NAURU

TECHNOLOGY NEEDS ASSESSMENT FOR CLIMATE CHANGE ADAPTATION AND MITIGATION

Technology Action Plan

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TECHNOLOGY NEEDS ASSESSMENT FOR CLIMATE CHANGE ADAPTATION AND MITIGATION

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Foreword

The Republic of Nauru has undertaken a Technology Needs Assessment (TNA) which was aimed at enhancing adaptation and mitigation to the impact of climate change across the country. For this reason, stakeholder consultations were held at the national level which identified the technologies that were prioritized under this transparent TNA process.

Thus, I am confident that through this TNA process initiated by the Department of Climate Change and National Resilience (DCCNR) in partnership with the United Nations Environment Program (UNEP), University of the South Pacific (USP) and UNEP DTU Partnership have resulted in identifying some effective strategies to increasing resilience against climate change vulnerabilities through transfer and diffusion of prioritized technologies as detailed in the Phases I[1] & Phases II[2] of the TNA reports.

I am further pleased to note that the entire process requires the formulation of Technology Action Plan (TAP). The TAP takes accounts of national projects which have been executed in the past in line with national aspirations for adaptation and mitigation to climate change, as well as prevailing national development framework and relevant sector policies.

In the TAP, two technologies in each of the sectors for both adaptation and mitigation were prioritized from the TNA process. For the water sector under adaptation, the prioritized technologies are (i) Rooftop rainwater harvesting system technology and (ii) Water reticulation system technology. While for coastal area management, technologies prioritized include (i) Coastal vegetation restoration technology and (ii) Locally managed marine area technology. Under mitigation, some logical changes were made to the outcome of the initial TNA multi-criteria analysis that is fully supported and justified in this TAP report. These include (i) OTEC technology and (ii) PHES technology for Energy Sector with (i) Waste segregation technology and (ii) Semi-aerobic landfill technology for Waste Sector. These technologies were then mapped out through the TAP process on how the country could pursue implementation of the activities identified for each technology.

I strongly believe that the implementation of both the adaptation and mitigation technologies above will help this country build inclusive resilience to the impact of climate change. On that note, I would like to thank the National TNA Project Coordinator, the National TNA Team and both the Adaptation and Mitigation consultants. Lastly, may I thank all the experts from USP, United UNEP, UNEP-DTU Partnership for their constant support and guidance for implementation of the TNA project especially this TAP report.

Hon. Rennier Gadabu, M.P
Minister for Climate Change and National Resilience

[1] TNA Phase I is the Nauru Technology Need Assessment Report (2020) *for both adaptation and mitigation.* Ministry of Climate Change & National Resilience, Nauru

[2] TNA Phase II is the Nauru Barrier Analysis and Enabling Environment Framework Report (2021). *Technology Action Plan.* Ministry of Climate Change & National Resilience, Nauru

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List of Abbreviations

AEWG	:	Adaptation Expert Working Group
AIT	:	Asian Institute for Technology,
BAEF	:	Barrier Analysis and Enabling Framework
BESS	:	Battery Energy Storage System
CBO	:	Community Based Organization,
CC	:	Climate Change
CED	:	Climate Change and Environment division,
CTCN	:	Climate Technology Centre and Network
DCIE	:	Department of Commerce, Industry and Environment,
DCCNR	:	Department of Climate Change and National Resilience
DoE	:	Department of Education (DoE),
DoF	:	Department of Finance
DTU	:	Technical University of Denmark,
GCF	:	Green Climate Fund
GEF	:	Global Environment Facility
GHG	:	Greenhouse Gas
INDC	:	Intended Nationally Determined Contributions
LMMA	:	Locally Managed Marine Area,
MW	:	Megawatt
NDA	:	National Designated Authority
NDE	:	National Designated Entity
NEPF	:	Nauru Energy Policy Framework
NERM	:	Nauru Energy Road Map
NFMRA	:	Nauru Fisheries and Marine resource authority,
NGO	:	None Government Organization,
NRC	:	Nauru Rehabilitation Corporation
NSDS	:	National Sustainable Development Strategy,
NUC	:	Nauru Utilities Corporation,
NWSHIP	:	National Water, Sanitation and Hygiene Implementation Plan,

NWSHP	:	National Water, Sanitation and Hygiene Policy,
OECC	:	Overseas Environmental Cooperation Centre
OTEC	:	Ocean Thermal Energy Conversion
PHES	:	Pumped Hydro Energy Storage
RE	:	Renewable Energy
RO	:	Reverse Osmosis,
RoN	:	Republic of Nauru
RONAdapt	:	Republic of Nauru Framework for Climate Change Adaptation .
RT RWHT	:	Rooftop Rainwater Harvesting Technology,
RTRWH	:	Rooftop Rainwater Harvesting,
SDG	:	Sustainable Development Goal
SIDS	:	Small Island Developing States
**SNC ` **	:	Second National Communication
SWAC	:	Seawater Air Conditioning
SWM	:	Solid Waste Management
T+TI	:	Tonkin and Taylor Ltd
TAP	:	Technology Action Plan
TEPCO	:	Tokyo Electric Power Company
TNA	:	Technological Need Assessment,
UNEP	:	United Nation Environment Program,
UNFCCC	:	United Nations Framework Convention on Climate Change
UNIDO	:	United Nation Industrial Development Organisation
USP	:	University of the South Pacific
WRS	:	Water Reticulation System

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Executive Summary

The Technology Needs Assessment (TNA) Project in Nauru is aimed at enhancing adaptation and mitigation to impacts of climate change. Through a series of national stakeholder consultation processes, the water and coastal area resource management sectors were selected for adaptation and waste management and renewable energy were selected for mitigation stream. The two sectors selected for adaptation are different but are inter-linked as the availability of water in its various forms supports replenishment of coastal vegetation, preventing soil erosion and impacts of sea-level rise (SLR) at the coastlines. On the other hand, water availability on the island nation is regarded as a key challenge for the national economy. If coastal landowners resort to "fast money" by selling their coastal resources (mainly through sand mining), it can impact water resources. With the mitigation, waste management and renewable energy are related to a certain extend since landfills could also offer a clean, renewable energy resource through the decomposition of waste.

The negative impacts of climate change in the four selected sectors need to be identified with clear intervention options developed and implemented to achieve and sustain socio-economic development. This rationale, therefore, informs the preparation of the Technology Action Plan (TAP). Therefore, there is an urgent need to transfer and diffusion technologies in these enlisted identified sectors, which will enhance resilience to climate change impacts. The TAP derives from the technology selection and prioritization outlined in the TNA report and the subsequent barrier analysis and enabling framework (BAEF) phase. In addition, the TAP also builds on climate change projects executed in the past for adaptation and mitigation. In this regard, the two prioritized technologies for each sector included in TAP are listed below.

For the water sector, these are:

(i) Rooftop rainwater harvesting system technology (RTRWHST),

(ii) water reticulation system technology (WRST)

For the coastal area management, these are:

(i) Coastal vegetation restoration (CVR)

(ii) Locally managed marine area (LMMA),

Water Sector – RTRWHST

The RTRWHST covers the collection, storage and use of rainfall collected by individual households or by community halls with the intention for multi-purpose use in the communities. In many areas around the island, small-scale rooftop rainwater harvesting collection infrastructure can contribute greatly to the volume of freshwater available for human use and other multi-purpose uses. The transfer and diffusion of this technology is envisaged for the 150 households around the Island country. The total cost of the project is estimated at **USD $1,050,000**.

For the rooftop rainwater harvesting from homes and community halls, the diffusion of this technology comes with certain economic and financial barriers as well as non-financial barriers. Economic and financial barriers were associated mainly with the technology's high construction and maintenance costs. The non-financial barriers relate to institutional and technical barriers. Institutional barriers identified included lack of community ownership of the water system, conflicting sectoral policies on promoting the technology and inadequate integration of the technology in policy plans. The technical barriers included the inadequate expertise displayed by locals to establish rooftop systems and maintenance in the various communities. All these barriers result in the weaking of the driving mechanisms from government agencies in pusing for widespred adoption of the technology.

Water Sector – Water Reticulation System Technology (WRST)

The water reticulation system technology aims to increase access to water by essential government departments such as hospitals, schools, police headquarters, and other government departments. An expansion to this technology would ensure water pipes reach more than 55 business houses and 1,650 households around the Island. The technology was partially implemented some years back in the country at certain locations. This technology is intended for diffusion across the Island nation with an estimated cost of **USD 5.5 million**. The main economic and financial barrier for this water reticulation system technology is the inadequacy of capital cost and the ageing infrastructure currently installed at some locations on the island but without use for more than 20 years or so. This results directly from high capital costs and inadequate access of communities and business houses to financial resources. The institutional barriers to the diffusion of this technology are the lack of specific policy design around the implementation of water reticulation system technology in the country, resulting in a lack of coordination by relevant authorities to obtain external assistance for maintenance and repair of the existing ageing infrastructure.

Coastal Area Resource Management Sector – Coastal Vegetation Restoration Technology

This report referes to replenishment of the coastal native vegetation as coastal vegetation restoration (CVR) . The technology aims at re-planting trees and floras at the coastline areas to prevent coastal erosion and saltwater inundation into the nearby communities. Replenishment of the coastal vegetation is critical to prevent storm surges and, in some areas, enhance soil fertility towards improving and preserving soil productivity. The benefit of the technology includes – increasing biodiversity and root systems filtering wastewater from the land to the sea, minimizing pollution of coastal marine areas. It is proposed that CVR be transferred and diffused as a project nationwide, particularly in coastal areas that are highly exposed to sea-level rise and coastal erosion. The target is to diffuse the technology to 50 landowning groups and NGOs around the island to enhance coastal vegetation in response to climate change adaptation. The estimated budget is **USD 1,500,000,** and it is estimated that more than 50% of the population will directly benefit from this technology.

Some identified barriers that prevent the diffusion and transfer of this technology to the communities are technical deficiencies of locally available specialists in CVR and attitudinal problems of land-owning groups for the locally managed marine area (LMMA). Socio-cultural and economic practices are also major barriers. A typical example is the practice of coastal sand mining for *"fast money*" by landowning groups that deplete vegetation in many cases on the limited arable lands along the coast. To control this, there is a need to develop policies and regulations on how individuals, business houses, and landowning groups could harvest these coastal resources. However, there is the need for a national programme on the transfer and diffusion of these technologies.

Coastal Area Resource Management Sector –Locally Management Marine Area

A Locally Managed Marine Area (LMMA) includes nearshore waters and associated coastal and marine resources that are partially or wholly managed locally by the coastal communities, land-owning groups, partner organizations, or collaborative government representatives that reside or are based in the locality of the designated area. In the context of Nauru, the Department of Fisheries has an existing LMMA model which could be developed in communities that participated in pursuing this technology. Households and land-owning groups must conserve their coastal area resources, but there must be an allocated area in which they could be allowed to fish and provide for their livelihoods. The LMMA conservation of

resources model can contribute to climate change adaptation by increasing the volume of fish and marine diversity at the conserved sites. This also increases food security in terms of fish and other marine resources to communities who have participated in this technology. TAP proposes the diffusion of LMMA in 25 selected communities around the Island to conserve their resources for future uses and risk from food insecurity. The estimated budget is **USD 1,250,000**.

Barriers to introducing this technology

Inadequate baseline data on LMMA in the country, surveillance difficulty, enforcement, and monitoring over the designed LMMAs and staffing cost are some of the challenges that the LMMA technology needs to address to be effective and viable. In addition, there are also the usual economic and non-economic barriers to overcome. The economic and financial barriers include the smooth promotion and diffusion of this technology which revolves around the lack of motivation for available fishery personnel and land-owning groups to venture into such investment. Furthermore, the absence or inadequacy of immediate financial benefits the LMMA technology could have on communities is also considered a demotivating factor for landowning groups to commit their resources under such undertakings. This also indicates the low level of awareness which respective communities' values on LMMA technology. Moreover, the inadequate training for the agents of land-owning groups is closely associated with the barrier above. However, the LMMA transfer and diffusion project can address some of these barriers.

Action Plans

Action plans have been developed for the four prioritised technologies. The development of the action plans involved a series of consultation processes that ensured that the key stakeholders participated in the decisions making of formulating the plan. The lead agencies that deliberated at the stakeholders' workshop on the technology action plans included the Department of Climate Change and National resilience (DCCNR), the Department of Industry and Environment (DIE), the Nauru Utility Corporation (NUC), the farmers, researchers, and civil society organizations. The experts presented the drafts of the plans and the working groups formed for the two sectors, namely, water and coastal area management, discussed the action plans and revised them appropriately. The experts later finalized the plans. It is envisaged that the technology transfer and diffusion of these four prioritised technologies in

the water and coastal area management sectors will be done in the appropriate phases. However, cross-cutting issues need to be considered as generally applying to the technology transfer and diffusion process. An important measure that cuts across is the review of national policies to address various issues, including market competition, financial regulations, socio-cultural practices, rights, and beliefs. For example, financial measures hinge mainly on the need for government action to reduce the cost of supply of inputs or materials and equipment for the technologies. This can be done at the macro level by reducing subsidies, reducing import duties, and providing incentives to individuals or landowning groups who have participated in this process.

Energy Sector

Nauru has relied on diesel for power generation since 1907 and first adopted solar water heaters in the 1970s. In 2004, Nauru conducted an assessment on key energy issues on barriers to the development of renewable energy (RE) to mitigate climate change (CC). By 2008, the first 40 kWp grid-connected solar PV system was installed on the roof of Nauru College. Nauru's first Energy Policy Framework was achieved in 2009 with a vision – "Reliable, affordable and sustainable energy, enabling the socio-economic development of Nauru." In 2014, the Nauru Energy Road Map (NERM-2014 to 2020) was developed, further building upon the energy sector development agenda in the National Sustainable Development Strategy 2005 -2025 (revised 2009).

To date, Nauru has an installed capacity of 2.6 MW of combined rooftop and ground-mounted solar PV system tied to the grid with an additional 6 MW of a planned ground-mounted solar farm to be installed and commissioned by the end of 2022. In addition, a BESS rated at 5 MW/ 2.5 MWh will also be included with the 6 MW solar farm. However, some notable future challenges associated with high penetration of solar-grid integration; if not properly planned or managed, can lead to serious instability on grid voltage and frequency stability; and overall power quality in the event of cloud coverage.

For the energy sector, the two mitigation technologies that have been prioritised for this TAP report are:

(i) Ocean Thermal Energy Conversion (OTEC)

(ii) Pumped Hydro Energy Storage (PHES)

Although grid-connected rooftop solar PV was ranked second in the TNA MCA, further analysis in the BAEF phase revealed issues related to over-penetration and grid-management. For this purpose, the prioritisation of PHES over solar PV is supported by the energy expert working group as the solution to this issue.

Energy sector - OTEC

The progress of OTEC development and its viability status for its construction in Nauru – 40 years since it was first piloted in Nauru back in 1981 is currently being implemented. OTEC capacity as a sustainable source for power generation and providing baseload and seawater desalination are key to achieving Nauru's sustainable development goals (SDG). The action identified by the expert working group for implementation as project ideas is a feasibility study noting that a pre-feasibility study is currently being implemented. Stakeholders who were initially involved in developing the first TNA report will be included as stakeholders during the implementation phase of the prioritised technologies.

Energy Sector - PHES

PHES may be a new technology to Nauru. However, the concept of pumping seawater to upper reservoirs has been used during the establishment of the phosphate mining industry as a source for engine cooling, firefighting, and residential non-potable use – toilet flushing and swimming pools. PHES is also cheaper than battery energy storage systems (BESS), commonly considered for grid storage. It also helps in grid management hence supporting the expansion of RE system installations like solar PV, firefighting, engine cooling, raw feed for reverse osmosis plants and non-potable use, to name a few. PHES installation is estimated at **USD 40,000,000** based on recent studies. One of the barriers identified for developing this technology is funding for a feasibility study.

Waste Sector

Nauru has developed several legislations, policies and projects that have shown slow progress is being implemented. During the TNA sessions conducted in 2019, stakeholders identified the waste sector as a major contributor to Nauru's GHG emissions, second to the energy sector.

Although composting was ranked first with waste segregation second during the TNA MCA process, waste segregation and semi-aerobic landfill have now been prioritised for this TAP

following the recommendations supported in the BAEF report for an integrated approach will address all four technologies. Waste segregation at the community level not only help the production of composting (wet waste) and baling (dry waste) but will also reduce wastes reaching landfill. In addition, semi-aerobic landfills with their segregation process have been prioritised for better commercial, hospital, and e-wastes.

(i) Waste segregation
(ii) Semi-aerobic landfill

Waster Sector – Waste segregation Technology

If integrated into a proposed solid waste management (SWM) strategy, waste segregation technology will make a lot of difference and improvement to the existing dumpsite. The success of a waste segregation technology includes the development of a waste segregation strategy that involves wider community participation in its planning and implementation and with full support from the Republic of Nauru (RoN). The strategy is best tailored, developed, and implemented by the community to increase the process's motivation and sense of ownership. Full participation and coordination from the community is key to the success and sustainability of a waste segregation process. Stakeholders support the concept in promoting community-based waste segregation systems set up in each district where resource recovery sites are established to collect wet and dry waste, composting green and organic waste, and sorting and crushing of recyclable waste. This process reduces waste ending up at the dumpsite and makes available compost for backyard gardening and crushed recyclable wastes for further recycling.

Waste Sector - Semi-aerobic landfill technology

Semi-aerobic landfill technology is a proven and widely used landfilling system that effectively protects the environment, including GHG emission reductions. The development of this technology in Nauru is still in its very early stages with observations and recommendations already implemented in 2018. Prioritised activities in this TAP report include access to funding from RoN or development partners to enable the development of a proposed Master Plan recommended and costed by Tonkin and Taylor Ltd (T+TI) in their 2018 observation report.

The main activity transformed from the measures to overcome the barriers identified in the BAEF report is establishing a new state-owned enterprise (SoE) and building capacity that focuses on developing and implementing a National SWM Roadmap. The current waste sector is structured under the Department of Environment, with several officer-level personnel struggling to drive the waste sector. At this stage, it is considered paramount to appoint a Director for SWM as a pathway to establishing an SoE. Development partners will see the upgrading of the waste sector as a responsive move to support the development and implementation of its waste management projects.

Chapter 1: **Adaptation Technology Action Plan and Project Ideas for the Water Sector**

1.1 TAP for Water Sector

Water is essential for life. The health and well-being of humans, plants and animals depend on a satisfactory supply of safe, potable water, with low levels of contamination. Small island nations in the Pacific, such as Nauru, have critical water supply problems. Nauru is a permeable island with very little surface runoff and no rivers or reservoirs. Potable water is collected in rainwater tanks from the roofs of domestic and commercial buildings. Water for nonportable uses is obtained from domestic bores at houses and now the desalination plants on the island. The water sector includes water engineering, operations, water and wastewater plant construction, equipment supplies and specialist water treatment chemicals, among others (Ghaffour, et al, 2013)[1]. The water sector is at the service of other industries, for example service to the agriculture sector, it provided water to crops, vegetable and other plants.

Figure 1: Picture of Nauru

The water sector is important for its impact across sectors of the entire economy. Water is vital for agriculture, industries, health including livelihoods and other cross sections of the

[1] Ghaffour, N., Missimer, T. M., & Amy, G. L. (2013). Technical review and evaluation of the economics of water desalination: current and future challenges for better water supply sustainability. *Desalination*, *309*, 197-207.

country. The Republic of Nauru acknowledges that water security is one of the challenges its residents have to face every day because of water scarcity on the Island. Thus, through its TNA process Nauru has nominated water as one of the sectors to be prioritised for technology considerations.

