OFFICE OF THE PRIME MINISTER

COOK ISLANDS TECHNOLOGY NEEDS ASSESSMENT REPORT

Cook Islands Climate Mitigation Technologies

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UNEP

CTCN
CLIMATE TECHNOLOGY CENTRE & NETWORK

UNEP DTU PARTNERSHIP

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CLIMATE CHANGE COOK ISLANDS
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Foreward

BY THE DIRECTOR, Wayne King

Kia Orana,

Technology is playing an ever increasing role in addressing climate change, whether it relates to mitigating, reducing emissions of greenhouse gases going into the atmosphere, or adapting to the increasing impacts of climate change. There are no boundaries in these circumstances. Countries are bound by being a part of the international community and are fully aware that in their own jurisdictions they have to undertake action.

While the Cook Islands is a very small member of the international community; it needs to understand and respond to climate change, within the same frameworks as much larger members. In addition the country has highlighted at the highest level our concerns and the lack of effort by some in this regard.

The Technology Needs Assessment (TNA) is a small slice of the effort the Cook Islands is making to address the overall impacts of climate change. It is not an isolated set of activities, strategies or plans. Rather, it is a set of distinct and strongly linked areas of consultation, planning, and foresight. This takes the TNA into the midst of design and development within a much larger sphere of work.

The TNA is the first step toward identifying relevant and appropriate technologies the Cook Islands can eventually utilise within its own development paradigm – one where climate change is overlaying development priorities. How can this be achieved, and for what gain?

The Cook Islands has been designated as a direct accredited entity to the Green Climate Fund and to the Adaptation Fund --both being multilateral finance mechanisms under the UN Framework for Climate Change and its Paris Agreement. Currently, the Cook Islands is at the stage of preparing a larger scale programme which will incorporate the identified technologies, and their uptake, through a set of barrier analysis. This will comprise of technical, financial, and policy constraints needed for the larger proposal to proceed. Which is in essence, all of the factors that is the enabling environment for the technology to succeed as a measure of its benefit to all in-country.

The TNA is the first step toward implementing the identified technologies, and is already mainstreamed into the development of our larger scale programmes -for which we are seeking the financial resources to prepare and then implement the programme across the entire country.

I commend the efforts of all those involved toward this end, and believe we will succeed in defining our own circumstance and eventual implementation in a structured and cohesive manner.

Acknowledgements

The Director of Climate Change would like to acknowledge the contribution of all public and private stakeholders from different sectors who were involved in preparing and finalising the Cook Islands Technology Needs Assessment report.

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Finally, special mention to Dr Christina Newport of Akairo Consulting and Mr Raymond Newnham of Ora Moana Ltd who prepared the final Cook Islands TNA Mitigation and Adaptation assessment reports.

This report has been prepared for the Government of Cook Islands, coordinated by the Office of the Prime Minister with funding from GEF through UNEP.

List of Acronyms

AIT	Asian Institute of Technology
CCCI	Climate Change Cook Islands
CIGov	Cook Islands Government
CIGT	Cook Islands General Transport Ltd.
CIREC	Cook Islands Renewable Energy Chart
COP	Conference of Parties
CTCN	Climate Technology Centre and Network
GCF	Green Climate Fund
GEF	Global Environment Facility
GHG	Greenhouse Gas
GHGI	Greenhouse Gases Inventory
Eq.	Equivalent
EVs	Electric Vehicles
ICI	Infrastructure Cook Islands
INDCs	Initial National Determined Contributions
IP	Implementation Plan
INDCs	Intended Nationally Determined Contributions
IPCC	Intergovernmental Panel on Climate Change
JNAP	Joint National Action Plan
kt	kilotons
MCA	Multi-Criteria Analysis
NDCs	Nationally Determined Contributions
NSDP	National Sustainable Development Plan
OPM	Office of the Prime Minister
POPs	Persistent Organic Pollutants
PS	Public Service
PV	Photovoltaic
RE	Renewable Energy
REC	Renewable Energy Chart
REDD	Renewable Energy Development Division
SNC	Second National Communication
SDGs	Sustainable Development Goals
SPREP	Secretariat of the Pacific Regional Environment Programme
TAP	Technology Action Plan
TAU	Te Aponga Uira
TNA	Technology Needs Assessment
TNC	Third National Communication
TWG	Technical Working Group
UDP	UNEP DTU Partnership
UNFCCC	United Nations Framework for the Convention of Climate Change
USP	University of the South Pacific

Executive Summary

This report presents the mitigation technology needs assessment and prioritisation processes along with the results for priority sectors for Cook Islands.

The aim of the Technology Needs Assessment project is to support Cook Islands to develop possible technologies for mitigating emissions- more so in accordance with their obligations under the United Nations Framework Convention on Climate Change (UNFCCC). Cook Islands has been a party to the UNFCCC since 1993.

The Climate Change Technology Center and Network (CTCN) and Technology Executive Committee (TEC) form the technology mechanism of the UNFCCC. CTCN aims to strengthen networks with countries, and collaborate and build capacity to accelerate climate technology transfer.

Cook Islands is in the South Pacific Ocean, between Tonga to the west, Kiribati to the north and French Polynesia to the east. Cook Islands has 15 islands with a total land area of 240 km2, spread across 1.97 million square kilometres of ocean. It has two main groups; the northern group consisting of seven atolls and the southern group, comprising eight volcanic and almost atoll-like islands. Of the 15 islands, 12 are inhabited and three uninhabited.

Cook Islands is active with implementing climate activities and it puts great effort to create an enabling environment for the activities to be carried out. The country is strengthening its policies and financial systems to administer project funding and facilitate future use of climate financing. More so, government and non-government agencies are incorporating and mainstreaming climate change in its policies and plans.

Forming the Cook Islands Climate Change (CCCI) office within the Office of the Prime Ministers (OPM) has heightened the importance of the country's climate change response.

The main contributions of Cook Islands in this Technology Needs Assessment report are the following:

- Identifying possible technologies for priority sectors
- Collaborating with government, private sector and relevant stakeholders on existing mitigation projects
- Prioritising technologies which are consistent with national goals, priorities and aligning with national policies
- Identifying barriers that prevent preferred technology, implementation and dissemination, and facilitate access to and transfer environmentally sound technologies

Technology prioritisation is the first step in the TNA project. This is implemented by applying the methodology proposed by the UNFCCC and UNEP/DTU partnership. The Technology

prioritisation is designed to elaborate possible mitigation technologies for climate change, stakeholder engagement, capacity building, and technology prioritising according to the developed criteria.

Technology fact sheets were created by the mitigation experts. Further consultation with relevant stakeholders was held whereby a Multi-Criteria Analysis (MCA) was carried out and two technologies for mitigation were identified.

Priority sectors as agreed by the TNA team and stakeholders are the land transport and waste sectors.

Priority technologies for the Land Transport sector include:

- Public service passenger vehicle fleet with electric vehicles (EV) for cars, scooters & passenger vans and vehicle pooling
- Establishment of workplace EV charge stations (government and private) for cars and bikes (generic hardware) smart chargers.

Solid Waste sector:

- Balers for preparing plastics and aluminum cans, hazardous waste for removal
- Establishing Pa Enua waste management disposal depots

SUMMARY AND CONCLUSIONS

The process for prioritising mitigation technologies and its response to climate change in the Cook Islands took into account multiple factors. The mitigation technologies selected for the next stage of the TNA process were revised using appropriate methodologies and confirmed by the CI TNA team; and technical groups consisting of Infrastructure Cook Islands (ICI), Ministry of Transport (MOT) and Te Aponga Uira (TAU).

CHAPTER 1 INTRODUCTION

1.1 About the TNA project

Technology Needs Assessment (TNA) is a set of country-driven activities leading to the identification, prioritisation and dissemination of environmentally-sound technologies for mitigation and adaptation to climate change. The TNA project is implemented through the Cook Islands Third National Communications (TNC) funded by the Global Environment Facility (GEF) through United Nations Environment Programme (UNEP). The technical support for TNA was provided by UNEP DTU Partnership in collaboration with University of the South Pacific (USP) and the Asian Institute of Technology (AIT). The funding for technical support delivered by UDP was provided by Climate Technology Center and Network (CTCN) and in-kind contributions were provided by Climate Change Cook Islands (CCCI) and Central Policy Planning Office (CPPO), Office of the Prime Minister (OPM), Cook Islands Government (CIG).

The TNA process is based around three main activities. These are

a) To identify and prioritise mitigation and adaptation technologies for selected sectors

b) To identify, analyse and address barriers hindering the arrangement and dissemination of the prioritised technologies, including the enabling framework for technologies;

c) To produce a Technology Action Plan (TAP). This can be a medium or a long term plan for the implementation of identified technologies.

Enhancing technology transfer for the mitigation of greenhouse gas emissions and adaptation to climate change through the TNA project is key to the Cook Islands response to climate change.

The Cook Islands Technology Needs Assessment Project (CI TNA) is based at the OPM. CCCI and CPPO co-coordinate the TNA project. The CI TNA team is the steering committee which includes two local experts. The team works with technical working groups in the selected sectors. The CI TNA team also consulted with relevant stakeholders in the whole process of the project.

Cook Islands joined the TNA project much later than other Asia/Pacific countries. In order to complete the necessary outputs within the larger projects scope and intended schedule, an ambitious approach was proposed. This included an 11-week schedule to carry out the steps of the TNA process and submitting a draft report in January 2020. As a result, the steps of the TNA process were modified to suit Cook Islands context and time demands.

1.2 Existing national policies on climate change mitigation and development priorities

MITIGATION & NATIONALLY DETERMINED CONTRIBUTIONS

Mitigation is defined as the human intervention to reduce the sources or enhance the sinks of Greenhouse gases (GHG) (IPCC, 2014). For Cook Islands, mitigation action is integrated with its sustainable development approach. Climate change and disasters are recognised as affecting the country's economic, social, environmental and cultural progress. In this regard, development strategies emphasise Cook Islands heritage and resilience as a large ocean state promoting low carbon economic development alongside social and environmental benefits.[1]

Several policies and plans are in place that contribute to mitigating the impacts of climate change and benefit the country's development trajectory. These include inter alia the:

1. Intended Nationally Determined Contributions (INDCs) 2015

2. Cook Islands Climate Change Country Programme 2018 – 2030

[1] Refer to Cook Islands Ministry of Finance and Economic Management website for further information.
http://www.mfem.gov.ck/development/development-programmes/national-programmes/327-climate-change

3. Cook Islands Climate Change Policy 2018 – 2028

4. Cook Islands Renewable Energy Chart 2012

5. Cook Islands Renewable Energy Chart Implementation Plans 2012 & 2016

6. Cook Islands Solid Waste Management Policy 2016 – 2026 and Strategies 2013 & 2017

7. JNAP II – Are We Resilient? The Cook Islands 2nd Joint National Action Plan (JNAP) – A sectoral approach to Climate Change and Disaster Risk Management 2016-2020.

A brief overview of each is set out below which provide direction on the objectives for the different sectors and inform the aim of the TNA and technology prioritisation.

1. Intended Nationally Determined Contributions (INDCs) 2015

The Cook Islands Intended Nationally Determined Contributions (INDCs) were developed in response to the commitments of the Paris Conference of Parties (COP) held in December 2015. The INDCs set conditional and unconditional targets in adaptation and mitigation which are fair and ambitious given the Cook Islands circumstances. The Cook Islands INDCs recognises that renewable energy and clean forms of transportation is a priority for reduction of GHG emissions.

It also contributes to ensuring energy self-sufficiency and security. Conditional Mitigation initiatives include:

- Storage for renewable energy
- Integration of energy efficiency and new technologies
- Technology transfer
- Strengthen capabilities for overall sustainability and co-benefits
- Reduce emissions from electricity generation by a further 43%, totaling an 81% emissions reduction by 2030 (relative to 2006)
- Low carbon transport technologies
- Incentives for transition towards clean energy transportation.

Mitigation through adaptation is also included in its INDCs. This is discussed separately in the TNA – Adaptation Report. Plans are underway in 2020 to review its INDCs as part of submitting an enhanced NDC as part of its Paris Agreement commitments.

2. Cook Islands Climate Change Country Programme 2018 – 2030

The Country Programme has built upon ongoing climate and development strategies in the Cook Islands which include the National Sustainable Development Plan (NSDP) 2016-2020; JNAP II – Are We Resilient? The Cook Islands 2nd Joint National Action Plan (JNAP) – A sectoral approach to Climate Change and Disaster Risk Management 2016-2020; Cook Islands Renewable Energy Chart 2016-2020; Intended Nationally Determined Contributions (INDCs) 2015; Second National Communication to the UNFCCC 2011; Cook Islands National Infrastructure Investment Plan 2015 – 2025; Individual Island Community Development Plans; Cook Islands State of the Environment Report 2017; Cook Islands National Biodiversity Strategy and Action Plan 2017-2021, and the Cook Islands Climate Change Policy 2018-28.

Key priority sectors for mitigation identified are electricity, transport, deforestation and land use change. Key challenges for mitigation action are access to finance, availability of appropriate low emission technologies to suit the Cook Islands context, and expertise in renewable energy and energy efficient technologies. The waste sector, including both solid and liquid, are also identified as a priority sector.[2]

[2] Refer to p. 10 of the CC country programme.

3. Cook Islands Climate Change Policy 2018 – 2028

The policy sets out "to further national goals through enhanced mobilisation of climate finance that contributes to low-carbon climate resilient development". The policy seeks to mobilise domestic and international climate finance resources to address Cook Islands climate change and national 12 development agenda, including the country's Intended Nationally Determine Contributions (INDCs) under the UNFCCC. It underpins the potential role that climate finance plays to support priority activities in key economic and environment sectors, as well as, the co-benefits of building social capital.

The objective is to:

> Facilitate activities in the climate change area that improve adaptation to and mitigation of, the impacts of climate change, to make the country more resilient.e private sector.

For mitigation, policies seek to:

- Promote a low carbon development approach towards development goals and Sustainable Development Goals (SDGs)
- Achieve 100% renewable energy generation in all islands by 2025
- Achieve 100% energy efficiency across the country by 2025
- Confirm a zero emissions target for Cook Islands by 2040.

