will be for government staff, private dive operators (particularly mentoring), SMA association members, local communities and women and youth leaders.

Location: All of Tonga, and particularly the outer islands.

Timeline: 2030 - with involvement of communities in SMAs essential to meeting this timeline.

Principles: This action is highly aligned to Environment, Culture, Traditional Knowledge and Core Values and is also well aligned to Autonomy, Inclusivity and Education.

Links to Second NDC: This action supports the NDC adaptation target to maintain existing stocks of fish and other marine species through a commitment to expand the area covered by MPAs and SMAs to 30 percent of Tonga's EEZ.

Links to other mitigation sectors: None.

AFOLU ACTION 6

Empower women to sustain and enhance home gardening through commercialising their produce.

GHG emissions reduction potential: Low.

Description: Expand production and improve productivity of home gardens, including household agroforestry, with particular attention to home gardens managed by women. This initiative is replicable in nearly every household, using practices that can easily be taught, and could therefore reach 90 percent or more of Tongan households. The action will empower women and youth groups to derive greater benefits from home gardening by commercialising their produce for sale at local markets. It is expected to stimulate productivity of land and boost food production and local income, as well as reducing emissions by increasing and sustaining carbon stocks in garden soils and biomass.

Policy changes to support this action will be needed down to the town council level, to facilitate women's use of unattended town allotments, provide organic and green agriculture incentives, and to make micro-financing available for seeds, tools, and planting and fencing materials. Women will also need support to get their produce to market. Appropriate technology to support food production, weather forecasting, and access to markets is also needed, with follow-up support from extension officers. At the community level, local Town Officers and District Officers can mobilise sub-committees and councils to begin this initiative with community members. This action is directly linked to community development plans as well as to a new food and health policy.

Supporting asset and capacity measures: None.

Location: The action will start in Tongatapu and will be progressively introduced to all of Tonga's islands.

Timeline: 2025 if funding can be mobilised quickly, otherwise 2030.

Principles: This action is highly aligned to Inclusivity, Autonomy and Core Values and well aligned to Culture and Environment.

Links to Second NDC: This action will contribute to the mitigation target to plant one million trees by 2023 and the adaptation target of 30 percent of land in Tonga to be utilised for agroforestry or forestry by 2025.

Links to other mitigation sectors: None.

Additional actions identified but not prioritised at this time are listed to the right. These can be considered again in future discussions around a low emissions future for Tonga:

- Protect mangrove forests: protect all (100 percent) of intact mangrove forests and other coastal vegetation, as called for in the 2009 National Forest Policy and 2017 Forest Management Plan. Tree density and carbon stock are high per ha. This would include amending the current policy regarding mangrove management, and an approach to explore would be payment for ecosystem services. This action would also include rehabilitation of mangrove forests.
- Rehabilitation of the Fanga'uta Lagoon of Tongatapu, which once provided abundant shellfish (Toó, Kuku, etc) and fish (particularly mullet) to its communities. This lagoon has played a major part in the life of the surrounding communities, with more than 85 percent of the population of Tongatapu residing within its catchment and beyond. First steps would be to survey the existing marine life and implement an SMA or MPA as appropriate.
- Creating new products / greater use of current byproducts: Upscaling biogas systems and production and diversifying the use of waste / agricultural bi-product (e.g. manure). Also piloting algae to biofuels, nutraceuticals and fertiliser for agriculture and healthy soils. This would represent a new field of work and decrease the need for imported fuels while increasing self-reliance.

Overall, traditional knowledge is very important in Tongan agriculture, forestry and fisheries and is integral to the forms of sustainable agriculture and agroforestry practiced for centuries in Tonga. Traditional agricultural practices have been well adapted to Tonga's environment and historical climatic conditions and are still followed by most rural, small-holder farmers. However, short term commercial opportunities and, in some places, local pressure on available land, have driven a shift to less sustainable practices, leading to soil loss and conversion of carbon-rich woodlands to carbon-poor open fields. Smallholder farmers require assistance to adapt to climate change and to ensure that their agriculture and agroforestry activities will contribute to LT-LEDS mitigation actions.

Examples include the need for provision of quality open-pollinated seeds, new varieties of climate and pest-resistant crops with shorter harvest cycles, and advice on the use of organic materials for mulching, composting, and fertilising. Promoting traditional agriculture and agroforestry by helping farmers understand its benefits is an important part of moving the AFOLU sector towards lower emissions. Promotion can use success stories, consultations with communities, and incentive programs for farmers and farming communities - including women and youth groups - to motivate the changes that are needed.

A key challenge for the AFOLU sector is the increasing demand for meat products, with imports rising in recent years to meet it. While there is potential to increase livestock production in Tonga, there is also a high risk that this would cause increased GHG emissions, unless initiatives are well planned and implemented through a climate-smart approach, including comprehensive waste recycling.

3.4.3 Socio-economic and environmental considerations

Skills and capacity building needed

Strengthening and expanding technical expertise by education and training is a key cross-cutting element for all LT-LEDS action in the AFOLU sector. Broad capacity building will be required for a diverse range of stakeholders, including government IT and technical staff; and non-government agencies in the AFOLU sector (MAFF, MEIDECC, etc); secondary, vocational, and tertiary students; NGOs, CBOs, and civil society organisations (such as community groups, committees and councils, women's and youth groups, and church groups); SMA association members and private dive operators; and other private sector organisations (such as business associations).

While most of the required training needs to take place in the short to medium term, some actions require capacity building to continue for the long term. Options to explore to boost capacity include potential graduate pools that are not being utilised which can be brought into the AFOLU sector; and incentivising the Tongan diaspora with the required skills to return to Tonga. An effort should also be made to tap into knowledge of traditional landowners and experts now present in retired communities who are willing to contribute their knowledge. Bringing in expertise for short term and long term support from the Pacific region and globally could also help bridge gaps in specific knowledge and skills ,until these become available in Tonga. Agencies such as The Pacific Community and the Secretariat of the Regional Environment Programme (SPREP) can assist in boosting expertise available.

Cross-sectoral considerations

Actions for AFOLU require a cross-sectoral approach encompassing agriculture, forestry, and fisheries and interlinkages between these sectors. This means actions will have to be implemented through close coordination of the various ministries and departments responsible for those sectors, as well as among a number of other Ministries and agencies that can play a supporting role. Coordination will also be needed to gain access to finance.

Beyond those specific sectors, there are strong linkages with food security, health, disaster risk management and livelihoods. Actions taken for emissions reduction should be designed to avoid negative impacts in these areas or to mitigate impacts that cannot be avoided. Low agricultural productivity, increasing food imports, and dietary shifts towards high fat, low quality meats and low fibre carbohydrates are already negatively impacting Tongan food security and health (Veatupu et al., 2019). The actions laid out in the AFOLU pathway are intended to deliver co-benefits to strengthen domestic food production, food security, and health. There is also potential for cross-sectoral co-benefits from using forest and farm waste to generate energy. Additionally, natural disaster response and recovery is an essential component of forestry and agriculture, as timber is needed in the aftermath of natural disaster events: rebuilding and resiliency of domestic agriculture are important to recovering quickly in order to provide food security and complement emergency food supplies.

Gender and social inclusion considerations

Consideration of gender and social inclusion is critical in the AFOLU sector, as land ownership, access, and roles differ between men and women. Most (88 percent) of employment in agriculture, fisheries and forestry is male (MAFFF 2015a). The actions described above will need to take into account these differences and strive to be inclusive, with proactive efforts made to ensure the inclusion of men, women, and marginalised and vulnerable groups is woven into the different initiatives, from policy and investments to outreach, training and capacity building. The initiatives also need to be replicable and sustainable at a community level, with inclusion of vulnerable and marginalised groups. New policies for AFOLU to support low emission development should be designed to mainstream gender and inclusivity and take into account the Tonga Gender Policy and Action Plan.

Environmental and social safeguards considerations

Where there are changes in land use, for example, from open field farming to agroforestry, among actions to implement LT-LEDS, environmental and social impact studies should be carried out as required. These should include consultation with landowners and communities to investigate potential positive and negative environmental and social (E&S) impacts. In the case of data management and collection, there should be minimal E&S impact; for example, using drones in remote areas will not disturb the natural environment.

Biosecurity should be considered when introducing new climate-smart seeds and plants, particularly to avoid the risk of introducing potentially invasive species to which Tonga's fauna and flora (including traditional crops) are vulnerable. Existing invasive species need to be managed carefully, with priority given to plants and tree species indigenous to Tonga, where these can provide suitable productive and service functions. On the other hand, some invasive species have also had positive impacts on land protection and soil improvement.

In cases where actions remain at the small-scale level such as those involving communities, village groups, households, and on land already under use, the E&S risks are low. However, if these actions are scaled-up and applied across Tonga, potential E&S risks should be examined. New policies and plans developed for low emissions should incorporate E&S risk assessment and mitigation actions, and apply environmental and biodiversity protection laws as needed. For conservation and protection measures (such as SMAs), environmental risks should be minimal, and benefits strong. However, if there are potentially negative social impacts such as the displacement or disruption of traditional livelihoods, social risks should be assessed and mitigating actions taken.

Key data gaps and solutions

Data gaps are recognised and actions included in the AFOLU and fisheries pathway to address them, particularly the establishment of a National Forestry Inventory, remote-sensing and mapping, and collecting information to make a digital library. Limitations around available data and resources constrains analysis of Tonga's forestry and agroforestry and leads to uncertainty in quantifying GHG emissions and carbon sequestration from forests and other woody biomass. The establishment of a forest inventory will resolve this issue and would also assist in tracking progress towards the one million trees planted goal of the Second NDC. For fisheries, improved data for production over time, export and licensing statistics and strengthened statistical information will allow for better planning.

Improved data availability across AFOLU and fisheries will enhance feasibility and other studies needed to implement a low emissions pathway. In terms of emission reduction estimates and calculations, the Global Warming Potentials (GWP) values used to calculate GHG inventory results are not clear at the moment. This needs to be clearly reflected, to improve transparency. For future reviews of the NDC, National Communications and the LT-LEDS, a clear statement on the methodology, values, formulas and any default values used will improve transparency, reporting and planning for emission reductions.

3.5 WASTE

3.5.1 Context

Introduction

Waste management in Tonga has been gradually improving over the last decade. Waste collection has increased, leading to a reduction in open burning of waste, particularly on the main island. Most waste is sent to landfill as there is minimal recycling capacity. There is a lack of recent data, though it is estimated that between 10,000 and 16,000 tonnes of waste are produced per year. A solid waste composition assessment in Tongatapu (ADB, 2014) revealed that 33 percent of municipal waste is green waste (mostly vegetation), 15 percent is organic waste (mostly food) followed by diapers, paper, plastic, glass, textiles, ferrous and nonferrous metals, and other materials waste.

In terms of climate impact, emissions are assumed to be minimal presently, and the more important waste challenge lies in the link to water supplies and adaptation of the surrounding ecosystem. If waste is unmanaged on the islands, it can permeate into groundwater and ecosystems, polluting fragile systems such as the oceans, coral reefs, and bringing harm to the rich biodiversity present. The target for the Waste sector is to ultimately reduce waste and increase recycling, but this is based on obtaining adequate equipment and funding to implement these plans and activities.

Image: Locally grown produce, presented at the annual Royal Agricultural Show in Neiafu, Vava'u. Taken in 2019.

Relevant national policies, sectoral policies and links with the LT-LEDS

Tonga's relevant legislation includes the Waste Management Act (2005) provides a comprehensive legislative base for the effective development and management of the sector. The Act allows for setting up the waste authority and mandating its functions, powers and responsibilities. In addition the Environmental Management Act (2010) governs the disposal of hazardous waste and chemicals and the transportation of all kinds of waste. While the Environment Management (Litter and Waste Control) Regulations (2016) have been effectively implemented in partnership with local governments and have also served as a tool for community education.

In terms of policy, Tonga's Second NDC has a non-emission target of expanding the formal waste collection system, including the collection of relevant data on waste amounts and waste composition, as a prerequisite to identifying a GHG emissions target for the sector in the 2025 NDC. The Tonga Strategic Development Framework 2015-2025 (TSDF II) includes Organisational Outcome 5.3: 'Cleaner environments and less pollution from household and business activities building on improved waste management, minimisation and recycling, making conditions safer, healthier and more pleasant for residents and visitors'. It also contains a specific target of 100 percent enforcement of the 'inefficient electrical appliance ban' at border control.