1.1.1 Water Sector overview

The RoN National Water, Sanitation and Hygiene Implementation Plan (NWSHIP 2011-2026) is a document embraced to implement the country's National Water, Sanitation and Hygiene Policy (NWSHP), which sets out the visions, goals, and objectives of the RoN for water and sanitation. Despite this well-designed initiative, the country continues to experience water challenges as it faces multifaceted factors from impacts of climate change and extreme events. For example, climate change will continue to impact Nauru's vulnerable water sector, leading to insufficient supply and harmful quality, with significant ramifications for public health including an increase in water-borne diseases. According to NWSHIP (2011-2026)[2] the existing water resources in RoN are under substantial stress due to the growing population, urbanization, and subsequent unplanned land use changes. The document outlines a multi-level of challenges that need to be addressed to achieve a reliable, safe, affordable, secure, efficient, and sustainable water supply on the islands. This is in line with the Nauru National Sustainable Development Strategy's (NSDS) (2005-2025)[3] goal to achieve better standard of living to all Nauruan. However, this objective will not be easily achieved as it also has its own challenges and constraints. One of the identified constraint factors to achieve better standard of living in Nauru is the poor quality of water and expensive water cost on the island. As matter of fact, the Nauru's water supplies are vulnerable to fluctuations in rainfall, embedded with the effects of climate change on temperatures, humidity, rainfall, and weather extremes are affecting the quality and quantity of water resources available on the Islands. This increases the risks for Nauruan households to depend on the expensive desalinated salt water supplied by Nauru Utility corporation (NUC) for sustenance and livelihoods.

Furthermore, the island nation continues to face non climatic challenges in the water sector. For example, weak enforcement water quality standards, high rate of diarrhoea and health

[2] The National Water, Sanitation and Hygiene Implementation Plan (NWSHIP) a blue print document of fifteen-year plan to implement the Republic of Nauru's 2011 National Water, Sanitation and Hygiene Policy (NWSHP),
[3] Nauru National Sustainable Development Strategy (2005). Department of Commerce, Industry and Employment, Republic of Nauru.

impacts from poor quality water, especially from groundwater resources, groundwater contaminated by sewage, oil, waste pits and other contaminants, reliance on energy intensive desalinated water (up to 1/3 of Nauru power production), lack of storage at both household and national levels, maintenance of infrastructure (includes existing water tanks, tanker trucks, Reverse Osmosis (RO) equipment's and delivery capacity for RO water. The RO production capacity of desalinated water is insufficient in major droughts, unaccounted for water and water loss up to 85% of RO production[4], effective strategy needed for water delivery to priority users such as schools, the hospital and dialysis unit, public and household rainwater harvesting and storage is insufficient, and is poorly maintained and inefficient, and list goes on.

With the above backdrop, the technological development and innovation in water sector could play a critical role to achieve food and water security targets of the country considering uncertain climatic conditions cast by climate change, sea level rise and other extreme events. Thus, the strategies develop in this TAP are aimed at addressing the identified barriers and provided alternate interventions with effective implementation strategies to ensure communities adapt and have access to clean, safe, and affordable water across the Island nation in the face of climate change.

[4] Unaccounted water and water loss during draught mainly due to miss handling of water distribution and theft

1.1.2 Action Plan for Rooftop Rainwater Harvesting

1.1.2.1 Introduction

An earlier study by South Pacific Applied Geosciences Commission (SOPAC) has recommended some very relevant resolutions to address the current impact of climate change in the community. In its recommendations, a national water plan must include the following:

(i) Continue to use the existing desalination salt water as the major source of portable water in Nauru,

(ii) Introduce water charges to maintain water supply facilities on a cost recovery basis,

(iii) Replace the desalination equipment at the end of its service life with two t/d desalination units to provide greater operational flexibility operating cost savings,

(iv) Rehabilitate the existing storage tanks to provide a 20-day supply (30,000 t) of water and allow for periodic down-time of the desalination equipment,

(v) Establish the rainwater collection system as the next source of portable water,

(vi) Ensure each house and building has guttering and a large rainwater tank,

(vii) Investigate ground water system as possible emergency water supply in times of droughts, limit the extraction to minimise the risk of over pumping and adverse environmental effects,

(viii) Implement a water conservation program,

(ix) If the safe yield of ground in draught period is too small to makeup the gap between rainwater and 500 t/d, then purchase an additional desalination plant for 250 t/d capacity.

Considering the above recommendations, the National Water Policy projects the vision of ensuring portable water supply to residents in Nauru (NWSHIP 2011-2026). The policy sets the framework on how all Nauruan's should use the limited water available for the benefit of individuals or communities, the same. Regardless of this policy, the water availability on the Island nation remained a scarce commodity. The introduction of saltwater desalination plants that transform salt water into fresh water by the NUC with the Australian government sponsored initiative is a positive step in the right direction for all Nauruan's to having access to clean and safe water. Nevertheless, this clean and safe drinking water comes with a price. The cost of safe drinking water on the Island is expensive. For example, per load for household is AUD$163.00 per load (any capacity) addition to the .0084 per litre, thus, rainwater

harvesting is considered an alternate source of water on the Island. Therefore, the need to adopt rooftop rainwater harvesting system technology that will enhance resilience of the vulnerable communities and promote effective adaptation behaviours to climate change across the island is crucial. Rooftop rainwater harvesting system consist of; catchments (roof), gutter, storage tanks, structures (connections) and the human capacity which includes knowledge in the system to install and repair.

1.1.2.2 Ambition for the TAP

The objective of this TAP is to provide an action plan on how to pursue the technology under consideration for implementation. The ambition is to secure funding for more than 800 units of rooftop rainwater harvesting technologies or 50% the household around the Island. The technology is envisioned with a total cost of USD**$1,050,000**. According to Scorza, & Santopietro, (2021)[5], an action plan is a document that lays out the tasks you need to complete to accomplish your goal. It also breaks up the process into actionable assignments based on a timeline. A good action plan will outline all the necessary steps to achieve your goal and help you reach your target efficiently by assigning a timeframe with a start and end date to every step in the process. Depending on your needs and preferences, you can use this document to set single or multiple goals.

a) Target for Transfer and diffusion

It is intended that the transfer and diffusion of the technology will be done within four (4) years phased, into two (2), two-year terms from 2022 (2022-2026). The target population are the communities living mostly surrounding the island nation with existing catchment structures already in place at their homes and where there is great need to ensure that reliable and affordable water sources is available to residents. The technology will also include some repair and maintenance to existing structures. Additional units will also be installed at community halls and structures for community usage at selected sites around the Island.

[5] Scorza, F., & Santopietro, L. (2021). A systemic perspective for the Sustainable Energy and Climate Action Plan (SECAP). *European Planning Studies*, 1-21.

1.1.2.3 Actions and Activities selected for inclusion in the TAP for RTRWHT

a) Summary of barriers and measures to overcome barriers

The fundamental problem this technology provides solution to, is the expensive cost of desalinated water and shortage of portable water by average households across the country. This will allow households and individuals to have access alternate source to clean and safe drinking water which is provided by Nauru Utility Corporation (NUC)[6].

The main economic and financial barrier that prevents individuals or households in the communities affording units or technologies of their own is inadequacy of funds. For example, it would cost approximately AUD$7,000[7] to install a single technology on the Island, See Table 1 below: The cost associates directly to (i) materials which includes tank water collecting components, rooftops, (ii) imports tariffs and (iii) labour. The fundamental root causes are the inadequate support from the government and inadequate support of external agencies resulting in limited support for individuals and communities to have access to this simple technology. Moreover, fluctuating rainfall is also considered as one of the emerging barriers or issues that the technology must anticipate going forward.

Table 1: Expenses related building a single rooftop water harvesting system

Main costs of producing roof top rainwater harvesting system in Nauru		
Activities	**Details**	**Costs**
Roofing	Not included – pre-installed	0
Guttering	$10 meter @ 46 m for above roofing area.	$460
Down pipes	$5 meter @ approx. 30 m	$150
Water catchment	Storage system	$6,000
Additional costs		390
Total cost estimated		**$7,000**

Source: Adopted from BAEF Report- Republic of Nauru

[6] Nauru Utility Corporation – is a government statutory department which looks after the provision of water in the country. They provide desalinated water to households across the country by orders.

[7] This cost will be reduced over 60% if it's installed in quantity.

The institutional barriers to diffusion of this technology includes lack of government's support and poor co-ordination in the implementation of its own policy by supporting this technology across the island. Limited local capacity to instal the infrastructure may also hinders the diffusion of the technology (BAEF, 2021[8]).

To overcome the barriers discussed above, the government must intervene and subsidize costs of rooftop rainwater harvesting technology system, this could be achieved through cost sharing arrangement, provision of tax exemption, and training of local personnel to start installing these technologies across the Island.

On the social and cultural barrier perspective, respective community must accept the join ownership and responsibility such as maintenance of such technology into the future. The root cause of this is inadequate community development advocacy and training to enhance ownership to achieve join benefit and improved well-being.

b) Actions selected for inclusion in the TAP for the RTRWHT

Rooftop rainwater harvesting technologies face several challenges in economic, financial, market condition, social, cultural and the behavioural awareness in the water sector. These barriers are hindering its affordability and deployment around the Island. Strong markets are needed to stimulate the required investments in technological development and deployment, yet further technological advances are needed to increase market demand. The lack of sufficient market pulls for rooftop rainwater harvesting technology, due to its comparatively higher costs, creates the need for policy-driven support to bridge this cost disadvantage. Thus, the following actions are tailored into the TAP.

i) Government subsidy – The government is required to meet partially the cost of the technology. This is aimed at leveraging the cost to individuals and household units across the country. The government must introduce new tax instrument on businesses/individuals to fund this new initiative.
ii) Government policy- This policy is aimed at provision of the technology to average and low-income earners and meeting obligations to provide clean and safe drinking water to its people.

[8] Barrier Analysis and Enabling Framework (2021). Adaptation Sector, Nauru TNA report, Nauru

iii) Training and awareness – these are aimed at increasing awareness around water usage and applications by households.

iv) Capacity building – Locals must be trained with the technological skills to maintain and sustain the technology after the project implementation.

c) Activities identified for implementation of selected actions

i) The Department of Finance (DoF) to establish this RTRWHT subsidy scheme and formulate regulation on how to implement to the public.

ii) The government to formulate policy surrounding the access to clean and safe drinking water by its people. For example, providing cost sharing arrangement especially to the low-income earners across the country.

iii) There must be a training and awareness component aligned to the technology. This activity should be an on-going one and be implemented through workshops, focus trainings and general awareness.

iv) Upskilling of locals to install and provide maintenance to the technology is critical for long term adaptation and sustainability.

d) Actions to be implemented as Project Ideas

The following ideas are to be implemented as part of the project idea.

i) Remove economic barriers – The removal of tariffs and provision of tax exemptions to households or organisations is a positive contribution by government to ensuring that average income earners across the community have access to clean and affordable water.

ii) Enforcement of Standards – This is enforcement by the government on firms and contractors to install or construct the standard level of rooftop rainwater harvesting technologies.

iii) Focused Training – This training is offered to locals with the relevant skills and capacity to assemble or install a whole rooftop rainwater harvesting system.

iv) Effective awareness program – The government through the Department of Infrastructure and Nauru Utility Corporation will assist with advocacy and awareness of the technology and its importance to the community.

e) Stakeholders and Timeline for implementation of TAP for RTRWHS Technology

The technology action plan and program suggested to achieve this TAP mainly relate to rooftop rainwater harvesting technology. The main stakeholder is the Department of Climate Change and National Resilience (DCCNR), which is responsible for all the laws and regulations in the water sector. Other government Departments, such as the Department of Commerce, Industry and Environment (DCIE), also has some major roles in the TAP since most water sector projects aim to increase the resilience and adaptation at the local levels. The private sector through NGOs and other business houses also has a major role in establishing projects that will lead eventually to achieving the TAP targets. See table 2 for more details.

Table 2: Stakeholders and time for implementation of technology activities - RTRWHST

Actions/Activities	**Years – Timeline 2022- 2025**			
	1st Half 2022	**2nd Half 2022**	**2nd half 2024**	**2nd half 2023/25**
	STAKE HOLDERS			
Government Policy	DCCNR			
Government Incentives	DoF/DCIE			
Awareness & Training	DCCNR			
Concept Development		NDA/AE		
Project Design		NDA/AE		
Project Implementation			IE/AE	
Monitoring &Evaluation				IE/AE

f) Overview of Stakeholders for the implementation of the TAP

The stakeholders that will be taking part in the implementation of the TAP includes the Department of Climate Change and National Resilience (DCCNR), the Department of Commerce, Industry and Environment (DCIE), Nauru Utility Corporations (NUC), and Non-government Organisation (NGO) through private sector and interested business houses. These stake holders perform various roles in the implementation of the TAP. For example, the DCCNR performs the overall coordinating role of the TAP implementation through seeking and negotiating funding from both the government and external sources, the DCIE ensures that the technology design and implementation complies with relevant environment policy and regulations while NUC ensures that the technology complies with water standards and requirements in the country. The NGOs which represent the private sector could partner with households and business houses to installing the technology at the local levels.

g) Scheduling and sequencing of specific activities

The implementation of the technology will commence proper in the second half of 2024 to last part of 2025 and into 2026. Prior to development of any concept, the TAP recognises the need to formulate policy first before any concrete action is adopted towards concept development and to project identification and design. See table 3 for the scheduling and sequencing of specific activities.

Table 3: Scheduling and sequencing of specific activities

Actions/ Activities	**Years – Timeline 2023-2024/26**			
	1st Half 2023	**2nd Half 2023**	**2st half 2024**	**2nd half 2025/26**
	STAKE HOLDERS			
Formulation of government Policy	DCCNR			
Government Subsidy	DCCNR			
Technology Awareness	DIE/DCCNR			
Concept Development		NDA		
Project Proposal		NDA/AE		
Project Implementation			DCCNR	
Monitoring & Evaluation				AE/IE

1.1.2.4 Estimation of resources needed for action and activities

a) Estimation of capacity building needs

The implementation of the RTRWHST will certainly require human capacity or expertise to implement the project. From importation into the country through custom clearance, domestic logistic support, storage and to installation at individual homes or community halls for public purposes. As discussed earlier, the authority importing the technology will engage or contract personnel with the required skills and expertise for the procurement (purchases), installation, maintenance of the technology.

b) Estimations of costs of actions and activities

The cost for installation of one RTRWHST system in Nauru could reach **USD$5,000**. The total could be more depending on other variables are added into the costs. The anticipated technology would cost **USD$ 1,050,000.00** to establish a total of 150 units across the country**.** See table **4** below.

Table 4: Estimation of costs (in USD) of actions and activities

Actions/ Activities	Years – Timeline 2023-2024/26				
	2ND half 2022	**1st half 2023**	**2nd half 2023**	**1st half 2024/25**	**Total**
Concept Development	$50,000				
Government Subsidy	N/A				
Technology Awareness	$20,000				
Policy Development			$10,000		
Project Proposal		$100,000			
Project Implementation, M & E				$870,000	
Sub-total Cost	$70,000	$100,000	$10,000	$870,000	**1,050,000**
Total cost (USD$)					**1,050,000**

1.1.2.5 Management Planning

a) Risks and Contingency Planning

There is a potential risk that the project may not be effectively implemented. Through the TAP process, the report explores various reasons which may have resulted in such outcome and provides potential pathway to overcome such risk should they arise. The identified risks include the followings:

(i) Financial constraints - The continuous inability of households and communities to have enough capacity to finance technology of such cost is always the concern the government and relevant authorities must deal with. The strategy to overcome such risk is for the government and responsible authority to secure both internal and external funding arrangement to finance such technology. Although it must be acknowledged from the outset that depending on donor to finance this technology could also be a risk of its own.

(ii) Government failure to progress and facilitate the technology through- There is likelihood that any ruling government may not regard this technology as its priority area of focus. Thus, a very important strategy to adopt is through the process in-depth consultation with the current government and ensure the technology falls within the priority focus area of their policy.

(iii) Frustration – Event of natural disaster may result in non-performance of the technology- Natural disasters are unavoidable and when occurs may cause frustration to the project implementation. To minimize this from happening the parties involved

in the technology ensures that the technology adheres to high level of compliances to environment and natural disaster risk compliances.

(iv) Unavailability of local skills and expertise to implement the project – As part of the technology design and implementation, the responsible authority is mandated to embed training and upskilling of locals for the long-term implementing of the technology.

b) Next Steps

i) Finance – The government will seek both internal and external funding to ensure the technology is implemented. External funding to name a few includes the Green Climate Fund (GCF), Global Environment Facility (GEF), Adaptation Fund (AF) and traditional donor aid partners both bilateral and multi-lateral sources.

ii) Continuous engagement – The responsible authorities to participate in continuous consultation and engagement with the RoN to ensure the technology is of government priority

iii) Proper planning and strategy are adopted to provide pathway forward.

iv) Training and upskilling of locals be part of technology implementation.

Table 5: TAP overview table - Rooftop rainwater harvesting system technology

TAP overview table								
Sector	WATER							
Sub-sector	RAINWATER HARVESTING							
Technology	ROOFTOP RAIN WATER HARVESTING SYSTEM							
Ambition	BUILD AND DIFUSE 800 units of RTRWHST across the Island							
Benefits	This will benefit more than 50 percent of the households in the country. The country has about 1,600 households.							
Action	**Activities to be implemented**	**Sources of funding**	**Responsible body and focal point**	**Time frame**	**Risks**	**Success criteria**	**Indicators for Monitoring of implementation**	**Budget per activity**
Action 1	**Activity 1.1:** Concept Development	Republic of Nauru (RoN) D of Finance	Department of CC and National Resilience	2nd Half 2022	No finance to support such development	Policy developed	Improved policy adopted	USD50,000
	Activity 1.2: Technology Awareness	RoN DCCNR	DCCNR	2nd Half of 2022	No finance to support such development	Awareness programs implemented	People and communities knew the importance of RTRWHST	USD20,000
Action 2	**Activity 2.1:** Policy Development	NDA/ IE	DCCNR/ UNDP	2nd half of 2023	Unavailability of IE No financial support	Concept Note prepared and submitted	Approval of such CN by donor partner	USD50,000
	Activity 2.2:	Project Identification and Design	DCCNR/ UNDP	1st half of 2023	Unavailability of IE and no financial support	Project Submitted for Approval	Approval of PIFS	USD100,000
Action 3	**Activity 3.1:** Project Implementation	Green Climate Fund	DCCNR/UNDP	2nd half of 2024	No Prioritization by Ruling Government	Successful Procurement and mobilization of technology	Effective implementation on time	USD870,000

1.1.3 Action Plan for Water Reticulation System Technology

1.1.3.1 Introduction

Water reticulation system technology (WRST) is a series of pipes that are connected to help transfer water from its original source to consumers. Its inclusive of a water collection and treatment systems ready for distribution and consumption by users (Botha, 2010).[9] It is an efficient and vital structure whereby water is distributed within a house or community. According to National Research Council (2007)[10], water reticulation system is aimed to provide clean water to consumers, many infrastructures now utilise the capabilities and features of water reticulation systems. These systems are designed to collect water for it to be treated before it can be distributed to the consumers. They are mostly comprised of a gridwork of pipes and fittings, allowing them to supply the needed water of households and different water-dependent industries. In Nauru, the construction of water reticulation system is aimed to distribute desalinated saltwater or reverse osmosis (RO) water from selective water reservoirs around the islands and distribute to the hospital, schools, hotels, and households with some costs. Republic of Nauru lacks the national capacity to store potable water beyond two weeks in event of disaster (Climate Change Adaptation in Nauru,2015).[11] The proposed water reticulation system plus its intended water reservoirs is projected to store water capacity beyond the current capacity of two weeks. The intension is store up water supplies for at least 3 to 4 weeks with better control system of distribution during disaster events.

Presently, both business and private household units rely on *rainwater harvesting* as primary sources of water. Having said that, it is important to note that there is no country-wide reticulated system available across the country (Personal Observation, May 2019)[12]. Desalinated water is being trucked to consumers on request. Nauru's secondary source of water which is the desalinated saltwater has four desalination plants throughout the island. However, the desalination plants require high quantities of energy to power and operate. The

[9] Botha, A. (2010). Optimising the demand of a mine water reticulation system to reduce electricity consumption (Doctoral dissertation, North-West University).

[10] National Research Council. (2007). Drinking water distribution systems: assessing and reducing risks. National Academies Press.

[11] Climate Change Adaptation in Nauru (2015)- A report on Expanding national water storage capacity and improving water security in Nauru by EU, GCCA, SPC and Government of Nauru.

