Fiji

TECHNOLOGY ACTION PLAN – MITIGATION

[March 2023]

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Executive Summary

In this Technology Needs Assessment (TNA) for Fiji, the sectors selected for mitigation were Energy and Transportation. After a series of stakeholder consultations, a further demarcation into subsectors resulted. For the Energy sector, the subsector was off-grid rural electrification while for Transportation, it was domestic maritime transportation. Both of these sub-sectors are inter-linked and aligned to the National Development Plan priorities of Fiji.

Subsequently, multi-criteria analysis was adopted to prioritize three technologies for each sub-sector. Followed by this, careful barrier analysis and enabling framework (BAEF) were designed through the use of a root cause analysis method. The rationale of BAEF after TNA is the basis for the preparation of the Technology Action Plan (TAP). The three prioritized technologies for the rural electrification sub-sector included in the TAP are listed below:

1. Standalone Ground Mount Solar PV with ESS (Community Based Electrification - Micro-Grids);
2. Ground Mount PV with Biofuel Generator Hybrid systems with ESS; and
3. Micro/Pico-hydro in microgrid configuration.

The three prioritized technologies for the domestic maritime shipping sub-sector included in TAP are:

1. Sail-powered Passenger/Cargo Ship;
2. Low Carbon/Zero Carbon Passenger Ferry Trials; and
3. Advanced Wind Propulsion Technologies: Eco-Flettner Rotor – retrofit and new-build technology.

Action plans have been developed for these three prioritized 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 Energy, Department of Transport, Fiji Maritime Authority, Maritime Safety Authority of Fiji, and the Climate Change Division among other key stakeholders as listed in Annex I.

The BAEF has highlighted that funding is an apex barrier in the deployment and adoption of new technologies in both of these sectors. As such many of the actions identified and the subsequent actions tries to address the funding issues for all six technologies in both the sub-sectors. Financial planning, adoptable financial model, low equity and low-interest rate financing, and engagement of the private sector have been the aim of this TAP. In addition to this, feasibility studies for new technologies are also of utmost importance and it is imperative that proper feasibility studies are carried out to avoid unwarranted issues. The TAP has developed actions and activities surrounding this. A lack of local capacity in the implementation and operations of new technologies requires education and training institutions to develop appropriate interventions in order to bridge the gaps.

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Acronyms

ADB	Asian Development Bank
APTC	Australia Pacific Training Coalition
BAU	Business-As-Usual
CAPEX	Capital Expenditure
CCD	Climate Change Division
CEO	Chief Executive Officer
CNO	Coconut oil
DoE	Department of Energy
DoT	Department of Transport
EFL	Energy Fiji Limited
EP-2022	Electrification Policy-2022
ESS	Energy Storage Systems
ESIA	Environmental and Social Impact Assessment
FBOS	Fiji Bureau of Statistics
FMA	Fiji Maritime Academy
FRCS	Fiji Revenue and Customs Services
FREPP	Fiji Renewable Energy Power Project
FSHIL	Fiji Ships and Heavy Industries Limited
GCF	Global Climate Fund
GEF	Global Environment Facility
GGF	Green Growth Framework
GHG	Greenhouse Gas
GRT	Gross Registered Tonnage
GSS	Government Shipping Services
HVO	Hydrotreated Vegetable Oil
IMEL	Industrial and Maritime Engineering Limited
IMO	International Maritime Organization
IRENA	International Renewable Energy Agency

ISO	International Solar Organisation
KOICA	Korea International Cooperation Agency
LEDS	Fiji Low Emission Development Strategy
MARPOL	International Convention for the Prevention of Pollution from Ships
MCA	Multi-Criteria Analysis
MCST	Micronesian Centre for Sustainable Transport
MCST	Micronesian Centre for Sustainable Transportation
MnE	Monitoring and Evaluation
MPWTMS	Ministry of Public Works, Transport and Meteorology Services
MSAF	Maritime Safety Authority of Fiji
NCCP	National Climate Change Policy 2018-2030
NDC	Fiji's Nationally Determined Contribution
NDC-IR	Fiji's Nationally Determined Contribution-Implementation Roadmap
NDP	National Development Plan – (2017-2036)
NGOs	Non-Government Organizations
NOx	Nitrous Oxides
NPTC	National Training and Productivity Centre
PPP	Private-Public-Partnership
PV	Photovoltaic
RESCOS	Renewable Energy Service Companies
SEEMP	Ship Energy Efficiency Management Plan
SEFP	Sustainable Energy Financing Project
SG	Solicitor General
SHS	Solar Home Systems
SOx	Sulphur Oxides
SPC	Pacific Community
SPREP	Secretariat of the Pacific Regional Environment Programme
TA	Thematic Areas
TNA	Technology Needs Assessment

UNEP CCC	UNEP Copenhagen Climate Centre
UNDP	United Nations Development Programme
UNEP	United Nations Environment Program
USP	The University of the South Pacific
VOC	Volatile Organic Compounds

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1.1 TAP for Sector Rural Electrification

1.1.1 Energy Sector Overview

Energy is the prerequisite for the economic development of any nation, yet it is imperative that energy is sourced from clean sources. A total of 191 nations committed in 2015 to keeping global warming well below 2 degrees with respect to pre-industrial levels. Subsequently, the Nationally Determined Contributions (NDCs) containing a description of mitigation strategies were prepared, shared, and maintained by each country. The first NDC of Fiji aims to reduce CO_2 emissions by 30% from a business-as-usual (BAU) baseline scenario by the year 2030 with strategies being proposed in the NDC Implementation Roadmap 2017–2030 (NDC–IR). The NDC-IR (2017-2030) expresses both the finance requirements and the potential mitigation measures for reducing CO_2 emissions from transportation, industry, and power generation sub-sectors. Fiji's NDC Investment Plan was developed in 2020 to identify key investments required in energy efficiency, land, and maritime transport, and domestic aviation to meet Fiji's commitment to Paris Agreement (NDC Investment Plan-2022). The energy sector in Fiji was responsible for approximately 59 % of GHG emissions from the years 2006 to 2011 (Republic of Fiji, 2019). As per the recent National GHG Inventory Report for 2019, Energy continues to remain the largest sector contributing to the overall emissions in Fiji making 52.7 % of the total emissions.

For the electricity sector, the GHG emissions are largely from the stationary combustion of fuels for electricity generation. In remote rural locations, diesel and premix (commonly known as two-stroke oil or zoom) are largely used in generators for electricity, and naphtha, kerosene, and solar lamps for lights. The key GHGs from stationary combustions are carbon dioxide and methane.

The government aims to achieve 100% renewables for grid-based power generation and economy-wide energy efficiency and has set a goal in the NDP (2017-2036) to generate 100% country's electricity from renewable sources by the year 2036 (NDP (2017-2036)). A Low Emission Development Strategy (LEDS) was further developed to define mitigation pathways that can be undertaken to achieve net-zero carbon status by 2050 and to leverage the adaptation co-benefits of mitigation actions (LEDS-2018).

The legislative foundation for a planned, national response to climate change is established by the Climate Change Act 2021. The Act serves to provide a system for measuring, reporting, and verifying GHG emissions, constructs a comprehensive response to climate change, provides the regulation and control of the national response to climate change, and addresses the associated issues. It also directs the development, execution, and evaluation of measures and activities related to economic, fiscal, financial, and market-based instruments on climate change mitigation, adaptation, displacement from climate change, planned relocation, and

oceans. The Climate Change Act-2021 foresees a whole-of-government approach to climate change.

The key strategies for "A resource-efficient, cost-effective and environmentally sustainable energy sector" in Fiji's NDP (2017-2036) are:

- Developing small grid systems in other islands where practical.
- Continue to develop and improve the human resource capacity in the energy sector.
- Review design and construction standards for energy facilities that are climate change resilient.
- Implement various measures and programmes to reduce the volume and cost of imported petroleum products, while ensuring the safety and security of supply.
- Continue research and implementation of programmes to develop and increase the production of biofuel if cost-effective.
- Improve the sustainable supply of copra to the rural biofuel mills through replanting programmes. There are 9 biofuel mills on the following islands: Koro, Cicia, Rotuma, Gau, Rabi, Lakeba, Vanuabalavu, Moala, and Matuku.
- Implement Green Growth Framework for Fiji, in particular Way Forward outlined in Thematic Area on Energy Security.
- Improve the effectiveness and sustainability of existing management models for off-grid rural electrification including Renewable Energy Service Companies and community cooperatives to provide electricity to isolated communities and areas not served by the FEA (renamed as EFL).

The aim of the NDP: 2017-2036 was to electrify rural areas and maritime zones with decentralized renewable energy sources such as solar, mini-hydro, and wind systems where feasible.

To harmonize and integrate the government's other development plans and policies, the Government of Fiji developed the Electrification Policy-2022 (EP-2022). The scope of electrification in EP-2022 was expanded to include the urban and peri-urban and informal communities. The EP-2022 sets out at improving the overall reliability and security of supply and quality of energy services, as well as continuing work on accessibility, sustainability, and efficiency. The key guiding strategy for EP-2022 entails the active engagement of important stakeholders via an inclusive, uncluttered, and transparent consultation process. The EP2022 calls for the development of an Electrification Master Plan and defines the Department of Energy's responsibilities, the on-grid supply, and the off-grid supply policies. Improvement of sustainability of solar home systems (SHS) and mini-grid business models are also outlined in the policy.