Responsible Ministries and sector stakeholders

The key government bodies are the Department of Environment through the Waste Management and Pollution Control (WMPC) Division and the Waste Authority Limited (WAL), a government-owned enterprise. The WMPC are actively engaged in regional dialogues and coordinate a range of projects to provide improved waste management for challenging waste streams such as asbestos, mercury, and chemical waste. WAL is responsible for waste management service delivery—waste collection, landfill operations and management, waste awareness, public bin services, liquid waste management, and recycling, including removal of end-of-life vehicles and bulky waste. Town and District Officers are responsible for community level initiatives, such as public bins and waste awareness, and private sector and NGOs also play complementary roles in the Waste sector.

Historical and current GHG emissions

The Third National Communication on Climate Change report (2019) states that the Waste sector represents about 0.3 percent of the country's greenhouse emissions. However, accurate data is lacking, as highlighted in the NDC.

Current initiatives

Over the last 20 years, there have been a number of important urban development and waste management projects that have been implemented with the help of donor funding , including from Australia, ADB, Japan and the United States.

The current National GCF Pipeline as part of the Tonga Country Programming Process (Period: 2020 -2023) includes a US$10 million project. It focuses on delivering proper waste disposal facilities for all of Tonga and innovative waste to energy technology including recycling facilities and solutions for better managing waste emissions.

A number of initiatives to develop regional waste management approaches for several Pacific Island countries are currently underway. The 'Moana Taka' partnership between China Navigation Company and SPREP, to which Tonga is eligible, enables Tonga to export recyclable materials for free (SPREP, 2018). The Pacific Regional Infrastructure Facility, working with SPREP, intends to produce a feasibility study for a regional recycling network as part of efforts to improve solid waste management in the Pacific. Funded through JICA and administered by SPREP, the Japanese Technical Cooperation Project for Promotion of Regional Initiatives on Solid Waste Management, Phase II (J-PRISM II) seeks to support technical capacity in Tonga and other Pacific Island countries.[4]

4 Please refer to the NDC Implementation Roadmap and Investment Plan with Project Pipeline, Appendix B, for more information on current and planned projects

3.5.2 Sector Pathways

The Waste sector vision is for:

‘A resilient, sustainable and educated Tonga. This is achieved through effective education and sustainable waste management.’

To improve the Waste sector in the most effective manner, the priority intervention is to develop a national waste strategy. With in-depth stakeholder consultation, the strategy will contain a list of costed actions with an implementation timeframe. Financing the national waste strategy to ensure effective implementation of key actions is also a priority. The final top priority is updating the current inventory database, as working with reliable and up to date data is essential.

Comprehensive education and awareness raising is critical to achieving long term gains in the Waste sector, together with using traditional knowledge, and prioritising the use of local/recycled goods when possible. GHG emissions reductions have not been accurately assessed as the proposed actions are in early development.

Image: Landfill at the Tapuhia Waste Management Facility in Vaini, Tongatapu. Taken in 2021.

WASTE

Sector Pathway Actions Over Time

1
Establish strong Waste strategy and integrate the strategy into community development plans
PRINCIPLES
Core Values

2
More efficient data collection and consistent update of the database
PRINCIPLES
NP

3
Secure financing for outer island waste processing
PRINCIPLES
NP

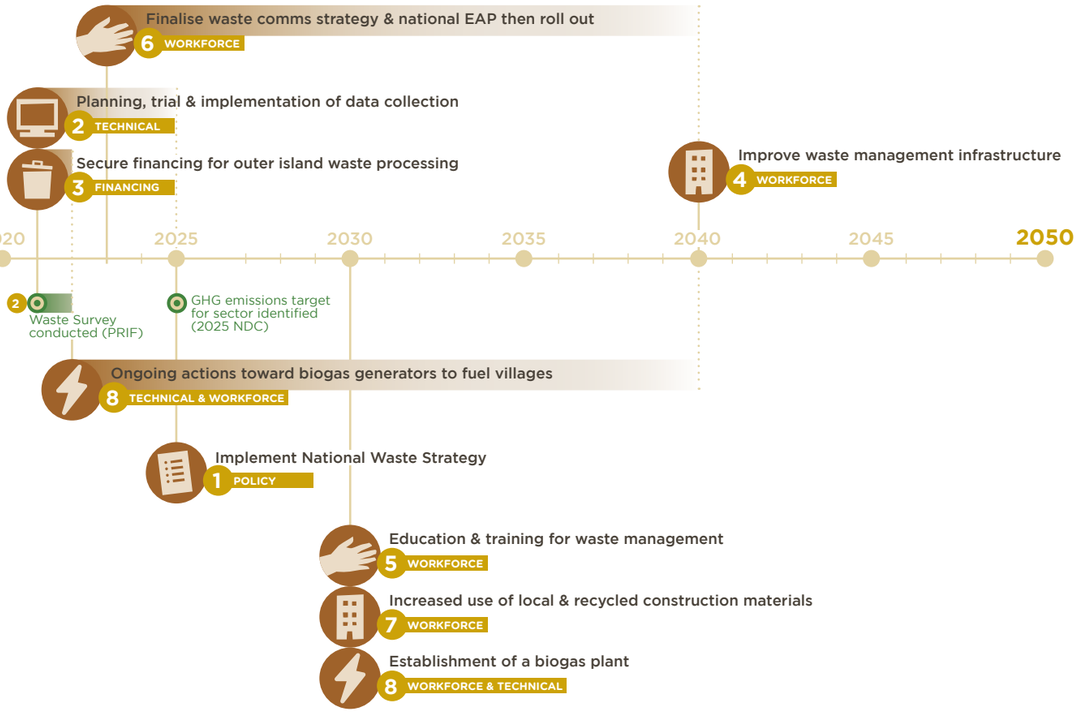
4
Developing/upgrading waste management facilities
PRINCIPLES
Autonomy & Culture

5
Educate and train individuals on waste handling and management
PRINCIPLES
Autonomy, Culture & Education

6
Unlearn old habits and teach healthy coexisting lifestyle to support short and long term training and public awareness on waste
PRINCIPLES
Education, Environment & Inclusivity

7
Increased use of local and recycled construction materials
PRINCIPLES
Autonomy, Culture, Core Values, Education, Environment & Inclusivity

8
Biogas generators to fuel villages; purchase best equipment and technology for Waste sector; create waste disposal bins at village level
PRINCIPLES
Autonomy, Culture, Education, Environment & Inclusivity



Existing Second NDC Targets

Pathway description

WASTE ACTION 1

Establish strong waste strategy and integrate the strategy into community development plans.

GHG emissions reduction potential: Low-Medium, once actions are implemented.

Description: The strategy will act as a road map with links to agriculture, forestry, fisheries and Energy sectors, as well as manufacturing, commerce and tourism, towards sustainable and improved waste management in Tonga. It will further flesh out actions proposed in LT-LEDS to enable implementation. Through comprehensive public consultation, including with the private sector, the development of the strategy will enable testing of 3R options: replacement, reduction, and refinement, along with the development of incentives, regulations (such as banning single use items, increasing fees or introducing a container deposit scheme) and processes for long term awareness raising and the need for infrastructure. Actions will be costed and a timeline for implementation will be defined.

Supporting asset and capacity measures: Public consultations, social media outreach programs, training and workshops, community and council meetings.

Location: All of Tonga.

Timeline: Start implementing the national waste strategy by 2025.

Principles: These actions align with Core Values, in particular cooperating and fulfillment of mutual obligations.

Links to Second NDC: Indirect link to the target of expanding formal Waste collection.

Links to other mitigation sectors: Potentially all sectors.

WASTE ACTION 2

More efficient data collection and consistent update of the database.

GHG emissions reduction potential: Low, as this is an indirect action. However, accurate data will enable other actions to be developed and implemented.

Description: Reliable data is crucial to identify and improve weaknesses within the waste system. Data collection will be strengthened by installing infrastructure (such as weighbridges at landfills), improving staff capacity (e.g. for conducting surveys), mapping out relevant stakeholders and by improving cross ministerial collaboration. In addition, data processing capacity will be enhanced by improving IT infrastructure (e.g. computers and servers) and training data scientists.

Supporting asset and capacity measures: Maintenance of weighbridge at the landfill; Improve and update computer technology at the landfill to record data. Capacity building for government employees.

Location: All of Tonga.

Timeline: This action is split into 3 phases: planning, trial and implementation (2021-2025). Data gathering and collation may leverage the waste survey to be conducted by the Pacific Regional Infrastructure Facility in 2021-22.

Principles: Not provided.

Links to Second NDC: Collection of relevant data on waste amounts and waste composition, as a prerequisite to identify a GHG emissions target for the sector in the 2025 NDC.

Links to other mitigation sectors: Potentially all sectors.

WASTE ACTION 3

Secure financing for outer island waste processing.

GHG emissions reduction potential: Medium, if it targets landfills and sewage.

Description: Securing funding will enable implementation of actions identified in the LT-LEDS and future actions that will be identified in the national waste strategy. This is particularly important for outer islands such as Vava'u, Ha'apai & 'Eua as remoteness and low population make waste interventions expensive. Partnerships with tourism operators will also be explored, where appropriate, to support improved waste management. Funding could be utilised for infrastructure such as landfills, public bins, transfer stations, septic beds and sewage treatment ponds, as well as through long term educational programs. Funding will be sought from the GCF for adaptation projects such as climate proofing landfills.

Supporting asset and capacity measures: Need for landfill sites, public bins, septic beds, transfer stations and sewage treatment ponds together with capacity building (e.g. for home composting) including farmers, women's groups and market vendors.

Location: Vava'u, Ha'apai and 'Eua.

Timeline: 2021-2022 then on an as needed basis to enable implementation of the strategy and when funding opportunities arise.

Principles: Not provided.

Links to Second NDC: Expanding the formal Waste collection system.

Links to other mitigation sectors: None.

WASTE ACTION 4

Developing/upgrading waste management facilities.

GHG emissions reduction potential: Low-Medium.

Description: Progressively improve waste management infrastructure in the country, including the development of controlled landfills, transfer stations, transport equipment, and small recycling facilities to process wastes such as organics, glass, plastics, fecal sludge treatment plant,and bulky items (whitegoods, cars). The scope of work will depend on the amount of funding secured. Efficient waste processing will be facilitated by improved upstream management such as source segregation of various materials, which can be organised through community waste management plans, partnerships with the private sector and improved inter-island collaboration. Capacity and infrastructure to process recyclables and wastes that may be exported is also needed, (e-waste, whitegoods, cars and batteries), particularly as Pacific regional recycling initiatives progress.

Supporting asset and capacity measures: Need to establish proper landfills rather than dumpsters, and color-classify waste bags to facilitate collection. Capacity measures are needed for the whole population (government, private sector, general population).

Location: All of Tonga.

Timeline: All required infrastructure in place by 2040.

Principles: Autonomy and Culture.

Links to Second NDC: Expanding the formal Waste collection system.

Links to other mitigation sectors: Energy.

WASTE
ACTION 5

Educate and train individuals on waste handling and management.

GHG emissions reduction potential: Low, as this is an indirect action. However, it will enable other actions to be developed and implemented.

Description: There is a need for education and training in conjunction with other actions such as providing recycling bins and a separate collection system. With strong leadership from government, private sector and community/traditional leaders, specific and targeted training on waste segregation and classification will be provided to the broader community. This will include training on e-waste, bulky waste and handling toxic materials/medical waste. Technical assistance can also be provided to government staff, SMEs and businesses.

Supporting asset and capacity measures: Equipment for households such as bins, and composting/biogas equipment. Training resources, materials (e.g. instructions on bins, simple picture education signs) and personnel to carry out training.

Location: All of Tonga, especially outer islands.

Timeline: Strategy in place by 2030.

Principles: Autonomy, Culture, Education.

Links to Second NDC: Indirect link.

Links to other mitigation sectors: Potentially all sectors.

WASTE
ACTION 6

Unlearn old habits and teach healthy coexisting lifestyle to support short and long term training and public awareness on waste.

GHG emissions reduction potential: Low, as this is an indirect action. However, it will enable other actions to be developed and implemented.

Description: Short and long term awareness raising is key. A national education awareness plan (EAP) and waste communication strategy will be developed and implemented. Including environmental concepts into the education curriculum and training teachers will ensure long term awareness among youth. It will also support the creation of a qualified workforce in required fields, including through Technical and Vocational Education and Training (TVET), such as environmentalists, data scientists, engineers and lawyers. For the broader community, implementation of the communication strategy through events, community and religious leaders, social media, radio and TV, will aim to change mindsets on environmental issues and 3R principles over the long term.

Supporting asset and capacity measures: Need for radio and television programs, mass texts and jingles and short videos.

Location: All of Tonga.

Timeline: Finalisation of the strategy and EAP by 2023, then ongoing roll out until 2040.

Principles: Education, Environment, Inclusivity.

Links to Second NDC: Indirect link.

Links to other mitigation sectors: Potentially all sectors.

WASTE
ACTION 7

Increased use of local and recycled construction materials.

GHG emissions reduction potential: Low - Medium.