4. Cook Islands Renewable Energy Chart 2012

The Cook Islands Renewable Energy Chart (CIREC) 2011 was the main document for climate change mitigation efforts. The Renewable Energy Chart (REC) was built on Cook Islands' aim to reduce its carbon emissions in line with the country's commitment to the Kyoto Protocol. The REC outlined how Cook Islands would achieve the goal of a national electricity generation system powered totally by renewable energy. This would equate to a reduction of 34% of national emissions based on 2006 levels.[3]

5. Te Atamoa o te Uira Natura - Cook Islands Renewable Energy Chart & Implementation Plans 2012 & 2016

In giving effect to the REC, the plan recognises the full benefits of investing in Renewable Energy (RE) sources for generating electricity. To implement the comprehensive set of actions laid out in the Implementation Plan (IP), the Cook Islands Government (CIG) will continue to exert strong leadership. The current institutional frameworks are considered appropriate for the scale of undertaking, with some minor legislative changes proposed. However, it will be challenging to align all stakeholders' priorities.

Also there needs to be a preparedness to alter roles and responsibilities should performance targets not be achieved.

The REC and IP were updated in 2016 and continues to guide all stakeholders. The RE policy goal of the REC is focused on measuring progress on the accessibility, use and composition of energy, as well as transport. While much progress has been made in RE electricity generation, unsustainable transport remains a crucial issue. This is due to the size of the Cook Islands territory, remoteness and widely dispersed islands. Frequent and reliable linkages between islands and further afield is essential to the economic, social, environmental security needs of the country. Consumer demand is also a factor.

This IP continues to serve as a guiding government document for actions and for development partners to support. As technologies, costs and demand for electricity, and sources of financing change over time, it is envisioned that the IP will be periodically updated to take these factors into account. IP is aligned with the policy targets and metrics articulated in the National Sustainability Development

[3] Cook Islands Intended Nationally Determined Contributions, Fig One, Page 1.

Plan (NSDP) particularly goal 6: Ensure access to affordable, reliable, sustainable, modern energy and transport.

Responsibility for the implementation of the CIREC rests with the Energy Commissioner. The Renewable Energy Development Division (REDD) has the overarching role in developing strategic directions and approval for proposed RE plans, ensuring funding and resources to complete the programme, and responsibility for monitoring and oversight. State owned electricity supplier, Te Aponga Uira (TAU) performs a substantial role in the detailed planning and practical implementation of the CIREC.

6. Cook Islands Solid Waste Policy 2016 – 2026

The vision of this policy is '*an informed and proactive community taking responsibility for sustainable solid waste management, aspiring towards Zero Waste Cook Islands'*. The policy recognises the challenges the Cook Islands faces in managing solid waste due to regulatory and institutional limitations, prohibitive transport and related infrastructure costs as well as poor management practices.[4]

The policy draws attention to the climate change threats to human and environmental health due to hazardous substances. Risks from toxic substances contained in, or produced by the degradation of waste not disposed of appropriately, are identified.[5]

The policy argues that 'global warming, as a result of climate change, has been shown to increase Persistent Organic Pollutants (POPs) emissions and concentrations. Extreme weather events that cause flooding trigger secondary emissions of POPs in agricultural lands and storage sites'. Furthermore, climate change is also predicted to increase precipitation - impacting on landfill management. The increase of leachate from precipitation is a real threat to the surrounding environment including the lagoon.[6]

Associated with this policy is the National Solid Waste Management Strategy 2013 – 2016 and the updated 2017 – 2021 strategy.

Solid waste defined under the Public Health Act 2004 includes:

a) Garbage, refuse, or litter

b) Hazardous waste

c) Medical & bio-waste

d) Building and demolition waste

e) Other discarded or superfluous things industrial, commercial, mining, agricultural, community, or other activities

f) That is not of a liquid or gaseous nature in its raw form.

However, 'liquid or gaseous waste' that contains persistent organic pollutants and heavy metals are classified as hazardous waste so are included in this strategy.

[4] 4 Refer to P. 2 of the Solid Waste Management Policy 2016 - 2026

[5] Refer to P.4. as above

[6] Refer to P. 4 Solid Waste Management Policy 2016 - 2026

7. JNAP II – Are We Resilient? The Cook Islands 2nd Joint National Action Plan (JNAP) – A sectoral approach to Climate Change and Disaster Risk Management 2016-2020

Strategy 6: Energy and Transport of the JNAP sets out actions and sub-actions in order to promote sustainable RE, energy security, energy efficiency and safe energy storage and transportation.

TABLE ONE. SUMMARY OF JNAP ACTIONS AND SUB-ACTIONS

Action 20: Promote energy efficiency, low carbon development and conservation to reduce GHG emissions	
Sub Actions	**Outputs**
a. Develop legislation and policy to guide and enforce energy efficiency (transport, public buildings, electricity supply) and energy efficiency standards (electrical goods) e.g. review vehicle and electrical goods importation policy. **b.** Develop and implement public awareness programmes and education programmes on transport, energy use, electricity use and conservation. **c.** Establish mechanisms and parameters for offsetting transport and energy (e.g. aviation and shipping) related carbon emissions produced by the industry e.g. reforestation and green policies. **d.** Undertake a greenhouse gas inventory at least every five years. **e.** Conserve and sustainably manage forests, coasts, wetlands, lagoons and other natural ecosystems to enhance carbon uptake. **f.** Develop and promote programmes and training to support low carbon development and the reduction of greenhouse gases.	• NSDP Indicator 11.1. • NSDP Indicator 11.2. • Decrease in GHG emissions per capita.

1.3 Sector selection

Sector contributions to GHG emissions in the Cook Islands are drawn from the GHG inventory report for the Third National Communication (TNC) 2019. The selection of climate change mitigation priority sectors is primarily determined by the relative contributions of different sectors and sub-sectors of GHG emissions in Cook Islands.

A starting point in selecting sectors for climate technologies drew upon the recently completed Cook Islands Climate Change Country Programme 2018 – 2030 which identified key sectors for mitigation. These are electricity, transport, deforestation and land use change. The fundamental challenge to mitigation interventions are access to finance, availability of appropriate low emission technologies to suit Cook Islands context and expertise in renewable energy and energy efficient technologies.

The Cook Islands Greenhouse Gas Inventory (GHGI) and mitigation report for the TNC 2019 identified five options for sectors to focus mitigation. These include the: Energy sector – electricity, energy efficiency and transport; Agriculture and Waste sectors.

These reports concluded that in the energy sector, the electricity sub-sector has been well covered given substantial progress in converting to solar Photovoltaic (PV) hybrid systems in the Pa Enua. The Rarotonga grid remains problematic with the need for large amounts of funding to be secured and substantial storage introduced to the required scale. Energy efficiency was also considered to be well covered as part of the Cook Islands OPM Renewable Energy Development Division (REDD) initiatives. Further funding is required to provide energy audits for industry and commercial sectors and provide training programmes for energy auditing.

Attention to land transport remains an outstanding sector attention alongside the waste sector and agriculture.

1.3.1 An overview of sectors, projected climate change, and GHG emissions status and trends of the different sectors .

GHG EMISSIONS STATUS AND TRENDS

The GHGI (Lloyd & Subbarao, 2019a) shows that overall, the Cook Islands main GHG emissions comprised carbon dioxide from the energy sector, with minor amounts of methane and nitrous oxide from agriculture and waste respectively.

Emissions were estimated to be around 73Gg per annum (73 thousand tonnes per annum) which remained reasonably constant throughout the reporting period, 2007 to 2014. For the Cook Islands 83% (average 2007 – 2014) were CO2 emissions, 10% methane, 4% N2O emissions and 3% other gases.

The Cook Islands' 73kt for around 18,000 persons works out at around four tonnes per capita or around 60% of the world average during the reporting period. In absolute terms the Cook Islands total CO2 eq. emissions were around 0.00014% of world emissions.

As an overview of GHG emissions by sectors, the figure below provides total GHG emissions trends for the energy, agriculture, waste and industrial processes and product use (IPPU) sectors from 2007 – 2014 (Lloyd & Subbarao, 2019a, p. 7).

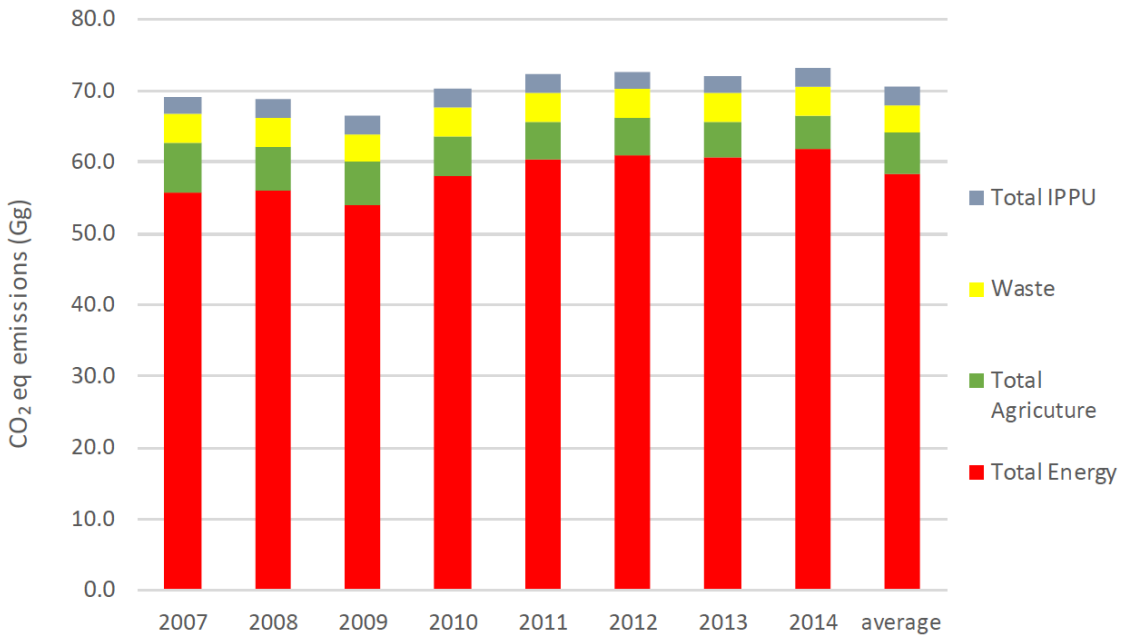

FIGURE 1: COOK ISLANDS TOTAL GHG EMISSIONS BY SECTOR (GG)

The sectors in Cook Islands with significant GHG emissions that make up 87% of total CO2 eq. emissions consists of land transport with 39%, electricity with 32%, and air transport and agriculture both with eight percent.

Figure 2 shows the GHG emissions by sector. The energy sector which is made up of transport, commercial, industrial and the electricity sub-sectors produce the most GHG emissions averaging 82% of total GHG emissions (Lloyd & Subbarao, 2019a, p.7).

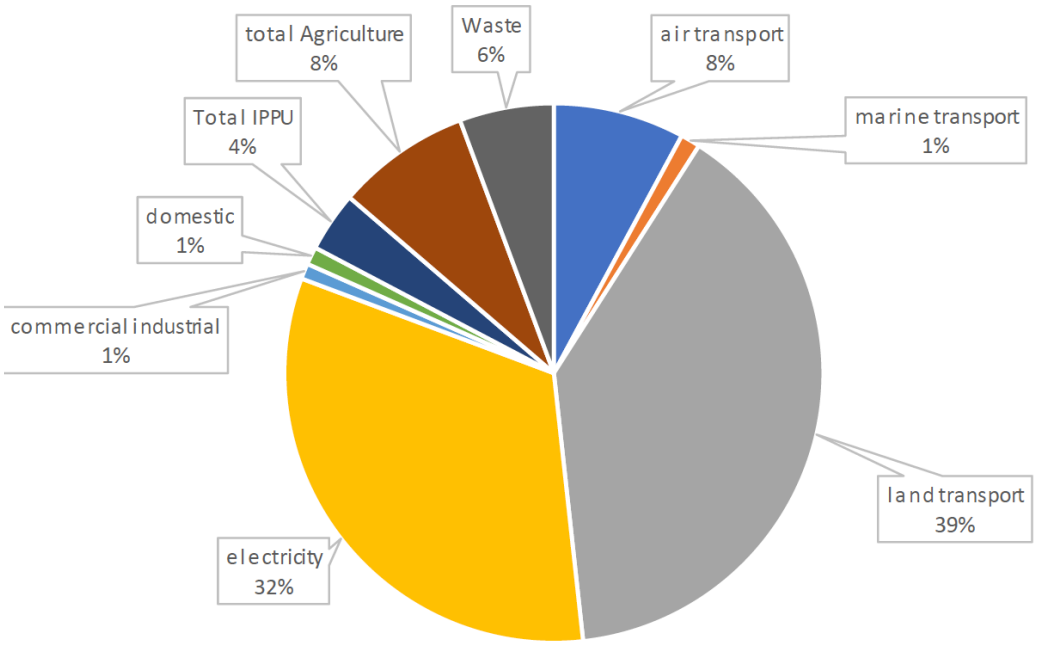

FIGURE 2: COOK ISLANDS GHG EMISSIONS BY SECTOR (AVERAGE 2007-2014)

Emissions by sector are discussed below. These include energy, industrial processes, agriculture, carbon dioxide removals (forestry) and waste.

Energy Sector

The table below shows that the key sources of emissions in the energy sector are land transport and electricity production with other sectors including domestic, commercial, industrial, sea and air transport making the balance. The sectoral breakdown does not change very much from year-to-year over the period 2007 to 2014.

TABLE 2: COOK ISLANDS ENERGY SECTOR GHG EMISSIONS (GG)

Cook Islands Energy GHG emissions (Gg)											
		2007	2008	2009	2010	2011	2012	2013	2014	average	% of sub sector
air transport		5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	9.5%
marine transport		0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	1.4%
land transport		24.8	25.2	24.0	26.7	29.1	30.3	30.3	31.4	27.7	47.4%
total transport		31.1	31.5	30.4	33.1	35.5	36.7	36.7	37.8	34.1	58.4%
electricity		23.3	23.1	22.3	23.5	23.3	22.9	22.5	22.4	22.9	39.2%
commercial industrial		0.6	0.6	0.6	0.6	0.7	0.7	0.7	0.7	0.7	1.1%
domestic		0.6	0.7	0.6	0.7	0.8	0.8	0.8	0.9	0.8	1.3%
Total Energy		55.7	55.9	53.9	58.0	60.3	61.1	60.7	61.9	58.4	100.0%

GHG estimates

GHG emissions for 2014 are provided in table 3 below.