The key strategies for Off-grid supply in EP-2022 include:

- Implement the least cost approach.
- Improve sustainability of SHS business models
- Proper Disposal of the Batteries, Solar Panels and other components.
- Improve sustainability of mini/micro-grid business models.

(EP-2022)

In the TNA process, the off-grid rural electrification sector was selected and the mitigation technologies prioritized were:

1. Standalone Ground Mount Solar PV with ESS (Community Based Electrification - Micro-Grids);
2. Ground Mount PV with Biofuel[1] Generator Hybrid systems with ESS; and
3. Micro/Pico-hydro in microgrid configuration.

These technologies require upscaling of SHS to a micro/mini-grid system where feasible. Over 500 diesel-powered mini-grids in the power range of 5-35 kVA are supported by Fiji DoE that are largely used at night. A few solar PV micro-grid (e.g., 30kW - Namara village, Kadavu and 50kW Nakoro Village, Navosa) have been implemented with varying degrees of success while some resorts (e.g., Naitauba Island Resort - 300.9 kW Mini PV-Grid) have solar PV systems with battery storage together with diesel generators as a backup (Prasad and Raturi, 2020). These mini/micro grid systems implemented so far have lower penetration levels largely due to unsustainable business models that the EP2022 aims to improve.

1.1.2 Action Plan for Standalone Ground Mount Solar PV with ESS (Community-Based Electrification - Micro-Grids)

1.1.2.1 Introduction

With the help of this technology, a small off-grid community would be able to have access to electricity for lighting and running other appliances; TVs, radios, fans, computers, and charging stations for mobile devices, depending on the size of the system. Although a battery storage system or a hybrid system with the addition of a generator handles the overnight demand, solar photovoltaics (PV) provide power during the day. Computed using 1983–2005 NASA data (NASA 2017), the average annual insolation on a horizontal surface in Fiji was found to be 5.4 kWh/m^2/day with a standard deviation of 0.6 kWh/m^2/day (Prasad and Raturi, 2020). The long-term annual average solar potential for Viti Levu's west coast is around 5.1 kWh/m^2/day, while for Viti Levu's interior (at Monasavu catchment) is around 3.7 kWh/m^2/day. The lowest insolation of 4.0 kWh/m^2/day was recorded during the mid-year, while from October to

[1] A new broader term Biofuel genset has been used in TAP instead of the Dual fuel (CNO/Diesel) (used in TNA and BAEF) as suggested by the stakeholders. A feasibility study will determine the type of biofuel that can be used for a particular application.

February the peak solar insolation of around 6 kWh/m^2/day is recorded between 1983-2005 (Prasad and Raturi, 2020). Hence, proper system sizing to meet the required demand is imperative (Fiji Renewables Readiness Assessment-2015). Since Fiji is an archipelago of more than 300 islands, grid expansions are not practical for Fiji's 110 permanently inhabited maritime remote islands, therefore this technology has the potential to feasibly provide access to modern electricity to remote and maritime communities. The following components build up the technology; solar photovoltaic (PV) modules, a charge controller, battery storage, and an inverter with a micro/mini-grid configuration.

Across systems and projects, there are variations in the typical capital costs. The solar PV equipment cost will depend entirely on the technology, size, and location of the project. The installation costs include feasibility study, design, and simulations, transporting heavy machinery and equipment to the islands, land acquisition and clearing, hiring barges and helicopters for site development, and other logistics. Many times the contractors had to build infrastructure, including roads to the villages so that the equipment can be transported. In these cases, the prior site visitation and necessary budget need to be factored in.

1.1.2.2 Ambition for the TAP

The ambition of this TAP is to increase electricity access to remote and maritime communities by upscaling the microgrid systems. To provide access to electricity to remote and rural communities, the Government of Fiji provides funding to the rural electrification unit of the Department of Energy (DoE). The DoE provides financial and technical support for the installation of solar PV home systems (SHS). Initially, the Type I SHS were installed, and then the upscaled Type II SHS replaced it. The Renewable Energy Service Company (RESCO) model has been adopted by the DoE in providing the SHS. The systems are owned and maintained by the government while the users pay a small fee (Rural Electrification Policy-2016).

The household electricity demand has been increasing, which requires larger systems to cater for the loads. Solar microgrids of sizes 249 kW, 153 kW, and 153 kW have been installed on three larger outer islands namely Kadavu, Lakeba; Rotuma, respectively (Engerati, 2015). Up to 40% of the electricity demand for these small islands is met by solar microgrids. Similarly, appropriately sized and designed microgrids would be pivotal in providing modern and decent electricity in other small islands.

The 20-year NDP (2017-2036) aims to have at least 10 hybrid systems installed in this period, hence in support of this, the target of TAP is to have more microgrids with at least 5 additional microgrid systems (PV + ESS).

1.1.2.3 Actions and Activities selected for inclusion in the TAP

Summary of barriers and measures to overcome barriers

There are a number of challenges in the development and adoption of solar PV with energy storage system (ESS) microgrids in Fiji. These challenges include economic, financial, regulatory, technological, and human capacity. The development of microgrids in rural and

maritime communities are constrained by these barriers. Strong markets are necessary to encourage the required investment in technical research and implementation. A summary of barriers and measures identified for Standalone Ground Mount Solar PV with ESS (Community Based Electrification - Micro-Grids) is provided in Table 1.1. These are derived from the TNA Barrier Analysis and Enabling Framework Report. The Standalone Ground Mount Solar PV with ESS has significantly higher prices compared to SHS, hence the smaller islands face significant financial issues and largely depend on the government for financial support.

Consultations with the stakeholders revealed additional institutional barriers to the diffusion of this technology. The EFL being a privatized and profit-oriented company has been highlighted as a constraint. EFL is the sole company responsible for electricity generation in Fiji for all the grids.

To overcome the barriers discussed above, the development of an electrification master plan with improved business sustainability models for SHS and mini/microgrids is necessary (Electrification Policy, 2022). Bespoke business models with an increased private-public-partnership-based cost-sharing agreement or similar have good potential. Other government incentives to encourage the private sector is through granting of a tax exemption, and training of locals into implementing these technologies throughout the rural and maritime communities.

Table 1.1: Summary of barriers and respective measures for PV and ESS microgrids.

Barriers	Measures
Economic and Financial	
Capital intensive. High capital and O&M costs.	-More access to capital funding -Tax incentives for the private sector. -Availability of direct capital investments and small grants. -Clear and adoptable financial model with income generation opportunities for communities. -Proper O&M planning and financing. -Comprehensive feasibility study.
Regulatory	
-There are no clear regulations on asset ownership and micro-grid operations. -insufficient encouragement for the private sector.	-Proper monitoring and evaluation frameworks to be developed and followed closely. -Incentives for the private sector. -NEP is expected to capture many of the barriers (Reviewed, yet pending approvals). -Mandatory regular energy audits. -The Electricity Act requires updating to allow better engagement of the private sector together with Energy Fiji Limited.
Technological	
-Communities more used to diesel generators.	-proper and dedicated information and knowledge dissemination.

-Lack of awareness of the technicalities of solar PV micro-grids. -Lack of know-how of system sizing and load usage by individuals at community levels.	-upsize the systems that can handle large surges, yet economic feasibility is imperative.
Capacity	
-Insufficient number of qualified technical, financial, and analytical experts for Solar PV microgrids. -Insufficient micro-grid design engineers. -Lack of dedicated professional training programs in technical institutes.	-training of professionals in technical, financial, and analytical aspects. -Train to meet current industry requirements. -train women as technicians. -Inclusion of gender quotas for technical and non-technical training and skill development opportunities.

Actions and Activities selected for inclusion in the TAP

After a wide-ranging identification of barriers and systematic analysis whilst identifying the enabling framework all driven by relevant stakeholders, the actions and activities were identified for inclusion in the TAP. During the BAEF phase, the new Electrification Policy was drafted and released in 2022 (Electrification Policy, 2022). This has incorporated many of the identified regulatory barriers, yet specific actions need to be taken for implementation. Table 1.2 presents the actions and activities that need to be implemented under the proposed TAP for solar PV and ESS systems.

Table 1.2: Activities to be implemented to enhance the diffusion of solar PV and ESS technology.

Actions	Activities
1. Increased access to capital funding.	1.1 Quality data collection and compiling. 1.2 Concept note and project proposal development.
2. Tax incentives for the private sector.	2.1 Clear/legitimate act and Cabinet verification of tax incentives for renewable energy technology for private sectors to be enforced. 2.2 Enabling environment for non-renewable energy companies to be involved in renewable energy projects implementation. 2.3 Increased awareness of tax incentives by Investment Fiji. 2.4 Regular review of energy and related policies.
3. Availability of direct capital investments and small grants.	3.1 Understanding the objectives of grant agencies and their criteria. 3.2 An energy portal (readily available for investors). 3.3 Quality data on economic activities, agricultural activity, and energy consumption to be made available.
4. Clear and adoptable financial model with income generation.	4.1 Business model with very high opportunity in economic activity - RESCO model. 4.2 Develop Standards (User friendly and efficient technology).

opportunities for communities.	4.3 Enhancing public-private partnership (PPP) models to attract investors and local communities
5. Implementation.	5.1 Involve the community and secure land lease. 5.2 Tendering. 5.3 Feasibility and resource assessment. 5.4 Engineering, procurement, project management, and construction. 5.5 Phasing out of diesel generators in remote non-grid connected areas (maritime zones and interior of mainlands).