Description: An increased use of low carbon local construction materials and traditional knowledge will be investigated in consultation with stakeholders, including from the forestry, agriculture, manufacturing, commerce, tourism and building industries. In addition, increased use of recycled materials, such as bricks, concrete, timber and glass will be assessed for technical and financial viability. This will include a review of the building code, developing guidelines and collaborating with neighboring countries on research and development.

Supporting asset and capacity measures: Greater production of local plant materials suitable as construction inputs (e.g. Bamboo, straw, other plants). Greater linkages to recycling of waste. Workforce training on the use of recycled/local material (e.g. TVET), production of guidelines.

Location: All of Tonga.

Timeline: 2030.

Principles: Autonomy, Culture, Core Values, Education, Environment, Inclusivity.

Links to Second NDC: Expanding the formal Waste collection system.

Links to other mitigation sectors: Human Settlements, Transport.

WASTE
ACTION 8

Biogas generators to fuel villages; purchase best equipment and technology for Waste sector; create waste disposal bins at village level.

GHG emissions reduction potential: Medium.

Description: Organic waste from household, industry and agriculture can generate high amounts of methane when treated or placed in landfills. Waste such as pig manure, food waste, fecal sludge and wastewater can be processed to generate biogas. Biogas harvesting can also be set up at a community level or as a standalone industrial facility. Using compost as a soil amendment returns valuable nutrients and carbon to land, while decreasing reliance on synthetic fertilisers which are polluting, unhealthy and expensive. While small scale options will continue to be encouraged in the short term, larger scale set ups will require feasibility studies to assess technical and financial potential. Finally, an increase in use of local food will reduce transport, packaging and food spoiling while supporting the local economy.

Supporting asset and capacity measures: Feasibility studies before installing infrastructure. Will require machinery for processing organic waste and better harvesting local food production, training and capacity building on farming cultivation and livestock management.

Location: All of Tonga: centralised on the main island, decentralised on smaller islands.

Timeline: Establishment of a biogas plant by 2030. Ongoing actions (2022-2040).

Principles: Autonomy, Culture, Education, Environment, Inclusivity.

Links to Second NDC: Expanding the formal Waste collection system.

Links to other mitigation sectors: AFOLU, Energy, Transport.

3.5.3 Socio-economic and environmental considerations

Skills and capacity building needed

The need for skills and for capacity building is addressed in Action 5 'educate and train individuals'. Modifying the curriculum, including TVET, and training teachers will encourage an increase in the skilled workforce for the long term. In the short term, targeted capacity building aimed at government officials and businesses can be impactful. Businesses can be made aware of their environmental obligations, while waste management businesses can receive technical assistance to operate equipment and in operation and maintenance of a landfill or transfer station. With continued donor support, SPREP can continue to build capacity for solid waste management as it is already doing through the J-PRISM II project. Train-the-trainer programs can be aimed at government officials; this will ensure they are better prepared to conduct environmental awareness activities among the general population and with businesses, for example on the need for source separation of waste. These officials can also be trained in obtaining and analysing data. Existing Tonga policies include JNAP2 - education for resilience target 16.

Cross-sectoral considerations

Lack of environmental awareness at both community and business levels is generally not limited to waste management. Awareness is also lacking in areas including energy efficiency, water conservation, climate change, forestry and land use. The development and implementation of a communication strategy, as outlined in Action 6, should therefore also encompass other sectors. Similarly, developing a data management system should encompass other sectors, as the lack of quality data is not specific to waste. Finally, Action 8, which targets organic waste, including growing locally and composting, has strong links with food security and the AFOLU sector.

Gender and social inclusion considerations

Action 3 proposes directly funding communities, especially on outer islands, while Action 7 and Action 8 have the strongest links to social inclusion, aligning with the TSDF II which states that 'Traditional societies produced limited waste and pollution, most of which was biodegradable. Modern trade and consumption generates vast amounts of waste that can easily lead to the pollution of our sensitive environment'. Action 7 and Action 8 propose increasing the use of local materials and crops: the process would benefit from close consultation with local communities for their traditional knowledge and may eventually create opportunities for them.

The gender component should be carefully assessed, especially during the development of the waste management strategy and the EAP, to ensure women are appropriately represented during development and implementation of these plans.

Environmental and social safeguards considerations

Environmental and social standards should be carefully considered when establishing new waste management infrastructure, especially if it reaches the industrial scale such as landfills, anaerobic digesters, composting and crushing facilities. Emissions such as dust, odors, noise and contaminants must be carefully assessed and minimised with regard to local residents and the environment.

Key data gaps and solutions

Several assessments that have been conducted for the Waste sector in Tonga state that the level of data and information available to adequately assess the Waste sector is currently missing. This includes waste volumes, waste characterisation, and how waste is managed both at the landfill stage and outside of it. Without data, it is challenging to estimate greenhouse gases from waste on all of the islands, and to then determine actions required to address these emissions. Data is also crucial to assessing the financial viability of infrastructure. The Second NDC highlights this point and has mentioned prioritising data collection in the Waste sector for Tonga in the next five years.

Image: Women's handicraft displays at the annual Royal Agricultural Show in Neiafu, Vava'u. Taken in 2019.

3.6 HUMAN SETTLEMENTS

3.6.1 Context

Introduction

Tonga consists of 170 islands, with less than 45 of these islands inhabited. Most Tongan islands are low-lying, making communities extremely vulnerable to flooding due to rising sea levels and storm surges. These effects are becoming more frequent as the climate warms. Coastal flooding damages buildings and endangers human lives. Furthermore, droughts and increased freshwater extraction endanger community groundwater supplies from saltwater intrusion. Urban areas in Tonga often experience flooding due to the lack of stormwater management infrastructure. Hence there is strong reasoning for the integration of stormwater drainage with the road network in urban areas, to prevent or reduce flooding.

The inclusion of Human Settlements as a sector in the LT-LEDS planning is to enhance the complementarity of plans with other sectors rather than the potential for greenhouse gas emission reduction.

Image: Flooding of a local residence at Fasi, Tongatapu after TC Gita. Taken in 2018.

Relevant national policies, sectoral policies and links with the LT-LEDS

The Tonga JNAP1 and JNAP2 consistently discuss these risks and the prioritisation of securing the safety of coastal communities. The focus on enhancing resilience is further emphasised in the National Infrastructure Investment Plan, though the plan does not explicitly prioritise coastal infrastructure or the built environment. The Second NDC submitted by Tonga emphasises the need for coastal management and flood management to address sea level rise. The World Bank supported the establishment of the Road Maintenance Fund in 2013, though there is a need to supplement the scope of the fund to ensure adequate coverage of road networks across the islands.

The Third National Communication (to UNFCCC) also describes the importance of timely maintenance and rehabilitation of road infrastructure to ensure all-weather access and as a means of job creation in Tonga. Climate-resilient buildings and infrastructure are also prioritised in the NDC as a key adaptation measure to climate change impacts. The Building Control and Standards Act is in the process of integrating updated specifications to account for increasingly intense weather events and wind loads. After the 2020 cyclone season caused significant building damage, building audits have commenced to assess the suitability of safe assembly points for evacuation in preparation for the next cyclone season.

Responsible Ministries and sector stakeholders

The Ministry of Infrastructure (MOI) oversees the maintenance, design and planning of road networks across the islands. MOI is also responsible for building standards and regulations, leading the process for updating the Building Code and developing capacity to fully implement it. The National Emergency Management Office (NEMO) coordinates planning for disaster-response, including assessing evacuation routes and safe assembly points.

Historical and current GHG emissions

Buildings and infrastructure are not a major source of greenhouse gas emissions in Tonga. They are, however, identified as a critical part of adapting to climate change impacts such as sea level rise and increasingly powerful winds and storms. Additionally, efforts are being made to reduce energy consumption in buildings through improving energy efficiency of appliances and building envelopes. The inclusion of the Human Settlements sub-chapter in LT-LEDS reiterates Tonga's commitment to a comprehensive low emission development trajectory.

Current initiatives

The Pacific Regional Infrastructure Facility is supporting the Government of Tonga to develop the Tonga National Infrastructure Investment Plan 2020-2030 (NIIP-3). The NIIP-3 will support improved screening and prioritising infrastructure projects for resource allocation for projects. In 2018, the World Bank approved a US$26 million grant to improve climate resilience of Tonga's land, sea and air transport infrastructure. This includes the integration of storm drains and road upgrades on major islands. Municipal infrastructure in Nuku'alofa has been upgraded through the recently completed US$14.6 million Nuku'alofa Urban Development Sector Project, funded by the Asian Development Bank (ADB) and the Australian Government.

For coastal protection, the ADB is financing the US$19.25 million Tonga Climate Resilience Sector Project which includes the installation of 8km of soft and hard coastal infrastructure to protect against storm surges. In addition, the Integrated Urban Resilience Sector Project, jointly funded by the ADB and the Australian Government, addresses institutional and infrastructure gaps for flood prevention on Nuku'alofa. A coalition led by the United Nations Development Program, including the Tongan Government, SPREP, New Zealand MFAT and research institutions, is developing a US$40 million proposal to the GCF. This would cover construction of coastal protection in Tongatapu, Vava'u and Ha'apai and enhancing disaster monitoring capabilities.

HUMAN SETTLEMENTS

Sector Pathway Actions Over Time

1

Inclusive development through life skills program

PRINCIPLES

Traditional Knowledge, Education, Environment & Culture

2

Implement disaster risk financing strategy to manage funds during disaster response so that communities can access climate resilient infrastructure

PRINCIPLES

Education, Environment, Inclusivity, Culture & Traditional Knowledge

3

Engage with donors and partners to source funds for infrastructure management and design, particularly on stormwater management and road design

PRINCIPLES

Core Values, Education, Environment & Inclusivity

4

Water security in all islands as a DRR measure

PRINCIPLES

Inclusivity, Environment, Education, Culture & Autonomy

5

Improve the climate resilience of housing and buildings, retrofitting to withstand high winds and damaging cyclones

PRINCIPLES

Environment, Inclusivity, Traditional Knowledge, Culture, Autonomy, Education & Core Values

6

Sustainable tourism in Tonga

PRINCIPLES

Education & Environment

7

Increase finance, resource and capacity building for education to build a knowledge based society

PRINCIPLES

Education

8

Increase access to financing for storm water management and road design by the MOI

PRINCIPLES

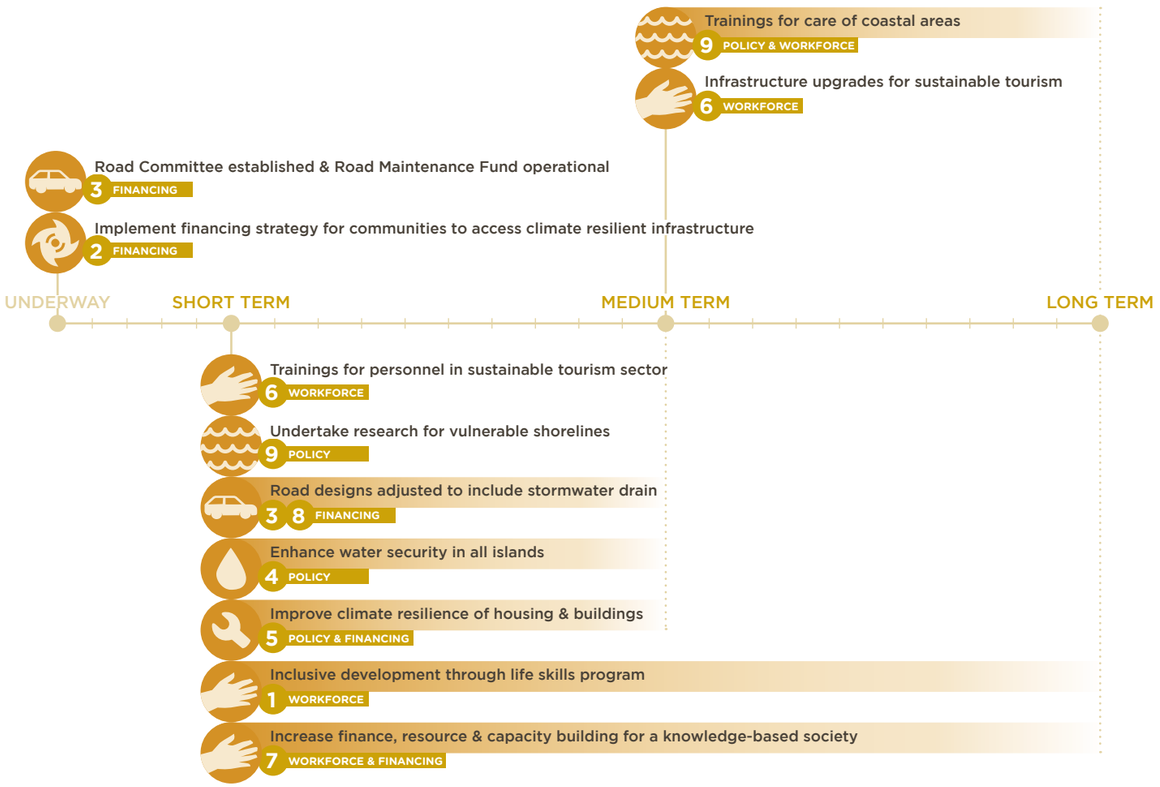
Autonomy

9

Strengthen and refine current policy on coastal protection in order to strengthen Marine Protected Areas

PRINCIPLES

Environment



3.6.2 Sector Pathways

The Human Settlements vision is:

‘Building a resilient and autonomous Tonga through transformation and strengthening of all sectors.’