TABLE 3: COOK ISLANDS ENERGY EMISSIONS 2006, (EMISSIONS ENERGY FRCA 2015)

2014	Cook Islands										
Sector	Energy										
Category	Fuel combustion activities										
Category Code	1A [a]										
Sheet	1 of 4 (CO_2, CH_4 and N_2O from fuel combustion by source categories – Tier 1)										
	Energy consumption					CO_2		CH_4		N_2O	
	A	B1	B2	B3	C	D	E	F	G	H	I
	Consumption	Conversion Factor[b]	Consumption Gg	Conversion Factor[b]	Consumption	CO_2 Emission Factor	CO_2 Emissions	CH_4 Emission Factor	CH_4 Emissions	N_2O Emission Factor	N_2OEmissions
	(Volume litres x 10^6)	Density (kg/litre)	B2=A*B1	(TJ/unit)	(TJ)	(kg CO_2/TJ)	(Gg CO_2)	(kg CH_4/TJ)	(Gg CH_4)	(kg N_2O /TJ)	(Gg N_2O)
					C=A*B		E=C*D/10^6		G=C*F/10^6		I=C*H/10^6
Liquid fuels											
land transport gasoline	7.619	0.74	5.64	44.3	250	69300	17	3	0.000075	0.6	0.000150
Other uses gasoline	0.381	0.74	0.28	44.3	12	69300	1	3	0.000004	0.6	0.000007
Total Motor Gasoline	8.000		5.92	44.3	262	69300	18	3	0.000079	0.6	0.000157
Aviation Gasoline	0.004	0.73	0.00	44.3	0	70000	0	3	0.000000	0.6	0.000000
Aviation Kerosene	2.174	0.81	1.76	44.1	78	71500	6	3	0.000023	0.6	0.000047
Total aviation	2.178		1.76		78		6	3	0.000023	0.6	0.000047
Domestic Kerosene	0.010	0.81	0.01	43.8	0	71900	0	3	0.000000	0.6	0.000000
Total Electricity	8.090	0.87	7.04	43	303	74100	22	3	0.000091	0.6	0.000182
On road land transport diesel	5.099	0.87	4.44	43	191	74100	14	3	0.000057	0.6	0.000114
Off road land transport diesel	0.255	0.87	0.22	43	10	74100	1	3	0.000003	0.6	0.000006
Marine transport	0.300	0.87	0.26	43	11	74100	1	3	0.000003	0.6	0.000007
Mining diesel	0.000	0.87	0.00	43	0	74100	0	3	0.000000	0.6	0.000000
Food processing diesel	0.000	0.87	0.00	43	0	74100	0	3	0.000000	0.6	0.000000
Other diesel	0.000	0.87	0.00	43	0	74100	0	3	0.000000	0.6	0.000000
Total Gas Diesel Oil	13.744	0.87	11.96	43	514	74100	38	3	0.000154	0.6	0.000308
Total land transport	12.718		10.07		441		31		0		0.000000
LPG autos	0.000			47.3	0	63100	0	1	0.000000	0.1	0.000000
Total transport	15.196	0.87	12.10	43.00	529.53	74100.00	37.84	6.00	0.00	1.20	0.00
LPG domestic											
LPG commercial				47.3	0	63100	0	1	0.000000	0.1	0.000000
LPG industrial				47.3	0	63100	0	1	0.000000	0.1	0.000000
Total LPG	0.000		1.50	47.3	71	63100	4		0.00		0.00
Total domestic	0.391		0.29		12.84		0.89		0.00		0.00
Total industry	0.255		0.22		10		1				0.000000
Total Commercial	0.000		0.00		0		0				0.000000
Total industry and commercial	0.255		0.22		10		1		0.000003		0.000000
Total	23.932		21		925		66		0.0003		0.0005

Industrial Processes and Product Use

There are no industrial emissions of GHG in the Cook Islands. Emissions are from lubricants and refrigerants – Hydrofluorocarbons (HFCs) only. Import data on lubricants from Customs imports for refrigerants was not deemed reliable to be reported in the 2019 GHGI.

Agriculture Sector

Methane emissions from enteric fermentation and manure management, is reported in the table below along with nitrogen (N2O) emissions from manure and livestock.

TABLE 4: COOK ISLANDS AGRICULTURE SECTOR GHG EMISSIONS (GG)

	SNC				TNC					Average
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2007-2014
Enteric fermentation	1430	1156	1135	1114	1093	1061	1051	1040	1030	1100
Manure management	2196	1979	1874	1769	1664	1505	1453	1400	1348	1600
N_2O from Manure	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible
N from livestock	3361	3261	3078	2895	2620	2528	2440	2352	2264	2700
Total CO_2 eq tonnes	7000	6400	6100	5800	5400	5100	4900	4800	4600	5400

Analysis shows the average emissions over the reporting period amount to around 5.4 Gg of CO2 eq. or around eight percent of total CO2 eq. emissions. The table above shows emissions have been declining over the reporting period of the GHGI.

Carbon Dioxide Removals (Forestry)
Forestry removals were not reported in the GHGI due to ongoing lack of data.

Projected Climate Change
Climate change projections for surface air temperature, sea surface temperature, aragonite saturation state, sea level rise and rainfall are given for three 20-year periods centred on 2030 (2020–2039), 2055 (2046–2065) and 2090 (2080–2099), relative to 1990 (1980–1999). See Annex 1.

These projections have been summarised in the table below from the TNC (CIGov, 2019).

TABLE 5: PROJECTED CHANGES OF CLIMATE ASPECTS IN THE COOK ISLANDS

Climate Aspects	Projected changes
Surface Air Temperature	Temperatures continue to warm with more extremely hot days in the future. Northern group to be slightly higher than in the Southern group. Night-time temperatures will also continue to increase.
Ocean Acidification (Aragonite saturation states)	To continue to increase and threaten coral reef ecosystem. This is likely to be compounded by other stressors including coral bleaching, storm damage, and nutrient loading, and fishing pressure.
Sea Level Rise	Sea level in Cook Islands has risen and will continue to rise throughout this century. By 2055 all models are predicting an increase of 10 to 30cm. Year-to-year variability will continue along with extreme sea level events. The sea level rise combined with natural year-to-year changes will increase the impact of storm surges and coastal flooding. As tropical cyclones are projected to become more intense, extreme sea level events linked to these may become more dangerous.
Sea Surface Temperature	Temperatures are projected to increase at a slightly lower rate to air temperatures. This rate of change is projected to be much faster than the 0.12°C per decade up to present. It is also predicted that coral bleaching will become an annual event rather than the 4-7-year cycles observed in the last few decades.[7]
Rainfall	Average annual rainfall not projected to change significantly, Rainfall patterns are projected to change over this century with more frequent and more intense extreme rainfall days. Rainfall may decrease in the dry season in the Northern Cook Islands. There is uncertainty around projected changes in the South Pacific Convergence Zone, so there is only low confidence in rainfall changes for the Cook Islands.
Tropical Cyclones	A decrease in the frequency of tropical cyclones by the late 21st century but a possible shift towards more intense categories. An increase in the average maximum wind speed of cyclones by between 2% and 11% An increase in rainfall intensity of about 20% within 100km of the cyclone centre.

Projected emissions

The quantitative emissions reductions recommended in the SNC suggested "a mitigation scenario is targeted that reduces growth in emissions every year by 0.5%. Under such a scenario GHG emissions would slightly increase until 2014 after which emissions start to drop off until they reach a level of 50Gg CO2 eq.in 2026, i.e. the scenario would result in a net reduction of GHG emissions compared to the 2006 levels" (Lloyd & Subbarao, 2019).

The figure below shows the scenario for GHG emissions from the recommended mitigation scenario (MS) compared to business as usual (BAU) and a high growth scenario (HG). The mitigation report for the TNC shows the actual emissions for the Cook Islands levelling off from 2007 until 2014 at around 73Gg and thus closely following the green line (MS) below (Lloyd & Subbarao, 2019, p.6).

Chart 6: Cook Island Scenarios for GHG Emissions

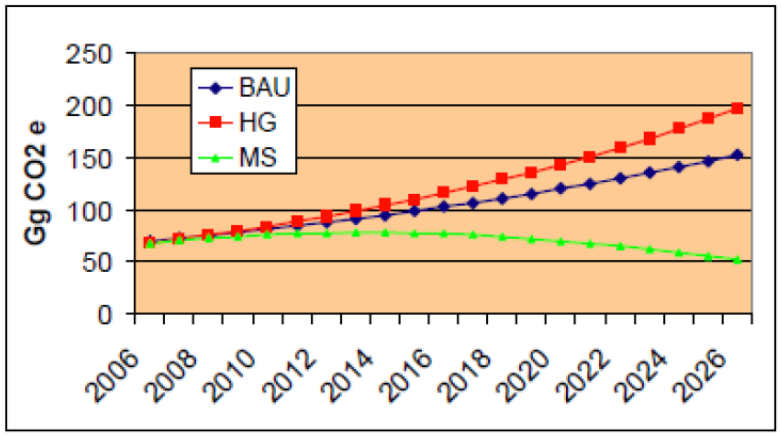

FIGURE 2: GHG EMISSIONS SCENARIOS

(Source: Zieroth, 2009)

Overall, the energy sector continues to be considered a main sector for mitigation opportunities that would not hinder development options. Waste can also be considered a priority sectors where emissions reductions together with other environmental benefits can be delivered.

1.3.2 Process and results of sector selection

The process for prioritising mitigation sectors took multiple factors into account. Firstly, considerations were given to alignment with the relevant policies and plans of the Cook Islands outline above. These were able to provide direction on priority actions.

The INDCs (CIGov, 2015) focused on sectors with high GHG emissions. The electricity and transport are high emitting sectors. The waste sector and particularly the Solid Waste sub-sector were identified as potential sectors. The results from the 2019 GHGI report for the TNC was also drawn upon to inform sector selection.

The rationale for selection also considered the current capacity needs and strengths of potential sector. This included the level of activity already underway in various sectors as well as the extent to which regulatory and institutional arrangements were in place to support the climate technology developments in each sector. The progress against RE actions already underway was also a consideration.

Deliberations on sector selection included some consultations with stakeholders. The TNA coordination team convened an expert panel of academics, mitigation and adaptation consultants (including those appointed for the TNA) and government representatives who met 31 October 2019 to consider sectors for the TNA.

TABLE 6: SECTOR SELECTION RATIONALE

Summary of Sector Selection Rationale	
GHG Emissions	Level of GHG emissions by sector
Policy direction	Mandate and direction provided by CCM related policies and plans
Enabling Framework	Regulatory and institutional arrangements in place
Capacity	Sector capacity needs and strengths
CCM/SD implementation	Progress made to date on implementing CCM related actions

Overall, the approach confirmed that the transport and waste sector were selected.

Based on the process and rationale above and taking into consideration time constraints, the two priority mitigation sectors prioritised for this TNA process are:

1. Energy Sector – Land Transport

2. Waste Sector – Solid Waste.

CHAPTER 2 INSTITUTIONAL ARRANGEMENT FOR THE TNA AND THE STAKEHOLDER INVOLVEMENT

2.1 TNA Institutional set up

The Cook Islands Technology Needs Assessment Project (CI TNA) is based at the Office of the Prime Minister. Climate Change Cook Islands (CCCI) and Central Policy and Planning Office (CPPO) co-coordinate the Technology Needs Assessment project. The core CI TNA team comprises of the National TNA Coordinators and two national consultants. The core CI TNA team works with technical working groups in the selected sectors. The CI TNA team also consulted with relevant stakeholders in the whole process of the project.

NATIONAL TNA CO-COORDINATORS

The Climate Change Cook Islands (CCCI) office designated Ms Rima Moeka'a and Ms Valentino Wichman as the TNA co-coordinators. Ms Rima Moeka'a is involved in national reporting for the climate change office and Ms Wichman is the director of CPPO and the senior policy expert.

The TNA co-coordinators are the focal points for the overall management and coordination of the TNA process. The TNA co-coordinators are responsible for facilitating, managing the project and most importantly communicate with national consultants, sectoral working groups, stakeholders, regional agencies and UDP.

NATIONAL STEERING COMMITTEE

The national steering committee is key in guiding the project. Members are to provide high level guidance to the national TNA team and are responsible for policy making. Their role includes providing guidance to the national team and assist in securing political acceptance for the Technology Action Plan (TAP).

The National steering committee consists of personnel from OPM, the ministries, private sector and key stakeholders.

NATIONAL CONSULTANTS

The lead national consultants were selected by CCCI and CPPO office, national TNA co-coordinators in close consultation with UDP following in-country processes, and an open and transparent selection process.

CCCI and CPPO selected Mr Raymond Newnham as the Cook Island TNA adaptation expert and Dr Christina Newport as the mitigation expert.

The adaptation and mitigation national experts are responsible for consulting relevant stakeholders; identifying and prioritising technologies for specific sectors; leading the process of analysing with stakeholders and sector working groups; participating in capacity-building workshops; working in close partnership with the national co-coordinators, sector working groups, and stakeholders; and preparing the TNA, BAEF and TAP reports

SECTOR WORKING GROUPS

The Climate Change Cook Islands office, at the suggestion of the co-coordinators and national consultants, established two working groups on mitigation technologies for transport and waste sector, and two working groups on adaptation technologies for agriculture and eco-system agriculture and coastal protection

The sectoral working group consists of representatives from the government ministries, private sector, academia, climate change experts and civil society.

[7] This is the Cook Islands Māori name given to distinguish all the other islands in the Cook Islands apart from Rarotonga

STAKEHOLDERS

The composition of stakeholders includes representatives of the government ministries, private sector, academia, climate change experts and civil society. The list of stakeholders are provided in Annex III.