[12] CCA national consultant observation trip in May (2019)

desalination process is also expensive and affects the beach environment (Nauru Environmental law planning and Assessment 1976)[13].

In 2014, water quality in Nauru took a remarkable U-turn with the development of a project by the Nauruan government which installed a solar PV system that operates the desalination plant at cheaper rate than it would have cost by relying on the diesel-based energy. It was projected that this project could produce 100 cubic meters of safe water per day. In addition, the PV system would generate 1.3% of the energy demand on the island, doubling the then existing energy production of solar energy. In nutshell, there is a lot of work been done on the ground to produce clean water ready for utilization through this technology- water reticulation system.

1.1.3.2 Ambition for the TAP for Water Reticulation system Technology

The ambition of this TAP is to provide an action plan on how to venture into construction and installation of water reticulation system technology across the country. For example, the strategy is to provide maintenance to the existing aging infrastructure which was already constructed and used in the early 90s to store water from container ships and distribute to certain locations across the country. In addition to those infrastructure, this technology aims to build additional infrastructure to increase the current capacity, build additional water banks as reservoirs at strategic locations and dispatch to various outlets across the Island during disaster events.

1.1.3.3 Actions and Activities selected for inclusion in the TAP for water reticulation system

a) Summary of barriers and measures to overcome barriers

i) High capital cost – This specific technology is expensive and requires high capital cost for its establishment. Capital costs are fixed, one-time expenses incurred on the purchase of land, buildings, construction, and equipment used in the production of goods or in the rendering of services (Al-Shammari, & Abdulmalek 2018)[14]. In other words, it is the total cost needed to bring a project to a commercially operable

[13] Environmental Law Planning and Assessment (1976)

[14] Al-Shammari, S. B., & Abdulmalek, N. (2018). Cost Evaluation of Compact DairyWastewater Treatment System in Kuwait. *Journal of Environmental Science and Engineering B*, 111.

status. Whether a particular cost is capital or not depend on many factors such as accounting, tax laws, and materiality.

ii) The fundamental problem this technology will solve is the capacity to store and supply portable water to various locations across the Island beyond two weeks of non-production of desalination water, for example in times of disaster events. Moreover, the expensive cost of water been trucked upon request by the NUC to consumers across the country has been solved through the established reticulation system. The technology will see cost of water reduced dramatically over the years since water will now be piped to various locations and spots around the Island. Nevertheless, the technology is estimated to cost about **USD$5,5000,000**. The cost includes refurbishment and improvement of some existing structures already in place. Part of the capital cost will be used to replace old pipes and build new structure from the NUC, the desalination plant to selected essential service sites. With the above high capital cost, no individual on the island nation would currently be able to fund such huge expense. The government will have to invest in this technology to make it available to its citizen. From the current impact of the COVID-19 pandemic, it would be impossible for the government to fund such undertaking by its own.

iii) Institutional ownership – In the event whereby a consortium of international donor partners or even one donor partner provides funding for the construction of such technology, there is always a cloud of uncertainty over the continuity and long-term success of such investments after project implementation. This calls for institutional ownership by the community or government into the technology to secure long term benefit and sustainability on the community.

iv) The national water, sanitation, and hygiene policy – This is a policy on water sanitation and hygiene in the country. Although its objective is noble, the government must take substantive action to fulfilling its mandate under this policy framework. This implies that none- implementation of policy is deemed as barrier to implementation of the technology.

v) Poor understanding of existing rights and rules on water – The public at large (Nauruan) need to know that basic things as health, clean and safe drinking water are their rights which the government must provide opportunities communities to access to.

vi) Water distribution – There must be better policy on how water is been distributed around the island nation.

vii) Local expertise to maintain the technology - This will be a large investment done at national and the community level. The question is whether there is an adequate level of expertise to run such technology effectively.

viii) Poor knowledge about the reticulation system- There is and how it operates at community level. The last time, part of the island nation has experienced having a water reticulation system was more than 30 years ago during the phosphate days.

b) Actions selected for inclusion in the TAP

The following actions are selected to be included as part of the TAP for WRST.

i) Government Investment into the technology - The government is required to invest or partially meet the cost of the technology. This aimed at reducing the cost of the technology to business houses and users at the local level.

ii) As part of the technology the government must formulate policy which is aimed at fulfilling its social responsibility to providing clean and safer (cheaper) drinking water to its citizen, average and low-income earners across the country.

iii) As key component of this technology the government must embed training and awareness to increase stake holder's knowledge about WRST across the country.

c) Activities identified for implementation of selected actions

i) Department of Finance must establish a subsidy scheme and formulate regulation on how to attract funding for this technology.

ii) The government through the NUC will develop a policy and regulation on the access to safe drinking water across the Island.

iii) Awareness by public on how to use the technology and training to NUC staff to ensure that the country has qualified staff to maintain such expensive infrastructure on the long term. Thus, this activity should be an on-going one and be implemented through workshops, focus trainings and general awareness.

d) Actions to be implemented as Project Ideas

The following ideas are to be implemented as part of the project idea.

i) Removal economic barriers – Providing incentives to potential investors by removal of tariffs and provision of tax exemptions to attract investment in this WRS technology is a positive contribution by government towards achieving this landmark technology.
ii) Concept Development – The RoN government must sponsor the design and formulation of a concept for this technology.
iii) Project Design – Upon approval of the concept note the government must identify Accredit entity to formally develop the proposal for funding, most probably GEF or GCF.
iv) Skill based Training – This training is offered to organisations to acquire the relevant skills and capacity to maintenance and sustain the technology into the future.
v) Effective awareness program – The government through the Department of Infrastructure and Nauru Utility Corporation will assist with advocacy and awareness of the technology and its importance to the community.

e) Stakeholders and Timeline for implementation of TAP

Currently there is no nationwide water reticulation system in the country. Although there were evidenced of some reticulation system in other parts of the country. As a very important project to transform the community, first it is critical that a proper research and assessment is made on the current infrastructure in the country. This includes identification and valuation of the structure which is currently on the ground. After this activity, then the relevant authority could start designing the concept note, followed by project identification and design. This is when the National Designated Authority with NUC and relevant government institutions could promote the importance of the technology and awareness to the community. Concurrently, the government must come up with a policy for the introduction of WRTS in the country, then followed by implementation and Monitoring and evaluation. All these activities are expected to be implemented by Implementing entity (IE) from second part of 2022 to second term of 2026. See Table 6.

Table 6: Stakeholders and Time for implementation of Technology activities - WRST-2022 to 2026

Actions/Activities	**Years – Timeline 2022- 2026**			
	2nd Half 2022	**1ST Half 2023**	**1st half 2024**	**1st half 2025/26**
	STAKE HOLDERS			
Infrastructure Project Design	DCCNR			
Concept Note Development	DNA/DIE			
Project Identification Design		NDA/DCCNR		

Technology Awareness	NUC/IE	NDA/AE		
Government Policy		NDA/AGC		
Project Implementation,			IE/AE	
Monitoring &Evaluation				IE/AE

f) Overview of Stakeholders for the implementation of the TAP for water reticulation system.

There is no country-wide water reticulation system in operation around the island, although there was pumping of some brackish water from the coastal area to the hilltop at a certain location. The main sources of water across the islands are rainwater, imported water, shallow unconfirmed ground water and desalination water. The aforesaid statement implies that, water reticulation system is not a new concept as part of the island once experienced such technology in the past 20 to 30 years (Oral history, May 2019)[15]. According to key informants (Personal Interview, 2019)[16], there were some parts of the Island which experienced the service of a water reticulation system during the prosperous years of the island nation. There is still an existing infrastructure to support that key informant's claim. There is a tank right at peak of the hilltop on the Island, where water was used to be pumped from the shipping lines. From that storage tank then water is being reticulated to other parts of the Island and then to the nearby households. The system mainly supported the senior executive management members of the Phosphate Mining company and some members of the diplomatic communities. Now the system is inoperative as there is no financial investment to support such technology.

g) Scheduling and sequencing of specific activities

Table 7: Time schedule for implementation of WRST - 2022 to 2026

Details	**Years – Timeline 2021-2023**			
	1st Half 2022	**2nd Half 2022**	**1st half 2023**	**2nd half 2023/26**
Infrastructure Project Design				
Concept Note Development				
Project Proposal Design				
Technology Awareness				
Government Policy				

[15] Oral history by, the Engineer of Nauru Utility Corporation, May 2019.
[16] NGO representative, TNA consultation process, May 2019.

Project Implementation				
Monitoring & Evaluation				

1.1.3.4 Estimation of Resources Needed for Action and Activities

a) Estimation of capacity building needs

The implementation of the WRST will be of large scale once it is implemented on the Island. It will certainly require human capacity or expertise to implement the project. From infrastructure design to concept note development, proposal development, technology awareness, government policy to project implementation. In addition to this, there must be also additional capacity for maintenance and sustainability of the infrastructure into the future.

b) Estimations of costs of actions and activities

The estimated cost for construction of the water reticulation system in Nauru is detailed below. This could be less or more depending on other variables are added or subtracted from the costs as detailed below:

Table 8: Cost (in USD) of Actions and Activities - WRST - 2022 to 2026

Details	**Years – Timeline 2021-2023/2026**					
	1st Half 2022	**2nd Half 2022**	**1st half 2023**	**2nd half 2024**	**1st half 2025**	**Total**
Infrastructure Project Design	$80,000					
Concept Note Development		$50,000				
Project Proposal Design			$310,000			
Technology Awareness	$40,000					
Government Policy		$20,000				
Project Implementation, M&E				$2,500,000	$2,5000,000	
Sub-total Project	**$120,000**	**$70,000**	**$310,000**	**$2,500,000**	**$2,500,000**	
Grand Total	**USD**					**$5,500,000**

1.1.3.5 Management Planning

a) Risks and Contingency Planning

i) There is a potential risk that the project may not be pursued and implemented as it is cost intensive compared to other technologies. Nevertheless, through the TAP process,

the report explores various reasons which may have resulted in such outcome and provides potential pathway to overcome potential risk should they arise. The identified risks include the followings:

ii) Economic and Financial risk - The continuous inability of the government through the NUC to have enough capital to finance a technology of such magnitude. The pathway to overcome such risk is for the government and responsible authority to secure both internal and external funding arrangement to finance such technology.

iii) Government's failure to progress the technology through- There is likelihood that the ruling government may not adopt water reticulation system technology as its priority. Thus, a very important strategy adopted is through high level engagement with the current government to ensure the technology falls within the priority focus area in their policy.

iv) Frustration – Event of natural disaster may result in non-performance of the technology- Natural disasters are unavoidable and when occurs may cause frustration to the project implementation. To mitigate costs of this nature, parties involved in the technology must ensures that the technology adheres to high level of compliances to environment and natural disaster risk compliances.

v) Unavailability of local skills and expertise to implement the project – As part of the technology design and implementation, the responsible authority is mandated to embed training and upskilling of locals for the long-term implementing of the technology.

b) Next Steps

i) Finance **–** The government will seek both internal and external funding to ensure the technology is implementing.

ii) High level engagement with ruling government – The responsible authorities to participate in continuous engagement to ensure the technology is of government priority.

iii) Training and upskilling of locals be part of technology implementation.

Table 9: TAP overview table - Water Reticulation

TAP overview table								
Sector	WATER							
Sub-sector	DOMESTIC WATER SUPPLY							
Technology	WATER RETICULATION SYSTEM TECNHOLOGY							
Ambition	To reconstruct the water reticulation system and expand current water reservoir storage beyond two weeks of disaster and supply water 100% to all households on the island.							
Benefits	MORE THAN 80% OF THE ENTIRE POPULATION WILL BENEFIT FROM THE TECHNOLOGY							
Action	**Activities to be implemented**	**Sources of funding**	**Responsible body and focal point**	**Time frame**	**Risks**	**Success criteria**	**Indicators for Monitoring of implementation**	**Budget per activity**
Action 1	**Activity 1.1:** Infrastructure Assessment – Project Design	Nauru Utility Cooperation	NUC/DIE	1st half of 2022	Economic Barriers and Technological skill	The Assessment of current Infrastructure is done	Provide valuation for existing infrastructure	USD80,000
	Activity 1.2: Concept Development	DoF/ UNDP	NUC/DIE	2nd Half of 2022	Under capacity to develop the CN	Submission of the CN to GCF	Approval of the CN	USD50,000
Action 2	**Activity 2.1:** Technology Awareness	DoF/UNDP	NUC/DIE	1st half of 2022	No government support	Submission of the PIFS	Approval of the Proposal	USD40,000
	Activity 2.2: Government Policy Development	NUC/DIE	NUC/DIE	2nd half of 2022	No government support	Successful implementation	Better coordination of WTST in country	USD20,000
Action 3	**Activity 3.1:** Project Implementation	GCF	NUC/DIE	1st half of 2024	No approval	Effective implementation	Quality Water to the selected government agencies & Public	USD5,500,000
	Activity 3.2: Monitoring & Evaluation	GCF	NUC/DIE	1st half of 2026	Poor Coordination	Knowledge Management	Better lesson learned for future	N/A

								Embedded as part of the PI

Chapter 2: Adaptation Technology Action Plan and Project Ideas for the Coastal Sector

2.1.1 Action Plan for Coastal Vegetation Restoration

2.1.1.1 Introduction

The coastal vegetation restoration technology is not a new concept on the island nation. Communities around the island nation now realised the importance to plant trees and replenish the vegetation between the beaches and identified fertile inland plots to prevent coastal flooding and beach erosion. While some random actions by the communities in this space are not well coordinated, literature found that some of the main drivers to soil erosion mainly in the shore zones areas are caused by human activities, such as sand extraction through beach mining for construction and reclamation purposes always result in long term depletion of the sand resources on the beach (Gillie (1997)[17] Thus, it significantly reduces the natural protection that the beach provides to the coastal communities. In order for replenishment of vegetation to hold, communities must learn from past mistakes and committed to this initiative. Figure 2 shows no vegetation protecting the beaches as result of sand mining.

Figure 2: One of the coastal areas on Nauru Island

[17] Gillie, R. D. (1997). Causes of coastal erosion in Pacific Island nations. *Journal of Coastal Research*, 173-204.

2.1.1.2 Ambition for the TAP

The ambition for the coastal vegetation restoration TAP is to map out activities that are aimed to replenish selective coastal areas which are vulnerable to the impact of climate change such as coastal flooding and soil erosion. The objective is to identify various land-owning groups at the coastal areas around the island and participate in nursery and replanting of vegetation for the coastal areas. This technology is aimed at preventing coastal erosion by planting of trees and other vegetation at affected areas; thus, government must assist the land-owning groups since this is a public good. The activities required for government's intervention include replenishment of coastal soil, replanting of coastal trees, replenishment of native vegetation and provision of guideline to prevent soil mining and cutting of trees or vegetation in general at these sites. The TAP is aimed to assist about 50 sites within the 12 tribes or land-owning groups in this endeavour on the Island. The country has 12 tribes across the Island nation.

2.1.1.3 Actions and Activities selected for inclusion in the TAP

a) Summary of barriers and measures to overcome barriers

The fundamental barrier this technology provides solution for on the Island is against the impact of coastal erosion and saltwater inundation into the villages at the low-lying zone along the periphery of the island nation. It is evidenced that individuals want to participate in coastal vegetation restoration, but the cost of such undertaking is expensive and thus only community or tribal groups working cooperatively in this space would effectively build resilience at the local level against this ever-growing threat.

The main economic and financial barriers that prevent coastal communities affording this technology like the earlier adaptation related technologies discussed in this TAP are inadequacy of funds and access to it by local population. For example, it will cost more than **USD$1,500,00** for 12 tribal groups and approximately 50 identified sites to participate in this costal vegetation restoration at various locations along the island nation. The associate costs include establishment of greenhouse nursery, planting of trees and native vegetation, importation of fertile soil, fertilizers, and labour costs.

The fundamental root cause of this incapacity is inadequate financial support by government and inability of the landowning group to self-finance such long term beneficial investment on coastal vegetation replenishment. The institutional barriers to diffusion of this technology

includes lack of awareness by community members on the impacts of climate change. This is again a reflection of poor coordination by stallholders, relevant government ministries, NGOs, landowning groups, investors, and public at large.

Land owning groups at these coastal sites must also change their attitude towards the type of development strategy they pursue with their coastal resources, particularly removal of sand by developers for fast cash at these zones. This is a household economic constraint matter that the government through the relevant authority must seriously consider providing solution to the community in general.

To overcome these barriers the government must intervene and provide incentives to landowning groups to participate in conserving the beaches, its vegetation, and related resources in this zone.

i) The government must develop a policy and regulation guarding the extraction and removal of sand, corals, and vegetation at the coastal areas. This will prevent the land owing group from resorting to beach extraction for economic gain within the coastal areas.
ii) The government and relevant authority must also provide the land-owning groups with access to financial and other livelihood schemes, particular resources owners. In absence of these, the land-owning groups will always be negatively induced to allow their beaches to be removed in bulk for other development purposes and in the process deforesting the coastal vegetation.
iii) The cost of individual investing in coastal vegetation replenishment program may be expensive for land owning group to sponsor by themselves. Thus, the government seek funding sources for such investment, either locally or externally.
iv) The types of vegetation and how to grow them on the Islands is also important. They are expensive to collect them or import them to Nauru. To address the concern, the project may do a nursery to raise them in, multiply them. Additionally, cost of sands, soils, nursery bags, distribution, planting tools are also costly.
v) Landowning group and public may not understand the importance of growing the coastal area vegetation to the community. Thus, public awareness and in this endeavour is critical for long term success of this technology.

b) Actions selected for inclusion in the TAP

The native vegetation in coastal areas plays an important role in stabilising the surface against wind erosion, coastal flooding and provides habitat for wildlife along the beaches. According to Muis (2020)[18], coastal dunes provide a buffer against coastal hazards such as wave overtopping, storm surges and tidal inundation during extreme sea events. In Nauru, coastal vegetation restoration technology face multiple challenges in economic, financial, social, cultural, and behavioural awareness in the coastal area resource management sector. These barriers prevent this technology to be promoted and accepted in general around the around the island. The government as the primary donor of these public related good product must provide investment to enable communities to participate in this process. Thus, the following actions are tailored into this TAP process.

i) Government donor funding – The government is required to meet partially the cost of the technology or secure funding from external sources to meet this important technology to the community. This is to enable the land-owning group to participate in this public good product for future beneficial to the community.

ii) Government policy- This policy is aimed to regulate and prevent land owning groups, investors, and public from unscrupulously extraction of the sand or initiating un environmentally friendly development along the beach.

iii) Public awareness - programs are key to increasing educating stake holders about the important reasons to participate in beach conservation and vegetation replenishment. The stakeholders include land owning groups, developers, government departments and public.

c) Activities identified for implementation of selected actions

i) Government to provide incentive through the relevant ministry and authority to encourage landowners and developers to participate in beach conservation and vegetation restoration activities at coastal areas.

ii) Government to formulate and develop policy and regulation to limit and prevent coastal area resource extraction and development.

[18] Muis, S., Apecechea, M. I., Dullaart, J., de Lima Rego, J., Madsen, K. S., Su, J., ... & Verlaan, M. (2020). A high-resolution global dataset of extreme sea levels, tides, and storm surges, including future projections. *Frontiers in Marine Science*, *7*, 263.

iii) Training and awareness – this training and awareness component is critical to acceptance of the technology by landowning groups and resource owners. Thus, this activity should be an on-going one and be implemented through workshops, focus trainings and general awareness.

iv) "Know -how" is explained as the knowledge or clear and certain perception, as of fact or truth to be cognizant or aware, as of some fact, circumstance, or occurrence; have information, as about something (Garud 1997)[19]. In this case, it is critical that the government and communities involved personnel who have expert knowledge about vegetation restoration, especially at coastal areas. This process starts from the identify the right trees, through selection criteria established for coastal plants in collaboration with local and regional botanist through research and development, this inclides training of presonals and community on plant breeding and nursery techniques for vegetation restortoration. Maintenance and monitoring will also included into this process.

d) Actions to be implemented as Project Ideas

i) Provide livelihood incentives to land owning groups and resource owners to allow their coastal areas for beach conservation, including coastal vegetation restoration and beach replenishment. This livelihood incentives could be implemented through provision of livelihood programs to land owning groups. For example, provision of micro finance scheme to household units that participate in the program.

ii) Policy and regulation. This is formulation and enforcement by the government officials on regulation that governs the coastal site developments including extraction of coastal area-based resources.

iii) Focused Training. This ongoing training and awareness about the importance of conserving and replenishment of coastal area vegetation.

iv) Effective awareness program – The government through the Department of Climate change and National Resilience will assist with advocacy and awareness of the technology and its importance to the community.