In the Human Settlements group, the inclusion of all parts of the Tongan population in the development of the nation was identified as a top priority. This requires concerted efforts to map all vulnerable groups and means to engage them in capacity development to improve livelihoods and early warnings in the event of disasters. The emphasis on inclusive development is reflected in almost all prioritised actions in this pathway.

Pathway description

HUMAN SETTLEMENTS ACTION 1

Inclusive development through life skills program.

GHG emissions reduction potential: This action does not have direct GHG reduction potential. There may be indirect contributions to GHG emission reductions.

Description: Engage all facets of society in the sustainable development of Tonga. This requires extensive consultations to identify all groups with different vulnerabilities and needs. Training programs need to be tailored for groups with consideration given to distinct constraints and capacities. These groups include women, youth, elderly, persons with disability and communities living in remote islands. Skills training and networking opportunities enhance the security of livelihoods for the people of Tonga. This action further requires policies and resources to support improved access to markets for the sale and exchange of products.

Supporting asset and capacity measures: Training materials and equipment e.g. home gardening equipment.

Location: Urban areas, unused land.

Timeline: This action will commence in the short term, after community outreach officers are trained and training materials developed. It is anticipated that actions in this area will be required up to the long term.

Principles: This action is highly aligned to Inclusivity and aligned with Traditional Knowledge, Education, Environment and Culture.

Links to Second NDC: None.

Links to other mitigation sectors: AFOLU – Gardening and agricultural products are the primary source of economic output at the household level.

HUMAN SETTLEMENTS
ACTION 2

Implement a disaster risk financing strategy to manage funds during disaster response so that communities can access climate resilient infrastructure.

GHG emissions reduction potential: This action does not contribute directly to GHG reduction.

Description: Ensure access to climate resilient community infrastructure during emergencies. Complementing the priorities in JNAP2, access to climate resilient assembly points needs to be connected with Village Emergency Management Plans. Facility and access upgrades need to be undertaken, as informed by the NEMO audit. The Shelter Cluster, consisting of all stakeholders in disaster response, can contribute by sharing communication networks to disseminate timely information during emergencies.

Supporting asset and capacity measures: Improve remote sensing capabilities, communications and evacuation networks.

Location: All islands.

Timeline: Implementation of this action is already underway, with NEMO auditing suitable evacuation centres in preparation for the next cyclone season.

Principles: This action is highly aligned to Education, Environment, Inclusivity and Culture and aligned with Traditional Knowledge.

Links to Second NDC: None.

Links to other mitigation sectors: All sectors.

HUMAN SETTLEMENTS
ACTION 3

Engage with donors and partners to source funds for infrastructure management and design, particularly on stormwater management and road design.

GHG emissions reduction potential: This action does not contribute to GHG reduction but could contribute to protection of low emission infrastructure assets.

Description: Integrate stormwater drainage infrastructure into urban road network and implement maintenance regime to enhance longevity of infrastructure. The action requires the systematic integration of stormwater planning in the design and construction of roads and pavements in urban areas. This complements the Road Maintenance Fund established in 2013. Technical support to enhance the work of the National Spatial Planning Agency Office (NSPAO) and the Road Committee will be needed.

Supporting asset and capacity measures: Install and maintain stormwater management infrastructure.

Location: Urban areas.

Timeline: Road Committee has been established and Road Maintenance Fund is operational. Over the short to medium term, road designs to be adjusted to include stormwater drains.

Principles: This action is aligned to Core Values, Education, Environment and Inclusivity.

Links to Second NDC: None.

Links to other mitigation sectors: Transport – The reduction of flooding enhances land-based transportation.

HUMAN SETTLEMENTS
ACTION 4

Water security in all islands as a disaster risk reduction measure.

GHG emissions reduction potential: This action does not contribute to GHG reduction.

Description: Enhance water security in all inhabited islands of Tonga. This would require the development of an integrated water management plan with specific considerations around the availability of groundwater in each island. Sensitisation to water containment and treatment methods needs to be conducted for all communities, with a focus on remote islands. Groundwater measurement, as recognised in previous surveys, is an important feature for improving water management and security.

Supporting asset and capacity measures: Rainwater catchment tanks, community reservoirs, emergency water purification kits, solar desalination plants, awareness raising on communal water management.

Location: Tongatapu, outer islands.

Timeline: This action will be implemented in the short to medium term.

Principles: This action is very aligned with Inclusivity. It also aligns with Environment, Education, Culture and Autonomy.

Links to Second NDC: None.

Links to other mitigation sectors: Energy - where it may be needed to power water supply and treatment systems.

HUMAN SETTLEMENTS
ACTION 5

Improve the climate resilience of housing and buildings, retrofitting to withstand high winds and damaging cyclones.

GHG emissions reduction potential: This action does not contribute to GHG reduction but could contribute to protection of low emission infrastructure assets.

Description: Improve resilience of housing and buildings to increasingly intense winds and storms through retrofits. An enhanced building code has been validated with industry and needs to be adopted as policy. Systematic capacity building for public and private sector stakeholders will be needed on adoption of the updated code. Materials standardisation and certification is needed for code implementation. Financing will also be needed to support existing buildings through necessary retrofits to withstand anticipated loading.

Supporting asset and capacity measures: Suitable materials and capacity development for compliance to an upgraded Building Code. Production capacity to produce suitable wood-based materials locally.

Location: Throughout the Kingdom.

Timeline: Activities in the action will be implemented over the short and medium term.

Principles: This action is well aligned with all the Tongan principles.

Links to Second NDC: None.

Links to other mitigation sectors: Energy – The updated Building Code pending adoption improves the energy efficiency of building envelopes and appliances, while enhancing structural adequacy.

HUMAN SETTLEMENTS
ACTION 6

Sustainable tourism in Tonga.

GHG reduction potential: Low to Medium.

Description: In anticipation of post-pandemic economic recovery, Tonga aims to promote sustainable tourism as a form of income generation. This includes putting in place tourist taxes which can then be channeled toward low emissions development and climate change adaptation measures in the tourism industry as well as promoting nature-based infrastructure solutions. Training programs will be organised to improve hospitality skills among the workforce while mainstreaming knowledge on sustainable tourism. Upgrades to telecommunications and transport infrastructure and vehicles/vessels while integrating renewable energy and energy efficiency, will benefit both tourists and the local population as it reduces the carbon footprint of the tourism sector.

Supporting asset and capacity measures: Telecommunications and tourism infrastructure including nature-based solutions, renewable and energy efficiency technologies, fuel efficient/low emissions vehicles and vessels, monitoring systems, early warning systems.

Location: Remote islands.

Timeline: Training programs for personnel in the tourism sector are planned for the short term while infrastructure upgrades will follow in the medium term.

Principles: This action is well aligned with Education and Environment.

Links to Second NDC: None.

Links to other mitigation sectors: Transport – land, sea and air transportation infrastructure within and between islands will be upgraded.

HUMAN SETTLEMENTS
ACTION 7

Increase finance, resource and capacity building for education to build a knowledge based society.

GHG Reduction Potential: This action does not have direct GHG reduction potential. There may be indirect contributions to GHG emission reductions.

Description: With disruptions to face to face gatherings increasingly possible (from global pandemics to natural disasters), Tonga is exploring mechanisms to ensure the continuity of quality education throughout any events. This will require significant financial resources to set up adequate communication channels in the outer islands and to ensure students have access to required equipment and materials when schools are not operating. This action also calls for a review of the curriculum, to increase environmental awareness and disaster preparedness through education. Consideration should be given to student loans to support vocational and tertiary education in particular. Teachers will have to undergo training to equip them with the skills to conduct lessons through new mediums. This action links with the Tonga Accelerate Resilience Program and links students with employment after completion of their studies.

Supporting asset and capacity measures: Upgraded school buildings and facilities, more training for teachers.

Location: Throughout the country.

Timeline: This action requires implementation from short to medium and long term. The initial focus is on low-income households, with support expanded to all teachers and students over time.

Principles: This action is well aligned with Education.

Links to Second NDC: None.

Links to other mitigation sectors: All sectors.

HUMAN SETTLEMENTS
ACTION 8

Increase access to financing for storm water management and road design by the MOI.

GHG Reduction Potential: This action does not have direct GHG reduction potential. There may be indirect contributions to GHG emission reductions.

Description: While the Road Maintenance Fund is operational and major defects and damages to road infrastructure are being repaired and rectified, there is a need for more systematic monitoring and maintenance of transportation assets in Tongatapu and beyond. Training for staff and the public to monitor and report defects for timely repairs as well as resourcing local teams to carry out regular maintenance works can extend the lifespan of road infrastructure at lower cost.

Supporting asset and capacity measures: Costed maintenance plan for all public infrastructure.

Location: Tongatapu, ‘Eua, Ha’apai, Vava’u, Niuas.

Timeline: None.

Principles: Autonomy.

Links to Second NDC: None.

Links to other mitigation sectors: Transport – Road infrastructure on larger islands will be regularly maintained.

HUMAN SETTLEMENTS
ACTION 9

Strengthen and refine current policy on coastal protection in order to strengthen Marine Protected Areas.

GHG Reduction Potential: Low to Medium.

Description: In line with climate change policy calling for coastal protection, this action prioritises the use of nature-based solutions for protection against storm surges and erosion. This entails leveraging traditional knowledge in plant selection for restoration of mangroves and replanting of foreshores. Restoration of mangroves, replanting and general strengthening of the coastal ecosystem will also have positive GHG emission sequestration outcomes although these cannot be quantified at the present time. Where vegetation is inadequate for blocking storm surges and sea level rise, revetments and seawalls may be needed to protect communities from the surrounding ocean incursions. Assessments and feasibility studies need to be conducted in each case to determine the most appropriate modality for coastal protection.

Supporting asset and capacity measures: Coastal replanting and seawall construction.

Location: Fanga’uta Lagoon Coastal Areas and Tongatapu.

Timeline: In the short term, research needs to be undertaken to determine the required intervention for each of the vulnerable shorelines, especially those closer to more populated areas. Over the medium to longer term, training for local communities, students and public officials for the protection and care of coastal areas will be conducted.

Principles: Environment.

Links to Second NDC: Planting one million trees by 2023 and prevention of any permanent loss of land to rising sea levels on Tonga’s four main islands.

Links to other mitigation sectors: AFOLU – Coastal mangroves contribute to carbon sequestration while protecting the coast from erosion.

3.6.3 Socio-economic and environmental considerations

Skills and capacity building needed

Training and capacity building have been identified as a first step in almost all the actions for Human Settlements. There is a shortage of technical expertise locally to maintain and upgrade the infrastructure systems and technologies that have been imported. External skills can be brought in periodically from within the region to upskill technical professionals in Tonga. At the same time, traditional knowledge in agriculture, water management and coastal protection can be mobilised to ensure solutions pursued are sustainable and locally appropriate.

Cross-sectoral considerations

The Human Settlements pathway is an enabling pathway, not limited to a specific sector. However, it brings together diverse aspects where concerted effort is required to ensure the wellbeing and livelihoods of Tongans in the wake of climate change impacts and economic development. The actions identified in this pathway intersect with Energy, Transport and AFOLU, and cross-sectoral collaboration can deliver optimal outcomes and mobilise external support, both in the form of technical assistance and financial support.

Gender and social inclusion considerations

Actions in this pathway have a strong focus on enhancing resilience, particularly to climate-induced impacts. These affect different groups in the population differently and substantial discussion has revolved around identifying the various forms of vulnerability that must be included in national and local planning. Gender, youth, disability, poverty, and remote locations are some of the factors that will require particular attention in the allocation of resources and planning for the actions listed in this pathway. Planning with vulnerability and social inclusion at the forefront of considerations will lead to more equitable outcomes to the actions taken to enhance the resilience of the country.