The figure below is a schematic representation of the CI TNA institutional structure

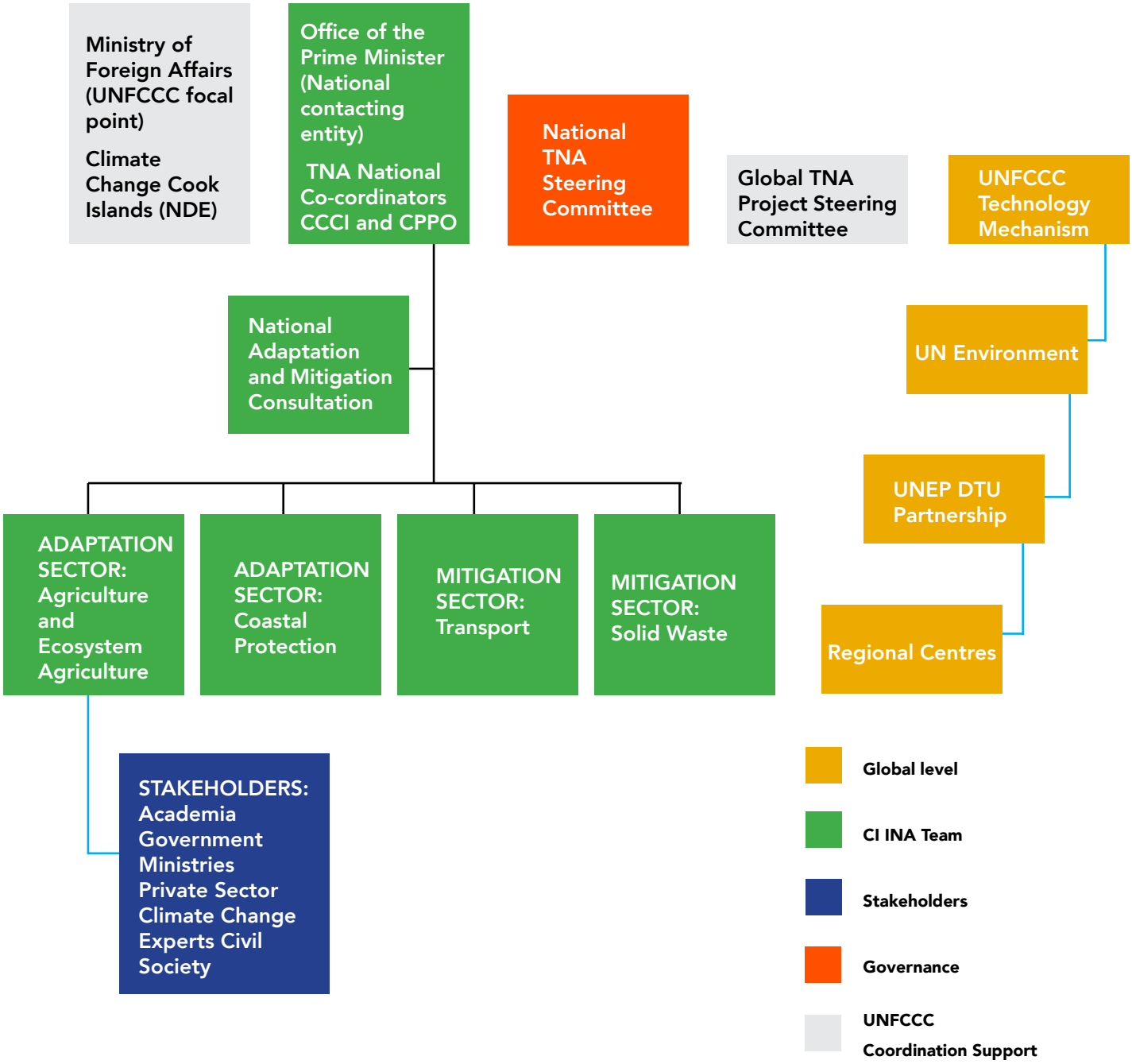

FIGURE 4: INSTITUTIONAL STRUCTURE

2.2 Stakeholder Engagement Process followed in the TNA – Overall assessment

Time was taken to identify and engage a lead government agency for each of the two mitigation sectors. This included an initial bilateral meeting with the head of the department and relevant senior staff.

The meeting introduced the purpose, outcomes and process of the TNA phases. Each agency was invited to participate based on their existing mandate within their respective sector. For the transport sector this was identified as the Ministry of Transport as the regulator for the sector. Infrastructure Cook Islands was identified as the lead agency for the waste sector as it is responsible for implementing waste measures nationally.

Stakeholder engagement included a mix of bilateral and technical working group meetings and stakeholder workshops to identify and prioritise technologies.

2.3 Consideration of Gender Aspects in the TNA process

Gender is considered a key aspect of the TNA process and was considered through the different stages of preparing this TNA report. Composition of the Transport technical working group was balanced with men and women representatives. The waste sector technical working group (TWG) was represented with more women than men. In addition, it was also important to ensure indigenous Māori representatives were included in the TWGs. This included a mix of Māori men and women representatives.

The MCA also included gender relevant criteria as part of the assessment.

[8] CINIIP (2015) pg. 10.

CHAPTER 3 TECHNOLOGY PRIORITISATION FOR THE LAND TRANSPORT SECTOR

This chapter explains the prioritisation for the Land Transport sector based on the MCA of technologies.

3.1 GHG emissions and existing technologies of the Land Transport sector

The high consumption of fossil fuel operated vehicles contributes to GHG emissions. The current level of GHG emissions for the transport sector is shown in Table 7 below.

The vehicle use of fossil fuels is closely linked to the petrol consumption which shows nearly a doubling in consumption over the years 2000 to 2014, or around a seven percent annual increase.

There is also a general need to improve data collection both in terms of vehicles (to include fuel type, engine size and annual km travelled) and to obtain accurate quantities of fuel used for transport.

TABLE SEVEN: COOK ISLANDS TOTAL REGISTERED VEHICLES BY VEHICLE TYPE 2017

VEHICLE REGISTRATIONS	2017
PEOPLE TRANSPORT	**NUMBER**
Ambulance	7
Bus	38
Car	4122
Jeep	420
Motor Cycle	11666
Pickup	1631
Station Wagon	201
Van	787
Freight & Construction Transport	
Bulldozer	2
Crane	4
Digger	1
Excavator	26
Fire Truck	5
Grader	14
Loader	32
Roller	20
Tractor	47
Truck	717
TOTAL	**19740**

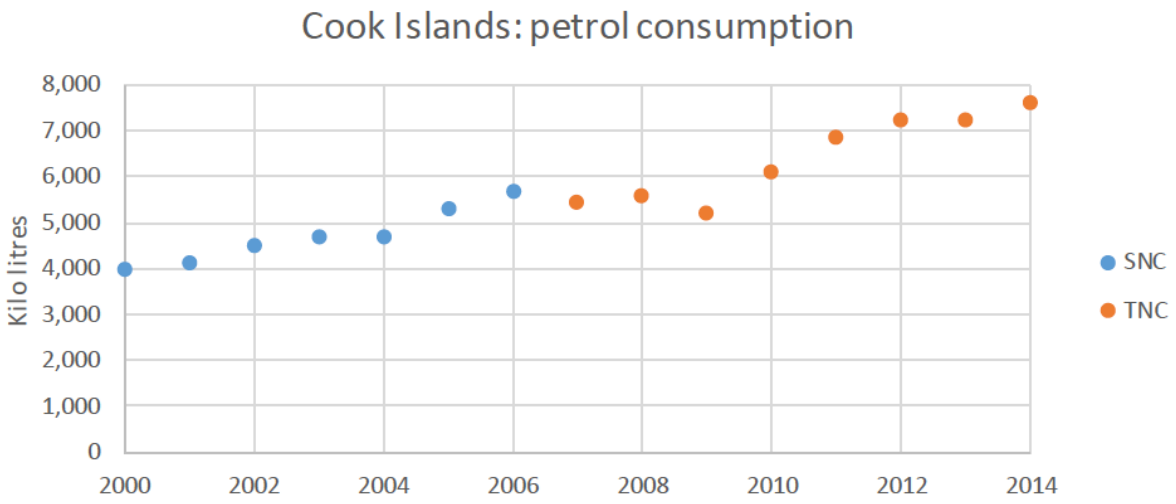

FIGURE 5 PETROL CONSUMPTION

(Source: Cook Islands TNC)

The change in petrol consumption between the SNC and TNC clearly shows that the transport sector contributions needs attention in terms of mitigation effort and improved energy security for the Cook Islands.

The GHGI 2019 identified that a high-status value was placed on private vehicle ownership by many Cook Islanders. The report, therefore, proposed that in the short term, a fuel replacement strategy rather than a major emphasis on reducing transport options were needed. In addition, the increasing number of vehicles can be attributed to the demand for rental vehicles due to increased tourist numbers.

The Bank of the Cook Islands (BCI) is the licensing authority. Historically, compiling the total number of vehicle on an annual basis has not been carried out. The total number of vehicles in the Cook Islands for 2017 was provided for the GHGI report. Details are provided in Table 7 above. This shows that there are likely to be more vehicles than people with many persons possibly owning both a car and a motorcycle. Informal inquiries to the BCI in November 2019 identified this number is now at approximately 23,000 registered vehicles. This number can be reduced when considering the number of derelict/damaged vehicles that have not been formally deregistered from BCI records.

The main technologies in use in the land transport area are land-based vehicles that have internal combustion engines burning gasoline and diesel. The type of roads vary with coral and tar seal across different terrains where a few islands are mountainous and most are low-lying islands. This has an impact on the efficiency of vehicles.

Demand for vehicles including cars and high number of motor bikes continues to increase. In addition the average engine size distribution for four-wheeled vehicles is also increasing.

3.2 Decision context

The decision context of prioritising technologies in the land transport sector considers the economic, political, social and technological environment that informs the technology prioritisation decision.

Mitigation options in the transport sector are progressively being promoted. Increasingly private vehicle owners are purchasing electric vehicles (EV) and tourism operators are making electric bicycles available to tourists. The government has also recently invested in purchasing a few EVs as part of its fleet on Rarotonga. With the shift to solar PV electricity and some private households and businesses supplying electricity to the grid, there is scope to expand EV as an alternative. An option to address the increase in the number of privately-owned vehicles includes investigating tariff options. However, more attention focused on building an integrated enabling environment is needed. Putting in place a long-term plan and sustainable finance to change the existing vehicle fleet to electric or biofuels vehicles is needed. Such a transition requires further coordination with the electricity sector renewable energy

plans. The option of also moving public transport options to EV options needs further investigation.[8]

In terms of sustainable development, the transport sector is important due to it being able to address the issues and challenges related to energy security and economic development as set out in the INDCs, NSDP and CIREC. The Cook Islands Climate Change Country Programme and Climate Change Policy also influences the selection for this sector.

Policies discussed earlier show that there are objectives in the sector which aim to reduce GHG emissions and pollution as well as improve economic efficiencies.

The transport sector is a large GHG emitter with land transport being the largest consumer of imported oil. Reducing dependence on imported fossil fuels is an important objective. Additionally the transport sector is responsible for producing high levels of air pollution therefore another important objective is air pollution reduction.

There are a number of challenges to achieving the objectives in the land transport sector. These include addressing the limitations in the current institutional and regulatory frameworks so as to be able to facilitate replacing existing fossil fuel vehicles with alternative options; managing the importation and disposal of diesel or petrol-driven vehicles; improving GHG and mitigation data collection, monitoring and reporting; and policy integration and cooperation among the range of stakeholders and interests. The GHGI report identified that for transport fuel volumes, it would be appropriate to obtain the information from the fuel retailers to enable a better analysis of transport emissions. Better coordination of transport data collection will also contribute greatly to public awareness and improve information on energy demand and supply for dissemination.

The main goal of the TNA in the land transport sector is to support the efficient transfer of technologies as part of a low carbon transport sector and development pathway.

3.3 An overview of possible mitigation technology options in the Transport Sector

There are various options available to achieving low carbon transportation (Lloyd & Subbarao, 2019). These include:

- Fuel shifts (Biofuels and Electric Vehicles),
- Modal shifts to low carbon transport systems (Buses, Rail, Walking and cycling etc.)
- Structural changes (design of urban areas and shifts to working at home)

In the Cook Islands case, analysis shows that attention to date has mainly focused on fuel and modal shifts. These two are discussed below.

FUEL SHIFT

The mitigation report 2019 for the TNC reported that EVs only reduce CO2 emissions if the electricity source to recharge the batteries is fossil-fuel free. Critically, fossil fuels are consumed in the production process of making the EVs alongside fossil fuel consumption in making the batteries. A positive aspect of using EVs is that if they are charged by an intermittent renewable energy sources, such as solar or wind, they can offset peak production in situation of high renewable grid penetration. In addition, the battery pack in e-vehicles can add storage to a grid that has a high intermittent renewable component. This could be an important supplement to RE storage on the TAU grid on Rarotonga.

Currently the cost of EVs is high compared to comparable petrol and diesel versions, but the costs are reducing. The main logistical problem with EVs is their limited range compared to petrol and diesel cars and the limited refueling (charging) opportunities. The world's top selling EVS, the Nissan Leaf, with a top speed of 150kph, has a range between 100km and 200km depending on terrain, speed and the condition of the battery pack. The Tesla model S with a top speed in excess of 200kph (depending on the version) has a range in excess of 400 km, but this model is at the top end of the price range. At the other end of the price scale the Indian produced Mahindra has a range of around 100km with a top speed of 80kph (Lloyd & Subbarao, 2019).

[8] Refer to Cook Islands GHGI and Mitigation Reports.

		
Nissan Leaf	**Tesla model S**	**Mahindra e_2o**

FIGURE 6: ELECTRIC VEHICLE OPTIONS

In the Cook Islands, there has been some experience with EVs with a number on the roads as of late 2018 (approximately 30 registered EVs). Neighbouring Fiji on the other hand has had a policy of no or low import tariff for both EVs and for hybrid vehicles (both an electric motor and a petrol engine). In conjunction with this, incentives [9] (tax holiday, capital subsidy, zero duty fee etc.) have also been devised and implemented for EVs and charging stations. Subsequently, these initiatives have experienced a significant increase in such vehicles that are used both as private cars and as taxi.

The advantage of introducing EVs to the Cook Islands is that the country has a high penetration of solar systems on the main Rarotonga grid. It follows that, where possible connecting the solar systems to the grid would assist the storage problem. EVs in the Cook Islands could have a reduced electricity charging tariff if charged at times of excess solar availability. In association with this, there could be benefit if these EVs were able to sell electricity back to the grid at times of shortage. Another advantage for EVs on Rarotonga is the very short journey length and flat terrain (coastal areas only). For instance, a Nissan Leaf could travel around the island several times without recharging.