[19] Garud, R. (1997). On the distinction between know-how, know-what, and know-why. *Advances in strategic management*, *14*, 81-102.

e) Stakeholders and Timeline for implementation of TAP

Table 10: Stakeholder and Timeline for CVR implementation: 2022 to 2026

Actions/ Activities	**Years – Timeline 2022-2023/2024/26**			
	1st Half 2022	**2nd Half 2022**	**1st half 2023**	**2nd half 2023/26**
	STAKE HOLDERS			
Coastal area vegetation identification	DIE			
Concept Note Development	DNA/DIE			
Project Proposal Design		DNA		
Technology Awareness	DIE/DCCNR			
Government Policy		DCCNR		
Project Implementation			DIE/DCCNR	
Monitoring & Evaluation				IE/AE

f) Overview of Stakeholders for the implementation of the TAP

Nauru is a single, raised coralline island with a land area of only 21 sq. km. but with an EEZ which extends over more than 431 000 sq. km. The island lies 41 km south of the equator. The island nation was formerly rich in phosphate, which has been the country's principal source of income for many years. Phosphate resources are now depleting, and the country needs to develop alternate sources of income to replace the declining mining revenues. With the above backdrop, household units especially land-owning groups along the coastline area resort to various options to earn the much-needed income to support their families. Thus, many families resort to options such as beach mining to earn the much-needed income "fast money" to support their livelihoods. This technology calls for landowning group to cease those fast income based alternate sources and participate in coastline conservation and beach area vegetation restoration. The technology will see the collaborative actions of the land-owning group, investors, developers, NGOs, government departments[20] and members of the public. Through this cooperative spirit the TAP outlines how the actions outlined for the development of the technology will be implemented in the country.

[20] Department of Agriculture, Fisheries, and marine resources

g) Scheduling and sequencing of specific activities

Table 11 shows the schedule and sequencing of the activities that needed for the implementation of this technology. It is expected is begin in the second quarter of 2022 with the technology preparatory work until full implementation in 2026.

Table 11: Scheduling and sequencing of specific activities: 2022 to 2026

Actions/ Activities	Years – Timeline 2022-2023/26			
	2nd Half 2022	1st Half 2023	2nd half 2024	2nd half 2025/26
Coastal area vegetation identification	NFMA			
Concept Note Development	NDA/IE			
Project Proposal Design		NDA/IE		
Technology Awareness	NFMA			
Government Policy		NFMA/AGC		
Project Implementation;			NFMA/LOG	
Monitoring & Implementation				NDA/IE

2.1.1.4 Estimation of Resources Needed for Action and Activities

a) Estimation of capacity building needs

The implementation of the coastline area vegetation restoration technology will certainly require human capacity or expertise to effectively implement the project. From identification of land-owning group at the coastline areas, to importation of vegetation seeds into the country through custom clearance, logistic support, storage and to nursery, and eventually transplanting at the selected sites. The importation will only be required for the plants which are not currently in the country. Otherwise, the local expert starts to nurture and cultivate the local plants awaiting transplanting purposes at the designated sites. As discussed earlier, the authority importing the technology will engage or contract personnel with the required local skills and expertise in this technology.

b) Estimations of costs of actions and activities

The cost for restoration of coastal area vegetation technology unit in Nauru is detailed below. This could be less or more depending on other variables are added or subtracted from the costs as detailed below:

c) Estimations of costs of actions and activities

Table 12: Estimation of costs (in USD) of actions and activities

Actions/ Activities	Years – Timeline 2022-2023/26				
	2nd t Half 2022	1st Half 2023	2nd half 2024	2nd half 2024/26	Total
Coastal area vegetation identification	$40,000				
Concept Note Development	$85,000				
Project Proposal Design		$120,000			
Technology Awareness	$35,000				
Government Policy		$20,000			
Project Implementation; M & E			$600,000	$600,000	
Sub-total	**$160,000**	**$140,000**	**$600,000**	**$600,000**	
Grand Total	**USD**				**$1,500,000**

2.1.1.5 Management Planning

a) Risks and Contingency Planning

There is a potential risk that the project may not be implemented as planned in the TAP. Thus, the TAP process, the report explores various reasons which may have resulted in such outcome and provides potential pathway to overcome such risk should they arise. The identified risks include the followings:

i) Financial constraints - The continuous inability for households and communities to have enough capacity to finance technology of such cost. The pathway to overcome such risk is for the government and responsible authority to secure both internal and external funding arrangement to finance such technology.

ii) Government failure to progress the technology through- There is likelihood that the ruling government may not regard this technology as its priority. Thus, a very important strategy adopted is through in-depth consultation with the current government and ensure the technology falls within the priority focus area in their policy.

iii) Frustration – Event of natural disaster may result in non-performance of the technology- Natural disasters are unavoidable and when occurs may cause frustration to the project implementation. To minimize this from happening the parties involved in the technology ensures that the technology adheres to high level of compliances to environment and natural disaster risk compliances.

iv) Unavailability of local skills and expertise to implement the project – As part of the technology design and implementation, the responsible authority is mandated to embed training and upskilling of locals for the long-term implementing of the technology.

b) Next Steps

i) Finance – The government will seek both internal and external funding to ensure the technology is implementing.
ii) Ongoing high -level engagement – The responsible authorities to participate in continuous consultation and high level consultation with government to ensure the technology is of government priority .
iii) Proper planning and strategy as way forward for technology implementation.
iv) Training and upskilling of locals be part of the technology implementation.
v) Training of locals/ resources owners on alternative livelihood sources for income.

Table 13: TAP overview table - Coastal Vegetation Restoration

TAP overview table								
Sector	COASTAL							
Sub-sector	COASTAL AREA RESOURCE MANAGEMENT							
Technology	COASTAL VEGETATION RESTORATION TECHNOLOGY							
Ambition	• TO ESTABLISH AT LEAST 50 SITES FOR CVR TECHNOLOGIES ACROSS THE ISLAND NATION							
Benefits	• MORE THAN 50% OF LAND-OWNING GROUPS TO BENEFIT FROM THE TECHNOLOGY • REDUCE COASTAL EROSION AND PROPERTY RELOCATION							
Action	**Activities to be implemented**	**Sources of funding**	**Responsible body and focal point**	**Time frame**	**Risks**	**Success criteria**	**Indicators for Monitoring of implementation**	**Budget per activity**
Action 1	**Activity 1.1:** Coastal area identification	RoN	Ministry of Home Affairs	2nd Half of 2022	No proper identification of Land-owning groups	True land-owning groups identified	No land dispute over the identified area	USD40,000
	Activity 1.2: Government Policy	RoN	Attorney General's Chamber (AGC)	2nd half of 2022	No government-will support the technology	Policy to develop coastal area developed	Effective implementation of the policy	USD15,000
Action 2	**Activity 2.1:** Concept Note Development	GCF/AE	SPREP/USP/NDA	2nd half of 2022	Capacity to develop CN	A CN well developed for submission	Well Design CN submitted	USD85,000
	Activity 2.2: Project Design	GCF/AE	SPREP/NDA	1st half of 2023	No capacity to develop Project Proposal	A well-designed PP developed	Project Proposal Submitted Approved	USD120,000
Action 3	**Activity 3.1:** Project Implementation	NFMA	NFMA/DIE/NDA	1st half of 2024	No government support	Well-designed planned	Timely implementation	USD600,000

2.1.2 Action Plan for LMMA

2.1.2.1 Introduction

A locally managed marine area (LMMA) is an area of nearshore waters and its associated coastal and marine resources that is largely or wholly managed at a local level by the coastal communities, land-owning groups, partner organizations, and/or collaborative government representatives who reside or are based in the designated area (Kawaka, et al, 2017)[21]. Community-based management and co-management are mainstream approaches to marine conservation and sustainable resource management (Cohen et al, (2015)[22]. In the tropical Pacific, these approaches have proliferated through the spread of locally managed marine areas. LMMAs have garnered support because they can be adapted to different contexts and focus on locally identified objectives, negotiated, and implemented by the people involved. While LMMA managers may be knowledgeable about their specific sites, broader understanding of objectives, management actions and outcomes of local management efforts remain limited. According to key informants (Personal Interview, May 2019)[23], the ridge to reef information on the island is limited. Despite this limitation some communities along the coastline are keen to participate in the LMMA purposively to conserves the marine resources but at the same time renourish the coastal beaches to grow and rebuild against sea level rise and coastal erosion including man made removal of beaches along the coast lines. With the LMMA communities are also can have some controlled access to their resources when need be.

2.1.2.2 Ambition for the TAP

There is not much data available on this technology across the Islands. Although there was recently an outreach by the ridge to reef program on this concept, but still yet to be aggressively pursued. The TAP therefore envisions to provide actions for land owning groups or communities surrounding the island to participate in the technology. The technology action plan is to develop and establish over 25 LMMA around the island. The TAP targets to transfer

[21] Kawaka, J. A., Samoilys, M. A., Murunga, M., Church, J., Abunge, C., & Maina, G. W. (2017). Developing locally managed marine areas: lessons learnt from Kenya. *Ocean & Coastal Management*, *135*, 1-10.

[22] Cohen, P., Evans, L., & Govan, H. (2015). Community-based, co-management for governing small-scale fisheries of the Pacific: A Solomon Islands' case study. In *Interactive governance for small-scale fisheries* (pp. 39-59). Springer, Cham.

[23] Interview with Stakeholders during the TNA Phase 1 consultation by Adaptation consultant on the Island.

and diffuse these 10 technologies within the next 4 years 2022-2026. The target population are mainly the communities that live within 100 meters from the sea. It is noted that majority of the population across the country lives on the flat land at the coastal sides of the Island. The benefit of this technology will therefore be shared by majority of the inhabitants of the island nation.

2.1.2.3 Actions and Activities selected for inclusion in the TAP

a) Summary of barriers and measures to overcome barriers

The fundamental problem this technology provides solution to, is the increasing level of sea rise into the inhabited areas of the island and moreover continuous increase in coastal soil erosion through removal and destruction of the coastal beaches, corals reefs and vegetations. The intension is to establish LMMA in the sea area surrounding the coastlines and controlled the community members including land owning groups access to harvesting of resources not only offshore but also inshore at the identified land and sea areas designated for LMMA zones. Although this technology looks perfectly suitable for the area, there are also several barriers preventing the communities and government investing into this initiative. The barriers are outlined below:

Like all the technologies identified and covered in detail for adaptation, the economic and financial barriers are identified as one of the main barriers that prevent individual and communities alike from establishing the technology for their own. For example, developing and establishing a technology of this magnitude would cost the community and individual householding an approximately USD$15,500 per annum. The cost related to policy development, land owning group identification, coordination, awareness, implementation, enforcement, and administrative matters.

Institutional barriers to diffusion of this technology includes little political-will support this technology which resulted in poor coordination and implementing this technology at selected sites around the island. It was also noted during the research trip that they are limited local capacity available to lead out in this process also hinders the transfer and diffusion of the technology. To overcome these identified barriers the government must take the leading role to intervene and perhaps seek external financial assistance to meet the capital and operational cost of the technology. The government could assist in the process by offering tax exemptions,

training of local personnel including land owning groups to support the establishment of the technology.

On the social and cultural barrier perspective, respective communities including land owning groups must understand the purpose of LMMA and benefits that come with. It is critical to note that, LMMA does not bring immediate cash benefits as many landowning groups may desire but its benefits are more long term oriented and its usually public good which most of the communities will directly benefit through restoration of beaches, corals reefs, fishing grounds and species, regrowing of vegetation which provides barriers against sea level rise and storm surges.

b) Actions selected for inclusion in the TAP

Like other identified adaptation technologies, LMMA technology faces several challenges in mainly the economic, financial, social, cultural, and behavioural awareness in the coastal area resource management sector. The barriers are identified as the key impediments that hinders coastal based communities and landowning group from development and establishment of LMMA around the island. Government's support together with its coordinating role in this endeavour is important to see the LMMA concept is understood and accepted by various land-owning groups. At this stanza, its also important to note that there is no government policy around this technology on the island. The potential pathway could be government sponsoring policy and framework around marine area conservation and protected areas at the national level. Thus, the following actions are tailored for inclusion into the LMMA TAP.

i) Government policy – There must be government policy around the establishment of this technology. Currently there is nonexistence and thus majority of the land-owning groups are reluctant to venture into this blue and green economy technology. This position was identified during the field trip on the Island.
ii) Baseline study – After deciding on the actual locations for establishment of the LMMA, the government through relevant stakeholders must participate in a study to determine what resources or species to conservation and the type of conversation that is applicable to that community.
iii) Government subsidy or investment – The RoN will invest through sponsoring the initial development and establishment of LMMA. In absence of this prospect, she will have to secure external sources to fund the identified LMMA around the island.

iv) Surveillance – It will be costly to land owning groups and communities who participate in this technology to run such initiatives by themselves. Thus, it is preferable that the government under the responsible Department invest in such technology.

c) Activities identified for implementation of selected actions

i) Nauru Fisheries and Marine Authority (NFMA) – will take the leading role in developing a LMMA conservation policy framework for the country. This policy will set the guidelines for land owning groups and communities to participate in the LMMA technology. This will also include conservation of marine resources, including policies governing the land-based resources along the coastal lines including coastal vegetation restoration and sand mining alone the beaches.

ii) The NFMA will also collaborate with other stakeholders on the Island to undertake the first baseline study to inform the platform on which the LMMA will be designed. This baseline study is critical to target the types of conservation the communities and land-owning group to adopt.

iii) Training and awareness – The long-term success of this technology depends on the understanding and the support through which the landowning groups and communities at the local level supports this technology. Thus, training and awareness before and during the technology implementation is vital.

d) Actions to be implemented as Project Ideas

The following ideas are to be implemented as part of the technology implementation.

i) Remove economic barriers – The government through relevant authorities such as the NFMA will have to secure sponsorship or funding to support the early work of the LMMA technology. It is identified that the current economic hardship the communities faces everyday are preventing their participation in the LMMA programs.

ii) Enforcement and Monitoring costs - enforcement and monitoring of vast offshore and inshore areas will be proven expensive to local land-owning groups and community residences. It will be effective if the government invest into the monitoring and enforcement.

iii) Staffing coasts - Staffing costs - This will be a burden on to the communities or land-owning groups if they decide to establish this technology. In the past, there were some similar technologies to this LMMA established but due to economic reasons, communities and land-owning groups discontinue those good intensions. The government must absorb this cost into its recurrent expenses to ensure the long-term sustainability of this technology on the ground.

iv) Continuous training and awareness by the responsible authority to the land-owning group and coastal communities are vital for long term sustainability of the technology. This action must be embedded as part of the project implementation at the local levels.

2.1.2.4 Stakeholders and Timeline for implementation of TAP

Table 14: Stakeholders and Timeline for implementation of TAP

Actions/ Activities	**Years – Timeline 2022-2023/2024/2025**			
	1st Half 2022	**2ndHalf 2022**	**1st half 2023**	**2nd half 2023/25**
	STAKE HOLDERS			
LMMA identification	LOG & NFMA			
Policy Development	NFMA & AGC			
Concept Development		NDA/DIE		
Project Identification & Design			NDA/AE	
Project Implementation				LOG/ IE
M & E Knowledge Management				NDA/IE

a) Overview of Stakeholders for the implementation of the TAP

The stakeholders that will be taking part in the technology implementation includes the Nauru Marine Fisheries Authority, the Nauru Attorney General's chamber, the ministry of Agriculture, Ministry of Climate Change and National resilience, NGOs and landowning groups around the island nation. Each ministry or department as referred on the island plays different roles. For example,

i) NFMA is responsible for formulating the policy and guideline for the establishment of LMMA on the island. They also become the champion of the technology across the country.

ii) NFMA – in addition to the above, they are also responsible for taking the leading role in undertaking a base line study to determine the scope and the coverage of the LMMA at the community level.

iii) Attorney General's chamber – This government department supervises the drafting and vetting of the LMMA policy. As it was earlier stated the NFMA takes the leading role but the AGC will have to vet and approve the policy.

iv) Department of Climate Change and National Resilience – This is department which oversees climate change related developments in the country. They must ensure that the policy meets the climate objective of the national government.

v) Private sector – this represents the landowning groups and the NGOs on the island that do have some vested interest in the technology.

b) Scheduling and sequencing of specific activities

Table 15: Scheduling and Sequencing of specific activities

Actions/ Activities	**Years – Timeline 2022-2023/2024/2025**			
	1st Half 2022	**2ndHalf 2022**	**1st half 2023**	**2nd half 2023/25**
	STAKE HOLDERS			
LMMA identification	LOG & NFMA			
Policy Development	NFMA & AGC			
Concept Development		NDA/DIE		
Project Identification & Design			NDA/AE	
Project Implementation				LOG/ IE
M & E Knowledge Management				NDA/IE

c) Estimation of capacity building needs

i) LMMA area identification – the relevant authority to establish a mechanism which true land-owning groups are ascertain and proper process are followed to be qualified as LMMA- capacity of consultation and communication are needed.

ii) Government policy- Under the auspicious leadership of NFMA to develop and the LMMA policy. This governs the management and administration of LMMAs.

iii) NDA/DCC&NR – This department will lead in both concept and Project development. Thus, project design capacity is needed.

iv) Training and awareness – this training and awareness component is critical to acceptance of the technology. Thus, this activity should be an on-going one and be implemented through workshops, focus trainings and general awareness.

d) Actions to be implemented as Project Ideas

The following ideas are to be implemented as part of the project idea.

i) Policy development – The NFMA is committed to develop a policy that will govern the general adaption and implementation of the technology. The policy should also outline the fringe benefit the land-owning group and communities should get by allowing their land for LMMA technology implementation.

ii) Monitoring and Evaluation & Knowledge management – This is monitoring and evaluating of the activities of the technology after implementation. The findings of such activities should be used for lesson learned for future operations.

iii) Focused Training – This training is offered to locals with the relevant skills and capacity to manage and look after the daily operations of the LMMA technology.

iv) Effective awareness program – The government through the DCC&NR in collaboration with NFMA will assist with advocacy and awareness of the technology and its importance to the community.

e) Estimations of costs of actions and activities

Table 16: Costs (in USD) and actions for LMMA timeline: 2022 to 2026

Actions/ Activities	Years – Timeline 2021-2023/26				
	1st Half 2022	2nd Half 2022	1st half 2023	2nd half 2023/26	Grand total
LMMA identification	$20,000				
Government Policy	$15,000				
Concept Note Development	$75,000				
Project Proposal Design		$125,000			
Technology Awareness	$15,000				
Project Implementation, M & E			$500,000	$500,000	
Subtotal	$125,000	$125,000	$500,000	$500,000	
Grand Total	**USD**				**1,250,000**

2.1.2.5 Management Planning

a) Risks and Contingency Planning

There is a potential risk that the project may not be effectively implemented. Through the TAP process, the report explores various reasons which may have resulted in such outcome and provides potential pathway to overcome such risk should they arise. The identified risks include the followings:

i) Financial constraints - The continuous inability for households and communities to have enough capacity to finance technology of such cost. The pathway to overcome such risk is for the government and responsible authorities to secure both internal and external funding arrangement to finance such technology.
ii) Government's failure to progress the technology through- There is likelihood that the ruling government may not regard this technology as its priority area. Thus, a very important strategy adopted is continuous engagement with the current government to ensure the technology falls within the priority focus area in their policy.
iii) Unavailability of local skills and expertise to implement the project – As part of the technology design and implementation, the responsible authority is mandated to embed training and upskilling of locals for the long-term implementing of the technology.

b) Next Steps

i) Finance **–** The government will seek both internal and external funding to ensure the technology is implementing.
ii) Ongoing high-level engagement – The responsible authorities to participate in continuous consultation and high-level consultation with government to ensure the technology is of government priority.
iii) Proper planning and strategy as way forward technology implementation.
iv) Training and upskilling of locals be part of technology implementation.