Environmental and social safeguards considerations

Measures to enhance resilience to disasters require stakeholders to be able to firstly, receive the information and then, to take action on warnings or information. Training and capacity building programs must not exacerbate social inequalities. Infrastructure upgrades and construction projects should be informed by comprehensive environmental impact assessments, to understand whether such projects would have wider impacts on local flora and fauna.

Key data gaps and solutions

Audit of community facilities has commenced in preparation for evacuation and assembly during disasters. Systematic building audits to determine which and to what extent each building needs to be retrofitted to withstand cyclones is the next urgent task, to guide resource mobilisation and distribution. A market study can be commissioned to determine the building materials available in Tonga, and how they meet requirements in the Building Code. It is essential the same level of attention is paid to buildings in less populated islands, to consistently ensure safe spaces for shelter during disasters.

Similarly for road infrastructure, a nationwide audit of the road network, condition of roads and stormwater drains will provide the first step towards developing a systematic road network maintenance and development framework. Traffic studies should be commissioned in urban areas to determine the adequacy of the network to traffic volumes and inform network expansion.

Image (opposite page): Niutao Project seawall construction in progress from Navutoka to Talafo'ou, Tongatapu. Taken in 2021.

4 MAJOR FIRST STEPS

Image: A view of surrounding islands from Mt. Talau, Vava'u. Taken in 2020.

LT-LEDS FIRST STEPS

Through the LT-LEDS development, Tongan stakeholders contributed and shaped the vision for:

A low emissions Tonga, where all sectors work together to create resilience, autonomy and self-reliance.

Through this process, stakeholders developed, revised and assessed possible near term steps that will advance Tonga towards this vision. They identified nine first steps as priorities, to implement the LT-LEDS. In no particular order these are:

- Loan program for low energy buildings
- Standardising lighting power consumption for buildings by 2025
- Low emission vehicles: government to pilot electric vehicles
- Develop a waste communication strategy
- Strengthen existing transport policies
- Mainstreaming important low emission policy elements into relevant ministries
- Promote Best Practices in agriculture, forestry and fisheries
- Develop and implement a national waste policy for Tonga
- Pedestrianising Nuku'alofa by 2022

These priority steps are described further in this chapter.

Loan program for low energy buildings

LT-LEDS stakeholders prioritised a loan program for businesses to improve their building's energy efficiency, replicating similar government programs provided in the agricultural sector. This step intersects with other intervention actions from the Energy, AFOLU and Human Settlements sectors with energy efficiency; low emissions, low cost, and retrofitting of houses and other structures to withstand high winds and damaging cyclones.

The development of this loan program should be undertaken by government and businesses, with support from village and community scale actors. It should be led by the Ministry of Infrastructure (MOI), Ministry of Lands and Natural Resources (MLNR), DCC, Department of Environment, Department of Energy (DOE) and Tonga Power Limited (TPL). Other key stakeholders include the construction sector, donors and NGOs, producers and makers like hardware stores such as EM Jones and electrical companies such as JH Electrical.

Users of energy efficient buildings include the general public, schools and government, essential buildings and businesses such as resorts. This step should incorporate the development lead designs for the most energy efficient buildings suitable for Tonga and follow with energy performance audits and the management of change.

This step should be implemented in percentages of building stock that are energy efficient. Stakeholders suggested these percentages would be achieved by 30 percent of buildings being energy efficient by 2030, 60 percent by 2040 and 100 percent by 2050.

This step aligns with the Tongan principles of Environment, Education, Inclusivity and Autonomy. It would bring positive social, technical and environmental impacts, contributing to Tonga's achievement of good health and wellbeing (SDG3), quality education and training for building retrofits (SDG4), gender equality (SDG5), affordable and clean energy (SDG7), decent work through retrofitting (SDG8), new industry, innovation and infrastructure sectors within the Tongan economy (SDG9), sustainable cities and communities (SDG11), responsible consumption and productivity (SDG12), climate action (SDG13), life on land (SDG15) and partnerships (SDG17). This step aligns with existing policies of TSDF II, TCCP, NIIP2, and TERM+.

Standardising lighting power consumption for buildings by 2025

The LT-LEDS prioritised the standardisation of lighting power consumption for buildings in Tonga by 2025. It is likely this step could affect how buildings will be designed in Tonga as we move towards more energy efficient designs for buildings, both in private and commercial sectors. It may also lead to behavioural impacts in the way people consume energy, in terms of both power and lighting. This would bring social, technical and financial benefits as the community saves more on their electricity bills.

The standardisation of lighting power consumption should be the responsibility of Tonga Power Limited, MOI, the Tonga Electricity Commission and MEIDECC, and mainly the Department of Energy. State partners include the MLNR, while non-state partners include contractors, building electrical contractors, architects and engineers.

This step should commence in 2022, with internal stakeholder consultations between MOI, Tonga Power Limited, Department of Energy and the Electricity Commission. This should be followed by public consultations on the draft policy over the next two to two and a half years, aiming for cabinet approval in 2024, and implementation in 2025.

This step aligns with the Tongan principles of Environment, Education, Inclusivity and Autonomy. This step will help reduce the cost of living by reducing electricity bills. Through the installation of energy efficient lighting, it will bring Affordable and clean energy (SDG7), Decent work and economic growth (SDG8), Industry innovation and infrastructure (SDG9), Sustainable cities and communities (SDG11), Responsible consumption and production (SDG12), and Climate action (SDG13). The step affects the National Building Code, which is currently being reviewed, along with energy policies and the TSDF II.

Low emission vehicles: government to pilot electric vehicles

Piloting of electric vehicles (EVs) in the government fleet is a priority to support implementation of the LT-LEDS. It intersects with other intervention actions to manage energy demand, low emissions, low cost and road design.

This pilot will be led by the GOT, MOI, and in particular, the Department of Environment, Climate Change and Energy. Other partners would include TPL, engineering firms, car dealers and electrical contractors. In terms of producers and makers, EVs could be supplied from Japan, Korea, China and the US. This step will start with a proposal to be developed by 2022 for funding consideration, with the aim that, by 2027, 100 percent of the government fleet are EVs.

This step aligns with the Tongan principles of environment, education, and inclusivity. It is expected to have a social and technical impact, contributing to Tonga's SDG fulfillment, particularly on in training and quality education (SDG4), affordable and clean energy (SDG7), support to energy efficient transport and therefore industry, innovation and infrastructure (SDG9), sustainable cities and communities (SDG11), climate action (SDG13), life on land (SDG15) and partnerships (SDG17). The existing policies include: TSDF II, TCCP, JNAP2, Second NDC, ministries corporate plans, procurement plan and TERM-PLUS.

Develop a waste communication strategy

The LT-LEDS also prioritises the development of a waste communication strategy and implementation of a national education awareness plan by 2025. It is expected to draw on complementary intervention actions to develop a communication strategy around waste, waste segregation, waste handling and management; threading these together with capacity building and education.

This strategy will be developed by the government, in particular the Department of Environment within MEIDECC, and the Waste Authority Limited. Other state partners will be engaged, including the Ministry of Education, Ministry of Health, the Ministry of Police, the Ministry of Finance (MOF), TSD, Ministry of Internal Affairs (MIA) and also the Prime Minister's Office (PMO). The step will also utilise non-state partners for information dissemination such as the Tonga Broadcasting Commission, radio and TV communities and the churches.

For implementation, 2021-2022 will be used for planning, followed by the development of a EAP, establishment of a waste committee and identification of stakeholders over 2022-23. Final review and securing funding is planned for 2023 with implementation commencing in 2024 and a review and lessons learnt process one year after.

This is aligned with the Tongan principles of Environment, Education, Inclusivity, Culture and Autonomy. This step will require support from technical, policy, workforce and financing avenues. For behaviour, the step aims to change mindsets and produce positive social changes through involvement from the public. The step will contribute to the following SDGs: Quality education (SDG4), Responsible consumption and production (SDG12), Climate action (SDG13), Life below water (SDG14) and Life on land (SDG15). This step maps Tonga's TSDF II, Climate Change Policy and JNAP2.

Strengthen existing transport policies

The LT-LEDS stakeholders prioritised the need for an inclusive and holistic policy that strengthens land, air and sea transport, to support sustainability and lower emissions. This will entail a stocktake of existing policies, followed by a gap analysis on existing policies and their implementation. The next step will be seeking to align policies across sectors, to address the gaps. Policies will align with multiple other sector intervention actions. Under Waste, regulations for waste and disposal of transport technology need to be considered, along with urban infrastructure and design of bridges and roads. For Energy, this step will support low GHG emissions. There are also links with the transport of AFOLU products and transport actions relating to tariffs, taxes, electric vehicles, maintenance overhaul and services.

This holistic policy will be owned by the MOI who will work with other state ministries creating related transport policies, industry, also other state partners like public enterprises or other bodies such as Tonga Airports Ltd. Non-state partners are donors (ADB, Australia, MFAT) who could help fund the strengthening of existing transport policies and provide support through technical assistance.

It is hoped that strengthened policy will prompt importers and suppliers to import and supply vehicles, airplanes or boats that follow the standards and the policy. As users are public consumers, monitoring and assessment of this step would occur through conducting surveys and audits with the public, to test policy effectiveness. The timeline for implementation is for the stocktake, gap analysis and alignment of policies to be complete by 2023. By 2025, the responsible entity will, if required, then create integrated laws or frameworks for land, air and sea transport, with parliamentary approval by 2028. Implementation can commence from 2031 onwards and will be reviewed in 2035 to measure the degree of implementation and impact.

This step aligns with Tongan principles of Culture, Environment and Inclusivity. Tonga has a culture of social and church functions which are important and should be considered when designing transport policies i.e. the priority of church functions when arranging inter-island transport. The most relevant SDGs this will contribute to are Affordable and clean energy (SDG7) and Climate action (SDG13). The step aligns with Tonga's Second NDC target for low transport emissions. The TSDF II, which covers all governmental sectors and sector plans, and corporate plans, will be related to the transport policy created through this step.

Mainstreaming important low emission policy elements into relevant ministries

LT-LEDS stakeholders recognised the need to mainstream the following intervention actions into the relevant ministries: energy efficiency, renewable energy and low emissions vehicles. This step is linked to the Alamea policy (see cross-cultural considerations), with priority given to identification of gaps in policy, duplication of policy, lack of enforcement and the need to connect policies across sectors where relevant.

This mainstreaming should be owned by the DOE, TPL and the broader government, with support from donors like GCF, ADB and New Zealand's MFAT. The time-frame to implement the step is by 2025, in accordance with targets already published in the TEEMP, JNAP2, the Second NDC - in 2030 to achieve 70 percent of RE and 100 percent in 2035 and moving forward for 2050 emission from Tonga will be 0 percent.

This step aligns to Tongan principles of education, environment and inclusivity. It will contribute to the following SDGs: Good Health and Well-being (SDG3), Quality Education (SDG4), Gender Equality (SDG5), Affordable and Clean Energy (SDG7), Industry, Innovation and Infrastructure (SDG9), Sustainable Cities and Communities (SDG11), Responsible Consumption and Production (SDG12) and Climate Action (SDG13).

Promote Best Practices in Agriculture, Forestry and Fisheries

LT-LEDS will prioritise the promotion of climate smart agriculture, agroforestry systems and traditional fishing practices. An example is increasing awareness of subsistence farmers to understand the importance of the agroforestry system and how the achievement of low emissions can include practices like mixed cropping. For farmers this might involve a return to traditional fishing using the lunar calendar.

These best practices will be promoted by the agriculture sector, fisheries sectors and the forestry sector. The state partners are MAFF, MOF, Ministry of Fisheries and all other line ministries, such as MEIDECC. Efforts will be made to use existing mechanisms, such as the Ministry of Agriculture's annual production survey and monitoring of SMAs and MPAs. The non-state partners are donors, agencies, local NGOs such as Live & Learn, MORDI Tonga Trust etc and private sectors. This step will also target producers or makers, the farmers and the fisherfolk. Implementation will start with planning and fundraising activities, with the aim that by 2028 capacity building and community awareness raising will be underway, along with the establishment of implementation areas. This step has a 50 percent implementation target by 2035, 75 percent by 2042 and 100 percent by 2050.

This step aligns with the Tongan principles of environment, education, inclusivity and culture. It will contribute to Tonga's development through No poverty (SDG1), Zero hunger (SDG2), Good health and well-being (SDG3), Gender equality (SDG5), Decent work and economic growth (SDG8), Climate action (SDG13), Life on the water (SDG14) and Life on land (SDG15). The step maps to existing Tongan policies, including the Second NDC (Forestry Target = 1 millions trees by 2023) and the TASP, TFSP, and National Forest Policy.