BIOFUELS

Shifts include expanding the use to biofuels to reduce fossil fuel consumption and GHG emissions. This would involve use of cleaner or lower carbon fuels. This would include producing biofuels as a net carbon reduction process. The use of biofuels would also be combined with using more efficient vehicles and strategies to reduce use of vehicles (UNEP, 2011). The production of coconut oil as a biofuel is one option that has been developed in the Pacific. Coconut oil can be blended with diesel fuel and in some situations can replace diesel. Options include pure coconut oil in unmodified engines, modified engines and use of a bio diesel blend in unmodified engines. Each option comes with different production, cost and technical advantages and disadvantages. For example small land mass and infrequent shipping services makes biofuel production restrictive. Harvesting copra would provide local employment however its high labour and transport costs would not make it a profitable export venture. Blending coconut oil with diesel is a possible option for Cook Islands particularly for the individual islands to operate heavy machinery and outboard motors.

MODAL SHIFTS

As identified above, the demand for more vehicles and higher engine size continues to increase with increased tourism visitors. These trends contribute to GHG emissions. Change in modes of transport from private to public transport would also require conversion from petrol and diesel-operated passenger vehicles to renewable energy-powered cars, vans, motor cycles and buses.

[9] http://www.frca.org.fj/wp-content/uploads/2016/06/2016-2017-Budget-Circular.pdf

Electric buses are also emerging as a solution for sustainable public transport system, with over 150,000 electric buses in service around the world (2016), mostly in China. In a few other countries, electric bus fleets of varying seating capacities (large and mini buses), and for specialty services, exist at the level of a few tens of buses (100 in India, 94 in the Netherlands, 30 in Sweden and 21 in Japan, according to EVI data submissions), and are deployed as pilots and demonstration projects in a few major cities. This represents a very rapid increase over the past three years, with the number is expected to continue to grow rapidly in more countries.

On Rarotonga, the round-the-island bus service could be converted to use electric transport alternatives, although the current global solution in terms of electric buses would probably need attention to redesign. Possibly an example of an alternative design to consider could be the "Bula Bus" (shuttle bus without windows or air-conditioning) used in the Denarau tourist district in Fiji.

Overall, transport needs require careful consideration. By taking an integrated approach government policy would need to combine fuel and modal shifts along with other policy measures that promote vehicle-free areas, walk and cycle ways. These can be combined with structural options giving attention to town planning, parking, road usage and maintenance, vehicle servicing, tax measures and end-of-life disposal measures.

RELEVANT TECHNOLOGY OPTIONS

A draft long list of technology options was compiled. These were drawn from the review of government plans, policies and proposals. The list also included options drawn from consultation with stakeholders. Those consulted included input from the members of the technical working groups via email and Face-to-face discussions. Islands leaders were also consulted during the national conference of mayors and executive officers in October 2019. From the combined consultations an initial long list was revised.

Criteria to identify options for the short list included:

- Identified priority in the Cook Islands Climate Change country programme and GCF concept notes
- Aligned to priority sub-sectors of land transport and solid waste
- Scale of impact of the technology - at national and/or island wide level.

An initial short list was carried out by the consultant and agreed by the TNA coordinators and TWG. A short list of five technologies was identified and prepared for further analysis.

The five technologies options included:

- Public service passenger vehicle fleet with EV (cars, scooters and passenger vans) with vehicle pooling
- Home EV solar off-grid charging carports to support Rarotonga and Pa Enua EVs without impacting existing power infrastructure
- Public electric wireless/trackless tram system for Rarotonga public transport
- Private sector – conventional electric buses, and/or with fast-swap spare battery packs, recharging for spare packs at terminus
- Establishment of workplace EV charge stations (government and private) for car and bike (generic hardware) smart chargers.

3.4 Criteria and process of technology prioritisation for Land Transport sector

Prior to the technology prioritisation workshop stakeholders agreed on the criteria, descriptions and weightings are listed in the table below. The MCA framework was used to prepare the initial draft. Through consultations with the TNA team and stakeholders, the MCA was adapted to suit the Cook Islands context. A series of meetings, face-to-face and email discussions were held with stakeholders. The process relied heavily on the expertise and experience of the TWG members. Weightings

were discussed and an adapted approach to the eight step TNA process was agreed upon. A key consideration was the need to ensure consistency between the two priority mitigation sectors, as well as avoiding an over-engineered approach.

Initial criteria were prepared by the consultant in discussion with the TNA team based on Cost and sustainable development benefits. The TWG then allocated level one criteria of Costs and Benefits weightings of 20% and 80% respectively. The Benefit weightings were broken down further to give equal weight to economic, social and environmental criteria. The two remaining criteria of technology and climate related were weighted 10% each. In reaching these weighting allocations, the TWG considered the costs, economic, social and environmental benefits of equal importance. They also considered these to be of higher importance over the technology and climate related benefits. The TWG reviewed draft Level three criteria. These were discussed and amended by the TWG agreeing on the 17 level three criteria and descriptions.

They allocated a weighting to each of the level three criteria. However, feedback from the TWG considered evaluating the options against the lower level to eliminate unnecessary complexity to the process with 17 criteria to be scored and weighted. Noting the time constraints and availability of the TWG members, the process was adapted. It was observed that the TWG had sufficient shared understanding of each level two and three criteria to be able to evaluate the performance and score each option. The scoring and weighting steps of the TNA process were subsequently adapted and agreed to by the TNA team. The performance of each technology was discussed and scored during the prioritisation workshop facilitated by the TNA consultant.

A draft performance matrix to evaluate each technology option against six of the 17 level three criteria was prepared but not used in light of amended process (See table below).

TABLE 8: DRAFT PERFORMANCE MATRIX

Option	Costs	Benefits				
		Economic	Social	Environment	Technology	Climate
	Costs of Technology	Improves economic performance	Protects Health	Addresses Plastic/HW streams	Ease of Implementation	GHG Emission Reduction potential
Unit	NZD	High/Low	High/Low	High/Low	Simple/ complex	High/Low
1						
2						
3						
4						
5						
Preferred Value	Lower	Higher	Higher	Higher	Simple	Higher
Data Source	Technology provider specs	Expert judgement/ monitoring data	Expert judgement/ monitoring data	Expert judgement/ monitoring data	Expert judgement/monitoring data	Expert judgement /monitoring data

The two TWGs, representing a range of interest and expertise, quickly developed common understanding of the framework and interpretation of the MCA. Their involvement through email and phone contact, meetings and workshops, was an important aspect of the process in establishing common ground for evaluating technologies.

The Transport Sector TWG included individuals representing:

- Te Aponga Uira (Rarotonga Electricity Utility)
- Te Ipukarea Society (Environmental NGO)
- Rarotonga Electric Vehicle Club
- Chamber of Commerce
- Private sector consultant for Renewable Energy and Development
- Ministry of Transport representative
- Economic Policy and Planning Division of the Ministry of Finance and Economic Management.

TABLE 9: MCA FOR MITIGATION TECHNOLOGY

LEVEL 1	LEVEL 2	LEVEL 3	Description/Consideration
Costs (20%)	**Cost of technology (20%)**	Capital cost Operation and Maintenance cost	Capital cost per unit e.g. cost of EV, etc. Includes operating and maintenance costs per year; outage (lost time/production) costs
		Sustainable funding options (Private sector, public sector, Development Partner)	Potential/likely funding source through private sector, public sector, development partner
Benefits (80%)	**Economic (20%)**	Improves economic performance	Economic benefit to sector, island, country – e.g. the technology improves production of goods/services/revenue opportunities
		Encourages private sector investment	Creates a business revenue stream
		Creates jobs	The population/island/sector benefits from having a 'piece of the pie'
	Social (20%)	Protect health	removing health hazards – e.g. removal of gases etc. linked to waste;
		Potential for gender impacts and reduces inequity	Households that are led by female figures have improved access to low carbon energy or transport solutions and infrastructure; time savings as a result of the technology
		Capacity development	Individuals, organisations and systems obtain, improve and retain skills, knowledge, tools, equipment and processes
		Preserves cultural heritage (intangible and tangibles)	Protect cultural knowledge/sites/artefacts
	Environmental (20%)	Reduces priority waste streams	Addresses plastics and hazardous waste streams
		Whole or partial repurposing of technology/products	Extend life of resource/product or support removal from the landfill
		Protect biodiversity and natural resources	Causes no harm/degradation
		Support ecosystem services	Improved air quality, noise reduction, habitat restored

Benefits (80%)	**Technology related (10%)**	Ease of implementation	Human capacity to implement including safety
		Alignment with national, sector, island development priorities - policy coherence	Identified priority in government plans (e.g. NIIP, JNAP, CCCP, ISDP, and NSDP etc.)
		Timely rate of technology diffusion	Able to distribute in a timely manner
		Fit for purpose Relative scale for impact	Efficient and effective compared to other alternatives; Wide scope - distributed nationally, or whole island coverage
	Climate related (10%)	Reduce/avoid GHG	Potential to reduce emissions, or emits less GHG compared to alternative
		Potential to reduce vulnerability and build climate resilience	Able to support existing strengths and know how to address risks

3.5 Results of technology prioritisation for Land Transport Sector

The tables below shows the results of the technology prioritisation processing using the MCA.

TABLE 10: AMCA TECHNOLOGY PRIORITISATION RESULTS

Technology Needs	Costs	Benefits					Total Score 100%	Rank
	Costs of Technology	Economic	Social	Environment	Technology Related	Climate related		
	20%	20%	20%	20%	10%	10%		
Public Sector EV Fleet & Pooling	20	18.25	17.5	18.75	8.75	9.25	92.5	1
Charging carports	12.5	10.75	10	18.75	6.75	9.25	68	4
Tram System	5	5	6.25	11.25	3	8.25	38.75	5
EV Buses	16.25	16	17	17	8.25	9.5	84	3
Workplace Charging Stations	16.75	17	13.5	18.25	9.5	10	85	2

The priorities that are identified for carrying out barrier analysis and action plans are:

1. Public sector (PS) passenger vehicle fleet with EV (cars, scooters & passenger vans) with vehicle pooling

2. Establishment of workplace EV charge stations (government and private), for car and bike (generic hardware) smart chargers

TABLE 11: TOP RANKED LAND TRANSPORT TECHNOLOGY PRIORITISATION

Technology Needs	Costs	Benefits					Total Score 100%	Rank
	Costs of Technology	Economic	Social	Environment	Technology Related	Climate related		
	20%	20%	20%	20%	10%	10%		
PS EV Fleet & Pooling	20	18.25	17.5	18.75	8.75	9.25	92.5	1
Workplace Charging Stations	16.75	17	13.5	18.75	9.5	10	85	2

CHAPTER 4 TECHNOLOGY PRIORITISATION FOR THE SOLID WASTE SECTOR

This chapter explains the prioritisation for the waste sector based on MCA of technologies.

4.1 GHG emissions and existing technologies of Solid Waste Sector

The current level of GHG emissions for the waste sector is discussed below. The GHGI for the Waste sector includes methane emissions for solid waste disposal and wastewater treatment, as well as emissions from other gases from open burning and incineration of solid waste. The total emissions from the waste sector were estimated at around 4 Gg per annum or 6% of total emissions over the reporting period 2007–2014 compared to the SNC value of 4359t CO2-e in 2006 (4.4Gg) with an uncertainty level of ±30%. Further data on solid waste emissions is limited and remains an ongoing area for development (CIGov, 2019).

The poor management of solid waste contributes to GHG emissions. At the same time, global warming increases the negative effects of inadequate waste management practices. For Cook Islands with its small land mass dispersed across a large ocean territory, transportation and resourcing exacerbate the issues associated with solid waste management practices.

To date, no holistic management framework is operating throughout Cook Islands, although an Integrated Solid Waste Management Framework has been designed under the Cook Islands Solid Waste Management Strategy.

In 2016 a detailed solid waste audit was performed which gave the following data to be used to calculate GHG emissions.

TABLE 12: COOK ISLANDS SOLID WASTE DATA

WASTE COMPOSITION, 2016 WASTE AUDIT

CATEGORY	SUB-CATEGORY	Rarotonga (Survey) /Aitutaki (Est)				Atiu (Est)	
		Rubbish		Recycling		Rubbish	
Paper/Card		16.0%		4.5%		13.3%	
	Paper		4.8%		0.9%		3.9%
	Cardboard		7.0%		1.5%		5.8%
	Non-recyclable		4.2%		2.1%		3.7%
Plastic		27.0%		11.9%		23.5%	
	Plastic Recyclable		7.4%		5.5%		7.0%
	Plastic Non recyclable		19.6%		6.4%		16.5%
Organic		13.8%		7.6%		12.4%	
	Food		10.0%		7.1%		9.3%
	Garden		3.8%		0.5%		3.1%
Ferrous Metal		7.9%		2.4%		6.6%	
	Ferrous metals Recyclable		7.6%		2.4%		6.4%
	Ferrous non recyclable		0.2%		0.0%		0.2%
Non ferrous metal		1.5%		1.5%		1.5%	
	Non-ferrous metals Recyclable		1.3%		1.5%		1.3%
	Non-ferrous metals non recyclable		0.2%		0.0%		0.2%
Glass		15.0%		60.6%		25.5%	
	Glass Recyclable		14.3%		60.5%		25.0%
	Glass Non recyclable		0.7%		0.1%		0.5%

Textiles	Textiles	2.2%	2.2%	0.0%	0.0%	1.7%	1.7%
Nappies/Sanitary	Nappies/Sanitary	13.5%	13.5%	11.0%	11.0%	12.9%	12.9%
Rubble	Rubble	0.8%	0.8%	0.0%	0.0%	0.6%	0.6%
Timber	Timber	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Rubber	Rubber	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%
Potentially hazardous	Potentially hazardous	2.3%	2.3%	0.5%	0.5%	1.9%	1.9%
Total		100%	100%	100%	100%	100%	100%

CLIMATE CHANGE IMPACTS

The climate change impacts, based on ICI concept note to the GCF are presented below. Persistent Organic Pollutants (POPs) are toxic, having a long-term effect on the environment and human health which includes cardiovascular disease, metabolic disorders and cancer. Some POPs are endocrine disrupters, altering the hormonal system and damaging reproductive and immune systems.