To have increased access to capital, funding the small and medium enterprises (SMEs) in the RE sector could be facilitated with long-term, low deposit, low-interest rate, equity financing, and if possible, government guarantees could be provided. Another important factor to consider in the successful implementation of the project is to involve the community and secure land leases well before the project feasibility begins as this has led to unsustainable microgrid implementations.

Actions to be implemented as Project Ideas

The stakeholder discussions and consultations revealed that there is ample human capacity within the DoE and the private sector to conduct the pre-feasibility study, feasibility study, environmental impact assessment, design, engineering, and project management of microgrids in Fiji. The key requirement is to have finances readily available with a proper financial model with income generation opportunities for remote and maritime communities. Hence, Actions 1 and 4 are further considered for project ideas with pilot studies.

1.1.2.4 Stakeholders and Timeline for implementation of TAP

Overview of Stakeholders for the implementation of the TAP

The DoE is the responsible organization for rural electrification. The role of DoE is clearly defined in the new Electrification Policy including managing and administering the off-grid electrification projects, assessing and developing RE resources and projects, effective O&M of electrification projects, and maintaining a database. With community micro-grid systems, donor-funded projects and PPPs other stakeholders need to be involved to have effective and sustainable implementations. Table 1.3 provides a list of stakeholders required and their representatives.

Scheduling and sequencing of specific activities

Rural electrification has been an ongoing initiative by the Government of Fiji. The TAP aims to upscale the initiative with solar PV microgrid technology. It is imperative that all relevant stakeholders are involved in these developments from the inception and pre-feasibility study including the landowners, communities/beneficiaries, DoE, Ministry of Environment, renewable energy companies and the donors (if any). In addition, the think-tank, research centers (e.g., Pacific Centre for Environment and Sustainable Development (PACE-SD),

Pacific Climate Change Centre (PCCC) and Centre for Climate Change, Energy, Environment and Sustainable Development (CCCEESD)) and tertiary education institutions can be pivotal in data collection for making informed decisions by looking at lessons learned and the best practices.

Table 1.4 outlines the proposed timelines with respective stakeholders that need to be involved at each stage. The timelines provided in Table 1.4 are estimates only. These can serve as a guideline for achieving the goals set in the NDP. The progress and findings will be ongoing and the timelines can be amended as new information is available at hand.

Table 1.3: Stakeholders for implementation of Solar PV and ESS microgrid.

Department	Representative
Climate Change Division – Ministry of Environment and Climate Change	Permanent Secretary Director of Climate Change Division
Department of Energy - Ministry of Public Works, Transport and Meteorology Services (MPWTMS)	Permanent Secretary Director of Energy Rural Electrification Unit
Fiji Revenue and Customs Services	CEO of FRCS
Energy Fiji Limited	CEO and/or recommended rep.
Solicitor General's Office	SG
Investment Fiji	CEO and/or recommended rep.
Fiji Bureau of Statistics	CEO and/or recommended rep.
Donor Agencies	GCF GEF World Bank ADB UNDP
NGOs, CROP Agencies, Think-Tank and Research Centers, and Education and training institutions	International Union for Conservation of Nature SPC SPREP Pacific Centre for Environment and Sustainable Development Centre for Climate Change, Energy, Environment and Sustainable Development. The University of the South Pacific Fiji National University The University of Fiji

Private Sector	Private sector design, engineering, and construction firms. Solar PV system suppliers.
Community	Community leaders Landowners

Table 1.4: TAP schedule and responsible stakeholders for implementation of TAP activities for solar PV and ESS microgrid.

Action	Activities	Timeline												Stakeholders (Responsible body and focal point)
		Q3-2023	Q4r-2023	Q1-2024	Q2-2024	Q3-2024	Q4-2024	Q1-2025	Q2-2025	Q3-2025	Q4-2025	Q1-2026	Q2-2026	
1. Increased access to capital funding	1.1 Quality data collection and compiling													DoE, RESCOS, Institutions, Government Organisations, NGOs
	1.2 Concept note and project proposal development.													DoE, MECC (CCD), NGOs,
2. Tax incentives for the private sector	2.1 Clear/legitimate act and cabinet verification of tax incentives for renewable energy technology for private sectors to be enforced													SG's office, MECC (CCD), MPWTMS, FRCS, DoE, RESCOS'
	2.2 Enabling environment for non-renewable energy companies to be involved in renewable energy projects implementation.													FRCS, RESCOS, DoE, MECC, Investment Fiji, EFL, NGO and Private sectors
	2.3 Increased awareness of tax incentives by Investment Fiji													Investment Fiji, Ministry of Finance, National Planning and Trade, Ministry of Tourism and Civil Aviation and Ministry of Public Works, Meteorology Services and Transport.
	2.4 Regular review of energy and related policies.													DoE to lead with all relevant stakeholders.
3. Availability of direct capital investments and small grants	3.1 Understanding the objectives of grant agencies and their criteria.													MECC (CCD), DoE, NGO.
	3.2 An energy portal (readily available for investors)													MECC (CCD), Dept. of Energy, NGOs, ICT-Division
	3.3 Quality Data on economic activities, agricultural activity, and energy consumption to be made available													MECC (CCD), Dept. of Energy, NGOs, FBOS

4. Clear and adoptable financial model with income generation opportunities for communities	4.1 Business model with very high opportunity in economic activity - RESCO model													SG's office, MECC (CCD), MPWTMS, FRCS, DoE
	4.2 Develop Standards (User friendly and efficient technology)													DoE, MECC, EFL, RESCO
	4.3 Enhancing PPP models to attract investors and local communities													SG's office, MECC, MPWTMS, FRCS, DoE, RESCOS'
5. Implementation	5.1 Securing land leases													DoE, Communities, Donor agencies, Ministry of iTaukei Affairs, Department of Lands.
	5.2 Tendering													DoE.
	5.3 Feasibility and resource assessment.													DoE, CCD, Landowners, communities, RESCO
	5.4 Engineering, Procurement, Project management and construction.													DoE, Landowners, communities, RESCO
	5.5 Phasing out of diesel generators in remote non-electrified areas (maritime zones and interior of mainlands).													DoE, RESCOS, Government Organisations, NGOs

1.1.2.5 Estimation of Resources Needed for Action and Activities

Estimation of capacity building needs

Capacity needs availability is important for the effective delivery and implementation of a project. Local experts are recommended to increase the capacity of locals and retain the know-how within the country. Local experts would also allow for efficient liaison with stakeholders, organizing visits, logistics, workshops and consultations, and providing information. Local personnel needs to be trained in areas where the country lacks expertise. Table 1.5 provides details on the availability of local capacity and the training requirement priority for the project.

Table 1.5: Availability of local capacity and training requirements priority.

Field of expertise	Specialist/ Trades person	Role	Local Capacity									
			Local Capacity					Training Requirement Priority				
			0-1	2	3	4	5	0-1	2	3	4	5
Data and Statistics	Local Statistics specialist and data scientist	For quality data collection and compiling Small project (hydro/PV) P50 report P90 report (wind)– bank requirement (ADB)				☐						☐
Energy Technology	Local Energy Specialist (Solar PV Hybrid specialist)	Standardized Resource assessment (ISO certification); Concept note and project proposal development; Develop Standards				☐				☐		
Energy Economics	Finance Specialist	Feasibility assessment. Concept note and project proposal development. Tax incentive propositions and awareness; Business model development.				☐						☐
Communications	Proposal Writers	Understanding the objectives of grant agencies and their criteria; Concept note and project proposal writing			☐							☐
Engineering	System Design Engineers	Solar PV and ESS microgrid design engineers; replacing diesel gensets with solar PV. (In-house with DoE for EPC contracts)				☐					☐	
	Solar PV installation technicians	Solar PV installation and maintenance					☐			☐		
Management	Project Manager/ Officer	Construction and Logistics project assistant				☐				☐		
	Administration Officers	General office work					☐	☐				
	Environment Officer	ESIA compliance.					☐	☐				
	OHS Officer	Construction and site safety compliance.					☐	☐				
General Construction workers.	Welders, Fitters, Electricians,	Structural and site development; General wiring installations					☐	☐				
	Mason/ Concreter;	General concrete foundation & structural works; General carpentry works' General plumbing installations					☐	☐				

	Carpenters; Plumbers											
	Control System Technician	Instrumentation & control wiring & system installation										

Local Capacity		**Training Requirement Priority**	
0-1	No Capacity	**0-1**	Low Priority
2	Low Capacity	**2**	Somewhat Priority
3	Moderate Capacity	**3**	Neutral
4	Functional Capacity	**4**	Moderate Priority
5	Highly Functional Capacity	**5**	High Priority

In many cases, the specialists are locally available or are trained by government departments and private companies, yet retention of highly skilled personnel is an issue in Fiji due to rural-to-urban migration and migration to other countries as well. To counter this, specialized training needs to be developed into courses at tertiary institutions so more locals can be trained and if one leaves, then there is no void in the system.