Table 17: TAP overview table - LMMA

TAP overview table								
Sector	COASTAL							
Sub-sector	COASTAL AREA RESOURCE MANAGEMENT							
Technology	LOCALLY MANAGED MARINE AREA							
Ambition	TO ESTABLISH ABOUT 25 LMMA ACROSS THE COUNTRY							
Benefits	MORE THAN 60% OF THE COASTAL AREA WILL BE PROTECTED OR MANAGED							
Action	**Activities to be implemented**	**Sources of funding**	**Responsible body and focal point**	**Time frame**	**Risks**	**Success criteria**	**Indicators for Monitoring of implementation**	**Budget per activity**
Action 1	**Activity 1.1:** LMMA Identification	NFMA/DoF	NFMA	1st half of 2022	Community Support	Community supports the initiative	Identification of all land-owning groups	USD20,000
	Activity 1.2: Government Policy formulation	NFMA/AGC	NFMA/AGC	1st half of 2022	In capacity to develop	Effective design and implementation	Policy of LMMA accepted	USD15,000
Action 2	**Activity 2.1** Concept Note development	GCF/AE	IUCN/NFMA	2ND half oF 2022	In capacity to develop the CN	Well-developed CN presented	CN Approved	USD75,000
	Activity 2.2 Project Proposal Design	GCF/AE	IUCN/NFMA	1st half of 2023	Poor project Design	Well-developed PP	Project Proposal Approved	USD125,000
Action 3	Technology Awareness	NFMA	NFMA	1st half of 2022	Importance to participate in LMMA	Communities well supported the technology	Land owning group support to the technology	USD15,000
	Project Implementation & M and E	GCF/AE	NFMA	1st half of 2023	Effective implementation			USD1,000,000

Chapter 3: **Technology Action Plan and Project Ideas for the Energy Sector**

3.1 TAP for Energy Sector

An overview of Nauru's progressive development within its energy sector is presented below in chronological order based on available literatures.

3.1.1 Energy Sector overview

Nauru has relied greatly on diesel for power generation since the development of its phosphate mining industry in 1907. Nauru was occupied by the Australian Expeditionary Force in 1914, while phosphate continued to be shipped all through World War I. In 1919, Nauru was made a League of Nations mandate of the British Empire, and the governments of Australia, New Zealand, and the United Kingdom agreed to administer the island jointly through an administrator to be appointed by Australia. By 1968 when Nauru gained its independence, the whole island had access to electricity. In the 1970's, solar water heaters were introduced and installed at all new housing although these were rarely maintained, nor used.

Figure 3: A 500 kW grid-connected solar farm in Nauru

On June 1992, Nauru signed the United Nations Framework Convention on Climate Change (UNFCCC) and ratified the Convention on 11 November 1993, which was entered into force on 24 March 1994. Nauru's First National Communication was developed in 1999 which

established a baseline from which to work in meeting its commitments under the UNFCCC that included its First Greenhouse Gas Inventory and position as of 1994.

In 2004, an assessment on key energy issues was carried out on barriers to the development of renewable energy; to mitigate climate change, and capacity development needs for removing the barriers. Findings were presented in the Pacific Regional Assessment: Nauru National Report 2004.

Sensing its worst economic downturn during 2005 and demonstrating its resilience and motivation; with the support of donor partners, Nauru responded with the development of its first National Sustainable Development Strategy (NSDS) that "*declares the development journey for a better quality of life for every Nauruan. It is a roadmap that reflects the reforms needed to be put in place and the strategies for implementation, as the platform for a better life. The NSDS therefore marks a key milestone in Nauru's development process.*

As part of the EU-funded Support to the Energy Sector in Five ACP Pacific Island Countries (REP-5) programme, a 40 kWp grid-connected solar PV system was installed on the roof of Nauru College in late September / early October 2008 that was activated on October 4th, 2008.

A 2009 review of the NSDS on sector strategy and milestone achievements of the 2005 NSDS showed considerable gains across the economic, social and infrastructure sectors. In the energy sector, electricity supply has improved and there has been some initiatives in renewable energy production. However, it was identified that further progress was needed to improve the electricity transmission. Some of the factors identified preventing the milestones from being achieved include:

- Lack of Funding
- Lack of Capacity
- Lack of Coordination
- Unclear goals
- Unclear land arrangements
- Lack of sound business environment
- Governance

The development of Nauru's first Energy Policy Framework (NEPF) was also achieved in 2009 taking into consideration the following three fundamental issues:

a) Supply issues: The provision of adequate, reliable, and cost-effective energy supplies through the promotion of indigenous energy resources and bulk purchasing of fuel is critical to ensuring security of supply.
b) Demand issues: The efficient utilization of energy and the discouraging of wasteful energy consumption is vital for a country that is so dependent on imported energy sources; and
c) Environmental issues: Due to the fragility of the environment in the region environmental issues are always high on Governments' agenda. Therefore, it is important that the energy policy is targeted at minimising the negative environmental impacts of energy production, transportation, conversion, utilisation and consumption.

In responding to the fundamental issues above, the strategic policy areas identified as critical to achieving the overall vision of the NEPF – "Reliable, affordable and sustainable energy, enabling the socio-economic development of Nauru" were developed as provided in Table 18.

Table 18: NEPF strategies

	Policy	Statement	Strategies
1.	Power	A reliable, affordable and safe power supply and services.	1. Ensure a financially strong and robust "Utilities". 2. Fair and equitable access to any subsidized basic supply of power to households with pre-payment meters. 3. Ensure an appropriate regulatory framework exists to govern the operation and management of Utilities.
2.	Petroleum	A reliable and safe supply of fossil fuels.	1. Secure supply and storage of fossil fuels. 2. Ensure fuel receiving and distribution infrastructure meet international standards. 3. Reduce dependence on fossil fuels by investing in renewable energy projects.
3.	Renewable energy	50% of energy used in Nauru comes from renewable sources by 2015.	1. Encourage the use of renewable energy as an alternative source of power generation. 2. Build in-country capacity in renewable energy technologies.
4.	Consumers	Universal access to reliable and affordable energy services.	1. Ensure the provision of electricity to all customers is financially sustainable. 2. Ensure that the different energy needs are equally addressed and promoted at all levels of society. 3. Ensure dissemination of relevant information to the public.
5.	Finance	Financial sustainability of the energy sector.	1. Ensure a robust financial framework is in place.

6.	Institutional strengthening and capacity building	Efficient, robust and well resourced institutions for energy planning and implementation.	1. Ensure appropriate policies and legislations are in place. 2. Ensure an appropriate skill base is available. 3. An institutional structure that promotes accountability. 4. Encourage stakeholder partnerships.
7.	Energy efficiency and conservation	An efficient supply and use of energy.	1. Encourage at all levels the use of energy efficient appliances and equipment. 2. Promote energy conservation and efficiency at all levels of society. 3. Promote environmentally friendly and sustainable use of energy.

A Nauru Energy Sector Overview report was published in October 2013 that was aimed to provide a stocktake of the situation in the energy sector of Nauru to inform a baseline to be used in the development of the NERM. In 2014, the Nauru Energy Road Map (NERM-2014 to 2020) was developed which further builds upon the energy sector development agenda laid out in the National Sustainable Development Strategy 2005 -2025 (revised 2009) and the NEPF of 2009. The outcomes and targets of the NERM are provided in Table 19.

Table 19: NERM outcomes and targets

NERM: 2014 to 2020
Outcomes
i) A reliable, affordable and safe power supply and services. ii) A reliable and safe supply of fossil fuels. iii) Universal access to reliable and affordable energy services. iv) An efficient supply and use of energy. v) A significant contribution from renewable energy towards electricity supply vi) Financial sustainability of the energy sector. vii) Efficient, robust and well resourced institutions for energy planning and viii) implementation.
Targets
i) 24/7 grid electricity supply with minimal interruptions ii) 50% of grid electricity supplied from renewable energy sources iii) 30% improvement in energy efficiency in the residential, commercial and government sectors

Following the adoption of its National Energy Policy and within the same year (2014), Nauru's Second National Communication (SNC) was developed which indicated a 25% increase in total GHG emissions in the energy sector over 1994-2010, due mainly to increase in petroleum fuel consumption.

Nauru submitted its initial Intended Nationally Determined Contributions (INDC) to the UNFCCC in April 2016 that was prepared through extensive consultations with all relevant stakeholders that was supported by strategies, plans and action for climate resilience and low

greenhouse gas emission that were developed from its NSDS 2005 – 2025 (revised in 2009), NERM 2014 – 2020, SNC and the Republic of Nauru Climate Change Adaptation and Disaster Risk Management Framework (RONAdapt).

> *The global goal underlying the assessment of mitigation contribution is to reduce fossil fuel imports by using indigenous renewable energy and implementing energy efficiency measures. In light of the above, for such a remote island already severely damaged by phosphate mining, Nauru's mitigation contribution is quite ambitious. With regards to equity Nauru cannot be expected to mitigate out of its own resources and would need extensive international assistance (Nauru INDC 2016[24]).*

The updated NERM 2018 to 2020 was developed in 2017/18 after a review of the NERM 2014 – 2020. This updated version is based on the original document and includes consultation outcomes on implementation progress to 2017. The only key changes include renaming the Action Plans, reducing the number of Activities to be implemented, ordering the Activities by Lead Agency and Time Frame, as well as revising wording for some of the Activities and Expected Results.

The revised NSDS 2019 – 2030 that was developed in 2019 highlighted that "*The supply of electricity has improved with stable supply in recent years. At the same time, the way in which electricity is delivered is not sustainable for Nauru. There is a need to upgrade infrastructure, increase efficiency, secure the benefits of renewable energy, and develop and implement sustainable water management policies."*

In 2019, the Voluntary National Review: 2030 Agenda for Sustainable Development Goals was published that stated: *"In January 2016, the 2030 Agenda for Sustainable Development officially came into effect, having been adopted by the UN Member States, including Nauru, in September 2015. The 2030 Agenda commits the UN membership to achieving a world that is just, rights-based, equitable and inclusive in which all stakeholders, including women, children, youth and future generations benefit from sustained and inclusive economic growth, social development and environmental protection."*

To date, Nauru has an installed capacity of 2.6 MW of combined rooftop and ground-mounted solar PV system that is tied to the grid with an additional 6 MW of a planned ground-mounted solar farm to be installed and commissioned by end of 2022. A BESS rated at 5 MW/ 2.5

[24] NDC (2018). National Determined Contribution of the Republic of Nauru, Department of Industry and Environment, Republic of Nauru.

MWh will also be included with the 6 MW solar farm. However, some notable future challenges associated with high penetration of solar-grid integration; if not properly planned or managed can lead to serious instability on grid voltage and frequency stability; and overall power quality in the event of cloud coverage.

Deviation of technology rankings

In the TNA report, the outcome of the MCA rankings for the energy mitigation technologies were as follow.

- 1st OTEC
- 2nd Grid-connected rooftop solar PV
- 3rd Biogas
- 4th PHES

During the BAEF consultation with the energy expert working group, OTEC technology has maintained its ranking despite its slow development and high costs. However, the rapid development of grid-connected rooftop solar PV installations on Nauru; plus the donor-funded 7.5MW grid-connected solar farms, is considered a great concern on issues with over-penetration and grid-management. The practical solution to this issue is to either establish and strengthen policies that regulates or limits the number of solar PV installations or put in place an energy storage system for better grid-management. This has resulted in the prioritisation of PHES technology over grid-connected rooftop solar PV that will provide grid-management support for future solar PV expansion projects. Therefore, the two energy technologies that has been prioritised for this TAP report are OTEC and PHES.

3.1.2 Action Plan for OTEC Technology

3.1.2.1 Introduction

Nauru's geographical location is very ideal for OTEC development because the temperature differences of the surface warm waters and the deeper cold waters surrounding the island are relatively great and because the seabed nearby has a steep inclination. During the day, the souring sun penetrates and warms the seawater to temperatures of 30 °C at depths of 12 meters the most. Below this depth, the temperature drops sharply and at about 500 to 700 meters deep the seawater temperature goes as low as 5 to 8 °C.

OTEC will assist Nauru in achieving its nationally determined contributions under the UNFCCC by providing a renewable 1 MW base-load system that is scalable and having

technology capacity for integrated seawater desalination and seawater air conditioning (SWAC).

3.1.2.2 Ambition for the TAP

The ambition of this TAP is to review the progress of OTEC development and its viability status for its construction on Nauru – 40 years since the first OTEC was piloted in Nauru back in 1981 that generated power that was used to power the plant with the remaining power fed into the grid. This pilot plant demonstrated that net power can be generated from a land-based OTEC system and delivered to a real power grid, and also provided accurate data on performance of complete power cycle. The goals of this pilot plant were all successfully accomplished[25].

OTEC capacity as a sustainable source for power generation and in providing baseload as well as seawater desalination are key to achieving Nauru's sustainable development goals (SDG). However, the ongoing pre-feasibility study by OECC will be modelled against the Kumejima OTEC demonstration plant to consider other viable applications of deep ocean water (DOW) that include aquaculture, agriculture and building cooling or seawater air conditioning (SWAC). These applications are already being adopted successfully in the Kumejima OTEC demonstration plant.

3.1.2.3 Actions and Activities selected for inclusion in the TAP

a) Summary of barriers and measures to overcome barriers

A summary of barriers and measures identified for OTEC is provided in Table 20. These are derived from the TNA Barrier Analysis and Enabling Framework Report.

Table 20: Summary of barriers and measures to overcome these OTEC development

	Barriers	Measures
A	**Economic & financial**	
(i)	• High capital cost – USD45,686,643 • O&M cost – 1% of capital cost = USD456,867	Implement economic analysis through pre-feasibility and feasibility studies. Co-financing with development donor partners.

[25] https://www.esmap.org/sites/default/files/esmap-files/OTEC%20%20Update%20World%20Bank%20102013v2_Reduced.pdf

	• Decommissioning cost – 5% of capital cost = USD2,284,332 • LCOE – USD0.21/kWh[26]	
B	**Non-economic & financial**	
(i)	Technology still being trialed	Update on technical and economic viability of technology
(ii)	Land access	Increase public awareness through consultations
(iii)	Tropical storms	Learn from past mistakes.
(iv)	No skilled personnel	Build capacity

b) Actions and Activities selected for inclusion in the TAP

The Nauru TNA project (phase III) commenced in early 2019 with the submission of its first TNA report in early 2020 which included OTEC technology as one of four potential mitigation technologies in the energy sector that was identified by stakeholders. Before the submission of Nauru's second TNA report – Barrier Analysis and Enabling Framework in September 2021, an OTEC pre-feasibility study had already commenced; late 2020 that was supported by CTCN and UNIDO and implemented by OECC.

The due date for this TNA TAP report is December 2021 while the OTEC pre-feasibility is also December 2021. Hence, the progression of this OTEC assessment and the OTEC pre-feasibility study have been included also as ongoing actions and activities in the TAP schedule.

Table 21 provides the actions and activities that need to be implemented under the proposed TAP for OTEC.

Table 21: Activities to be implemented to enhance diffusion of OTEC technology

Actions	Activities
1. Enabling environment and needs assessment	1.1 TNA mitigation report (completed) 1.2 BA&EF mitigation report (completed) 1.3 TAP report (Oct 2021)
2. OTEC Concept note and pre-feasibility study	2.1 Define need & specify scope – OTEC concept (Dec 2021) 2.2 Framework selection & justification – OTEC viability (Dec 2021)
3. Feasibility Study	3.1 Technology evaluation and approval – OTEC viability to generate 1 MW of electric power only.

[26] LCOE = (Capital cost + O&M + Decommissioning cost)/ Lifetime electricity generation

Lifetime electricity generation = 315,360 MWh

(Source: OECC Nauru OTEC pre-feasibility study)

	3.2 Technology evaluation and approval – OTEC viability to co-generate electricity and desalinated water.
4. Implementation	4.1 Tendering 4.2 Project management and construction

c) Actions to be implemented as Project Ideas

Action 3 above in Table 21 will be considered for implementation as project ideas since Actions 1 and 2 are already being implemented.

3.1.2.4 Stakeholders and Timeline for implementation of TAP

a) Overview of Stakeholders for the implementation of the TAP

Transparency to the people using stakeholder participation to support infrastructure development projects in Nauru is paramount to obtain stakeholder and National confidence and sense of ownership to projects that are fully supported and in-line with National sustainable development goals and commitments to UNFCCC objective.

Land tenure issues which have been identified as one of the major barriers to the transfer and diffusion of infrastructure developments are normally informed through stakeholder awareness workshops and consultations. Stakeholders who are already engaged with the TNA project and the OTEC pre-feasibility study; as provided in Table 22, will be included for the TAP implementation.

A National Designated Entity (NDE) is a nominated national institute that communicates directly to CTCN requesting for technical assistance that reflect national circumstances and priorities that addresses CC. Nauru's NDE is the GoN Department of Climate Change and National Resilience (DCCNR) and the focal point of contact is the Secretary for DCCNR.

Table 22: OTEC TAP implementation stakeholders

Department	**Representative**
Dept. of Climate Change & National Resilience – GoN (NDE)	Secretary Director of Energy Director of Climate Change Director of Water
Dept. Commerce, Industry & Environment – GoN	Secretary Director of Environment
Dept. of Finance – GoN	Secretary Director of Aid Planning
Dept. of Education - GoN	Manager – Strategic Planning & Implementation

Dept. of Home Affairs	Secretary Director of Women Affairs
Nauru Utilities Corporation – SoE	CEO and/or recommended rep.
Nauru Ports Authority – SoE	CEO and/ or recommended rep.
Nauru Rehabilitation Corporation – SoE	CEO and/or recommended rep
RONPhos – SoE	CEO and/or recommended rep
Nauru Fisheries & Marine Resources Authority – SoE	CEO and/or recommended rep
NGO's	EcoNauru Private sector as recommended
Community	Community leaders Land-owners

b) Scheduling and sequencing of specific activities

The ongoing development of a concept note and pre-feasibility study are anticipated to be completed by December 2021 that will determine OTEC potential and for the implementation of a feasibility study as provided in Table 23. This table also indicate the responsible stakeholders for each of the actions and activities identified earlier. It is usually common to include all relevant stakeholders during a feasibility study that include RoN Ministries and their respective departments, SoE's, Private sectors and community representatives.

However, for bigger projects that require a wider range of stakeholders, these are normally carried out through bi-lateral arrangements with each relevant group from the RoN (CC, Finance, Health, Education, Women's Affairs, etc), SoE's (NUC, NRC, NFMRA, etc), the private sector (EcoNauru, Capelle & Partner, etc) and the Community (District Representatives, land owning groups, etc.).

Table 23: OTEC TAP schedule and responsible stakeholders for implementation of TAP activities

Action/ Activities	**Timeline**							
	2nd Half 2021	6 months	6 months	6 months	6 months	6 months	12 months	12 months
1.1 TNA Mitigation Project - OTEC	DCCNR TNA Mitigation Consultant							
2.1 Concept note development 2.2 Pre-feasibility study	DCCNR NUC All							
3.1 Feasibility – 1MW OTEC plant		DCCNR NUC All	DCCNR NUC All					
3.2 Feasibility – Co-generation				DCCNR NUC All	DCCNR NUC All			

of electricity & water								
4.1 Implementation - Tendering						DCCNR NUC DoF		
4.2 Implementation - Construction							DCCNR NUC All	DCCNR NUC All

The progress and findings from the ongoing CTCN - Ocean Energy Technical Pre-Feasibility Study[27] in Nauru was presented through a recent virtual stakeholder consultation meeting to finalise GCF concept note. Pending GCF funding approval, a feasibility study is anticipated to commence in 2022. The timelines provided in Table 23 for actions 3.1 to 4.2 are estimates only, however these will be timely scheduled in the feasibility study.