POPs leach from improperly managed waste such as plastic, heavy metals in electrical appliances, and agricultural chemicals. POPs enter the air, groundwater, soils and marine environment, and eventually end up in the food chain. Global warming worsens POP emissions and concentrations while increased rainfall intensity triggers secondary emissions of POPs in agricultural lands and storage sites.

The change from ozone depleting substances (CFCs, HCFSs) for refrigeration gas to GHGs (HFCs), changes the risk from ozone layer degradation to adding to the greenhouse effect when released.

Degrading organic waste in landfills and dumps contributes a large portion of GHGs emissions. For example, ICI reported that total organics to the landfill is 13.8% of waste or 254 tonnes of 1844 tonnes per year. In addition, the regular and common practice of burning all types of waste adds to waste sector emissions. This includes the burning of plastic and rubber which releases dioxins into the air. Global warming exacerbates the degradation of wastes and the associated leaching of pollutants. The expected increases in storm intensity and associated flooding from climate change will result in more and more of this waste entering the ocean with runoff.

With all types of waste including recyclables and hazardous waste remaining on many islands and not being properly managed, there is an increasing risk to the populations that inhabit them. This is because poor waste management practices include waste being dumped, buried, littered and as mentioned above, burned in yard fires.

Sand mining for construction is a common practice across all islands. On some islands including Rarotonga, when sand is mined from the coastal zone, the mined holes are filled with soil. This soil will eventually be leached into the lagoon which will have a negative impact on the marine environment -placing more pressure on marine ecosystems alongside climate change (ICI, 2019). [10]

Waste management is a significant issue for Cook Islands. In relation to solid waste, efforts are undertaken to encourage the practice of refuse, reduce, reuse and recycle. Solid waste management systems are vulnerable with landfill flooding due to extensive rainfall, carrying the risk of ground water contamination. Increased temperatures equate to increased levels of combustion at sites.

Currently there are built waste management facilities only on Rarotonga and Aitutaki, which are near capacity. There is regular roadside collection of organic and sorted waste (plastics, glass and aluminum cans) on these two islands. The rest of the islands practice open dumping. Dumpsites are usually located at low levels and are excavated with little planning and hydraulic protection (CIGov, 2019).

[10] This section is drawn from Infrastructure Cook Islands Concept Note 2019 draft to the Green Climate Fund.

4.2 Decision context

The decision context of prioritising technologies in the solid waste sector are determined by economic, political, social and technological influences. In terms of sustainable development, the solid waste sector is important in addressing challenges related to population health, environment protection and economic development, as set out in the NSDP and Solid Waste

Management policy. The Cook Islands climate change country programme and policy also inform the selection of this sector.

Policies discussed earlier show that there are objectives in the sector relevant to mitigating GHG emissions through improved waste management practices.

The main goal of the TNA in the solid waste sub-sector is to support technology transfer that supports the goal of zero-waste and GHG removal, with effective waste management practices.

4.3 An overview of possible mitigation technology options in the Solid Waste sector and their mitigation/adaptation potential and other co-benefits

GHG emissions in the waste sector can be reduced with different technologies that are also able to provide co-benefits in areas such as health, food security, water security, ecosystem services, and infrastructure and built environments, resilient livelihoods of people and communities, energy generation and access, and land use. The GHGI identified solutions to strengthen resilience and adaptation to the impacts of climate change. Attention to waste sector technologies has significant implications on building resilience of the economy given the dependence on healthy ecosystem services to sustain tourism and agriculture (CIGov, 2019, p.35).

The major constraints identified for waste-to-energy projects in the Cook Islands include low awareness and lack of appropriate information on waste-to-energy; inadequate technical capacities to develop real projects; low availability of financial services; and insufficient institutional capacity, as well as unspecific and unfavourable policy frameworks. It was also observed that the capacities and requirements to deal with risks associated with waste-to energy initiatives among key stakeholders remains generally low, both in the public and private sector (CIGov, 2019, p. 35).

Opportunities for better management of solid waste have been raised, including the construction of waste management facilities on all islands and turning waste to energy.

Possible technology options to reduce GHG in the waste sector include:

- Waste, waste residues and resources, resulting mainly from medium and large sources and enterprises;
- Provide opportunities for large-scale centralised power generation. One option considered was to use energy from existing burnable waste. However, it was found that the Rarotonga supply could only support a 200kW waste to energy plant which would not be sufficient to substantially offset the need for load shifting storage (KEMA, 2012).

For the solid waste sector, policy solutions include:

- Ban on single use plastics, which includes replacing plastic bags in supermarkets
- Introduction of an advanced disposal fee is another solution.

RELEVANT TECHNOLOGY OPTIONS

As stated above in Land Transport technology options, a draft long list of technology options was compiled. These were drawn from the review of government plans, policies and proposals. The list also included options drawn from consultation with stakeholders. Those consulted included input from the members of the technical working groups via email and face-to-face discussions. Islands leaders were also consulted during the national conference of mayors and executive officers in October 2019. From the combined consultations and initial long list was revised.

Criteria to prioritise the short list included:

- Must be an identified priority in the Cook Islands Climate Change country programme and GCF concept notes
- Aligned to priority sub-sectors of land transport and solid waste
- Scale of impact of the technology at national and island wide level.

An initial short list was carried out by the consultant and agreed by the TNA coordinators and TWG. A short list of five technologies was identified and prepared for further analysis.

The five technologies options included:

- Pa Enua waste management depot
- Village collection and storage containers
- Rarotonga storage facility for EV and hazardous waste
- Balers for disposal preparation
- Shredder for disposal.

4.4 Criteria and process of technology prioritisation for the Waste sector

The process was the same as undertaken for the Transport sector. Refer to chapter 3.4 for details.

The Waste Sector TWG included individuals representing:

- Infrastructure Cook Islands
- Cook Islands General Transport - Private Sector representative
- National Environment Service
- Ministry of Finance and Economic Management

4.5 Results of technology prioritisation for the Waste sector

The table below shows the results of the technology prioritization processing using the MCA.

TABLE 13: RESULTS FOR WASTE SECTOR TECHNOLOGY PRIORITISATION

Technology Needs	Costs	Benefits					Total Score 100%	Rank
	Costs of Technology	Economic	Social	Environment	Technology Related	Climate related		
	20%	20%	20%	20%	10%	10%		
Pa Enua WM Depot	8.5	8.75	12	19	9.25	6.25	63.75	3
Village Collection & storage	14	8	11	15.25	8	5	61.25	4
Rarotonga Facility for EV/ Hazardous Waste	6.75	17.75	13.5	19.5	6.25	8.25	72	1

Balers for disposal preparation	13	13.75	10.75	15.75	8	7.5	68.75	2
Shredder	7	13.75	10.5	14.75	9	5.75	60.5	5

The top three ranked technologies were the Rarotonga storage facility for disposal/repatriation of EV batteries and other hazardous waste, Pa Enua waste management depots, and balers for preparing waste for disposal.

During consultations the top ranked option was removed as it was identified that recent funding through development assistance meant that this was no longer a priority.

Subsequently, the two priorities that are identified for carrying out the barrier analysis and action plans are:

1. Balers for preparing plastics and aluminum cans, hazardous waste for removal
2. Pa Enua waste management disposal depots.

TABLE 14: TOP RANKED SOLID WASTE TECHNOLOGY

Technology Needs	Costs	Benefits					Total Score 100%	Rank
	Costs of Technology	Economic	Social	Environment	Technology Related	Climate related		
	20%	20%	20%	20%	10%	10%		
Balers for disposal preparation	13	13.75	10.75	15.75	8	7.5	68.75	1
Pa Enua WM Depot	8.5	8.75	12	19	9.25	6.25	63.75	2

CHAPTER 5 SUMMARY AND CONCLUSIONS

The process for prioritising mitigation sectors took multiple factors into account. Relevant policies and plans of the Cook Islands provided direction on key sectors. Combined with GHG emissions, the transport sub-sector is a high emitting sub-sector. The waste sector and particularly the solid waste sub-sector was identified as a potential sector due to its co-benefits. The rationale for selection also considered the current capacity needs and strengths of sectors including the level of activity already underway in various sectors, and the extent to which regulatory and institutional arrangements were in place to support climate technology developments in each sector. The progress against RE actions already underway was also a consideration.

The multi-criteria assessment used the MCA framework to prepare an initial draft. This was revised and finalised the criteria, descriptions and weightings with the TNA team and stakeholders. The process relied heavily on the expertise and experience of the TWG members who established a common understanding of the criteria for appraising technologies. The main criteria covered cost.

The results of prioritising sectors and technologies are as follows:

For the Land Transport sector, prioritised technologies identified for the barrier analysis and actions plans are:

1. Public service passenger vehicle fleet with EV (cars, scooters & passenger vans) with vehicle pooling.
2. Establishment of workplace EV charge stations (government and private) for car and bike (generic hardware) smart chargers.

For the Solid Waste sector, the two priorities that are identified for carrying out barrier analysis and action plans are:

1. Balers for preparing plastics and aluminum cans, hazardous waste for removal
2. Pa Enua waste management disposal depots.

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ANNEX ONE: CLIMATE CHANGE PROJECTION UNDER THREE SCENARIOS

Climate change projections for surface air temperature, sea surface temperature, aragonite saturation state, sea level rise and rainfall are given for three 20-year periods centred on 2030 (2020–2039), 2055 (2046–2065) and 2090 (2080–2099), relative to 1990 (1980–1999). Confidence in the projections is also given.

This means that there is not one single projected future for the Cook Islands, but a range of possible futures. These projections also refer to an average change over the whole country based on projections for the region around the Cook Islands.

TABLE 15: PROJECTED CHANGES IN CLIMATE ASPECTS IN THE COOK ISLANDS UNDER THREE SCENARIOS

CLIMATE ASPECT	NORTHERN GROUP			SOUTHERN GROUP			CONFIDENCE LEVEL
	2030	**2055**	**2090**	**2030**	**2055**	**2090**	
Surface Air Temp(C°)	+0.6 ± 0.4 +0.8 ± 0.4 +0.7 ± 0.2	+1.1 ± 0.4 +1.4 ± 0.5 +1.4 ± 0.4	+1.5 ± 0.6 +2.2 ± 0.8 +2.6 ± 0.6	+0.6 ± 0.4 +0.7 ± 0.4 +0.7 ± 0.3	+1.0 ± 0.5 +1.3 ± 0.6 +1.3 ± 0.4	+1.3 ± 0.6 +2.0 ± 0.8 +2.5 ± 0.7	Moderate
Sea Surface Temp(C°)	+0.6 ± 0.3 +0.7 ± 0.4 +0.7 ± 0.4	+0.9 ± 0.4 +1.2 ± 0.5 +1.3 ± 0.6	+1.3 ± 0.5 +2.0 ± 0.8 +2.3 ± 0.8	+0.6 ± 0.3 +0.6 ± 0.3 +0.7 ± 0.3	+0.9 ± 0.4 +1.1 ± 0.4 +1.2 ± 0.4	1.3 ± 0.4 +1.9 ± 0.5 +2.3 ± 0.7	Moderate
Aragonite Saturation State	+3.6 ± 0.2 +3.6 ± 0.2 +3.6 ± 0.1	+3.4 ± 0.2 +3.3 ± 0.2 +3.3 ± 0.2	+3.3 ± 0.1 +2.9 ± 0.3 +2.7 ± 0.1	+3.5 ± 0.1 +3.5 ± 0.1 +3.5 ± 0.1	+3.3 ± 0.1 +3.1 ± 0.1 +3.1 ± 0.1	+3.1 ± 0.1 +2.7 ± 0.1 +2.5 ± 0.1	Moderate
Mean Sea Level (cm)	+10 (5–15) +10 (5–15) +10 (4–15)	+18 (10–26) +20 (10–30) +19 (10–29)	+31 (17–45) +38 (19–56) +38 (19–58)	+10 (5–15) +10 (5–15) +10 (4–15)	+18 (10–26) +20 (10–30) +19 (10–29)	+31 (17–45) +38 (19–56) +38 (19–58)	Moderate
Rainfall (%)	+3 ± 8 +4 ± 9 +3 ± 13	+5 ± 12 +6 ± 25 +6 ± 26	+6 ± 22 +8 ± 33 +9 ± 37	+1 ± 11 +3 ± 10 +5 ± 9	+2 ± 8 +3 ± 13 +5 ± 11	+5 ± 14 +6 ± 13 +8 ± 24	Low

SOURCE: Australian Bureau of Meteorology & CIRSO 2011, Climate Change in the Pacific Report.