Estimations of costs of actions and activities

The actual cost of implementation of solar PV and ESS microgrid is contingent upon a number of factors from the availability of solar resource, site, remoteness, number of households, and land leasing. Table 1.6 provides an estimate of the associated costs that can incur. Previous experiences of stakeholders show that the bulk of the funding is required for a proper feasibility study, cartage of equipment and heavy machinery to the islands, hiring barges, and helicopters, and taking own heavy machinery and operators and workforce for site development and other logistics. At times the contractors have to develop infrastructure such as roads to the villages to cart the equipment. These costs are huge and need to be properly factored into the overall project budget to avoid a large overhead. The costs will depend entirely on the technology, size, and location of the project. The costs may change at the point in time of implementation due to many reasons including system sizing, type of Solar modules/batteries/other components and fiscal policies/incentives. The cost is for equipment and installation only and does not include costs of feasibility studies, ESIA and cartage costs, etc.

Table 1.6: Estimated costs for TAP activities for the diffusion of solar PV and ESS technology.

Action/ Activities	Estimated Costs (USD)
1.1 Quality data collection and compiling	100,000[2] (Consultants)
1.2 Concept note and project proposal development.	20,000/proposal
2.1 Clear/legitimate act and cabinet verification of tax incentives for renewable energy technology for private sectors to be enforced	80,000
2.2 Enabling environment for non-renewable energy companies to be involved in renewable energy projects implementation.	50,000
2.3 Increased awareness of tax incentives by Investment Fiji	80,000
2.4 Review Energy Policy 5 years	50,000
3.1 Understanding the objectives of grant agencies and their criteria.	Staff time
3.2 An energy portal (readily available for investors) CCD + DoE + MECC	100,000
3.3 Quality Data on economic activities, agricultural activity, and energy consumption to be made available	100,000 (Consultants)
4.1 Business model with very high opportunity for economic activity - RESCO model	50,000
4.2 Develop Standards (User friendly and efficient technology)	30,000
4.3 Enhancing PPP models to attract investors and local communities	50,000
5.1 Securing land leases	10,000 USD/20yrs
5.2 Tendering	Equipment cost only: 5000 – 7500 USD/kW 30kW - $1.5M USD (Namara village, Kadavu) 50kW - $1.2M USD (Nakoro Village, Navosa)
5.3 Feasibility and resource assessment, inaccessible site	
5.4 Engineering, Procurement, Project management and construction.	
5.5 Phasing out of diesel generators in remote non-grid connected areas (maritime zones and interior of mainlands).	

[2] E.g., For physical monitoring, the cost could be more. For wind monitoring stations, there are 15 stations costing around $0.5 M (supply, installation, monitoring) of wind data.

1.1.2.6 Management Planning

Risks and Contingency Planning

Solar PV home systems are quite mature technology for Fiji and the Pacific. However, the standalone microgrids to electrify a community still prove to be a challenging task. The technology is capital intensive and hence is considered not viable at a smaller scale. In addition, the remote and maritime communities suffer from a lack of income generation opportunities leading to financial difficulties in paying the required tariff and O&M costs. Surely an integrated approach with the development of PV and ESS microgrids with income generation opportunities is imperative to make the projects a success. To avoid all these, a proper business plan and private-public partnership initiative need to be developed in detail before implementation. A comprehensive resource assessment and feasibility study would also reduce the associated risks.

In addition, electricity generation is weather dependent and the communities might lose confidence in solar PV microgrids in comparison to the diesel gensets if the systems are not designed properly for the current and future loads. A proper design, load assessment, and future load requirements would greatly reduce this risk. In the Pacific and Fiji, the greatest risk is imposed by tropical cyclones and storm surges on small islands. In many small islands, the only feasible site is a saltwater swamp near the coast. Hence, the impacts are unavoidable. As a result, a climate-resilient infrastructure needs to be erected for all installations and following all the latest building and electrical codes. This microgrid development could be combined with the sea-wall development in coastal communities to complement each other and provide coastal protection and energy to vulnerable communities.

Next Steps

The Electrification Policy has been revised and the latest one was released in 2022 (EP2022). This was done in consultation with a number of relevant stakeholders. This policy builds on the previous ones and has addressed a number of barriers highlighted in the BAEF. Using the EP2022 as the basis, new plans and strategies are to be developed for accelerated adoption of RE technologies and better access to electricity for rural and maritime communities. The schematic in Figure 1.1 summarizes the next steps for ease of implementation.

A plan followed by a gradual phasing out of diesel generators in remote non-grid connected areas (maritime zones and interior of mainlands) would be the most immediate step for transition to this technology as many communities are very accustomed to diesel gensets. To have an effective transition, a gradual change would be more effective. Concurrently, the next steps in Figure 1.1 can be followed in terms of data collation, compilation, and business model development as this will require baseline data.

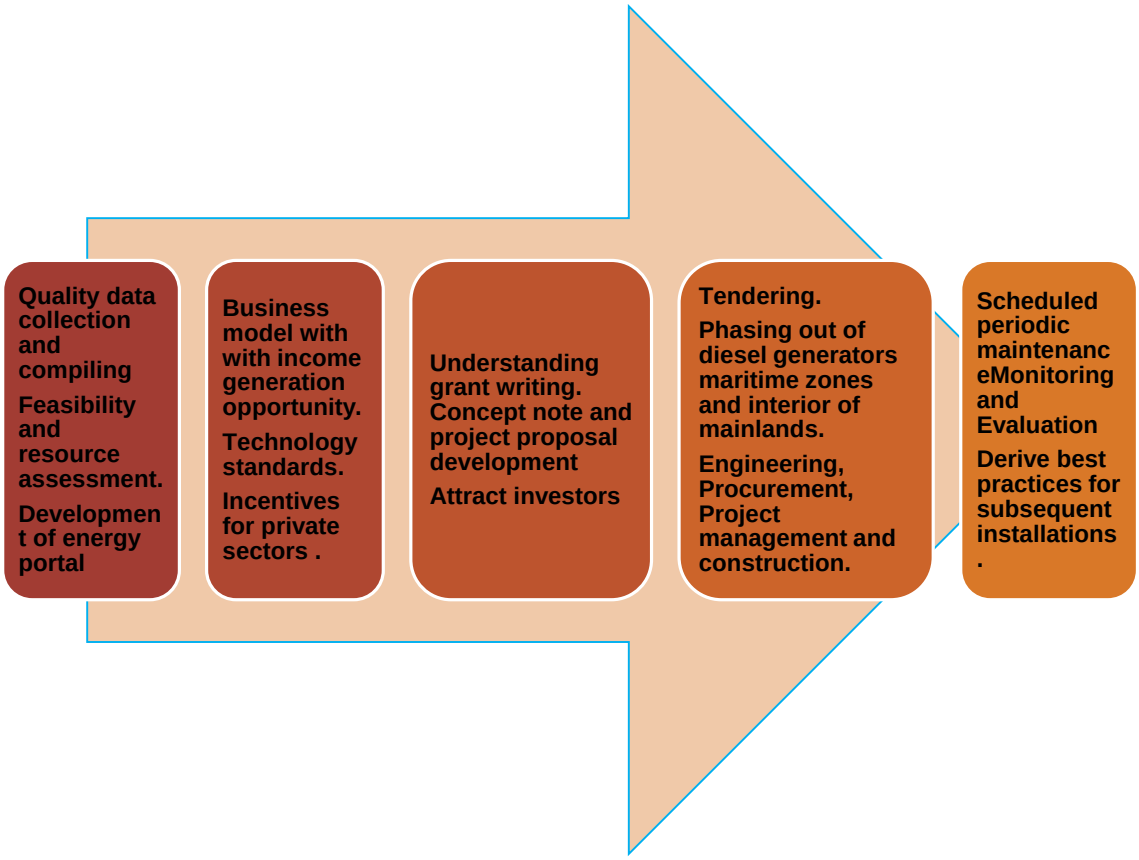

Figure 1.1: Proposed sequence of next-step activities for Solar PV and ESS microgrid adoptions.