Develop and implement a National Waste Policy for Tonga

The LT-LEDS will be supported by the development and implementation of a national waste policy for Tonga by 2025. In doing so this step will draw upon intervention actions of a feasibility study, identifying stakeholders and gaps, national awareness, developing a national waste strategy and collecting waste data. A feasibility study will identify gaps and the current situation, in order to identify entry points that can be strengthened. These will provide the foundations of the National Waste Policy. National awareness aims to increase participation, inclusivity, ownership and buy-in from the public, for more effective implementation and support. The collection of accurate waste data will support the preparation, operation and future planning of the National Waste Strategy, allowing for further information for revision and tracking of progress.

Ownership over this policy will be with the DOE and Waste Authority Limited, working with other state partners in the PMO (to develop the policy), Ministry of Health (for data), TSD (for data), MLNR, and Ministry of Internal Affairs (MIA) (awareness raising). Non-state partners include church leaders, private businesses and schools. Producers and makers include MORC, who are responsible for borders, and importing of waste like plastic. Implementation will occur over the next ten years, with 2021-2022 as a planning phase. This will be followed by data collection, reviewing reports and analysing data in 2023-2024. Based on this timeline, the National Waste Policy will be developed in 2025 followed by implementation, review in 2027 and incorporation of lessons learned in 2030.

This step is aligned with Tongan principles of Environment, Inclusivity, Education, Culture and Autonomy. It will also contribute to Good health and wellbeing (SDG 3), Sustainable cities and communities (SDG 11), Responsible consumption and production (SDG 12), Climate Action (SDG 13), Life below water (SDG 14), and Life on land (SDG 15). This step will contribute to Tonga's Second NDC, existing Waste and Litter regulations, JNAP2.

Pedestrianising Nuku'alofa by 2022

In order to support LT-LEDS implementation, stakeholders prioritised the pedestrianisation of Nuku'alofa urban area by 2022, aligning with intervention actions in the Human Settlements sector pathway, transport actions such as road maintenance and energy, through street lighting.

This pedestrianisation will be led by the NSPAO as a division under MLNR, MOI, the Ministry of Police, and Ministry of Health. Other partners include NGOs, MOT, communities, churches, urban businesses and public enterprises. This step will be implemented over 2022, starting with a draft policy, consultation with urban communities, then cabinet approval followed by implementation and enforcement.

This step aligns with all six Tongan principles: Environment, Education, Inclusivity, Autonomy, Culture, Core Values, and will contribute to nearly all SDGs. This step maps to Tonga's Public Health Act, Non Communicable Disease strategy, TSDF II, Nuku'alofa Greater Urban Structure Plan and the NIIP II.

CROSS-SECTORAL MEASURES

In addition to sectoral interventions outlined in Chapter 3, successful reduction in GHG emissions requires the consideration of cross-sectoral measures to drive comprehensive climate action across multiple sectors. Tongan stakeholders identified five cross-sectoral considerations essential to support the implementation of interventions mentioned under Chapter 3. These cross-sectoral considerations are underpinned by the need for:

- Capacity building through education, particularly in relation to any changes being made or new policies being implemented.
- Cross-sectoral coordination
- Funding directly to communities via education
- Effective data collection and management
- Identifying policy gaps and duplications

There is a clear desire to work cross-sectorally to eliminate duplications, share data and resolve any policy overlaps. This includes identifying where policies can be formed cross-sectorally.

LT-LEDS stakeholders grouped these into five areas:

New-Niu Winds of change: education and training

New interventions and actions should consider the education and training of people accordingly. For new policy standards and legislation, training and consultation - which may include induction and orientation programs - should be included to build public awareness. A common requirement is the need for new equipment, with standard operating procedures being used by subject matter experts who are available locally. Tonga aims to use local expertise and develop local protocols to support the implementation of intervention actions under all five sectors.

Vehicles and Waste

Consideration should be given to the interconnectedness of vehicles, road maintenance and solid waste disposal. Challenges include coordination between ministries, lack of enforcement of regulations, limited access to data collection between line ministries and the lack of policies for vehicles and for waste disposal. The importation of vehicles into Tonga is already restricted to those manufactured from 2006 onwards, with vehicles older than this classified as waste in limited landfill sites. The focus is on the importance of road maintenance and waste segregation to support the implementation of transport and waste intervention actions.

Pa'anga (Mai Ange): securing financing

Finance and securing funding is an important requirement to fulfill nearly all intervention actions under each sector. Funding needs to be publicly increased and go straight to the community for education and awareness. In particular, there needs to be an increased focus on strengthening vulnerable populations, ensuring they are involved and consulted in the implementation of all sector intervention actions.

Deeply rooted policy change

Good quality data and community education are needed to understand policy changes brought about by the LT-LEDs. This could be achieved through the establishment of a data policy to enable the collection of good quality data which can then inform better decision making. Further conducting awareness raising initiatives that use community-friendly language will support the implementation of any new policies resulting from the LT-LEDS. Data collection and community awareness will benefit all sector intervention actions.

In terms of emissions reduction estimates and calculations, the Global Warming Potentials (GWP) used to calculate the GHG inventory results are not clear at present. This needs to be clearly reflected to improve transparency. For future reviews of the NDC, national communications and the LT-LEDS, a clear statement on the methodology, values, formulas and any default values used will improve transparency, reporting and planning for emissions reductions.

Alamea Policy: strengthening existing policies

Priority should be given to identification of gaps in policy, duplication of policy, lack of enforcement and the need to connect policies across sectors, where relevant. Current examples include duplication in urban planning processes, transport policy linked to energy policy (via the TERMPLUS) and the mainstreaming of policies into corporate, sector and annual plans. Low enforcement can be the result of limited human resources and equipment. In the development of the LT-LEDS it is important to avoid re-phrasing existing policies and all sector intervention actions will consider existing policies that can be built on.

Image: A boat during low tide, in the intertidal zone on the coast of Manuka, Tongatapu. Taken in 2021.

5 CLIMATE RESILIENCE & ADAPTATION

5.1 NATIONAL CONTEXT: CLIMATE CHANGE IMPACTS IN TONGA

Tonga faces near and long term exposure to the negative impacts of climate change and natural disasters. Tonga was ranked the second highest disaster risk country globally, according to the World Risk Report in 2020 (Bündnis Entwicklung Hilft, 2020). Tonga's future climate will see annual mean temperatures and extremely high daily temperatures continue to rise; ocean acidification is expected to continue and tropical cyclones are projected to be less frequent but more intense.

Temperature and Rainfall

Annual and wet season mean and minimum temperatures have increased in Nuku'alofa since 1949 (Pacific-Australia Climate Change Science and Adaptation Planning Program, 2013). Wet season maximum temperatures have increased at a rate of 0.15°C per decade and dry season minimum temperatures have increased at a rate of 0.13°C per decade over the same period. By 2030, under a very high emissions scenario, this increase in temperature is projected to be in the range of 0.4–1.0°C. Further, the 1-in-20-year maximum temperature for Nuku'alofa will increase by 1.5°C by 2050, though some climate models project an even greater rise of over 2°C (ADB, 2019).

Since the 1940s, there have not been clear trends in wet season or annual rainfall in Tonga. However, projections suggest that extreme rainfall days will occur more often and be more intense (Pacific-Australia Climate Change Science and Adaptation Planning Program, 2013). The same data shows that since the 18th century, the level of ocean acidification has slowly increased in Tonga's waters.

Sea Level Rise

With most settlements close to the coast, Tonga is particularly vulnerable to sea level rise. Satellite data collected by Tonga's Meteorological Service and Pacific-Australia Climate Change Science and Adaptation Planning Program, indicates that sea level has risen near Tonga by about 6 mm per year since 1993. This is larger than the global average of 2.8–3.6 mm per year. According to their very high emissions scenario, this rise in sea level is projected to be in the range of 7-17 cm annually, by 2030. However, research by ADB projects that sea level will rise by 24 35 cm by 2050 under the RCP8.5 scenario, and by 80325 cm by 2100 under the RCP8.5 scenario (ADB, 2019). The risk of inundation due to sea level rise is projected to remain relatively low until 2050. According to the ADB, the Sopu wetlands will continue to attenuate tidal heights and reduce coastal inundation from extreme high tides. The Sopu wetlands currently dampen the tidal range to around 30 cm. This effect is projected to continue out to 2050, and high tides will probably be only 10 – 15 cm higher than present. As sea levels rise, the dampening effect of the Sopu wetland on the tides will diminish, and risks from inundation will eventually impact most of the low lying areas of Nuku'alofa by 2090 under the RCP8.5 scenario. By this time, many houses will be completely inundated at high tide, and low lying areas may have to be abandoned.

Image (opposite page): Seawall along the village of Manuka in the Eastern district, Tongatapu. Taken in 2021.

5.2 EXISTING POLICIES FRAMEWORKS AND COMMITMENT TO CLIMATE ADAPTATION

Despite these challenges Tonga has demonstrated commitment to achieving a resilient Tonga by 2035.

The Tongan Strategic Development Framework (see Section 1.3) states 'Tonga is our inheritance and our wealth in the form of our people, our land, and our strong Christian and traditional values that underpin our culture. We have inherited this from our families. We must pass it on to our children in an improved condition.' (TSDF II, page 17).' This is supported by the complementing policies of the Tonga Climate Change Policy (TCCP, 2016) and JNAP2 (introduced in Section 1.3).

The LT-LEDS aligns with Tonga's key policies in regards to resilience and adaptation in the following ways:

Tonga Strategic Development Framework 2015-2025: the LT-LEDS vision and ambition supports a TSDF II National Outcome for 'A more inclusive, sustainable and effective land administration, environment management, and resilience to climate and risk'. In particular, sector pathways for Energy, Transport and Human Settlements align with the following Organisational Outcomes:

- Organisational Outcome 4.1: The LT-LEDS includes steps and actions to progress towards more reliable, safe, affordable and widely available energy services with the aim to increase use of renewable energy.
- Organisational Outcome 4.2: Actions under the Transport pathways support more reliable, safe and affordable transport services that are energy and environmentally efficient.
- Organisational Outcome 4.4: The Human Settlements pathways contains actions and measures to support more reliable, safe and affordable buildings and other structures, that consider disaster resilience and energy efficiency.
- Organisational Outcome 4.5: The process of developing the LT-LEDs enabled stakeholders to practice 'improved foresight' by employing futures thinking principles to consider Tonga's low emissions futures (See Chapter 2).

Tonga Climate Change Policy: the LT-LEDS contains actions that will support the delivery of targets under the TCCP, specifically its adaptation targets:

- Target 1: The AFOLU pathways inclusion of MPAS and SMAs supports the TCCP target that every coastal community has a special management area and protected coastal environment as a means to protect against sea level rise and storm surges.
- Target 2: The redesign of roads, buildings and other infrastructure so they are resilient to disasters is integrated into Transport and Human Settlement pathways through actions such as 'Human Settlements Action 2: Develop a disaster risk financing strategy to manage funds during disaster response' and 'Transport Action 3: Strengthening Road maintenance - Tanu Hala'.
- Target 3: Human Settlements pathways actions will support climate resilient homes, schools, and community halls, through actions such as 'Improve the climate resilience of housing and buildings' (Action 5).

JNAP2: the LT-LEDS supports the overall objectives of JNAP2, in particular, Objective 4 on designing and implementing on-the-ground actions that build a Resilient Tonga by 2035 at national, island and community levels, specifically against the following objectives:

- Objective 2: As JNAP2 seeks to implement a coordinated approach to research, monitoring and management of data and information, this will be supported by the LT-LEDS under the AFOLU pathway in Action 2 to improve coordination of public and private sectors to harmonise existing data collection.
- Objective 4: The LT-LEDs has specific actions to support climate resilient infrastructure under Energy pathways Action 2: Draft regulation and policy paper for infrastructure developed using green infrastructure standards.
- Objective 5: Seeks to secure and mobilise the required finances and resources to build a Resilient Tonga by 2035, which is supported under the Human Settlements pathway by Action 2: Develop a disaster risk financing strategy to manage funds during disaster response so that communities can access climate resilient infrastructure, and Action 3: Engage with donors and partners to source funds for infrastructure management and design, particularly on stormwater management and road design'. The Energy pathway also supports this objective through Action 6: Increase access to finance for the private sector to fund supply-side renewable energy, projects and green infrastructure.

Tonga's Second NDC: the LT-LEDS and the Second NDC are well aligned in terms of mitigation and adaptation, specifically the Second NDC's three adaptation targets have been integrated into the LT-LEDS in the following ways:

- 30 percent of land in Tonga utilised for agroforestry or forestry by 2025: integrated into the AFOLU pathway under Action 1 to strengthen Public Private Partnerships to drive requirements of organisations with the aim of sharing responsibility to promote best practices in agriculture and forestry.
- Prevent any permanent loss of land to rising sea levels on Tonga's four main islands (Tongatapu, Ha'apai, Vava'u, and 'Eua): This is supported by Action 9 under the AFOLU pathway to 'Strengthen and refine current policy on coastal protection'. This action will leverage traditional knowledge in plant selection for restoration of mangroves and replanting of foreshores.
- Maintenance of existing stocks of fish and other marine species through a commitment to expand the area covered by Marine Protected Areas (MPAs) and Special Management Areas (SMAs) to 30 percent of Tonga's Exclusive Economic Zone (EEZ): This will be supported through the establishment of an SMA association and ensure its maintenance through financial support and capacity (Action 5) with the purpose of expanding the number of MPAs and SMAs.