ANNEX TWO: TECHNOLOGY FACTSHEETS FOR SELECTED TECHNOLOGIES

TRANSPORT FACT SHEET 1

Technology:	Public service passenger vehicle fleet with EV (cars, scooters & passenger vans) with vehicle pooling
Sector Area:	Transport Sector
Priority Alignment:	Climate Change Country Programme
Background:	Land transport is the major subsector that now needs attention in terms of mitigation. It makes up 47% of total average emissions in the Energy sector compared to 39% in the Electricity sector and 8% in Air Transport (CIG, 2019). Preference for individual transport options in the Cook Islands shows increasing number of motor vehicles annually. The vehicle use of fossil fuels is closely linked to the petrol consumption. Consumption has nearly doubled over the years 2000 to 2014 representing an annual increase of around 7% (CIG, 2019). The conversion of government vehicles to an EV fleet includes promoting the deployment of a range of suitable EVs to suit and to carry our government transport requirements during the day & night and in line with the Government Fleet Management Policy (CIGov, 2018). There are potential opportunities for Vehicle to Grid (V2G) or grid support applications such as financial incentives, or a requirement for maintaining grid supply quality and reliability. With the planned centralising of government departments into one building, there is an opportunity to centralise fleet and vehicle charging facilities at the one site. Nissan offers an eight-year, 160,000km warranty for its battery, which includes a capacity-loss guarantee. Essentially, if the battery degrades below 75% of its original capacity in that time, the carmaker will replace it. In 2014, an EV battery cost US$300 per kilowatt-hour, and Nissan sold replacement Leaf battery packs for US$5500. By 2020, battery costs are expected to have fallen to US$200 per kilowatt-hour, and are expected to drop to US$150 per kilowatt-hour in the next five years. [11]
Climate Change Rationale:	Emissions are reduced due to plug-in electric vehicles with DC electric motor and a rechargeable battery instead of internal combustion engine and gas tank. The emissions reduction in electrifying the transport sector will be in step with increased renewables energy contributions for Rarotonga. Combined with pooling system, the number of vehicles are also reduced leading to further reduction. Reduce traffic congestion.
Implementing Agency:	Ministry of Transport, CIIC (OPM – CC & REDD; OPSC)

[11] Refer to https://www.consumer.org.nz/articles/a-guide-to-electric-vehicles

[12] Refer to https://www.consumer.org.nz/topics/electric-vehicles

Estimated Cost: Item/OM/project	EV – Car – $18-25,000 second hand - $200,000 range of cost and determined by age of battery Nissan Leaf (new) - $45,000.12 O&M $1300 per annum ($25 per week – warrant, registration, tyres, servicing). As a starting point, the Energy Efficiency and Conservation Authority (EECA) calculates charging an EV equates to paying about 30¢ per litre for petrol — approximately 6 or 7 times less than the cost of petrol. Based on the same car comparisons as per the EECA calculation and incorporating average pricing in Rarotonga, driving electric comparatively costs you $2.13 per litre only slightly lower than fuel. TAU is developing a new home and business solution that should make EV charging more attractive when taking advantage of grid connected PV. Please note costings above does not include other operating costs and will be different for each vehicle being considered. E-Scooter – $1000 – $2000 (O&M costs to be determined) Nissan E Van – $29,000 (O&M costs to be determined).
Further Action/Info needed:	Project concept and proposal details including costings
Development Impact: Economic, environmental, social, political	Economic – Has the potential to improve efficiency of government operational costs. This includes a reduction in foreign exchange spending. Social – more spending available for social, health and education initiatives. Environmental – Reduced traffic congestion and need for land for the road network and parking spaces.
Potential Issues:	Range anxiety of users – e.g. 135km per charge for Nissan Leaf. Will give you 3-4 trips around Rarotonga. Adequate local support service facilities. Agreed purchase parameters - Price if government policy requires purchase of brand; ensure vehicle $/kWh BESS and range based on need, compatible with V2G technology.
Present Status:	Technology has potential alignment with Vaikapuangi Development – Avarua
Timeframe:	Potentially up to 2 -3 year for project development phase although could be sooner given procurement cycle in place.

TRANSPORT FACT SHEET 2

Technology:	Home EV solar off-grid charging carports to support Rarotonga and Pa Enua EVs without impacting existing power infrastructure
Sector Area:	Transport Sector
Priority Alignment:	Climate Change Country Programme
Background: General Info on technology, developed and ready to use, used elsewhere	Land transport sector is identified as a priority sector for meeting the Cook Islands nationally determined contributions to reducing GHG emissions. BCI records show there are over 25,000 registered vehicles in the Cook Islands. It is estimated that 17,000 are operational throughout the country. This equates to about one vehicle for every person in the Cook Islands. To date there are approximately 30 EV (cars). There are also several e-scooters/bikes and three-wheeler tuk-tuk types operated by the private sector. For electric vehicle (EV) owners, having convenient access to a charging station is as important as a normal driver having access to a gas station. However, there are notably less public EV charging stations available than gas stations. Many EV owners decide to install their own EV charging station at their home. If they want to be independent of the grid and want to maximise their use of the renewable energy that they are generating, they can set up their own system to direct some of their solar panels generated energy into their EV battery. If not, EV consumers will need to fit a solar carport/canopy, an EV charging station and a solar inverter. Together, these create a pipeline where the energy from a solar panel can be converted and fed into the EVs.
Climate Change Rationale:	Zero/ reduced emissions due to plug-in electric vehicles with DC electric motor and a rechargeable battery instead of internal combustion engine. No air pollution.
Implementing Agency:	OPM – REDD & Ministry of Transport
Estimated Cost:	USD$24,000 initial outlay. [13] O&M battery replacement costs. Subsidy – shared costs with government/consumer.
Further Action/Info needed:	Detailed technology specifications and costings needed.
Development Impact: Economic, environmental, social	Reduces demand for existing grid supply. Reduced EV operating costs for consumer. Cheaper running and maintenance costs for owners of EVs. Reduced air and noise pollution.
Potential Issues:	Restrictive cost for potential owners. Need for incentives to encourage uptake and accessible to potential low-income consumers. Need for suitable banking/financing and insurance products. Importance of maintaining grid-tied EV charging to support higher levels of renewable energy used by the Rarotonga customer. Need for a flexible load to help manage times where there is either too much PV generation (by increasing load through higher EV charging) or too little (by reducing load through turning off distributed EV chargers).

[13] For example, see www.solarking.co.nz/off-grid-solar/

Present Status:	Technology alignment with GCF Concept Note which includes a RE plan and e-transport policy.
Timeframe:	Potentially 12–18 months for concept/project development.

TRANSPORT FACT SHEET 3

Technology:	Public - Electric wireless/trackless tram system for Rarotonga public transport: no batteries, capacitor energy storage, short range, fast auto charging (30 seconds) at each bus station (e.g. Taiwan's Kaohsiung or Israel's Tel Aviv system).
Sector Area:	Transport Sector
Priority Alignment:	Climate Change Country Programme
Background: General Info on technology, developed and ready to use, used elsewhere	The world's largest manufacturer of railway stock, CRRC, in Zhuzhou, China. CRRC produces Autonomous Rail Rapid Transit (ART), or the trackless tram. The trackless tram seeks to replicate the light rail experience. The differences are that optical guidance systems replace rail, with rubber tyres on railway-type bogeys replacing steel wheels. Many of the tracklaying and utility relocation costs of light rail construction can be avoided. The capital cost of light rail has risen to around A$210 million per km. For A$4m/km, trackless trams can be introduced very quickly on a road of acceptable quality. Optical guidance delivers very precise ride quality, without the sway of buses. Multiple carriages offer greater capacity (up to 500 passengers). The first, four-stop trial began in Zhuzhou in 2017. Trackless trams have since been launched in Yongxiu and Yibin. Note road quality affects the ride. Historically, it does not take away from road capacity, but rather adds to public transport capacity. The vehicles are electric, using supercapacitor batteries which are mounted on the roof and charged via a collector at stations only (which feature an electric 'umbrella'). Super-capacitor technology is not new, and has been launched in Shanghai (buses), Nanjing (light rail), Guangzhou (light rail) and Ningbo (buses) over the past decade. Its multi-axle hydraulic steering technology and bogie-like wheel arrangement designed with less overhang thus requiring less clearance in turns. On the Zhuzhou test track, the vehicles require just 3.83m of swept path clearance, as compared with 5.74m for a standard rigid bus. Each section of the 32m vehicle is around 10.5m long, and a minimum turning radius of 15m is required.
Climate Change Rationale:	Emissions are reduced due to being an electric vehicle with quick charge super capacitor instead of internal combustion engine. Reduce traffic congestion.
Implementing Agency:	Ministry of Transport
Estimated Cost:	USD4–5million per km - USD2.5 million per tram
Further Action/Info needed:	Project concept and design with technical specifications and costs.

Development Impact: Economic, environmental, social	Economic – has the potential to improve efficiency of government operational costs. This includes a reduction in foreign exchange spending. Social – more spending available for social, health and education initiatives. Environmental – reduced traffic congestion and need for land for the road network and parking spaces.
Potential Issues:	Road quality, traffic reduction policy, 5km range before charging ports. 2.65 metres wide 3.4m high.
Present Status:	No project design.
Timeframe:	2–3 years for project development phase.

TRANSPORT FACT SHEET 4

Technology:	Private Sector - Conventional electric buses, and/or with fast-swap spare battery packs, recharging for spare packs at terminus. (E.g. Wellington City Council NZ).
Sector Area:	Transport Sector
Priority Alignment:	Climate Change Country Programme`
Background:	Today, about 17 percent of the world's buses are electric — 425,000 in total, but 99 percent of them are in China. Electric buses bring with them a wide range of advantages, where the most important one is a reduction of air pollution levels. Switching to use electric buses should significantly improve the quality of air. The cost of maintenance is about 25% lower than the maintenance cost of a diesel bus. An electric engine's energy losses are significantly lower than diesel engine's energy losses, so the cost per kilometre of electric bus travel is about a third of the cost of a diesel bus ride. The electric bus is much quieter than a diesel bus, significantly reducing the environmental noise. The electric buses combine a regenerative braking system that generates electricity during the braking process. The electric bus is two times more expensive than a diesel bus, but the cost is expected to go down. Conventional charging system limits the driving distance. Charging systems that enable long driving distance are very expensive. Charging times can be reduced by battery swapping and completed in 10 minutes. Adoption of this technology includes constructing/renovating public transport facilities/terminals to accommodate low or no emission buses. Travel range of 150km per overnight charge.

Climate Change Rationale:	Zero/ reduced emissions due to plug-in electric vehicles with DC electric motor and a rechargeable battery instead of internal combustion engine produces no air pollution. Reduce traffic congestion
Implementing Agency:	Ministry of Transport and Private Sector bus companies
Estimated Cost:	USD450, 000 – USD700, 000 per vehicle.
Further Action/Info needed:	Project concept and design details needed.
Development Impact: Economic, environmental, social	Economic – has the potential to improve efficiency of operational costs. Social – health benefits from reduced air pollution. Environmental – potential for reduced traffic congestion.
Potential Issues:	Cost of installing technology outlay is two times more than diesel buses. Many challenges are of a technical nature: the size of feeder pillars has an impact on street planning; the availability of data and a good-functioning back office support is important to provide real-time and useful information to bus drivers; under-dimensioned network infrastructure could be an obstacle for charging infrastructure availability; but the overall reliability of the buses is key for both client and driver satisfaction. Moreover, maintenance and repairing of electric buses can proof to be difficult due to limited expertise.
Present Status:	No project concept or design.
Timeframe:	Up to two years for project development phase before implementation.

TRANSPORT FACT SHEET 5

Technology:	Establishment of workplace EV charge stations (government and private), for cars and bikes (generic hardware) and smart chargers.
Sector Area:	Transport Sector
Priority Alignment:	NSDP, Climate change country programme
Background: General Info on technology, developed and ready to use, used elsewhere	Development of an e-transport policy (noting Government Fleet Management policy, 2018) and review of current Renewable Energy plan to be carried out. The development of a land transport strategy, institutional and regulatory frameworks, are expected to facilitate e-transport initiatives and services in Cook Islands. There are approximately 30 electric cars in Cook Islands with an increasing number of electric scooters and bikes operating to support the transport needs and experience of the tourism industry.

Background: General Info on technology, developed and ready to use, used elsewhere	As the number of government and private sector EVs rises, more charging stations will be required to improve EV charging needs. Not all cars can be charged at the same time or the capacity of the local grid will overload. There are two ways to increasing the number of EV charging technology. This includes both the EV charging stations and EV charging load controlling technology, or smart charging. Controlled or smart charging helps with reducing the simultaneous charging. Vehicles are often plugged in for a longer time than they need to take power in. This leaves room for smart charging: cars can be plugged in at home and at work, and charged when it is the most efficient, both cost-wise and grid wise. Vehicles can be charged during low demand periods – for instance delaying charging time from high demand evening hours to more grid-friendly time. Car batteries can also be used to balance the grid during peak moments. With smart systems, charging power can be momentarily dropped down to hinder launching expensive and inefficient extra power plants. People charging their cars don't even notice the small effect.
Climate Change Rationale:	Emissions are reduced due to reduced use of petrol and diesel vehicles. Reduce use of fossil fuels for generation to improve grid stability.
Implementing Agency:	Ministry of Transport and OPM REDD & Private Sector
Estimated Cost:	$2000 per charging unit. O&M costs to be determined. Potential for co-financing through PPP.
Further Action/Info needed:	Project concept and proposal details including costs needed.
Development Impact: Economic, environmental, social	Economic – potential to leverage tourism destination promotion/ experience. Potential for additional economic incentives through trading of electricity using the grid as a conduit, when suitable EVs and charging facilities are sourced i.e. V2G capable. Social – education, training and career opportunities with new technology. Environment – noise reduction.
Potential Issues:	Non-generic technology used. EV compatibility with charging station – EV charging connector or plug type standard varies across EV models.
Present Status:	New - no project design.
Timeframe:	12-18 months for project development phase, including feasibility and environmental and social safeguards assessments.

WASTE MANAGEMENT - FACT SHEET 1

Technology:	Pa Enua Solar Powered Waste Management depots
Sector Area:	Waste & Energy Sectors
Priority Alignment:	Cook Islands Climate change country programme, Island Development Plans, Draft Solid Waste Management Strategy 2017-2021
Background: General Info on technology, developed and ready to use, used elsewhere	Waste management is a significant issue for the Cook Islands. Although efforts are undertaken to encourage the practice of reduce, reuse and recycle, solid waste management systems are vulnerable with landfill flooding due to extensive rainfall, carrying the risk of ground water contamination. Increased temperatures equate to increased levels of combustion at sites. Currently there are built waste management facilities on Rarotonga and Aitutaki, which are near capacity. The rest of the islands practice open dumping, which has detrimental impacts on ecosystems, health and community livelihoods. Dumpsites are usually located at low levels and excavated with little planning and hydraulic protection (CIGov, 2019). This technology seeks to set up a depot to sort/separate by identified waste streams on each island for repatriation, recycling or reuse purposes. This technology is part of a private sector initiative to manage and reduce waste volumes of all types with increasing impacts on the environment, communities, livelihoods and the economy. Overall plan to eliminate stockpile of waste on all islands and instigate systems to eliminate future waste streams.
Climate Change Rationale:	Increased temperatures and increased rainfall intensity accelerate the release of Persistent Organic Pollutants (POPs) from waste into the environment and the food chain. Climate change has accelerated the need to find measures to reduce and manage the waste we create. Reduction and reuse of waste will help reduce pressure on the planet's natural resources while potentially reducing emission of greenhouse gases created through mass production and burning of fossil fuels. The expected increase in intensity of storms also pose a risk to keeping waste contained on small islands and atolls in Cook Islands. The move to using global warming gases for refrigerants adds new pressure to global warming. Inorganic waste represents greenhouse gases emitted previously during the manufacturing process. All manufactured goods use natural resources, and this results in the emission of greenhouse gases, particularly carbon dioxide and other pollutants. Rubbish sent to a dumpsite or landfill represents a significant amount of greenhouse gases already emitted to the atmosphere and have contributed to climate change (SPREP, 2009).[14]

[14] https://www.sprep.org/climate_change/PYCC/documents/ccwaste.pdf

Implementing Agency:	ICI, OPM – Pa Enua Governance; CIGT – Concept Note to the GCF
Estimated Cost:	US$600,000 Total cost for 10 depots (150m2each). US$192,000 Total coast for Solar power units.
Further Action/Info needed:	Incorporation of technology into full proposal development as part of GCF pipeline. Confirmation of technology costs and design details.
Development Impact: Economic, environmental, social	Economic - shift towards circular economy approach. Provides enterprise and job creation opportunities. Social – removal hazards such as open dump sites and health impacts. Environmental - reduced effects of pollution and land degradation.
Potential Issues:	Need for GCF concept note integration.
Present Status:	Concept Note prepared for GCF assessment of eligibility.
Timeframe:	Potentially this will take up to18 months for development and 2-3 years for implementation.