1.1.2.7 TAP overview table

TAP overview table								
Sector	Energy							
Sub-sector	Rural Electrification							
Technology	Standalone Ground Mount Solar PV with ESS							
Ambition	The ambition is to increase electricity access and provide electricity to remote and maritime communities by upscaling the microgrid systems. The 20-year NDP (2017-2036) aims to have at least 10 hybrid systems installed in this period, hence in support of this, the target of TAP is to have more microgrids with at least 5 additional microgrid systems (PV + ESS).							
Benefits	Provide access to modern electricity to the remotely located maritime communities. Electricity is used for income generation, education, and recreational activities. Provide modern health care in remote communities. 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 (USD)**
Action 1- Increased access to capital funding	**Activity 1.1** Quality data collection and compiling	Govt, private sector, and donor agencies	DoE (major mandate) MECC, and MPWTMS, DoE.	24 months	Data is not of high quality or disaggregated.	Data collation template and a repository	Stakeholder inputs	100000
	Activity 1.2 Concept note and project proposal development.	Govt, private sector, and donor agencies	MECC (CCD), MPWTMS, and DoE	6 months	Proposals being declined	Proposal accepted and grants solicited from donors	Donor funded projects	20,000/proposal

Action 2-Tax incentives for the private sector	**Activity 2.1** Clear/legitimate act and cabinet verification of tax incentives for renewable energy technology for private sectors to be enforced	Govt, private sector, and donor agencies	DoE (major mandate), MECC (CCD), MPWTMS, Ministry of Finance, FCCC, and FRCS, DoE	33 months	Lack of private sector participation	More PPP agreements endorsed	No. of PPP ventures.	80000
	Activity 2.2 Enabling environment for non-renewable energy companies to be involved in renewable energy projects implementation	Govt, private sector, and donor agencies	MECC (CCD), MPWTMS, DoE	18 months	RE companies do not get the full benefit.	More RE companies and businesses are involved in RE projects.	PPP ventures and RE projects.	50,000
	Activity 2.3 Increased awareness of tax incentives by Investment Fiji	Govt, private sector, and donor agencies	MECC (CCD), MPWTMS, DoE	30 months	Companies are not fully aware.	All RE companies and businesses are benefitting from the incentives.	FRCS tax report and stakeholder responses.	80,000

	Activity 2.4 Regular review of energy and related policies	Govt, private sector, and donor agencies	DoE (major mandate), MECC, MPWTMS, DoE	Every 4/5 years	Policies not reviewed on time	Timely review and update of policies.	Updated policies are being enacted.	50,000
Action 3- Availability of direct capital investments and small grants	**Activity 3.1** Understanding the objectives of grant agencies and their criteria.	Govt, private sector, and donor agencies	MECC(CCD), MPWTMS, DoE	9 months	Unable to receive grants	Proposal accepted and grants solicited from donors	No. of grant proposals submitted and the success rate.	Staff time
	Activity 3.2 An energy portal (readily available for investors)	Govt, private sector, and donor agencies	MECC(CCD), MPWTMS, DoE	12 months	Data is not of high quality or disaggregated.	An energy portal is developed.	Up-to-date energy portal.	100,000
	Activity 3.3 Quality Data on economic activities, agricultural activity, and energy consumption to be made available	Govt, private sector, and donor agencies	MECC(CCD), MPWTMS, DoE	6 months	Data is not of high quality or disaggregated.	Quality data has been collated.	Continuation of the MRV after the CIBIT project	100,000 (Consultants)

Action 4-Clear and adoptable financial model with income generation opportunities for communities	**Activity 4.1** Business model with very high opportunity for economic activity - RESCO model	Govt, private sector, and donor agencies	MECC (CCD), MPWTMS, DoE	12 months	Unavailability of data for a business model; projects are uneconomical	An effective and workable model is developed.	Implementation of business models in RE ventures.	50,000
	Activity 4.2 Develop Standards (User-friendly and efficient technology)	Govt, private sector, and donor agencies	MECC (CCD), MPWTMS, DoE	24 months	Standards are not developed	Standards are developed, gazetted, and enforced.	Accepted standards are developed by the DoE and enforced.	30,000
	Activity 4.3 Enhancing PPP models to attract investors and local communities	Govt, private sector, and donor agencies	MECC (CCD), MPWTMS, DoE	12 months	The private sector is reluctant	Increased private sector engagement in RE development	More PPP agreements are being signed.	50,000
Action 5- Implementation	**Activity 5.1** Involve the community and secure land lease	Govt, private sector, and donor agencies	MECC (CCD), MPWTMS, DoE, Ministry of Itaukei Affairs, Ministry of Lands and Mineral Resources	33 Months (Ongoing)	The community has a sense of insecurity.	The land is secured during the initial stage of the project.	No. of leases for special RE projects.	10,000 USD/20yrs

	Activity 5.2 Tendering	Govt, private sector, and donor agencies	MECC (CCD), MPWTMS, DoE	9 months	Lack of private sector participation. Lengthy tendering process.	Successful bidding by the private sector.	Project tenders are being executed.	Equipment cost only: 5000 – 7500 USD/kW 30kW - $1.5M USD (Namara village, Kadavu) 50kW - $1.2M USD (Nakoro Village, Navosa)
	Activity 5.3 Feasibility and resource assessment.	Govt, private sector, and donor agencies	MECC (CCD), MPWTMS, DoE	12 months	Lengthy process. Data is not of high quality. High cost of feasibility studies.	Feasible sites identified.	No. of sites identified for RE projects like solar PV, wind, and micro-hydro for microgrid development.	
	Activity 5.4 Engineering, Procurement, Project management, and construction.	Govt, private sector, and donor agencies	MECC (CCD), MPWTMS, DoE	12 months	Unavailability of skilled workers, equipment, supply chain issues, and weather.	The project is being successfully implemented.	Commissioning of the project and regular O&M	
	Activity 5.5 Phasing out of diesel generators in remote non-electrifies areas	Govt, private sector, and donor agencies	MECC (CCD), MPWTMS, DoE,	27 months	Diesel gensets are still in use.	All diesel gensets have been successfully replaced	Electrification rate and off-grid Renewable Electricity generation mix.	

1.1.3 Action Plan for Ground Mount PV with Biofuel Generator Hybrid systems with ESS (micro-grid)

1.1.3.1 Introduction

This hybrid technology has the potential to provide rural communities that rely on small solar home systems or generators with a 24-hour reliable electrical source. It consists of a solar PV system with a battery bank and a biofuel generator that can use either a recommended biofuel or diesel or a mix of two. The government has developed microgrids with diesel generators in remote and isolated communities and rural government stations. Similar technology is also used in some remote schools. The main purpose of these diesel-powered mini-grids is to provide light during the nighttime for different purposes.

However, the rising fuel costs make it a challenge for the communities to afford diesel to keep the generators running. Ground Mount PV with Biofuel Generator Hybrid systems with ESS (micro-grid) is a hybrid system whereby the Solar PV can be used to meet demand during the daytime, while excess electrical energy can be stored and used during the night, while the biofuel generator can support the night-time heavy loads and provide electricity during prolonged low sunshine periods. This technology is not common in Fiji but could be implemented in remote communities and remote maritime communities where grid extension is not feasible. An appropriate biofuel generator can be selected during system design and simulation that can run on one of the readily available and cost-effective biofuels.

This hybrid system has a high capital cost as a result of the inclusion of PV, ESS, and the genset. In order to decrease reliance on the generator while minimizing the cost function, a thorough feasibility analysis and system optimization are required. The costs will depend entirely on the technology, size, and location of the project. Similar to Technology 1, the stakeholders experienced significant expenses associated with the logistics of the feasibility study, transportation of heavy equipment to the islands, site development, personnel mobilization, and other activities, in addition to the cost of equipment and installation.

1.1.3.2 Ambition for the TAP

The fuel price has been volatile and the impact of COVID-19 and the Ukraine crisis has compounded the issue for a small island nation like Fiji. Increased transportation costs added more burden to the high diesel costs in rural areas. This recent surge in prices of energy commodities has only strengthened the need for energy independence. Many remote communities depend largely on diesel generator-powered microgrids installed by the government.

The ambition of this TAP is to increase electricity access to remote and maritime communities by upscaling the microgrid systems and making them more reliable. Larger systems are required to cater for increasing electricity demand and to provide a decent livelihood. Upscaled reliable microgrids would be pivotal in providing modern and decent energy to all. In its Bio-fuel (Ethanol/Biodiesel) Programme the NDP (2017-2036) aims to have at least four plants and at least 10 hybrid systems installed in this period. Considering this, the target of TAP is to have more microgrids with at least 5 additional biofuel-hybrid microgrid systems (PV + ESS +

Biofuel genset). Utilization of Biofuels is expected to provide a boost to the declining copra and other agricultural industry in Fiji in addition to providing energy independence to the community.

The transitioning from diesel gensets to the use of locally available biofuel resources would require advanced technologies. The use of locally available biofuel resources such as coconut oil can assist in strengthening the livelihoods of maritime communities. Co-benefits in terms of income generation from localized copra industry, increased coconut oil production, and savings are possible, yet will require a sustainable developed strategy since coconut products are also high in demand both locally and internationally.

1.1.3.3 Actions and Activities selected for inclusion in the TAP

Summary of barriers and measures to overcome barriers

Maritime communities across the islands have to bear the high cost of electricity and the implementation of this technology will try to reduce some of the burdens. The technology is also expected to provide households with a cost-effective, sustainable and round-the-clock electrical supply. Solar PVs with biofuel fuel generator hybrid systems and ESS faces several challenges in terms of economic, financial, regulatory, capacity and institutional for deployment and adoption. A summary of barriers and measures identified for Ground Mount PV with Biofuel Generator Hybrid systems with ESS (micro-grid) is provided in Table 1.7. These are derived from the TNA Barrier Analysis and Enabling Framework Report.

Table 1.7: Summary of barriers and respective measures for PV +Biofuel generators and ESS microgrids.