The TSDF II, TCCP and JNAP2 form a whole-of-Tonga approach to building resilience over the next decade. This approach aligns with international agreements, including the Paris Agreement under the UNFCCC, the Sendai Framework, the Montreal Protocol, the UN Sustainable Development Goals, the Small Island Developing States Accelerated Modalities of Action Pathway and the Framework for Resilient Development in the Pacific.

5.3 SYNERGIES BETWEEN MITIGATION AND ADAPTATION IDENTIFIED THROUGHOUT THE STAKEHOLDERS CONSULTATION PROCESS

The Government of Tonga has implemented a variety of adaptation measures to enhance climate resilience and to minimise the adverse impacts of climate change on the community, economy and our everyday lives.

The LT-LEDS is no different, with multiple co-benefits for adaptation and resilience identified in the process of developing sectoral pathways.

The following measures captures these synergies and cut across the sectoral pathways:

Improve productivity and diversity of agroforestry

The diversity of species within the agroforestry and woodlands-dominated landscape of Tonga is credited with helping to maintain the general health of plants and ecosystems (GOT, 2010b). Improving agroforestry and subsequent mixed production can also bring greater resilience, by increasing land productivity and efficiency in the use of water and other resources and protecting against soil erosion, as well as serving carbon sequestration objectives (IPCC 2014). However, stakeholders acknowledge efforts will need to be made to overcome dependency on imported foods and limited space in urban areas, and to assess the net effect on agricultural crops grown under agroforestry regimes.

Improving the productivity and diversity of agroforestry for food, fiber, and timber and increasing the standing stock (biomass) of trees in agroforestry systems will bring mitigation benefits by increasing the carbon stock of Tonga's soil and woody biomass. This action will also provide significant adaptation co-benefits for climate change adaptation and resilience. These include income generation and subsistence from productive species and commodities; maintenance of tree cover to protect and regenerate soil fertility and sources of freshwater; and revitalisation of well-adapted customary practices and associated traditional knowledge.

Active agroforestry systems also help minimise land tillage (especially repeated ploughing); restricts the slashing and burning of weeds; increases the use of mulching and composting materials; and minimises incidences of pest and disease infestation. A climate-smart approach to sustainable agroforestry will draw on local expertise and the experience of Tongan landholders in the growing and use of trees as part of their traditional agroforestry regimes. This will be enriched by the appropriate introduction of climate resilient crop varieties and practices based on best available scientific knowledge.

Expansion of Marine Protected Areas and Special Management Areas

The LT-LEDS supports Tonga's Second NDC with maintenance of existing stocks of fish and other marine species through a commitment to expand the area covered by MPAs and SMAs. SMAs will help prevent any permanent loss of land to rising sea levels on Tonga's four main islands, while MPAs will support the maintenance of the existing stocks of fish and other marine species.

This combination of measures will improve overall resilience by improving fisheries productivity and management, thereby boosting livelihood opportunities and incomes for local fishing communities and reducing vulnerability to food shortages. It is expected that they will also attract greater numbers of international tourists, with associated benefits for employment and economic growth. Stakeholders acknowledge that a common definition is required regarding what is included in MPAs and SMAs, along with support to communities and enforcement of permissible uses within the areas.

Reforestation as part of promoting best practices in agroforestry

Tonga has made strong commitments to reforestation, including planting one million trees under its Second NDC. These additional trees will increase Tonga's mitigation potential. They will also deliver adaptation and resilience benefits by improving the health and biodiversity of Tonga's ecosystems, reducing exposure to extreme weather events, protecting waterways, improving soil structure, avoiding erosion and protecting against flooding. If reforestation is implemented with mixed production systems, this will increase land productivity and efficiency in the use of water and other resources.

Stakeholders noted that forestry officers need to better quantify the costs and benefits of trees, including assessing the benefits of mixed production. In addition there is a need to utilise local experts within MAFF and other partners to carry out this field research and determine potential tree species, tree-crop associations, tree/crop-soil categorisation, species selection, soil preparation techniques and management techniques. Landowners should be engaged in a participatory manner in order to generate ownership of these approaches and technologies from the outset. The proposed community nurseries will allow communities to actively take part in the national reforestation efforts.

Enhance home gardening

Tonga seeks to expand production and improve the productivity of home gardens, including household agroforestry, with particular attention to home gardens managed by women, to produce multiple vegetable crops for household consumption. The intended result is increased productivity and local income, increased food production at the household level and increased land productivity and efficiency in the use of water and other resources, to protect against soil erosion as well as serve carbon sequestration objectives. Unnecessary burning of organic wastes will be prevented through the use of mulching and composting techniques, where locally-made organic fertilizer will be available at home. In addition, home gardens help women plant trees of social, cultural and economic value, such as the paper mulberry for feta'aki (tapa cloth) making. All these outcomes will represent co-benefits from the perspective of climate change adaptation and resilience, in addition to the mitigation effects of protection of soil organic matter and increased plant biomass in home gardens.

Co-benefits of energy interventions

A number of energy interventions in Tonga's sectoral pathways will bring adaptation and mitigation benefits. For example, demand response systems can help keep a power grid stable by balancing electricity supply and demand. This stability will mean resilience and reliability during natural disasters and other disruptions. Likewise, the introduction of battery storage will bring grid stability, though stakeholders noted the need for proper disposal of batteries lest they cause negative environmental impacts. Further, fulfilling new and existing renewable energy targets will bring more energy to the grid and reduce Tonga's reliance on imported fuels. However, not all renewable energy is cyclone proof, so stakeholders suggest consideration should be given to a mix of renewable options, alongside careful placement.

Other energy conservation measures should bring adaptation and resilience co-benefits. For example, in order to implement building standards for energy efficiency, a review of the building code will be required. This will provide an opportunity to ensure that new constructions are well-engineered to withstand the worsening effects of tropical cyclones. Tonga also seeks to improve street lighting through LED lamps, which will reduce energy consumption and increase safety and pedestrian access. However, stakeholders noted that consideration needs to be given to the correct light-spectrum to ensure new LED lighting does not bring negative impacts to wildlife, such as the risk of nesting turtles being attracted to bright lights.

Impacts of EV uptake on transport and waste

Tonga is keen to encourage the uptake of electric vehicles, with Transport stakeholders suggesting the adoption of EVs for the government fleet. This will bring resilience during disasters as batteries enable Tongans to be better prepared and less reliant on imported fuels (the supply of which is often disrupted during tropical storms and cyclones), as well as saving money on imported fuel costs. However, the batteries needed for EVs may bring negative environmental impacts through leaching and contamination into soil and water. Stakeholders therefore stressed the need for due consideration to be given to safe and clean waste disposal.

Image: Mangroves at the Fanga'uta Lagoon along Havelu, Tongatapu.Taken in 2021.

Reduced waste production and sustainable waste disposal

The way in which Waste integrates with other sectors, as well as adaptation and resilience was given much consideration through the LT-LEDS development. Interactions include liquid waste, solid waste and the disposal of battery storage and EV batteries.

Proper collection of liquid waste (such as wastewater and fecal sludge) prevents runoff and water and soil contamination. This would result in adaptation and health co-benefits, particularly during storms and cyclones (when waste infrastructure can be damaged and septic tanks/pit latrines can overflow). Further, ad hoc solid waste can turn into debris during tropical storms and cyclones. Thus, the proper collection and sorting of solid waste can reduce the risk of marine, coastal and ecosystem pollution, thus serving as a co-benefit towards adaptation. In particular, Tonga's efforts to reduce single-use plastic and increase the use of local materials could lead to green job creation through traditional materials markets, the introduction of an alternative materials economy in Tonga and reduced dependence on imported goods.

Tonga's action on composting and returning organics to the land will also bring climate resilience and adaptation benefits. These include using compost as soil amendment to return valuable nutrients and carbon to land, while decreasing reliance on synthetic fertilisers; these are polluting to manufacture, import and use (including through the release of nitrous oxide), unhealthy and extremely expensive. Further, it can reduce soil erosion events that are higher during periods of intense rain; these will become more common due to climate change. It will also improve crop yields through the use of compost and improving moisture retention of soil (resulting in lower irrigation requirements). Finally, composting leads to improved soil conditions in areas degraded by climate change or industrial activities (e.g. mines, quarries and old landfill).

Resilient community infrastructure in human settlements across Tonga

With most Tongans living in an urban environment, human settlement interventions primarily aim to address climate adaptation and resilience objectives. For example, the introduction of Disaster Risk Reduction (DDR) remote sensing capabilities, specifically GIS and satellite imaging to create and map resilient community infrastructures by digitisation, will create access to resilient community infrastructure such as schools, churches and community halls. These facilities provide a dual purpose of social convening and as assembly areas during emergencies. Further, DRR remote sensing capabilities and enhancing information sharing with regional monitoring facilities will improve access to timely information for emergency evacuations, to the whole of Tonga's populations. Investing resources to regularly upgrade and maintain community infrastructure will ensure that climate resilient assembly facilities can keep communities safe during emergencies.

Upgrading roads to integrate stormwater drainage and improve road design will reduce flood risk in Tonga's urban areas and increase road resilience to flood damage. As rainfall becomes increasingly unpredictable, a number of measures could improve Tonga's water supply. These include revising the Resource and Supply Master Plan, centralising water supply systems (such as in villages), and amending legislation and policy. This will have a positive impact on Tonga's ability to adapt to water shortages resulting from climate change.

Finally the retrofitting of houses and other buildings that may be done for the purpose of energy efficiency should also be combined with disaster retrofitting. This would mean houses and buildings can withstand damaging winds and tropical cyclones and will improve Tonga's ability to prepare and manage disasters as they occur.

6 GOVERNANCE, MONITORING & REVIEW

Tonga is committed to co-ordinating processes for it's LT-LEDS and future NDCs, with the aim to bring alignment between long and short term actions, thereby avoiding duplication of efforts and allowing for regular exchange of information between the two documents. This alignment will occur under institutional arrangements, systems for monitoring and assessing progress, and revisions or review cycles.

Institutional

Tonga already has a preexisting institutional arrangement as a precondition for effective LT-LEDS and NDC alignment. The JNAP management structure will continue to oversee the implementation of the LT-LEDS and subsequent revisions of NDCs (see more on this cycle below). It is intended that the Mitigation Division will facilitate communication and exchange of critical information (e.g. data, projections, policy priorities) across teams and working groups, promoting the development of coherent and aligned policies and priorities for both the LT-LEDS and the NDCs. (See Annex B for governance arrangements).

The JNAP Secretariat has clear roles and responsibilities (see JNAP2 for full details), leading coordination and linkages between Parliament and Cabinet, the National Climate Change Coordination Committee, the National Emergency Committee, and the JNAP Technical Team. The Secretariat will advise the GOT on appropriate and effective policy responses on climate change issues, coordinate all climate change related activities and liaise with all ministries to ensure the implementation of mainstreaming into government plans, data and information management, capacity building and resilience building actions.

Measurement, Reporting and Verification (MRV) & Monitoring and Evaluation (M&E) systems

Tonga will use existing MRV and M&E systems in the context of review and revision cycles of both LT-LEDS and NDCs. Monitoring, measuring and evaluating progress of short-term action and NDC implementation can be useful to inform and readjust longer term strategies. Tonga will continue with MRV and M&E arrangements that are common to both the NDC and the LT-LEDS, through the NDC M&E Framework and JNAP2's Monitoring and Evaluation System Guide.[1]

The JNAP2 M&E system is designed to support and contribute to reporting towards the TSDF and NDCs. It is operationalised by the JNAP Secretariat and National Planning Division. The GOT remains committed to indigenous notions of data gathering, synthesis and learning, exemplified in the Kakala Learning Framework[2] which is at the heart of this M&E system.

Image (opposite page): Seedlings at the Forestry Division's (MAFF) nursery at Tokomololo, Tongatapu. Taken in 2020.

1 This document acknowledges that at the time of publication Tonga's Second NDC's Monitoring and Evaluation Framework 2021 was still being finalised. The Government of Tonga will seek to align the LT-LEDS M&E with that of the Second NDC.