3.1.2.5 Estimation of Resources Needed for Action and Activities

a) Estimation of capacity building needs

For effective implementation of feasibility studies, a local expert is normally engaged to provide coordination, technical and logistical support to the implementing team. Local expert support may include liaising with stakeholders, organising visits, workshops and consultations, and providing information; as needed, for preparation of reports.

The estimated local expertise and their availability for engagement during the construction and commissioning stages of an OTEC plant is provided in Table 24. It is noted that there is a limited number of local engineers available in the fields of electrical, mechanical and civil engineering. Therefore, there will certainly be a need for capacity building for plant operators and maintenance.

Table 24: Local capacity needs and availability

Field of expertise	Specialist/ Trades person	Role	Local Capacity
Consultants	Local expert	Local project coordinators	Yes
Management	Project Manager/ Officer	Construction project assistant	Yes
	Administration Officer	General office work	Yes
	OH&S Officer	Construction site safety Officer	Yes

[27] This OTEC study is lead by OECC in partnership with Institute of Ocean Energy – Saga University (IOES), Deloitte Tohmatsu Financial Advisory LLC (DTFA) and R-Quest Corporation. Collaborating entities include Xenesys Inc., The University of Tokyo and JAG Consulting Engineers – Nauru. Project financing entity is CTCN through UNIDO.

Construction (Diving skills will be required where deep seawater works are required)	Welder	Plant structural – beams, pipe, etc	Yes
	Mechanical Fitter		Yes
	Electrician	General wiring installations	Yes
	Mason/ Concreter	General concrete foundation & structural works	Yes
	Carpenters	General carpentry works	Yes
	Plumbers	General plumbing installations	Yes
	Control System Technician	Instrumentation & control wiring & system installation	Yes
	Equipment operator	Crane, forklift, etc. operators	Yes

b) Estimations of costs of actions and activities

The costs indicated for activities 1.1, 2.1 and 2.2 in Table 25 are actual costs taking note that all these activities are currently being implemented. However, all other costs are estimates only based on an estimated figure of USD30 million for a 1 MW OTEC plant only with no seawater intake system. With the inclusion of an intake system and integration of a desalination unit, the estimated cost will been increased to an estimated USD60 million. Based on this amount, the feasibility study is costed by multiplying 0.8% with capital estimated cost to get USD500,000 which is distributed amongst activities 3.1 and 3.2.

Table 25: Estimated costs for TAP activities

Action/ Activities	Cost estimations
1.1 TNA Mitigation Project	USD46,000
2.1 Concept note development 2.2 Pre-feasibility study	USD217,800
3.1 Feasibility – 1MW OTEC plant	USD300,000
3.2 Feasibility – Co-generation of electricity & water	USD200,000
4.1 Implementation - Construction	USD60,000,000

The outcome of the CTCN Nauru OTEC Pre-feasibility study that is being implemented by OECC has provided an estimated capital cost; for a 1 MW plant and desalination plant with capacity of 360,000 m³, of USD45,686,643.

3.1.2.6 Management Planning

a) Risks and Contingency Planning

The technical risks for developing an OTEC plant on a small and remote island like Nauru is considered low given the fact from the lessons learnt from one of the first OTEC demonstration plants ; that was built in Nauru 40 years ago by TEPCO that succeeded in

meeting its goals as highlighted in *Section 3.1.2.2 – Ambition for TAP*. It is noted also that because the Nauru OTEC installation was only a pilot plant, the installation of pipes were not planned to be fully secured to the reef. However, although this technology is capital intensive and considered not viable at small scale of power output, surely if integrated to co-generate electricity and water it could become economically viable. To overcome the high capital cost of OTEC technology, a small scale plant should be considered first that is scalable for transitioning in line with the lifespan of the existing and ongoing solar PV system installations.

For Nauru to focus on the surrounding ocean as its main source for energy to generate baseload as well as produce desalinated water is beyond renewable and sustainable. In the past, seawater was widely used as a source for cooling diesel engines, a reticulation source for non-potable use to hundreds of households, offices and workshops including for firefighting purposes. To this date, seawater is still being pumped from the ocean for desalination using reverse osmosis technology. Another application for seawater that is not assessed here is for air conditioning.

The only risks facing the progress of studies and the implementation of this technology are the border closures imposed by the Covid-19 global pandemic restricting consultants from traveling into Nauru to collect relevant site data. However, this does not restrict the engagement of local expertise in obtaining data and information relevant for pre-feasibility and feasibility studies.

b) Next Step

A concept note and pre-feasibility study are being finalised for submission to GCF; through CTCN, for approval of funding for a feasibility study. Below are set of activities that were recently presented by OECC to stakeholders on Nauru through a virtual meeting. A summary of planned activities for OTEC development in Nauru is illustrated in Figure 4.

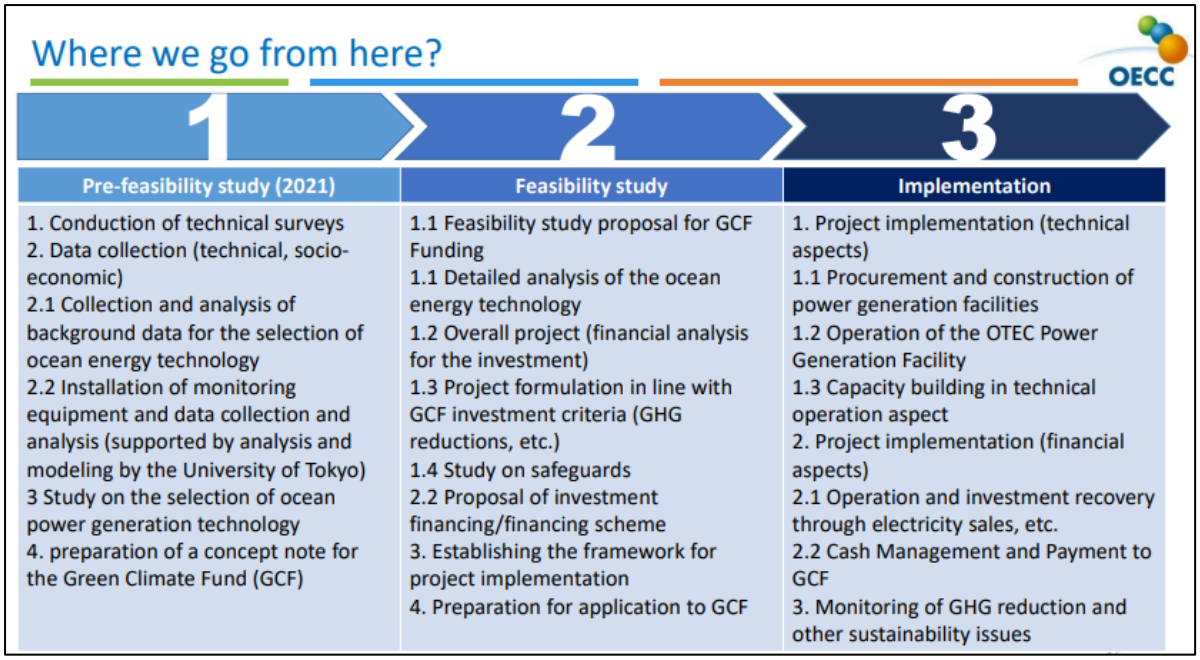


Figure 4: OTEC development planned activities (Source: OECC)

Table 26: TAP Overview table for OTEC technology

TAP overview table								
Sector	ENERGY							
Sub-sector	RENEWABLE ENERGY							
Technology	OCEAN THERMAL ENERGY CONVERSION							
Ambition	• SUSTAINABLE ENERGY – DEMONSTRATION OF A 1 MW PLANT							
Benefits	• REDUCTION IN DIESEL GENERATION & GHG EMISSION • PROVISION OF BASE-LOAD 24/7 • JOB CREATION							
Action	**Activities to be implemented**	**Sources of funding**	**Responsible body and focal point**	**Time frame**	**Risks**	**Success criteria**	**Indicators for Monitoring of implementation**	**Budget per activity**
Action 1: Enabling environment & needs assessment	**Activity 1.1:** TNA – Mitigation (OTEC) .	GEF Trust Fund	Nauru TNA Coordinator DCCNR	Deadline 31 Oct. 2021	Non-approval of report	Report submission within timeframe.	Stakeholder inputs	USD46,000
Action 2: Concept note & pre-feasibility study development	**Activity 2.1:** Concept note	CTCN/ UNIDO	NDE (DCCNR), NUC	December 2021	Failure to secure funding. Travel restrictions due to Covid-19 pandemic. Community acceptance. Land lease rates and agreement.	Study in progress. Contract awarded to OECC	Resource availability.	USD217,800
	Activity 2.2: Pre-feasibility study							
Action 3: Feasibility study development – Technology evaluation and approval	**Activity 3.1:** OTEC viability to generate 1 MW	GoN, Development Partners		12 months.		Funding secured. Feasibility study completed within timeframe.	Modeling based on local data.	USD300,000
	Activity 3.2:			12 months				USD200,000

	OTEC combined viability to co-generate electricity and water					Reviewed and approved.		
Action 4: Implementation	**Activity 4.1:** Tendering process			6 months	Bidders meet compliance criterion	Number of bidders	Security of bids received. Transparency during opening of bids and shortlist through a review process for non-compliance.	
	Activity 4.2: Project Management & Construction			24 months	Border closures due to Covid-19 pandemic	Land owners agreeing to and signing of contract	Construction progress within approved schedule	USD60,000

3.1.3 Action Plan for PHES Technology

3.1.3.1 Introduction

Nauru's rapid development in harnessing solar as its most viable source for sustainable energy has triggered the concern in over penetration that will have an impact on grid stability. During the feasibility study of the ADB-funded 6 MW solar development farm in 2018, BESS was factored into the design for grid management. However, GHD seeing the viability of a pumped hydro energy storage as an alternate source for energy storage have included in their feasibility report a high-level study on PHES.

PHES technology was initially introduced to the stakeholders during the development of the first TNA report and although it was highly prioritised by the stakeholders based on its viability, it was ranked 4th in the MCA process scoring low in the capital cost, potential to create jobs and gender aspects criterion. However, during the BAEF reporting, PHES was more highly considered in terms of its viability and the trend in solar PV installations which by 2023 will most likely reach 60% penetration to the grid. PHES technology is further supported against BESS due to their great differences in cost and lifespan.

Other applications or uses for an upper reservoir for PHES was also considered favourable when considered for other uses such as for firefighting, reticulation for non-potable use, engine cooling and reverse osmosis. The ocean as a source for the above is not new to Nauru including its use also for OTEC. Hence, Nauru's use of its vast ocean water resources should never be limited on use for seawater driven technologies.

3.1.3.2 Ambition for the TAP

The Command Ridge which is located on the highest point on Nauru at an estimated 70 meters above sea water has three concrete tank reservoirs that were built in the late 1960's to supply seawater reticulation for firefighting, generator engine cooling and for residential and office non-potable use. With Nauru's limited water resources, the availability of an upper reservoir for conjunctive use will be an advantage.

3.1.3.3 Actions and Activities selected for inclusion in the TAP

a) Summary of barriers and measures to overcome barriers

A summary of barriers and measures identified for PHES is provided in Table 27. These are derived from the TNA Mitigation Barrier Analysis and Enabling Framework Report.

Table 27: Summary of barriers and measures for PHES

	Barriers	Measures
A	**Economic & financial**	
(i)	High capital and running cost	Implement economic analysis through pre-feasibility and feasibility studies. Co-financing with development donor partners.
B	**Non-economic & financial**	
(i)	Biofouling or build up of biological matters when used with seawater	Use Okinawa Yanbaru plant as model to build from and adapt to Nauru's need and situation.
(ii)	Land access	Increase public awareness through consultations
(iii)	Impacts to environment through seepage on land and to marine life	Develop environment legislations to reduce impact
(iv)	No skilled personnel	Build capacity
(v)	Lack of public awareness	Increase awareness through media and stakeholder consultations.

b) Actions and Activities selected for inclusion in the TAP

The TAP actions and activities selected for the PHES technology will include the progressive findings of this TNA project and a recent pre-feasibility study that was recently carried out by GHD utilising seawater as the medium. Additional actions that have been selected; as provided in Table 28, include the development of a pre-feasibility utilising freshwater as a medium prior to implementing a full feasibility study with a water medium; between seawater and freshwater, that will be recommended in the pre-feasibility stage.

Table 28: Activities to be implemented to enhance diffusion of PHES technology

Actions	Activities
1. Enabling environment and needs assessment	4.3 TNA mitigation report (completed) 4.4 BA&EF mitigation report (completed) 4.5 TAP report (Oct 2021)
2. PHES Pre-feasibility study	2.1 Framework selection and justification – PHES viability & analysis using seawater (completed) 2.2 Framework selection and justification – PHES viability & analysis using freshwater
3. PHES Feasibility Study	3.1 Technology evaluation and approval
4. Implementation	4.1 Tendering

	4.2 Project management and construction

c) Actions to be implemented as Project Ideas

Action 2 (and Activity 2.2) and Action 3 will be considered for implementation as project ideas. It is noted that an expression of interest together with a proposed feasibility scoping and budget has been received by GHD.

3.1.3.4 Stakeholders and Timeline for implementation of TAP

a) Overview of Stakeholders for the implementation of the TAP

Because OTEC and PHES technologies share common barriers, the same stakeholders for OTEC will be engaged with the PHES TAP implementation phase of the project as provided in Table 29.

Table 29: PHES TAP implementing stakeholders

Department	Representative
Dept. of Climate Change & National Resilience – GoN	Secretary Director of Energy Director of Climate Change Director of Water
Dept. Commerce, Industry & Environment – GoN	Secretary Director of Environment
Dept. of Finance – GoN	Secretary Director of Aid Planning
Dept. of Education - GoN	Manager – Strategic Planning & Implementation
Dept. of Home Affairs	Secretary Director of Women Affairs
Nauru Utilities Corporation – SoE	CEO and/or recommended rep.
Nauru Ports Authority – SoE	CEO and/ or recommended rep.
Nauru Rehabilitation Corporation – SoE	CEO and/or recommended rep
RONPhos – SoE	CEO and/or recommended rep
Nauru Fisheries & Marine Resources Authority – SoE	CEO and/or recommended rep
NGO's	EcoNauru Private sector as recommended
Community	Community leaders Land owners

b) Scheduling and sequencing of specific activities

Table 30 illustrates the ongoing activities 1.1 and 2.1 for PHES development with activities that include a completed pre-feasibility and a proposed feasibility study by GHD[28] who have also provided their timelines as indicated in the table. The major stakeholders who will be responsible in coordinating the activities of this development will include DCCNR (NDA) and NUC.

Table 30: PHES TAP schedule of activities and relevant stakeholders

Action/ Activities	**Timeline**							
	2019	Sept. 30/21	7 weeks	4 weeks	6 weeks	4 weeks	3 weeks	2-3 years
1.1 Seawater Pre-feasibility	GHD Complete							
2.1 TNA Mitigation Project - PHES		DCCNR TNA Mitigation Consultant						
3.1 Freshwater Pre-feasibility study (GHD)			DCCNR NUC					
3.2 Feasibility study – Initial studies (GHD)				DCCNR NUC All				
3.3 Feasibility study – Concept design (GHD)					DCCNR NUC			
3.4 Feasibility study – Development of CAPEX and LCOE (GHD)						DCCNR NUC		
3.5 Feasibility study – Final report draft (GHD)							DCCNR NUC All	
4.1 Implementation - Construction								DCCNR NUC

The role of TNA is to initially identify Nauru's most vulnerable sectors for mitigation and prioritise technologies through a country-driven process. However, previous studies on PHES have stalled due to lack of technical support and funds. Following the BAEF process, PHES

[28]GHD Group Pty Ltd is an Australian employee-owned multinational technical professional services firm providing advisory, architecture and design, buildings, digital, energy and resources, environmental, geosciences, project management, transportation and water services.

technology has become more favourable over grid-connected rooftop solar PV technology due to grid-management issues. The outcome of this TAP report is anticipated to support the progressive development previously done on PHES technology.

3.1.3.5 Estimation of Resources Needed for Action and Activities

a) Estimation of capacity building needs

For effective implementation of feasibility studies, a local expert is normally engaged to provide coordination, technical and logistical support to the implementing team. Local expert support may include liaising with stakeholders, organising visits, workshops and consultations, and providing information; as needed, for preparation of reports.

The estimated local expertise and their availability for engagement during the construction and commissioning stages of a PHES plant installation is provided in Table 31. It is noted that there is a limited number of local engineers available in the fields of electrical, mechanical and civil engineering. However, for the long term sustainability of a PHES plant, there will certainly be a need for capacity building for plant operators and maintenance.

Table 31: Local capacity needs and availability

Field of expertise	Specialist/ Trades person	Role	Local Capacity
Consultants	Local expert	Local project coordinators	Yes
Management	Project Manager/ Officer	Construction project assistant	Yes
	Administration Officer	General office work	Yes
	OH&S Officer	Construction site safety Officer	Yes
Construction	Welder	Plant structural – beams, pipe, etc	Yes
	Mechanical Fitter		Yes
	Electrician	General wiring installations	Yes
	Mason/ Concreter	General concrete foundation & structural works	Yes
	Carpenters	General carpentry works	Yes
	Plumbers	General plumbing installations	Yes
	Control System Technician	Instrumentation & control wiring & system installation	Yes
	Equipment operator	Excavators, crane, forklift, etc. operators	Yes

b) Estimations of costs of actions and activities

The cost for activity 1.1 in Table 32 although has been implemented by GHD, this is not available. Actions and activities from 3.1 to 3.5 are actual costs as provided by GHD.

Australian Nation University indicate that pumped hydro cost is USD800/ kW and USD70/ kWh. This translates to USD4 million for the power infrastructure and USD700,000 for the reservoir. Note that this is not a cost estimate for the Nauru installation, but a guideline only for large pumped hydro installations[29].

Table 32: Estimated costs for TAP activities

Action/ Activities	Cost estimations
1.1 Pre-feasibility study – Seawater	N.A
2.1 TNA Mitigation Project	USD46,000
3.1 Pre-feasibility study – Freshwater	USD115,000
3.2 Feasibility study – Initial studies	USD64,000
3.3 Feasibility study – Concept design	USD226,000 (freshwater) Or USD250,000 (seawater)
3.4 Feasibility study – Development of CAPEX and LCOE	USD78,000
3.5 Feasibility study – Final report draft	USD54,000
4.1 Implementation – Tendering & Construction	USD40,000,000

3.1.3.6 Management Planning

a) Risks and Contingency Planning

Some of the risks associated with a pumped hydro scheme is obtaining a land lease agreement with the respective landowners and access to a land corridor from the upper reservoir to the ocean which can result in a number of dwellings to be removed.

b) Next Step

The progression of PHES technology for its transfer and diffusion rely greatly on funding availability for a feasibility to take place. GHD has already expressed its interest by providing costing for a proposed feasibility study which if implemented will take Nauru to the next level and challenge in securing funding for construction and in paving the way for future solar PV expansion projects to meet its commitments to the UNFCCC.