Barriers	Measures
Economic and Financial	
- Despite the costs of solar PV and batteries has been declining, the costs of hybrid systems are high for remote and maritime communities as cash flow is very low in these communities. -unsustained operations -Improper financial management procedures -Develop market on the mainland, export market	-More access to capital funding e.g., Sustainable Energy Financing Project (SEFP) with low equity and interest rates. -Availability of direct capital investments and small grants. -Clear and adoptable financial model with income generation opportunities for communities. -Proper O&M planning and financing. -smart pre-paid metering. -Climate-resilient infrastructure and civil works. -Subsidies to all rural, remote, and maritime communities. -Comprehensive feasibility study

Regulatory	
-insufficient encouragement for the private sector. -Unfavourable IPP framework for rural and remote electrifications.	- Private sector encouragement through policies is required. -Better IPP framework for rural and remote electrifications. -Mandatory regular energy audits. -Subsidies on land purchases and CNO/biofuel production equipment. -The guideline developed in the Fiji Renewable Energy Power Project (FREPP) and the Electrification Policy-2022 needs to be implemented.
Capacity	
-Insufficient number of qualified technical, financial, and analytical experts for Solar PV microgrids. -Insufficient micro-grid design engineers -Lack of dedicated professional training programs in technical institutes. -System optimization is crucial for hybrid systems.	- More dedicated training of professionals. -Train to meet current industry requirements. -train women as technicians. -Inclusion of gender quotas for technical and non-technical training and skill development opportunities.
Institutional	
-Insufficient or intermittent supply of CNO fuel. -lack of confidence in the coconut and copra industry. -irregular maritime transportation for sourcing CNO from other islands.	-Positive economic benefit of biofuel development for rural areas needs to be capitalized on. -Maritime transport networks and frequency have to be improved

The EP2022 has been developed that has captured many concerns for the mini/microgrid implementations from defining the roles of DoE, the approvals and implementations of donor-funded projects, and monitoring of the projects. The policy also encourages the least cost options, innovative mini/micro grid business models, PPP engagement, and gender empowerment. Once newer fuels such as hydrogen technology become mature and affordable, the transition to hydrogen fuel could also be explored.

Actions and Activities selected for inclusion in the TAP

After a comprehensive identification of barriers and systematic analysis whilst identification of enabling framework all driven by relevant stakeholders, the actions and activities were identified for inclusion in the TAP. During the BAEF phase, the Electrification Policy was drafted and released in 2022 (EP2022). This has incorporated many of the identified regulatory barriers, yet specific actions need to be taken for implementation. Table 1.8 presents the actions and activities that need to be implemented under the proposed TAP for solar PV and ESS

systems. Actions and activities were chosen for inclusion in the TAP after stakeholder consultations.

Table 1.8: Activities to be implemented to enhance the diffusion of solar PV with biofuel generator hybrid systems with ESS (micro-grid).

Actions	Activities
1. Increased Access to Capital Funding e.g., Sustainable Energy Financing Project (SEFP) with low equity and interest	1.1 Screening and Strengthening Partnerships with key funding agencies e.g., IRENA, KOICA, JICA, China AID, ISA, etc. 1.2 Align key priorities areas for Capital Funding i.e., energy, climate mitigation and adaptation, resilience, etc. 1.3 Project mapping and identifying communities for low equity and interest projects. 1.4 Favourable IPP framework for IPPs for renewable energy projects. 1.5 Monitoring of the IPP framework.
2. Availability of direct capital investments and small grants	2.1 Consultation and discussions with key funding agencies and setting up a steering committee. 2.2 Development of financing framework. 2.3 Dedicated MRV in place.
3. Clear and adoptable financial model with income generation opportunities for communities	3.1 Revamping the existing IPP models and developing new IPP models. 3.2 Community and stakeholder engagement on IPP models.
4. Proper O&M planning and financing	4.1 Develop O&M & financing frameworks. 4.2 Align O&M and financing process between key agencies.
5. Implementation with Smart Pre-paid Metering	5.1 Tendering 5.2 Feasibility and resource assessment. 5.3 Engineering, Procurement, Project management and construction.

With this technology as well, the securing of land leases well before the project feasibility begins has been encouraged for the microgrid implementation to be sustainable.

Actions to be implemented as Project Ideas

Discussions with stakeholders and engagements with them indicated that the DoE and the private sector have enough human resource capacity to carry out the pre-feasibility research, feasibility study, environmental impact assessment, design, engineering, and project management of hybrid PV and biofuel microgrids in Fiji. For hybrid microgrid systems to operate at their peak efficiency, special training in operations and maintenance would be required. The main prerequisite is having easy access to finance for SMEs and the private sector together with a proper financial strategy for remote and maritime communities for income

generation opportunities. In order to further explore project ideas, the aforementioned measures are considered.

1.1.3.4 Stakeholders and Timeline for implementation of TAP

Overview of Stakeholders for the implementation of the TAP

The DoE is the responsible organization for rural electrification. To have effective and sustainable implementations of community micro-grid systems, donor-funded projects, and PPPs other stakeholders need to be involved while the DoE will be the entity that will be managing and administering the off-grid electrification projects, assessing and developing RE resources and projects, effective O&M of electrification projects and maintaining database as clearly defined in the new Electrification Policy. Table 1.9 provides a list of stakeholders required and their representatives.

Table 1.9: Stakeholders for implementation of Solar PV with biofuel fuel generator Hybrid systems with ESS (micro-grid).

Department	Representative
Climate Change Division – Ministry of Environment and Climate Change	Permanent Secretary Director of Climate Change Division
Department of Energy - MPWTMS	Permanent Secretary Director of Energy Rural Electrification Unit
Fiji Revenue and Customs Services	CEO of FRCS
Energy Fiji Limited	CEO and/or recommended rep.
Solicitor General's Office	SG
Investment Fiji	CEO and/or recommended rep.
Fiji Bureau of Statistics	CEO and/or recommended rep.
Donor Agencies	IRENA KOICA GCF GEF World Bank ADB UNDP ISO
NGOs, CROP Agencies, Think-Tank and Research Centers, and Education and training institutions	International Union for Conservation of Nature SPC SPREP

	Pacific Centre for Environment and Sustainable Development Centre for Climate Change, Energy, Environment and Sustainable Development. The University of the South Pacific Fiji National University The University of Fiji
Private Sector	Private sector design, engineering, and construction firms. Solar PV system suppliers CNO/Diesel genset suppliers
Community	Community leaders Landowners

Scheduling and sequencing of specific activities

The involvement of pertinent stakeholders is imperative in rural electrification projects. The goal of the TAP is to upscale and strengthen the Fiji Government's ongoing rural electrification initiatives with ground-mount solar PV with biofuel generator hybrid and ESS systems micro-grid technology. To enhance this initiative for its affordability and accelerated deployment, all stakeholders including the resource owners, communities/beneficiaries, DoE, Ministry of Environment, private sectors, and donors need to be involved from the commencement and pre-feasibility study. Furthermore, the contributions from the think-tank center can be fundamental in data collection for making conversant decisions by observing the lessons learned and the best practices. Table 1.10 provides the projected timelines with relevant stakeholders that are to be engaged at each stage. The suggested timelines in Table 1.4 are simply estimations that serve as a guideline to achieve TAP goals. The timelines are prone to amendments for any new information as the progress and outcomes will be ongoing.

Table 1.10: TAP schedule and responsible stakeholders for implementation of TAP activities for solar PV + biofuel generator and ESS microgrid.

Action/ Activities	Timeline												Stakeholders (Responsible body and focal point)
	3rd Quarter - 2023	4th Quarter - 2023	1st Quarter - 2024	2nd Quarter - 2024	3rd Quarter - 2024	4th Quarter - 2024	1st Quarter - 2025	2nd Quarter - 2025	3rd Quarter - 2025	4th Quarter - 2025	1st Quarter -2026	2nd Quarter - 2026	
1.1 Strengthen Partnerships with key funding agencies e.g., IRENA, KOICA, etc.													DoE, Institutions, Government Organisations, Donors, and financial institutions.
1.2 Align key priorities areas for Capital Funding i.e., energy, climate mitigation and adaptation, resilience, etc.									Progress/ Review				MECC, DoE, RESCOS, Government Organisations, NGOs
1.3 Project mapping and identifying communities for low equity and interest projects.													MECC, DoE, Ministry of Finance, National Planning and Trade, NGOs, Climate Change Division
1.4 Favourable IPP framework for IPPs for renewable energy projects.													SG's office, Ministry of Finance, National Planning and Trade, FRCS, Climate Change Division, DoE, RESCOS'
1.5 Monitoring of the IPP framework.													FRCS, RESCOS, DoE, Ministry of Finance, National Planning and Trade, Investment Fiji, EFL, NGO and Private sectors
2.1 Consultation and discussions with key funding agencies and setting up a steering committee.													Ministry of Finance, National Planning and Trade, Ministry of Tourism and Civil Aviation and Ministry of Public Works, Meteorology Services and Transport, DoE
2.2 Development of financing framework													MECC, Ministry of Finance, National Planning and Trade, Climate Change Division, DoE, NGO
2.3 Dedicated MRV in place.													Ministry of Finance, National Planning, and Trade, Climate

													Change Division, DoE, NGOs, ICT-Division
3.1 Revamping the existing IPP models and developing new IPP models.													Ministry of Finance, National Planning, and Trade, Climate Change Division, Dept. of Energy, Private Sector
3.2 Community and stakeholder engagement on IPP models.													SG's office, Ministry of Finance, National Planning and Trade, MCTTT, FRCS, Climate Change Division, DoE, Private Sector, and Community representatives.
4.1 Develop O&M & financing frameworks.													DoE, Ministry of Finance, National Planning and Trade, EFL, RESCO's
4.2 Align O&M and financing process between key agencies.													Ministry of Finance, National Planning and Trade, FRCS, Climate Change Division, DoE, RESCOS'
5.1 Securing land leases													DoE, Communities, Donor agencies, Ministry of iTaukei Affairs, Department of Lands.
5.2 Tendering													Ministry of Finance, National Planning, and Trade, DoE, Climate Change Division
5.3 Feasibility and resource assessment.													DoE, Climate Change Division, Landowners, communities, RESCO
5.3 Engineering, Procurement, Project management and construction.													DoE, Climate Change Division, Landowners, communities, RESCO

1.1.3.5 Estimation of Resources Needed for Action and Activities

Estimation of capacity building needs

The implementation of this Ground Mount PV with biofuel generator hybrid systems with ESS (micro-grid) technology will certainly require expertise. Table 1.11 provides the details on the availability of local capacity and the training requirement priority for the project. Local experts are recommended to allow for efficient liaison with stakeholders, organizing visits, logistics, workshops and consultations, and providing information. Where local expertise is not available, the in-country capacity building would be suited to retain the know-how within the country.