2 Thaman, K. H. (2009). Towards cultural democracy in teaching and learning with specific references to Pacific Island Nations (PINs). International Journal for the Scholarship of Teaching and Learning, 3(2), 6

Review and revision cycles

Tonga plans to undertake regular review and revision of its LT-LEDS to ensure it remains strategic and relevant, and reflective of changing national circumstances. Changes in national, regional and global context and macroeconomic trends e.g. rapid cost declines in certain mitigation technologies, may require LT-LEDS assumptions and decisions to be reconsidered. Information from the MRV and M&E systems may also prompt Tonga to reconsider or adjust the LT-LEDS and its sector pathways if they are not achieving the desired outcomes.

Tonga will update its LT-LEDS in line with the five-year cycle of review under the provisions of the Paris Agreement. Thus subsequent NDCs and LT-LEDS will be updated in a single coordinated manner, encouraging alignment of near-term policy, planning and targets with long-term sectoral pathways. Participatory engagement on NDC enhancement and LT-LEDS will be held jointly with stakeholders, and the associated resources required will be streamlined. This coordinated review and revision will occur under the same government entity, Department of Climate Change, further maximising synergies between NDCs and LT-LEDS.

Figure 2. Proposal for harmonised revision cycles of Tonga's NDCs and LT-LEDS

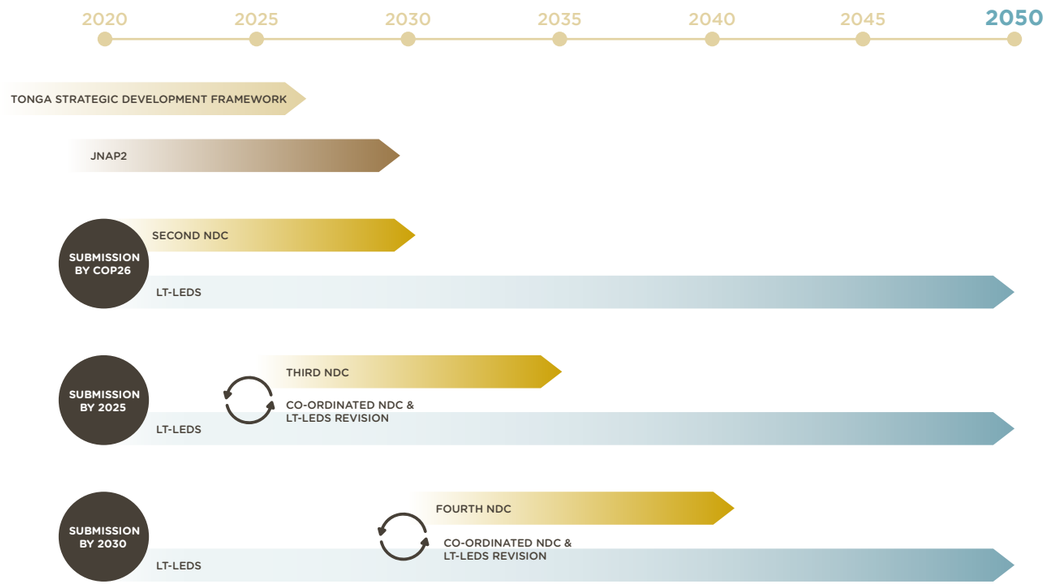


Image (opposite page): Aerial view of the city of Nuku'alofa, Tongatapu at dawn. Taken in 2021.

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ANNEX A. CONSULTATION LIST

The following participants participated in Tonga's long-term low emission development strategy process by attending one of the 3 workshops (October 2020, February 2021 and July 2021) or contributing to virtual stakeholder consultations (April - May 2020) and the validation workshop (October 2021). We thank them for their invaluable participation and feedback.

FIRST NAME	LAST NAME	ORGANISATION	ORGANISATION TYPE
Cardinal Mafi		Roman Catholic Church in Tonga	FBO
'Inoke	Kupu	Church of Jesus Christ of Latter-day Saints	FBO
Mele	Moimoi	Tonga National Council of Churches (IDRIT Project)	FBO
Salote	Sakalia	Caritas Tonga	FBO
Malialosa	Tapueluelu	Caritas Tonga	FBO
Keasi	Pongi	Civil Society Forum of Tonga	CSO
Emele	Latu	Civil Society Forum of Tonga	CSO
Timote	Lomu	Civil Society Forum of Tonga	CSO
Olive	Mafi	Tonga Youth Employment & Entrepreneurship (TYEE)	CSO
Vesta	Guttenbeil	Tonga Youth Employment & Entrepreneurship (TYEE)	CSO
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Vanessa	Lolohea	Tonga National Youth Congress	CSO
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Paula	Taumoepeau	Tonga Chamber of Commerce & Industries	CSO
Sam	Vea	Tonga Chamber of Commerce & Industries	CSO
Carrie	Vaea	Tonga Chamber of Commerce & Industries	CSO
Crystal	Ake	Mordi Tonga Trust	CSO
Timote	Laume	Live & Learn Tonga	CSO
Lola	Tonga	Waste Authority Limited	SOE
Nikolasi	Fonua	Tonga Power Limited	SOE
Pesa	Tohi	Tonga Power Limited	SOE
Seti	Chen	Tonga Power Limited	SOE
Talo	Fonua	Tonga Power Limited	SOE
Vahid	Fifita	Tonga Power Limited	SOE
Andrew	Kautoke	Tonga Power Limited	SOE
Quddus	Fielea	Tonga Water Board	SOE
Evaleti	Fuapau	Tonga Water Board	SOE
Norma	Lavemai	Tonga Airports Limited	SOE
Andrew	Niukapu	Ports Authority Tonga	SOE
Mefilina	Tohi	National Reserve Bank of Tonga	SOE
Seneti	Lasike	National Reserve Bank of Tonga	SOE
Siosiua	Talanoa	Friendly Islands Shipping Agency	SOE
Ifalemi	Ma'u	Pacific Energy	Private
Jesse	Tikomailepanoni	TOTAL Limited	Private
Dean	Corpuz	TOTAL Limited	Private
Lopeti	Palu	Raeworx Limited	Private
Akesa	Ahokava	Raeworx Limited	Private
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Hemaloto	Tupou	Marine Ports Division, MOI	Government
Tevita	Lavemai	Land Transport Division, MOI	Government
Peni	Fa'aui	Buildings Division, MOI	Government
Roki	Fatiaki	Buildings Division, MOI	Government
Hepi	Oko	Land Transport Division, MOI	Government
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'Atelaite	Palu	Ministry of Infrastructure	Government
'Otile	Talanoa	Ministry of Infrastructure	Government
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Viliami	Tongamana	Ministry of Health	Government
Tevita	Faka'iloatonga	Ministry of Health	Government
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Posevima	Havea	Department of Climate Change	Government
Akesiu	Fifita	Department of Climate Change	Government
Loiloi	Latu	Facilitator	Government
Lilu	Moala	Department of Climate Change	Government
Elenoa	Maile	Department of Climate Change	Government
Mary	Tuila	Department of Climate Change	Government
Star	Pau'u	Facilitator	Other
Inoke	Taufa	Facilitator	Other
Taniela	Hoponoa	Technical Expert	Other
Richard	Kautoke	Technical Expert	Other
Polikalepo	Kefu	Facilitator	Other
Katrina	Ma'u Fatiaki	Facilitator	Other

ANNEX B. PROCESS GOVERNANCE

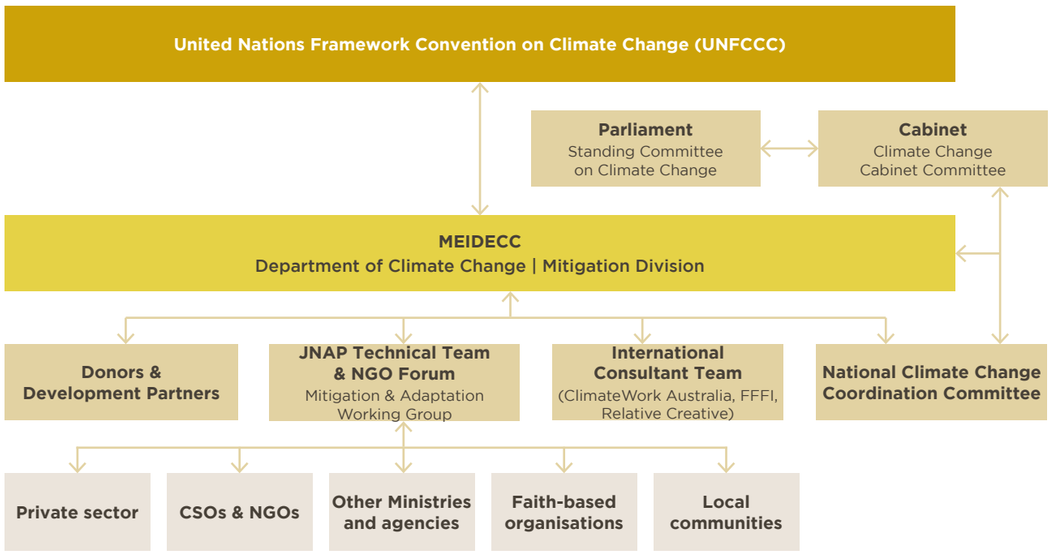
The LT-LEDS was developed by a project team made up of key officials from Tonga's Department of Climate Change from MEIDECC and staff from ClimateWorks Australia, GGGI and Relative Creative:

- **The Department of Climate Change's Mitigation Division at MEIDECC** was responsible for overall coordination, arranging and conducting all meetings and workshops with stakeholders including government and civil society (see Annex A for full list of consulted stakeholders), reviewing and revising workshop reports, providing guidance to international team on cultural concepts, protocols and sensitivities, providing illustrations and core concept for document design, final reviewing of the overall document, as well as consultations with development partners.
- **ClimateWorks Australia** had primary responsibility for overall project management, ensuring the team understands work assigned and timelines, and managing grants and contracts.
- **GGGI** was responsible for technical pathways analysis and advice on strategies and policy.
- **Relative Creative** led on the design of the workshops, support for facilitators and professional visual communication design of product outputs.

Governance and project oversight was provided by the existing JNAP Technical Team, a group of high-level Tongan officials with the mandate to provide high level guidance to the JNAP Secretariat, advise the National Climate Change Coordination Committee (NCCCC) on technical matters relating to JNAP2 and liaise with all Ministries.

The Project Team prepared the LT-LEDS draft for approval by the Tongan government. The JNAP Technical Team and Technical Working Groups reviewed, validated and finally endorsed the document. After approval and recommendation from the Director of Department of Climate Change, the CEO of MEIDECC and the Minister of MEIDECC, the LT-LEDS was submitted to Cabinet for approval in November, 2021. The Government of Tonga submitted its LT-LEDS to the UNFCCC in November, 2021.

Figure 3. Institutional Arrangements for LT-LEDS Development



ANNEX C. RELEVANT LEGISLATION AND POLICY

National

- Tonga Strategic Development Framework (TSDF II, 2015-2025)
- Tonga Climate Change Policy (TCCP, 2016)
- Joint National Action Plan 2 Climate Change and Disaster Risk Management, 2018 -2028 (JNAP2)
- Tonga's Second Nationally Determined Contribution (NDC, 2020)
- Third National Communication (TNC, 2019)
- National Women's Empowerment and Gender Equality Tonga Policy and Strategic Plan of Action 2019-2025

Energy

- Renewable Energy Act (2008)
- Electricity Act (2007)
- Petroleum Act (1959)
- Tonga Energy Road Map 2010-2020 (TERM)
- TERM-PLUS Framework
- Tonga Energy Efficiency Master Plan (TEEMP)

Transport

- Tonga National Infrastructure Investment Plan (NIIP II) 2013 -2023

AFOLU

- Tonga Agriculture Sector Plan (TASF) 2016-2020
- Tonga Forestry Act 2016
- Tonga National Forest Policy (TNFP) 2009
- Code of Practice for Sustainable Management of Forests 2010
- Tonga Fisheries Sector Plan 2016-2024
- Management Plan for the Forests and Tree Resources of Tonga 2017
- Agricultural Commodities Export Act 2002
- Animal Disease Act 1979
- Birds and Fish Preservation Act 1915
- Copra Act 1926
- Food Act 2014
- Markets Act 1976
- Noxious Weeds Act 1917
- Pesticides Act 2002
- Plant Quarantine Act 1982
- Pounds and Animals Act 1918
- Rhinoceros Beetle Act 1912

Waste

- Waste Management Act (2005)
- Environmental Management Act (2010)
- Environment Management (Litter and Waste Control) Regulations (2016)

Human Settlements

- Tonga National Infrastructure Investment Plan 2020-2030 (NIIP 3)

TONGA LEDS

Department of Climate Change
Ministry of Meteorology, Energy, Information, Disaster Management, Environment, Climate Change and Communications (MEIDECC)

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