WASTE MANAGEMENT - FACT SHEET 2

Technology:	Village Collection and storage containers as part of implementing Pa Enua household/community collection and sorting strategy for removal off island.
Sector Area:	Waste Management Sector
Priority Alignment:	Cook Islands Climate change country programme, Island Development Plans, Draft Solid Waste Management Strategy 2017-2021 – ICI & CIGT GCF Concept Note.
Background: General Info on technology, developed and ready to use, used elsewhere	The Waste sector contributes 6% to the GHG emissions 2007 – 2014 average behind Agriculture and Air Transport sectors on 8% each (CIG, 2019). As part of establishing the Pa Enua depots, all recyclable and waste material would be collected weekly by the Islands Council and delivered to the depot. Each village will have suitable containers supplied, to enable villagers to deposit all recyclable and non-organic waste. Waste will be removed to depot for preparation and stored ready for shipping back to Rarotonga for further processing to recycle, reuse or repatriation.
Climate Change Rationale:	Of high concern is the burning of plastic and rubber which releases dioxins into the air. Global warming exacerbates the degradation of wastes and the associated leaching of pollutants. The expected increases in storm intensity and associated flooding from climate change will result in more of this waste entering the ocean with runoff. With all types of waste including recyclables and hazardous waste remaining on many islands and not being properly managed, there is an increasing risk to the populations that dwell on these islands. This is because of poor waste management practices which include waste being dumped, buried, littered and as mentioned above, burned in yard fires.

Implementing Agency:	CIGT & Island Councils
Estimated Cost:	US$175,000 - cost for containers at 35 district centres. O&M – to be determined. Potential funding from GCF and PPP with government/CIGT and adoption of an Advanced Disposal Fee (ADF) policy currently being developed for consideration.
Further Action/Info needed:	Project design details
Development Impact: Economic, environmental, social	Economic - shift towards circular economy approach away from traditional economic approach of make–use–dispose, to make-use-reuse approach. Provides enterprise and job creation opportunities. Social – removal of waste related hazards that impact on health from open dump sites, leaching into water sources/lagoon. Environmental - reduced effects of pollution and land degradation – reduce burning practices to dispose of waste thereby reduce air pollution.
Potential Issues:	
Present Status:	Concept Note under development and assessment by GCF/ Government.
Timeframe:	2-3 years to implementation; ongoing initiative.

WASTE MANAGEMENT - FACT SHEET 3

Technology:	Rarotonga storage facility for disposal/repatriation of EV batteries and other hazardous waste
Sector Area:	Waste Management & Land Transport
Priority Alignment:	CCCP, NSDP
Background: General Info on technology, developed and ready to use, used elsewhere	Managing the hazardous waste stream is a key concern and a component of the Solid Waste Management Strategy. Furthermore, with growing interest in EV public and private transportation solutions, the reuse, recycling and disposal of batteries requires attention. In the case of batteries deemed too worn out for driving, lithium-ion batteries can still have sufficient charge left in them. Their life can be extended in helping prop up grids and maintain even electricity flow before recycling. In the case of older technology, 96% of the materials of lead acid batteries can be recovered in the recycling process. Disposing for recycling would require safe storage and handling for repatriation to offshore recycling plants. This is because batteries carry a risk of giving off toxic gases if damaged.

Background: General Info on technology, developed and ready to use, used elsewhere	Also, core ingredients such as lithium and cobalt are finite, and extraction can lead to water pollution and depletion. It is a priority for ICI GCF proposal to establish a site for hazardous waste where there is no overseas solution. This facility is to be established in conjunction with CIGT GCF proposal where other hazardous waste from e-waste, and white ware will be processed.
Climate Change Rationale:	It is commonly understood that waste sector policies and activities address broad environmental objectives, such as preventing pollution, mitigating odours, preserving open space and maintaining air, soil and water quality. These policies and activities offer co-benefits for climate change mitigation as GHG emission reductions result (IPCC, 2007. P.610). As such hazardous waste management is also able to contribute to reduction of harmful chemicals and gases.
Implementing Agency:	ICI
Estimated Cost:	Indicative US$2M to be confirmed. Potential funding through ADF.
Further Action/Info needed:	Costings and design details
Development Impact: Economic, environmental, social	Economic - shift towards circular economy approach away from traditional economic approach of make-–use–dispose to make-use-reuse approach. Provides enterprise and job creation opportunities. Social – removal of waste-related hazards that impact on health from open dump sites, leaching into water sources/lagoon. Environmental - reduced effects of pollution and land degradation – reduce burning practices to dispose of waste thereby reduce air pollution.
Potential Issues:	GCF alignment between ICI and CIGT proposals;
Present Status:	Draft GCF concept note
Timeframe:	2 – 3 years proposal development to implementation

WASTE MANAGEMENT - FACT SHEET 4

Technology:	Balers for preparing plastics and aluminum cans, hazardous waste for removal
Sector Area:	Waste Management
Priority Alignment:	CCCP, Pa Enua Plans GCF Concept Notes
Background: General Info on technology, developed and ready to use, used elsewhere	As part of implementing the Solid Waste management strategy and GCF concept notes, waste management facilities and Pa Enua depots will need equipment to support collection and preparation of waste material for storing and shipping. Balers are used to compress recyclable and waste materials into small, manageable bales. Balers are used in many industries such as manufacturing, schools, retail outlets, recycling facilities, and other businesses.

Background: General Info on technology, developed and ready to use, used elsewhere	Materials such as cardboard, textiles, foam, plastics, cans and bottles are compressed in balers and then baled for transport to a waste or recycling facility. For recyclables, balers help streamline waste processing routines and also reduce hauling requirements. Benefits also include fire hazard reduction and better overall sanitation due to waste containment and control.
Climate Change Rationale:	Recycling measures lead to indirect energy savings, reductions in GHG emissions, and avoidance of GHG generation. This is especially true for products resulting from energy-intensive production processes such as metals, glass, plastic and paper (Tuhkanen et al., 2001). Recycling reduces GHG emissions through lower energy demand for production (avoided fossil fuel) and by substitution of recycled feedstocks for virgin materials. Efficient use of materials also reduces waste. Material efficiency can be defined as a reduction in primary materials for a particular purpose, such as packaging or construction, with no negative impact on existing human activities. At several stages in the life cycle of a product, material efficiency can be increased by more efficient design, material substitution, product recycling, material recycling and quality cascading (use of recycled material for a secondary product with lower quality demands) (Bogner et. al., 2007 p.602).
Implementing Agency:	ICI & CIGT
Estimated Cost:	USD160,000 cost for 5 x baler machines
Further Action/Info needed:	Project design details – detailed equipment specifications
Development Impact: Economic, environmental, social	Economic - shift towards circular economy approach away from traditional economic approach of make–use–dispose to make-use-reuse approach. Provides enterprise and job creation opportunities. Social – removal of waste related hazards that impact on health from open dumb sites, leaching into water sources/lagoon. Environmental - reduced effects of pollution and land degradation – reduce burning practices to dispose of waste thereby reduce air pollution, restoration of open dump sites.
Potential Issues:	GCF alignment between ICI and CIGT proposals;
Present Status:	Draft GCF concept note
Timeframe:	2 – 3 years proposal development to implementation

WASTE MANAGEMENT - FACT SHEET 5

Technology:	Supply and Installation of shredder machinery and facility
Sector Area:	Waste Management (Land Transport)

Priority Alignment:	CCCP, Solid Waste Management Strategy, Island Development Plans
Background: General Info on technology, developed and ready to use, used elsewhere	BCI records show there are currently 24,378 registered vehicles in the Cook Islands. With a number off the road but still registered, it is estimated that given the Cook Islands population (census 2016 of 17,434 and 13,007 in Rarotonga) this would equate to 17,000 vehicles on the road or one vehicle for every man, woman and child in the country. There is also substantial heavy machinery waste in the Cook Islands. The SWMS includes the removal and disposal of vehicles and machinery to achieve environmental objectives. This requires obtaining suitable shredder machinery. Associated with removing and transporting scrap metal from the Pa Enua to Rarotonga, there would be a need for other equipment such as metal cutters and packing/cartage metal crates. A car shredder will turn a car into a large bucket of scrap steel and the rest of the car into non-ferrous materials, plastics and waste called automatic shredder residue. The glass, fabric, plastic, and all other non-ferrous materials are separated by eddy-current magnets in place of heavy media separation. The profit from the non-ferrous materials often covers the operating cost for the shredder. Metal scrap recycling is a large industry that processes scrap iron and steel, copper, aluminium, lead, zinc and stainless steel, and smaller quantities of other metals on a yearly basis.
Background: General Info on technology, developed and ready to use, used elsewhere	An engineered enclosure to contain noise and dust, and associated loading and grading equipment and storage facilities, will also be required. The shredder can also be used to shred motorbikes, white ware, air conditioners and other scrap metals. Steel particles can be used in place of gravel, or in concrete. Rubber particles can replace gravel in roading, and aluminum can be exported for reuse.
Climate Change Rationale:	The mitigation of GHG emissions from waste relies on multiple technologies of which the recycling of scrap metal and non-ferrous materials is one such technology. Recycling of such materials reduces the demand on landfills and open dumping of vehicles, machinery and white ware.
Implementing Agency:	ICI & CIGT
Estimated Cost:	Capital cost USD1.5m - Metal cutting machinery USD50, 000; Cartage metal crates x 3 USD15, 000; Shredder USD200, 000, metal sorting plant USD400, 000 and building USD800, 000. O&M costs to be determined. Co-funding through PPP.
Further Action/Info needed:	Detailed costing and proposal details

Development Impact: Economic, environmental, social	Economic – potential for private sector investment with PPP. Provides enterprise and job creation opportunities. Social – removal of waste related hazards that impact on health from open dump sites, stagnant water hazard. Environmental - reduced effects of pollution and land degradation.
Potential Issues:	
Present Status:	GCF concept notes drafted
Timeframe:	Potential 18-month project development phase.

ANNEX THREE: LIST OF STAKEHOLDERS INVOLVED AND THEIR ENGAGEMENT

LAND TRANSPORT

NAME	ORGANISATION	CONSULTATION APPROACH	TOPICS
1. John Hosking	Head of Ministry, Ministry of Transport	Face-to-face and email discussions, workshop	MCA, compiling technology, policy development and institutional arrangements
2. Jolene Bosanquet	Te Ipukarea Society/Tourism sector/EV owner	Face-to-face and email discussions, workshop	Vehicle stock information Technology prioritisation
3. Steve Anderson	Chamber of Commerce	Face-to-face and email discussions, workshop	Technology specification information and prioritisation
4. Tangi Tereapii	Renewable Energy Development Division	Email discussion	Policy and sector development
5. Ngateina Rani	Renewable Energy Development Division	Face-to-face and email discussions	Policy and sector development, MCA
6. Jessie Sword	Cook Islands General Transport Ltd	Face-to-face and email discussions	Technology prioritisation
7. Malcolm Sword	Cook Islands General Transport Ltd	Face-to-face and email discussions	Technology prioritisation
8. Kai Berlick	Ministry of Finance and Economic Management	Face-to-face and email discussions, workshop	MCA, Technology prioritisation
9. Teresa Trott	Independent Consultant	Face-to-face and email discussions, workshop	Policy and sector development and institutional arrangements, MCA Technology prioritisation
10. Michelle Aisake	Te Aponga Uira – Government Power Supplier	Face-to-face and email discussions	Electricity generation & PV options Technology prioritisation

11. Dallas Young	Te Aponga Uira – Government Power Supplier	Face-to-face and email discussions	Electricity generation, PV options Technology prioritisation
12. Tama Heather	Te Aponga Uira – Government Power Supplier	Face-to-face discussion	Electricity generation, PV options Technology prioritisation
13. Daniel Webb	Te Aponga Uira – Government Power Supplier	Face-to-face discussion	Electricity generation, PV options Technology prioritisation
14. Rino Mareko	Te Aponga Uira – Government Power Supplier	Face-to-face discussion	Electricity generation, PV options Technology prioritisation

WASTE MANAGEMENT

NAME	ORGANISATION	CONSULTATION APPROACH	TOPICS
1. Jaime Short	Infrastructure Cook Islands	Face-to-face and email discussions, workshop	MCA, Technology options and prioritisation
2. Kate McKessar	Te Ipukarea Society	Email discussion	MCA
3. Jessie Sword	Cook Islands General Transport Ltd	Face-to-face, Phone and email discussions	MCA, Technology options
4. Rerekura Teaurere	Waste Management Consultant	Face-to-face and email discussions	MCA
5. Louisa Karika	National Environment Service	Face-to-face and email discussions, workshop	MCA, Technology options and prioritisation
6. Kai Berlick	Ministry of Finance and Economic Management	Face-to-face and email discussions, workshop	MCA
7. Mani Mate	Ministry of Finance and Economic Management	Email discussion, workshop	Technology prioritisation
8. Malcolm Sword	Cook Islands General Transport Ltd	Face-to-face and email discussions	Technology prioritisation
9. Diane Charlie	Head of Ministry – Infrastructure Cook Islands	Face-to-face and email discussions	Sector, policy and institutional arrangements MCA. Technology prioritisation

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