Table 1.11: Availability of local capacity and training requirements priority.

Field of expertise	Specialist/ Trades person	Role	Local Capacity									
			Local Capacity					Training Requirement Priority				
			0-1	2	3	4	5	0-1	2	3	4	5
Data and Statistics	Local Statistics specialist and data scientist	For quality data collection and compiling				☐				☐		
Energy Technology	Local Energy Specialists and	Resource assessment; Concept note and project proposal development; Develop Standards				☐				☐		
Energy Economics	Finance Specialist	Feasibility assessment. Concept note and project proposal development. Tax incentive propositions and awareness; Business model development.				☐				☐		
MRV	MRV planners	Understanding MRV; development of MRV criteria			☐							☐
Engineering	System Design Engineers	Solar PV and ESS microgrid design engineers; replacing diesel gensets with solar PV.			☐						☐	
	Solar PV installation technicians	Solar PV installation					☐			☐		
	Operations and Maintenance Technicians	Develop O&M & financing frameworks and Align O&M and financing processes between key agencies			☐							☐
Management	Project Manager/ Officer	Construction and Logistics project assistant				☐				☐		
	Administration Officers	General office work					☐	☐				
	Environment Officer	ESIA compliance.					☐	☐				
	OHS Officer	Construction and site safety compliance.					☐	☐				
	Welders, Fitters, Electricians	Structural and site development; General wiring installations					☐	☐				

General Construction workers.	Mason/ Concreter; Carpenters; Plumbers	General concrete foundation & structural works; General carpentry works' General plumbing installations											
	Control System Technician	Instrumentation & control wiring & system installation											

Local Capacity		**Training Requirement Priority**	
0-1	No Capacity	**0-1**	Low Priority
2	Low Capacity	**2**	Somewhat Priority
3	Moderate Capacity	**3**	Neutral
4	Functional Capacity	**4**	Moderate Priority
5	Highly Functional Capacity	**5**	High Priority

To overcome the issues of retention of highly skilled personnel due to rural-to-urban migration and migration to other countries, specialized training needs to be developed into relevant courses at tertiary institutions so more locals can be trained to replace the ones that have left.

Estimations of costs of actions and activities

A number of factors affect the actual cost of the technology including the availability of solar resource, site, and remoteness, number of households, electricity demand, and land leasing. Only the equipment cost can range from 6500–9000 USD/kW. Significant funding is usually required for proper feasibility study, system design, sizing and optimization, the type of solar PV modules/batteries/components/genset, and fiscal policies/incentives. The estimated costs as provided by the stakeholders are in Table 1.12.

Contractors and developers also have to cart the equipment and heavy machinery to the island on barges and develop infrastructure such as roads to the villages to cart the equipment, with site development, workforce mobilization, and other logistics. These additional costs need to be properly factored into the overall project budget to avoid a large overhead during project implementation.

Table 1.12: Estimated costs for TAP activities for the diffusion of solar PV with biofuel generator hybrid systems with ESS (micro-grid).

Action/ Activities	Estimated Costs (USD)
1.1 Strengthen Partnerships with key funding agencies e.g., IRENA, KOICA, etc.	10,000
1.2 Align key priorities areas for Capital Funding i.e., energy, climate mitigation and adaptation, resilience, etc.	20,000
1.3 Project mapping and identifying communities for low equity and interest projects.	100,000
1.4 Favourable IPP framework for IPPs for renewable energy projects.	150,000
1.5 Monitoring of the IPP framework.	50,000
2.1 Consultation and discussions with key funding agencies and setting up a steering committee.	Staff time
2.2 Development of financing framework	100,000
2.3 Dedicated MRV in place.	70,000
3.1 Revamping the existing IPP models and developing new IPP models.	80,000
3.2 Community and stakeholder engagement on IPP models.	30,000
4.1 Develop O&M & financing frameworks.	50,000
4.2 Align O&M and financing process between key agencies.	Staff time
5.1 Securing land lease	10,000 USD/20yrs
5.2 Tendering	Equipment cost only: 6500–9000 USD/kW (500,000 USD for Biodiesel plant)
5.3 Feasibility and resource assessment.	
5.4 Engineering, Procurement, Project management and construction.	

1.1.3.6 Management Planning

Risks and Contingency Planning

Remote and maritime communities have low-income generation opportunities and smaller economies of scale development. Prior to designing the system, solar irradiance data and the current availability of biofuels such as CNO for gensets need to be evaluated. The most expensive component is the battery bank, which requires optimal sizing to reduce generator operation time and fuel usage (biofuel/diesel). A good supply chain of biofuels is necessary and the biggest risk is the lack of supply that will soar the price of biofuels. Another key risk is that the copra industry and CNO supply chain development may work in the short term yet long-term consistent supply development is required. Analysis of changes in future load demand and load usage profiles needs to be factored in as the system lifetime is for 20-25 years. Additionally, a proper business plan and private-public partnership initiative need to be developed in detail prior to implementation. A comprehensive resource assessment and feasibility study would also reduce the associated risks.

Climatic conditions play an important role in the production of biofuels such as CNO compounded by extreme events such as tropical cyclones and droughts. A decrease in the local production of biofuel would increase the fuel price and arrangements could be made to procure biofuel from nearby islands or have storage facilities. A proper PV system design, load assessment, and future load requirements would greatly reduce the risks. Climate-resilient infrastructural development following all the latest building and electrical codes is mandatory.

Next Steps

The Electrification Policy has undergone revisions, with the most recent one being released in 2022 (EP2022). In consultation with a number of relevant stakeholders, many barriers mentioned in the BAEF have been addressed by EP2022, which builds on earlier NEPs. New plans and strategies are to be created, using the EP2022 as a foundation, to accelerate the adoption of RE technology and improve access to power for rural and maritime communities. The schematic in Figure 1.2 describes the subsequent phases for ease of implementation.

Yet, a gradual change to transition from a diesel genset microgrid to a hybrid one is necessary. The most immediate step for transition to this technology would be the gradual phasing out of diesel generators in remote non-electrified maritime zones and remote communities with subsequent steps in Figure 1.2.

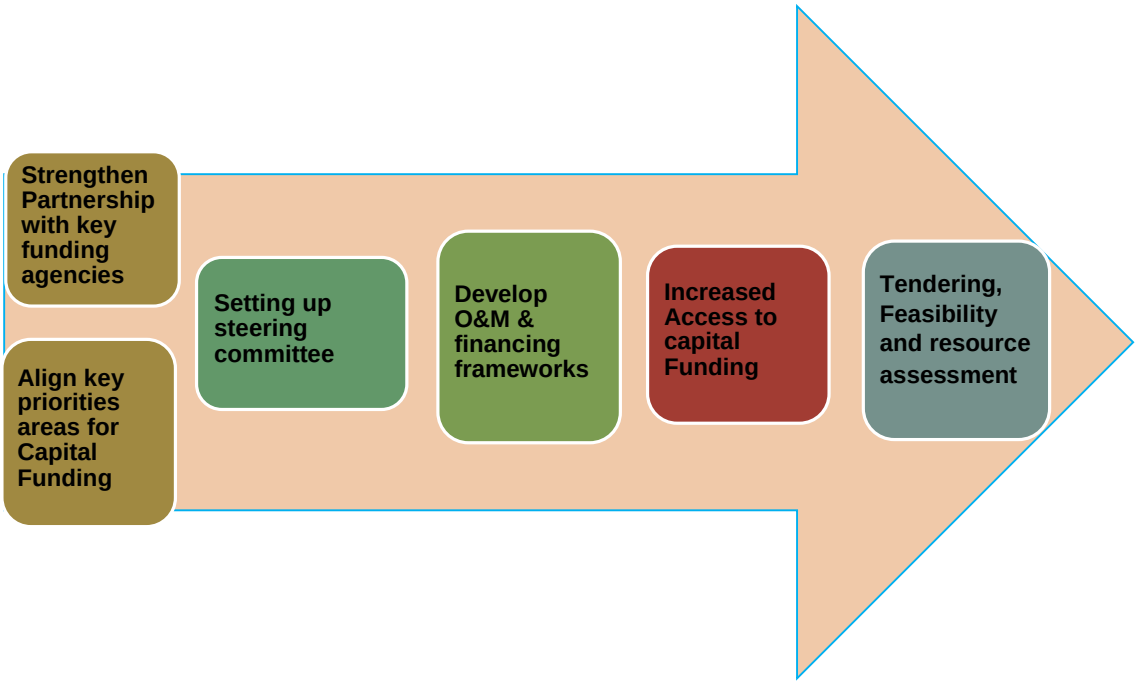

Figure 1.2: Proposed sequence of next-step activities for Solar PV with Biofuel generator hybrid systems with ESS (micro-grid).