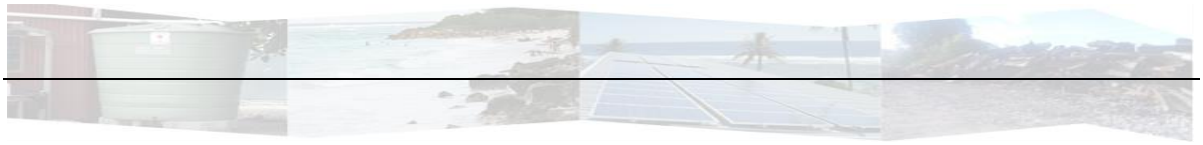
[29] ADB Report – NAU-01 Project Preparation-Consultancy: Solar Expansion Plan (GHD 2018)

Table 33: TAP overview table - PHES technology

TAP overview table								
Sector	ENERGY							
Sub-sector	HYDRO ENERGY STORAGE							
Technology	PUMPED HYDROELECTRIC SYSTEM							
Ambition	• RENEWABLE ENERGY STORAGE SYSTEM THAT SUPPORTS RE (SOLAR) EXPANSION UP TO 80% • PROVISION FOR FIREFIGHTING & WATER CONJUNCTIVE USE							
Benefits	• LOAD SHIFTING CAPABILITY • GRID STABILITY • USES SURPLUS RE FROM SOLAR TO PUMP WATER FROM THE OCEAN TO THE UPPER RESRVOIR • LIFE SPAN OF OVER 50 YEARS AS COMPARED TO 10 YEARS FOR BATTER STORAGE • REDUCTION IN GHG EMISSION							
Action	**Activities to be implemented**	**Sources of funding**	**Responsible body and focal point**	**Time frame**	**Risks**	**Success criteria**	**Indicators for Monitoring of implementation**	**Budget per activity**
Action 1: Pre-feasibility study	**Activity 1.1:** Seawater intake	MFAT	DCCNR-Energy, NUC	-	-	Completed	-	-
Action 2: Enabling environment and needs assessment	**Activity 2.1:** TNA – Mitigation (PHES)	GEF Trust Fund	Nauru TNA Coordinator DCCNR	Deadline 31 Oct. 2021	Non-approval of report	Report submission within timeframe.	Stakeholder inputs	USD46,000
Action 3: Pre-feasibility & Feasibility studies	**Activity 3.1:** Pre-feasibility - Freshwater intake	CTCN/ UNIDO	NDE (DCCNR), NUC	7 weeks	Sector/ technology supported by National policy and planning documents (INDC, NSDS,	Funding secured. Feasibility study completion within timeframe.	Study progression within timeframe. Minimum 80% land owner signatories.	USD115,000
	Activity 3.2: Feasibility – Initial studies			4 weeks				USD64,000
	Activity 3.3:			6 weeks				USD226,00 (freshwater)

	Feasibility – Concept design				Roadmaps, etc) Failure to secure funding. Community acceptance. Land lease agreement	Land lease approval Reviewed and approved.	Reduction in GHG emissions Tariff reduction	Or USD250,000 (seawater)
	Activity 3.4: Feasibility – Development of CAPEX and LCOE			4 weeks				USD78,000
	Activity 3.5: Feasibility – Final report draft			3 weeks				USD54,000
Action 4: Implementation	**Activity 4.1:** Tendering process	GoN GCF		6 months	Bidders meet compliance criterion	Number of bidders	Security of bids received. Transparency during opening of bids and shortlist through a review process for non-compliance.	USD40,000,000
	Activity 4.2: Project Management & Construction		NDA (DCCNR) NUC	2-3 years	Border closures due to Covid-19 pandemic	Land owners agreeing to and signing of contract	Construction progress within approved schedule	

Chapter 4: **Technology Action Plan and Project Ideas for the Waste Sector**



4.1 TAP for Waste Sector

4.1.1 Waste Sector overview

The management of waste materials is a worldwide problem. In the small island developing states of the Pacific (Pacific SIDS), waste management is becoming an acute problem as urban population increases, the economies of these countries develop, and the quantities of waste materials requiring management increases. The environmental and health impacts of such operations are potentially significant, and the lack of management and monitoring of the dumps and impacts on the surrounding community, land and water is becoming a matter of concern. Common significant waste management problems in Nauru and likewise with Pacific SIDS include:

- A lack of effective planning and implementation of the resultant plans.
- Ineffective institutional arrangements.
- A lack of sustainable funding.
- Increasing quantities of waste requiring management; and
- A lack of land for undertaking landfill waste disposal.

There may be a wide range of options for addressing the waste management problems in Pacific SIDS, however, the situation in each country is invariably different and requires the development of a specific strategy / plan (solution) to improve the situation.

Three of the most critical aspects that need to be addressed to maximise the chances of success of the plan are ownership of the plan, developing effective institutional arrangements for waste management, and developing and implementing a mechanism for generating sustainable funding for waste management services and infrastructure.

4.1.1.1 National waste legislations, policies and reports

An overview of existing waste legislation, policies and reports for Nauru is best summarised by a consultancy team from the University of Melbourne as part of the PacWastePlus Waste Legislative Review project that was published on 16 March 2020. These are highlighted in chronological order in Table 34 and Table 35.

Table 34: Legislation impacting waste governance in Nauru

Legislation	Description
Sanitary Inspectors' Ordinance 1921 Ordinance Revision Ordinance 1967	Section 5 requires a sanitary inspector to direct an owner or occupier to clean an unclean or unsanitary area and report it to the Administrator for further instructions if it is not cleaned.
Litter Prohibition Act 1983 Litter Prohibition (Amendment) Act 2014	General prohibition on littering and offence provisions. Legislation contains no power to make regulations under it.
Environment Management Bill 2006 (not yet in force)	It proposed to set a framework vesting powers and responsibilities in the government and permitting regulations to be made to deal with a full range of environment related issues.
The Derelict Sites Management Act 2017	'An Act to make provision for the identification, control, removal, disposal and management of derelict properties, buildings and vehicles in the Republic and for related purposes'.
Naoero Roads Act 2017	Contains prohibition on discharge of wastewater or other liquids on public roads.
Ports and Navigation Act 2019	Part 5: Environmental Protection and Part 4: Liability and Limitation of Liability - Division 6 – Hazardous and noxious substances – deals with obligations under international conventions.
Environmental Management and Climate Change Act 2020	The Act makes provision for the management and protection of the environment, climate change, the promotion of sustainable development, to facilitate compliance with the Republic's international and regional environment related obligations and for related purposes.

(Source: Stocktake of Existing and Pipeline Waste Legislation: Nauru. November 2020)

Table 35:Policies and reports impacting waste governance in Nauru

Policy	Description
National Environmental Management Strategy 1996	Although dated, this comprehensive report is referred to in many other reports. Chapter 4, s 4.3.5: Environmental issues and Challenges - Inadequate, or Non-enforcement of Environmental Legislation and s 4.7: Pollution and Waste Management Chapter 5: National Environmental Action Plan • Objective 3: Strengthening Environmental Institutions and Legislation • Program 3.8 Enactment of New Environmental Legislation
National Sustainable Development Strategy 2005-2025 National Sustainable Development Strategy 2005-2025 (revised 2009)	Priority regarding infrastructure sector is increased use of waste management. Poor waste management identified as threat to target 10 (halving proportion of people without safe drinking water).

Economic Infrastructure Strategy and Investment Plan 2011	Includes analysis of infrastructure related to sanitation and waste management, and priorities for this sector. Also includes a solid waste management infrastructure stocktake.
National Implementation Plan for Persistent Organic Pollutants (POPS) 2012	Submitted as part of Nauru's obligations as a party to the Stockholm POPs Convention. Section 2.2.4 states that 'There are currently no laws or regulations targeted directly at addressing POPs, and consequently the Department of Commerce, Industry and Environment as lead agency is unable to fully implement the Convention's requirements.
National Water, Sanitation and Hygiene Implementation Plan 2012 (Draft)	Includes discussion of wastewater and sewage. Waste identified as risk to water quality. Policy objective 3.1 includes activity to establish regulations for disposal of septic tank and cesspit wastes.
Framework for Climate Change Adaptation and Disaster Risk Reduction 2015	Waste management prioritised as a strategy under Objective A2.7 Land management and rehabilitation
Water and Sanitation Master Plan 2015-2035 (2015)	Technical report including analysis of existing water and sewerage system and planning of system with 20-year program.
National Solid Waste Management Strategy 2017-2026	Analysis of current solid waste management situation in Nauru, with future recommendations and thematic priorities including legislation, education, capacity, and waste management.
Nauru Integrated Environment Policy 2018 (final draft)	Waste management and pollution control identified as theme 4 of policy.
Reports	**Description**
Second National Communication 2014	Includes discussion of waste in Nauru and associated emissions.
Basel Convention National 2004 Report 2006	Report submitted in fulfilment of Nauru's obligations as a Basel Convention party.
Environmental Due Diligence Report for Nauru Regional Processing Centre 2012	Provides an overview of environmental legislation in Nauru and international treaties, agreements and conventions that relate to environmental issues to which Nauru is a signatory. Relevant Nauru Acts are discussed at pp 22–7 but based on outdated National Environmental Management Strategy from 1996.
Solid Waste Management in the Pacific: Nauru Country Snapshot 2014	Asian Development Bank overview of solid waste management in Nauru as part of wider Pacific project.
Fifth National Report to the Convention on Biological Diversity 2014	Ineffective pollution control and solid waste management identified as a key threat to Nauru biodiversity. Case Study 3 on the Clean and Green Programme discusses the waste situation in Nauru.
Distribution and Status of Asbestos: Nauru Country Report 2015	Includes survey of asbestos-use in Nauru, risk assessment, remedial options, and significant discussion of disposal, including local burial.
Infrastructure Review 2018	Report assessing Australia's infrastructure investments in Nauru. Waste management recommended as future investment area. Nauru has also developed and submitted its 6th National Report to the Secretariat of the CBD which a large part of the report is to provide an update on the progress of Nauru in implementing the Aichi Targets.
Review of Natural Resource and Environment Related Legislation: Nauru 2018	Overview of environment-related legislation in Nauru as of January 2018. Includes section on waste management and pollution.
Waste and Dumpsite Management Report 2018	Includes discussion of legal and institutional context, issues with existing dumpsite, options for a new dumpsite and possible different approaches for waste disposal. This includes a resource recovery centre, waste billing and organic waste.

(Source: Stocktake of Existing and Pipeline Waste Legislation: Nauru. November 2020)

4.1.1.2 Waste Management Programs

a) PacWaste and PacWastePlus

Nauru have been participating in the PacWaste 2010-2015 program – *a four year, EUR 7.85 million project that is funded by the European Union and implemented by SPREP to improve regional hazardous waste management across the Pacific in the priority areas of asbestos, healthcare waste, E-waste and integrated atoll solid waste management. PacWaste is aimed to strengthen regional collaboration and information sharing by establishing a recycler's network as well as national coordination committees for each waste type. PacWaste facilitated regional workshops to showcase the interventions introduced in priority countries and facilitated the sharing of experiences and lessons learnt within and between participating countries. To ensure best practice is maintained, SPREP provided additional assistance to Pacific island governments in the development of national waste management policies and frameworks to support new and existing regulatory systems.*

Following the PacWaste 2010-2015 program, many countries in the region still lack the appropriate infrastructure, legislation, and personnel needed to adequately manage waste and pollution. To respond to these challenges, the PacWastePlus 2018-2023 program was established that was aimed at taking a broader approach to look across eight different waste streams at data availability, legal framework, and capacity building to deliver good waste management practices across the pacific Island Countries[30]. PacwastePlus also seeks to mainstream gender equality and social.

4.1.1.3 Way forward

The Nauru waste sector have all the resources in terms of legislations, policies, and concepts for the implementation of a solid waste management infrastructure that needs to be prioritised for action by the GoN given its ongoing commitments to the UNFCCC. There is certainly the challenge to change the mindset and behaviour of locals to overcome the barriers identified in the BAEF report. Nauru has the advantage of being small and capacitive adaptive as witnessed in its economic recovery and development of its energy sector during its worst economic downturn in 2005.

[30] https://pacwasteplus.org/news/sprep-and-eu-helping-the-pacific-to-deal-with-waste-related-issues/

4.1.2 Action Plan for Waste Segregation Technology

4.1.2.1 Introduction

Waste segregation is an effective waste management strategy, a process that is key to waste minimisation reaching landfill, best carried out by waste producer, improves community health and protects the environment. Waste segregation is best carried out where it is initially produced (home, restaurants, etc) simply by separating the dry wastes from the wet wastes. Dry waste includes cans, bottles, plastics, metals, etc, while wet waste typically refers to organic waste. In more developed countries, different coloured bins are normally used for collection of dry and wet wastes.

In rural areas, segregated wastes can be recycled or sorted where dry wastes like cans and plastics are crushed and bottles are collected for refund. Wet wastes which are normally green or organic are ideal for composting when properly mixed with soil and water. In urban areas, segregated wastes are normally collected and taken to a sorting site where the dry and wet wastes are further sorted; by hand or machinery, for recycling.

The need for an effective waste management strategy like segregation is key to reducing wastes ending up at the landfill, hence reducing environmental and health issues.

4.1.2.2 Ambition for the TAP

For effective waste segregation processes, there is the need for a holistic approach in public awareness, information and education on its benefits to health and the environment.

4.1.2.3 Actions and Activities selected for inclusion in the TAP

a) Summary of barriers and measures to overcome barriers

Waste segregation require cultural and habitual changes for its effective implementation. It is a process that should begin at the household and involve every individual. The ratio of individual participation will determine the success of this process. KPI[31]'s can be determined by the volume of waste reaching the landfill as well as the number of established composting

[31] Key performance indicator

and recycling sites. Barriers and measures for better management of waste segretation as identified in the BAEF report are reproduced in Table 36.

Table 36: Summary of barriers and measures for segregation

	Barriers	Measures
A	**Economic & financial**	
(i)	Lack of funding availability that is allocated specifically for the supply of segregation equipment.	DCCNR to seek GoN and Development Partners for financial support to promote communities in establishing waste segregation strategies and equipment.
B	**Non-economic & financial**	
(i)	Lack of awareness and policies specific for waste segregation.	Develop a waste segregation strategy. Increase awareness on segregation processes and benefits that includes home composting techniques, kitchen gardening and recycling.
(ii)	Lack of capacity.	Build capacity at community level.

b) Actions and Activities selected for inclusion in the TAP

Community engagement and ownership of a segregation process has many benefits to the community that include sustainable supply of compost; from green waste to promote kitchen gardening, collection of food wastes for pig farms and compacting of recyclable waste to supply waste recycling processes. Hence, the development and availability of a waste segregation strategy will be an essential tool for any community-based project. With Nauru's small population of around 10,000, it has the advantage of easily developing adaptive capacity.

Table 37: Activities to be implemented to enhance diffusion of segregation process

Actions	Activities
1. Development of a Waste Segregation Strategy	1.1 Develop concept note for review & approval. 1.2 Seek funding for development of strategy and associated legislations and policies. 1.3 Consult all 12 districts.
2. Project implementation	2.1 Seek funding to supply equipment identified. 2.2 Community engagement – workshops & implementation
3. Monitoring & evaluation	3.1 Review/ measure against KPI's
4. Quality management & control	4.1 Make changes where necessary for improvement.

c) Actions to be implemented as Project Ideas

The development of a Waste Segregation Strategy (Action 1) will be an essential tool to provide guidance to the people on good waste management concepts and practices. This can further enhance community participation if adopted into an annual clean-up and kitchen

gardening event that is fully supported by the GoN. Waste segregation as part of a National "Keep Nauru Clean and Green" campaign targeting the community will provide great benefits that include a clean environment, sustainable gardening as source for food security and job creation to name a few. The impact to the dumpsite will be better control of waste ending up for landfill.

4.1.2.4 Stakeholders and Timeline for implementation of TAP

a) Overview of Stakeholders for the implementation of the TAP

The proposed waste segregation strategy should be community driven with the full support of the GoN by providing guidance through legislations and policies. Every district should be encouraged to develop own waste segregation process and a sorting site to be established within their community where segregated waste is collected and sorted for composting and baling. The DCCNR should take the lead role in funding the development of a waste segregation management strategy and to involve community members, NGO's and the private sector in the development of the strategy. Table 38 provides a list of stakeholders who should be involved in the proposed activities for development of the strategy.

It is recommended that a 4-6 member committee is established and to be coordinated by DCCNR and DCIE. This committee will be responsible in communicating with all other stakeholders through consultations and workshops. For the purpose of this report, the committee will be named Waste Segregation Project Committee or WSPC.

Table 38: Stakeholders for waste segregation TAP implementation

Department	Representative
Dept. of Climate Change & National Resilience – GoN	Secretary Director of Climate Change Director of SWM
Dept. Commerce, Industry & Environment – GoN	Secretary Director of Environment
Dept. of Finance – GoN	Secretary Director of Aid Planning
Dept. of Education - GoN	Manager – Strategic Planning & Implementation
Dept. of Home Affairs	Secretary Director of Women Affairs
All SoE's	CEO and/or recommended rep
NGO's	EcoNauru Private sector as recommended
Community	District members of parliament

	Community leaders Land owners
WSPC	Local Technical Advisors (4-6)

b) Scheduling and sequencing of specific activities

A set of activities and timelines to promote waste segregation in Nauru is provided in Table 39 which includes relevant stakeholders who should be involved.

Table 39: Scheduling of specific activities

Action/ Activities	**Timeline**							
	2 months	3 months	4 months	4 months	6 months	12 Months (4-monthly)		
1. Development of a Waste Segregation Strategy								
1.1 Develop concept note.	DCCNR DCIE WSPC							
1.2 Seek funding for development of strategy and associated legislations and policies.		DCCNR DCIE						
1.3 Consult all 12 districts.			DCCNR DCIE WSPC					
1.4 Develop Waste Segregation Strategy through bilateral and participatory process to include list of equipment			DCCNR DCIE WSPC					
1.5 Review and endorsement of strategy and equipment			DCCNR DCIE WSPC All					
2. Project implementation								
2.1 Seek funding to supply equipment identified. Procurement.				DCCNR DCIE WSPC				
2.2 Community engagement - Workshops					DCCNR DCIE WSPC			
2.3 Implementation						All		
3. Monitoring & evaluation								
3.1 Review/ measure against KPI's developed in strategy document						WSPC		
4. Quality management & control								
4.1 Make changes where necessary for improvement.							DCCNR DCIE WSPC	

4.1.2.5 Estimation of Resources Needed for Action and Activities

a) Estimation of hardware per district

For the implementation of a National waste segregation process, the basic hardware components or resources required for each district will include:

- Separate collection bins for dry and wet wastes
- Transportation for collecting of bins
- Baling/ compacting machines
- A dedicated and cleared site (fenced) within the district
- Site to accommodate composting area and an area for sorting dry recyclable waste for crushing/ baling.
- An option that can be integrated into this process is the collection of food waste to support a piggery farm at the same site.
- Revenue can be generated from the supply of compost, seedlings, pigs (whole pork or chunks, cooked or raw), etc.

The number of hardware components and land area required will be determined by the number of people per district and land availability. For project sustainability, project ownership and government support is critical.

b) Estimation of capacity building needs

The specialists list provided in Table 40 are to be represented from each of the 12 districts

Table 40: Local capacity needs and availability

Field of expertise	Specialist	Role	Local Capacity
Consultants	Local expert	Local project coordinator	Yes
Management	Project Officer	Waste segregation	Yes
	Project Officer	Composting	Yes
	Project Officer	Sorting, baling and recycling	Yes
Operations	Truck driver & assistant	Drivers	Yes
	Laborers	Composting, baling & recycling	Yes

c) Estimations of costs of actions and activities

Table 41 provides some estimate costs for the implementation of actions and activities for the transfer and diffusion of a waste segregation strategy in Nauru. The development of a concept note should include a review of existing strategies already developed and build on these by

adding measures to barriers experienced during their implementation. The concept can be built from regional experiences or can be tailored to suit Nauru's culture, economy and environment. Local consultants should be encouraged to take up the challenge in developing the concept. The only capital-intensive component of this technology is the provision of wheelie bins to supply individual households, or the supply of skip bins that are located in selected locations, or combination of both where a wheelie bin is supplied only to households for dry wastes only and skip bins for wet, green or organic wastes. The provision of community collection trucks for each district is most preferred hence the cost estimated for Activity 2.1 in the table.

Estimate costs for other hardware components have not been included which include baling and recycling machineries. Based on the progress and success of the segregation concept being developed, further financial support from GoN and Development Partners should consider funding for a centralised recycling factory. The cost for implementation (Activity 2.3) is for land lease per annum. This is calculated from the current land lease commercial rate of AUD8.5/ m².

Table 41: Estimated costs for TAP activities

Action/ Activities	Cost estimations
1. Development of a Waste Segregation Strategy	
1.1 Develop concept note.	AUD10,000
1.2 Seek funding for development of strategy and associated legislations and policies.	-
1.3 Develop Waste Segregation Strategy (Desktop study)	AUD30,000
2. Project implementation	
2.1 Funding to supply equipment (bins and collection trucks).	AUD2,000,000
2.2 Community engagement – workshops/ capacity building (AUD4k/ district)	AUD48,000
2.3 Implementation (land lease)	AUD1,250p.a
3. Monitoring/ evaluation/ reporting (Quarterly)	
3.1 Review/ measure against KPI's (Quarterly reporting – consultancy)	AUD20,000 p.a.
4. Quality management & control	
4.1 Make changes where necessary for improvement (Optional)	-

4.1.2.6 Management Planning

a) Risks and Contingency Planning

Waste if defined in a manner that changes its aspect from rubbish to partially an invaluable resource is key to changing the mindset of people and in developing an effective waste segregation process that not only provides employment opportunities but also sources of food security. When further promoted as an annual event for a cleaner and healthier environment, the whole aspect of waste handling will become a coordinated activity that everyone would enjoy and look forward to. The challenges are simply having available the tool – a comprehensive guide to a waste segregation strategy, the resources, the cultural and behavioural change to the definition of and recycling of waste, the ownership and driver of the system and the full support of the GoN.

b) Next Steps

Introducing the concept of waste segregation into the school curriculum, to run in parallel with a stakeholder and community consultations program will provide some benefits in rolling out the implementing phase of a waste segregation program where both adults and children have been versed on the concept and benefits. KPI for a waste segregration process can include ratio of community participation based on data collected and reported.

Promoting of the same can even be shared through media. The advantage is that although waste is a global issue, Nauru has funding opportunities through its supported SDG’s to establish a tailored strategy that suits its society, economy, and environment.

Table 42: TAP overview table - Segregation

TAP overview table								
Sector	WASTE							
Sub-sector	SOLID WASTE MANAGEMENT							
Technology	WASTE SEGREGATION – COMMUNITY LEVEL							
Ambition	• REDUCE WASTE ENDING UP AT LANDFILL • PROMOTE WASTE RECYCLING & COMPOSTING (GARDENING) IN COMMUNITIES							
Benefits	• GHG REDUCTION • POLLUTION CONTROL • GROUNDWATER FREE OF CONTAMINATION							
Action	**Activities to be implemented**	**Sources of funding**	**Responsible body and focal point**	**Time frame**	**Risks**	**Success criteria**	**Indicators for Monitoring of implementation**	**Budget per activity**
Action 1: Develop waste segregation strategy	**Activity 1.1:** Develop concept note tailored for Nauru	GoN	DCCNR – Waste sector DCIE – Environment sector WSPC – Waste Segregation Project Committee (proposal)	2 months	GoN support Funding availability. WSPC capacity	Quality & approval of concept note.	Concept note developed and approved.	AUD15,000
	Activity 1.2: Seek funding for development of strategy	-		3 months		GoN & Donor supported.	Funding approved.	-
	Activity 1.3: Develop waste segregation strategy (Desktop study)	GoN and Development Partners		4 months		Quality of strategy. Approval of strategy.	Fully supported and endorsed by community.	AUD30,000
Action 2: Project implementation	**Activity 2.1:** Seek funding to supply equipment (bins and collection trucks).			4 months		GoN & Donor supported	Equal and fair distribution of equipment to communities.	AUD2,000,000
	Activity 2.2: Community engagement – workshops/ capacity building.		DCCNR – Waste sector	6 months	Community participation, acceptance & support.		% of community attendance and acceptance of concept.	AUD48,000 (AUD4,000/ district)

	(3 to 5 days per district. 2 districts per month.)		DCIE – Environment sector Community groups		Production and quality of compost. Volume or tons of recyclable waste compacted or crushed. Management of operations. Stakeholder support			
	Activity 2.3: Implementation			Ongoing	Land availability. Cost of operations.	Land lease agreement for resource recovery area. Worker salaries acceptable.	Access to a resource recovery area within a district.	AUD21,250p.a 250m² of cleared land area for resource recovery. Land lease rate (commercial) at AUD8.50/ m²
Action 3: Monitoring/ evaluation/ reporting	**Activity 3.1:** Review/ measure against KPI's (Quarterly reporting – consultancy)		WSPC to implement and report to DCCNR and DCIE	Quarterly	Ongoing monitoring and support to community	Jobs created Increased kitchen gardens and crops	Resource land area use and management.	AUD20,000p.a
Action 4: Quality management & control (optional)	**Activity 4.1:** Make changes where necessary for improvement.						To be managed based on data collected from Activity 3.	-

4.1.3 Action Plan for Semi-aerobic Landfill

4.1.3.1 Introduction

Nauru's response and actions to reducing its GHG emissions has been concentrated mainly to the energy sector with very minimal progress in the waste sector which is known also as a major contributor to GHG emissions. The processes that have achieved success stories in the energy sector, if adopted to the waste sector can achieve the same goals in not only reducing GHG emissions but also in improving livelihood to the people as the energy sector has done.

Semi-aerobic landfill technology protects the environment in many ways. However, when integrated with other waste management technologies like waste segregation, the environmental impact can be greatly reduced, and the site developed for semi-aerobic landfilling will certainly have an extended life due to minimal waste ending up at the dumpsite.

Nauru may have all the legislations, policies and strategies available for SWM, however, it is noted that there is lack in motivation to implement these proven waste related technologies as reflected in the lack of personnel establishment in the waste sector. The HR structure in the waste sector is driven by NRC and DCIE however there is noted lack of driving capacity and support to the community who are in fact the main sources of waste generation.

Nauru needs to re-define the term "rubbish" that comes from a tangible object considered worthless, to something that can be added value to that contributes to sustainable development.

4.1.3.2 Ambition for the TAP

The environmental impact posed by open and uncontrolled dumping is enormous when compared to a semi-aerobic landfill where groundwater is protected from contamination, build up of flammable gas is reduced thus eliminating fire hazards, pollution is controlled and GHG is greatly reduced. In the same instance, other forms of waste segregated from the source are transformed into compost to improve home and commercial gardening and bales of recyclable wastes ready for recycling. Nauru should be very mindful and motivated by the fact that if its energy sector can be improved at a great cost, then surely any improvement to the waste sector; requiring less financial support can be accomplished. To overcome this barrier, there is the need for a shift in behaviour at all levels of the society to inform the people

through public awareness and information the need and advantages for an integrated National SWM strategy that must be heavily driven by communities.

4.1.3.3 Actions and Activities selected for inclusion in the TAP

This section looks at the barriers and measures identified in the BAEF report to determine the actions and activities most relevant for the transfer and diffusion of a semi-aerobic landfill technology.

a) Summary of barriers and measures to overcome barriers

Table 43 provides a summary of barriers and measures obtained from the BAEF report taking note that these barriers are within GoN capacity to provide awareness and financial support for its implementation to show their commitment and to build community momentum.

Table 43: Summary of barriers and measures for Semi-aerobic Landfill

	Barriers	Measures
A	**Economic & financial**	
(i)	Source of funding to develop a semi-aerobic landfill Master Plan	GoN to provide funding to show its commitment and motivation for technology transfer and diffusion that will be reflected in reduced GHG emissions.
B	**Non-economic & financial**	
(i)	Uncontrolled dumping	Enforce integration of other waste management concepts like segregation.
(ii)	Weak HR structure in waste sector	Improve structure and capacity by creating position for a Director of SWM at government level and establish an independent SoE in waste management.
(iii)	No clear goals.	Develop an integrated SWM roadmap
(iv)	Lack of community support.	Encourage community engagement and ownership of waste management strategies at community level that will contribute to controlled landfill.

b) Actions and Activities selected for inclusion in the TAP

The dumpsite is currently managed by a Waste Management Unit through NRC, an SoE that already has other great responsibilities in managing the mining sector and land rehabilitation scheme hence placing the priorities of the Waste Management Unit in a difficult position to develop. For better management and access to donor funding, the GoN should consider establishing a separate SoE with blinkers that focuses on SWM alone that achieves National Development Priorities, Values and Principles as outlined in the NSDS 2019-2030. The actions and activities selected for this TAP are provided in Table 44.

Table 44: Actions and activities selected for TAP for semi-aerobic landfill

Actions	Activities
1. Preliminary advice on waste management systems operations and policy (T+TI).	1.1 Observation on dumpsite conditions, HR, construction resources, waste collection and handling practices. 1.2 Report submission on recommended activities to improve dumpsite facility.
2. Establishment of a new SoE dedicated to the development of the waste sector.	2.1 GoN to assess the needs and to develop Bill. 2.2 Parliament to pass
3. Seek funding to support development of a Master Plan for dumpsite.	3.1 GoN waste sector to seek funding from Development Partners.
4. Development of Master Plan by T+TI.	4.1 Concept design 4.2 Detailed design & costing 4.3 Approval of Master Plan
5. Implementation	5.1 Tendering process 5.2 Awarding of contract 5.3 Construction & project management
6. Monitoring and evaluation	6.1 Review/ measure against KPI's.

c) Actions to be implemented as Project Ideas

Action 2 is a GoN decision to make that may require a legal adviser and full stakeholder participation to establish. This action is seen by stakeholders as relevant for the effective transfer and diffusion of the semi-aerobic landfill technology and other related technologies like waste segregation. However, for immediate implementation, Action 3 should proceed to be followed by Action 4 once funding is secured. Cost estimates provided by T+TI are provided in Table 48.

4.1.3.4 Stakeholders and Timeline for implementation of TAP

a) Overview of Stakeholders for the implementation of the TAP

To support uptake of the semi-aerobic landfill technology will require as many stakeholders to participate in discussing the needs and benefits of this and related technologies because every individual contribute to the generation of waste on a daily. Every office generate waste of some sort and these waste products are mostly recyclable. NUC for example generate tons of waste oil which in the past are used by RONPhos as furnace fuel to dry phosphate rock. Stakeholder list provided in Table 45 is provisional only.

Table 45: Stakeholders for Semi-aerobic Landfill TAP implementation

Department	Representative
Dept. of Climate Change & National Resilience – GoN	Secretary Director of Energy Director of Climate Change Director of Water
Dept. Commerce, Industry & Environment – GoN	Secretary Director of Environment Waste Management Officer
Dept. of Finance – GoN	Secretary Director of Aid Planning
Dept. of Education - GoN	Manager – Strategic Planning & Implementation
Dept. of Home Affairs	Secretary Director of Women Affairs
Dept. of Health Services	Secretary Director
Dept. of Justice	Director
Nauru Rehabilitation Corporation – SoE	CEO and/or recommended rep
Nauru Utilities Corporation	CEO and/or recommended rep
RONPhos Corporation	CEO and/or recommended rep
NGO's	EcoNauru Private sector as recommended
Community	District leaders & members

b) Scheduling and sequencing of specific activities

The scheduling of activities in Table 46 are estimates only. Responsible stakeholders for implementation of activities have also been included.

Table 46: Schedule of activities

Action/ Activities	Timeline							
	2018	12 months	3 months	6 months	3 months	3 months	12 months	Ongoing process
1. Preliminary advice on waste management systems operations and policy (T+TI).								
1.1 Observation on dumpsite conditions, HR, construction resources, waste collection and handling practices. 1.2 Report submission on recommended activities to improve dumpsite facility.	Completed							
2. Establishment of a new SoE dedicated to the development of the waste sector.								
2.1 GoN to assess the needs and develop Bill. 2.2 Submission of Bill parliament		NDA (DCCNR & DCIE) NRC Proposed Bill to be						

		passed by parliament.						
3. Seek funding to support development of a Master Plan for dumpsite.								
3.1 GoN waste sector to seek funding from Development Partners.			NDA (DCCNR & DCIE)					
4. Development of Master Plan by T+TI.								
4.1 Concept design 4.2 Detailed design & costing 4.3 Approval of Master Plan				NDA (DCCNR & DCIE) All				
5. Implementation								
5.1 Tendering process					NDA (DCCNR & DCIE)			
5.2 Awarding of contract						NDA (DCCNR & DCIE)		
5.3 Construction & project management							NDA (DCCNR & DCIE) NRC	
6. Monitoring and evaluation								
6.1 Review/ measure against KPI's.								NDA (DCCNR & DCIE)

4.1.3.5 Estimation of Resources Needed for Action and Activities

a) Estimation of capacity building needs

Landfill preparation require breaking and removal of protruding pinnacle rocks first by using excavators fitted with hydraulic hammers. Dump trucks are used to transport remains of pinnacle rocks. Most of the heavy machineries required for this process are available including operators as illustrated in Table 47.

Table 47: Local capacity needs and availability

Field of expertise	Specialist	Role	Local Capacity
Consultants	Local expert	Local project coordinator	Yes
Heavy equipment operators	Surveyor	Surveyor	Yes
	Project supervisors	Project site supervision	Yes
	Excavator operators	Pinnacle rock breaking, land clearing & leveling	Yes
	Dump truck drivers	Sorting and recycling	Yes

b) Estimations of costs of actions and activities

Table 48: Estimate cost for TAP activities

Action/ Activities	Cost estimations
1. Preliminary advice on waste management systems operations and policy	
1.1 Observation on dumpsite conditions, HR, construction resources, waste collection and handling practices.	Completed (2018)
1.2 Report submission on recommended activities to improve dumpsite facility.	Completed (2018)
2. Establishment of a new SoE dedicated to the development of the waste sector.	
2.1 GoN to assess the needs and develop.	-
3. Seek funding to support development of a Master Plan for dumpsite as proposed by T+TI.	
3.1 GoN to seek funding from Development Partners.	-
4. Development of Master Plan by T+TI.	
4.1 Nauru Dumpsite Master Plan	AUD75,000
4.2 Nauru Dumpsite Operations Plan	AUD40,000
4.3 Construction information requirements & specification	AUD10,000
4.4 Site supervision during construction (per week)	AUD23,000
4.5 Waste policy development	AUD30,000
5. Implementation	
5.1 Tendering process	-
5.2 Awarding of contract	-
5.3 Landfill cell construction & project management	USD1,000,000
6. Monitoring and evaluation	
6.1 Review/ measure against KPI's.	-

4.1.3.6 Management Planning

a) Risks and Contingency Planning

Funding availability is paramount to the development of a Master Plan and Waste Policy, and an estimation cost for the implementing stages. As recommended, the establishment of a new and dedicated enterprise to manage the dumpsite is relevant to the success of this and related waste management projects. Community engagement to develop a sense of ownership is key to the sustainability of any waste management project.

b) Next Steps

Managing other wastes like e-waste, whitegoods, derelict vehicles and waste oils can be the next challenges including the development of viable waste recycling plants in Nauru. Given its central location, Nauru can become a regional waste recycling hub for certain types of wastes.

Table 49: TAP overview table - Semi-aerobic Landfill

TAP overview table								
Sector	WASTE							
Sub-sector	SOLID WASTE MANAGEMENT							
Technology	SEMI-AEROBIC LANDFILL							
Ambition	• REDUCE GHG EMISSIONS							
Benefits	• IMPROVED WASTE DECOMPOSITION PROCESS • FASTER STABILISATION OF WASTE LANDFILLED • REDUCE POLLUTION • ELIMINATE/ REDUCE FIRE HAZARDS • ELIMINATE GROUNDWATER CONTAMINATION • LESS MAINTENANCE							
Action	**Activities to be implemented**	**Sources of funding**	**Responsible body and focal point**	**Time frame**	**Risks**	**Success criteria**	**Indicators for Monitoring of implementation**	**Budget per activity**
Action 1: Preliminary advice on waste management systems operations and policy (T+TI).	**Activity 1.1:** Observation on dumpsite conditions, HR, construction resources, waste collection and handling practices. **Activity 1.2:** Report submission on recommended activities to improve dumpsite facility	GoN	DCIE	Done.	Nil	Observation and reporting activities completed in 2018. Report preparation and submission done.	-	NA.
Action 2: Establishment of a new SoE dedicated to the	**Activity 2.1:** GoN to assess the needs and develop Bill. Engage consultant to implement.	GoN	NDA (DCCNR & DCIE) to raise initiative.	8 months	Not approved by GoN to proceed	Acceptance by the community GoN support	Establishment of new SoE. Company name established and	-

development of the waste sector						Established company name. Transfer of all related legislations, policies and projects to established SWM company. Support from regional and international SWM companies	passed in parliament. Eg. Nauru SWM Corporation	
	Activity 2.2; Submission of Bill	GoN		4 months	Bill passing in Parliament			-
Action 3: Seek funding to support development of a Master Plan for dumpsite.	**Activity 3.1:** GoN waste sector to seek funding from Development Partners.	GoN Development Partners	NDA (DCCNR & DCIE)	3 months	GoN funding availability Approval of Master Plan		Interest and support from GoN & Development Partners.	USD128,000
Action 4: Development of Master Plan by T+TI.	**Activity 4.1:** Concept design	GoN Development Partners	NDA (DCCNR & DCIE) NRC	6 months			Presentation and quality of plan. Acceptance and approval of plan	USD128,000
	Activity 4.2: Detailed design & costing							
	Activity 4.3: Review & approval of Master Plan	NDA (DCCNR & DCIE)						
Action 5: Implementation	**Activity 5.1:** Tendering process	NDA (DCCNR & DCIE)		3 months	Number of interested bidders		Number of interested companies to develop concept	-
	Activity 5.2: Awarding of contract	GoN Development Partners		3 months			Transparent mode in reviewing bidders	-
	Activity 5.3: Construction & project management			12 months	Project delays – border closures due to Covid-a9.		Construction within timeframe Job creation for locals	USD1,000,000
Action 6: Monitoring & evaluation	**Activity 6.1:** Review/ measure against KPI's	NDA (DCCNR & DCIE)		Ongoing	System not functional	Development of KPI's. Effective tools for data collection and analysis	Reduction in waste ending up at landfill Reduced environmental pollution at dumpsite No fire hazards	USD29,000p.a

							Less excavating activities Effective design and operation of semi-aerobic landfill	

Chapter 5: **Conclusion**

This combined adaptation and mitigation TAP report presents the final 8 selected technologies for the final part of the TNA process for the government perusal. These eight represent some of the most critical technologies which the government could seek funding to support. These could be summarised as follows:

Adaptation

- Rooftop rainwater harvesting system technology
- Water reticulation System technology
- Coastal Vegetation restoration
- Locally Managed Marine Area

Mitigation

- Ocean Thermal Energy conversion
- Pumped Hydro Energy Storage
- Waste segregation
- Semi-aerobic landfill

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Annex A: List of Local Expert Woking Group

A.1 Water Sector Working Group

i)	Reagan Moses	Secretary for Climate Change & National Resilience, GoN
ii)	Jayden Agir	Water Strategy Manager, Dept. CC&NR, GoN
iii)	Mark Hiram	Water Services Manager, NUC
iv)	Abraham Aremwa	TNA Mitigation Consultant

A.2 Coastal Sector Working Group

i)	Reagan Moses	Secretary for Climate Change & National Resilience, GoN
ii)	Bryan Star	Director for Environment, Dept. CIE, GoN
iii)	Frankie Ribauw	Director for Coastal (Seawall), Dept. CIE, GoN
iv)	Abraham Aremwa	TNA Mitigation Consultant

A.3 Energy Sector Working Group

i)	Reagan Moses	Secretary for Climate Change & National Resilience, GoN
ii)	Midhun Ajaykumar	Director of Energy, DCCNR, GoN
iii)	Carmine Piantedosi	CEO, NUC
iv)	Ali Mohammed	General Manager operations, NUC
v)	Apenisa Manuduitagi	Renewable Energy, Metering & Regulatory Affairs, NUC
vi)	Tyron Deiye	Consultant – CC & Migration Specialist, GoN
vii)	Abraham Aremwa	TNA Mitigation Consultant

A.4 Waste Sector Working Group

i)	Reagan Moses	Secretary for Climate Change & National Resilience, GoN
ii)	Bryan Star	Director of Environment, DCIE, GoN
iii)	Grace Garabwan	SWM Officer, DCIE, GoN
iv)	Jallah Jeremiah	Director of Water Unit, DCCNR
v)	Creiden Fritz	Director of Commerce, DCIE, GoN
vi)	Abraham Aremwa	TNA Mitigation Consultant