1.1.3.7 TAP overview table

TAP overview table								
Sector	Energy							
Sub-sector	Rural Electrification							
Technology	Solar PV with Biofuel Generator Hybrid systems with ESS							
Ambition	To increase electricity access to remote and maritime communities by upscaling the microgrid systems. In its Bio-fuel (Ethanol/Biodiesel) Programme the NDP (2017-2036) aims to have at least four plants and at least 10 hybrid systems installed in this period. Considering this, the target of TAP is to have more microgrids with at least 5 additional biofuel-hybrid microgrid systems (PV + ESS + Biofuel genset).							
Benefits	Income generation from localized biofuels and copra industry, increased coconut oil production, and savings.							
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: Increased Access to capital Funding e.g., Sustainable Energy Financing Project (SEFP) with low equity	**Activity 1.1** Screening and Strengthening Partnership with key funding agencies e.g., IRENA, KOICA, JICA, China AID, ISA, etc.	Govt, private sector, and donor agencies	MECC, MPWTMS, and DoE.	6 months	Bureaucratic processes. International geopolitics.	Donor-funded projects are being implemented.	Funding agencies and door agencies are keen to continue their support.	10,000

and low-interest rates	**Activity 1.2** Align key priorities areas for Capital Funding i.e., energy, climate mitigation and adaptation, resilience, etc.	Govt, private sector, and donor agencies	MECC, MPWTMS, and DoE.	24 months	Lack of finances. Natural Disasters. Change in government priorities.	Capital funding is available for mitigation, and adaptation.	Donors and the private sector investment in the mitigation and adaptation projects.	20,000
	Activity 1.3 Project mapping and identifying communities for low equity and low-interest projects.	Govt, private sector, and donor agencies	MECC, MPWTMS, and DoE.	9 months	Incomplete or unreliable data. Unavailability of capacity.	Self-financing projects in communities.	Communities becoming self-reliant.	100,000
	Activity 1.4 Favourable IPP framework for IPPs for renewable energy projects	Govt, private sector, and donor agencies	MECC, MPWTMS, and DoE.	12 months	The economy of scale. Projects deemed unfeasible. New IPPs are not interested.	New IPPs in the country.	IPPs work coherently with EFL and DoE in project implementations.	150,000
	Activity 1.5 Monitoring of the IPP framework.	Govt, private sector, and donor agencies	MECC, MPWTMS, and DoE.	12 months	IPPs pulling out of agreements.	Continuation of IPPs in the country.	Longevity of the IPP agreement and operations.	50,000

Action 2: Availability of direct capital investments and small grants	**Activity 2.1** Consultation and discussions with key funding agencies and setting up a steering committee.	Govt, private sector, and donor agencies	MECC, MPWTMS, and DoE.	9 months	Lack of stakeholder participation. Not enough consultations.	Effective consultations and stakeholder concerns are taken into consideration.	Ongoing Steering Committee and consultations.	Staff time
	Activity 2.2 DevelMECCent of financing framework	Govt, private sector, and donor agencies	MECC, MPWTMS, and DoE.	9 months	Not a win-win situation for financers/beneficiaries.	A win-win financing framework for both financers and beneficiaries.	Implementation and adoption of financing frameworks.	100,000
	Activity 2.3 Dedicated MRV in place.	Govt, private sector, and donor agencies	MECC, MPWTMS, and DoE.	9 months	Data is not of high quality or disaggregated.	Quality data has been collated.	Continuation of the MRV after the CBIT project	70,000

Action 3: Clear and adoptable financial model with income generation opportunities for communities	**Activity 3.1** Revamping the existing IPP models and developing new IPP models.	Govt, private sector, and donor agencies	MECC, MPWTMS, and DoE.	9 months	Unavailability of data for IPP model; projects deemed uneconomical	An effective and workable model is developed.	Implementation of business models in RE ventures.	80,000
	Activity 3.2 Community and stakeholder engagement on IPP models.	Govt, private sector, and donor agencies	MECC, MPWTMS, and DoE.	12 months	Lack of stakeholder participation. Not enough consultations.	Effective consultations and stakeholder concerns are taken into consideration.	Ongoing IPP framework and models.	30,000
Action 4: Proper O&M planning and financing	**Activity 4.1** Develop O&M & financing frameworks.	Govt, private sector, and donor agencies	MECC, MPWTMS, and DoE.	12 months	Ownership of O&M is not taken on board by the stakeholders and/or communities.	O&M and financing framework is developed and approved.	Projects are adopting the O&M and financing framework	50,000

	Activity 4.2 Align O&M and financing process between key agencies.	Govt, private sector, and donor agencies	MECC, MPWTMS, and DoE.	12 months	Agencies are unable to reach a consensus.	O&M and financing processes in place.	More projects are emulating O&M and financing processes	Staff time
Action 5: Implementation with Smart Pre-paid Metering	5.1 Securing land lease	Govt, private sector, and donor agencies	MECC, MPWTMS, and DoE.	33 Months	The community has a sense of insecurity.	The land is secured during the initial stage of the project.	No. of leases for special RE projects.	10,000 USD/20yrs
	Activity 5.2 Tendering	Govt, private sector, and donor agencies	MECC, MPWTMS, and DoE.	9 months	Lack of private sector participation. Lengthy tendering process.	Successful bidding by the private sector.	Project tenders are being executed.	Equipment cost only: 6500–9000 USD/kW (500,000 USD for Biodiesel plant)
	Activity 5.3 Feasibility and resource assessment	Govt, private sector, and donor agencies	MECC, MPWTMS, and DoE.	12 months	Lengthy process. Data is not of high quality. High cost of feasibility studies.	Feasible sites identified.	No. of sites identified for RE projects like solar PV, wind, and micro-hydro for microgrid development.	

	Activity 5.4 Engineering, Procurement, Project management, and construction.	Govt, private sector, and donor agencies	OPM, MPWTMS, and DoE.	12 months	Unavailability of skilled workers, equipment, supply chain issues, and weather.	The project is being successfully implemented.	Commissioning of the project and regular O&M	

1.1.4 Action Plan for Micro/Pico-hydro in micro-grid configuration

1.1.1.4 Introduction

Pico hydropower is seldom fed into the power grid system and is used to power a household or a community. To have an effective Pico/micro hydro system, proper feasibility in terms of hydro resource availability is imperative. The knowledge of the head, flow rate, and volume of the dam together with the energy demand of the community is very critical. The Pico hydro system operates continuously without battery storage, hence knowledge of rainfall patterns is another important factor. It is one of the most economical ways to deliver electrical energy when ample resources are available. Micro/Pico hydro turbines might be used to power a single home or a small group of homes. Typically, this technology offers power for rural/remote villages or communities, distant from the grid. The actual cost could only be determined after a site and hydro resource assessment as each site has varied engineering challenges that require additional funding. Funding is required for a long-term feasibility study, site development, and workforce mobilization. There is a lack of finance and viable financing mechanisms, and access to finance for private project developers is difficult due to high-interest rates. In addition, the previous micro hydro projects faced operational issues due to improper financial management plans.

1.1.4.2 Ambition for the TAP

The volatile fuel price has been continuously driving small island nations like Fiji to look for alternative energy sources to provide reliable access to electricity in remote and maritime communities. Increased cartage and transportation costs added more burden to the high diesel costs in rural areas. The ambition of this TAP is to increase reliable electricity access to remote and maritime communities by upscaling to microgrid systems. Larger systems are required to cater for increasing energy demand and to provide a decent livelihood. Upscaled microgrids would be pivotal in providing modern and decent energy to all. The 20-year NDP (2017-2036) aims to have at least 10 mini hydro systems installed during this period, hence, the target of TAP is to have at least 5 micro/pico-hydro systems developed in micro-grid configuration.

1.1.4.3 Actions and Activities selected for inclusion in the TAP

Summary of barriers and measures to overcome barriers

The volatile fuel prices compounded by increasing cartage cost of fuel to the remote and maritime communities are becoming unbearable for the rural dwellers. Micro/Pico-hydro has the potential to feasibly supply the required energy for remote maritime and remote households. A summary of barriers and measures identified for Micro/Pico-hydro in micro-grid configuration is provided in Table 1.13. These are derived from the BAEF Report.

Table 1.13: Summary of barriers and respective measures for Micro/Pico-hydro in micro-grid configuration.

Barriers	Measures
Economic and Financial	
-lack of finance and viable financing mechanisms. -Capital intensive. -Lack of accurate and adoptable financial model	-Reviving Sustainable Energy Financing Project (SEFP) -Development of a clear and adoptable financial model. -Easy access to financing. -Comprehensive feasibility study
Regulatory	
-private sector participation in assessment and development is lacking. -Unfavourable IPP framework for rural and remote electrifications.	-Provision for financial and tax incentives. -Subsidies on land purchases. -Development of a better IPP framework
Capacity	
-Insufficient high-quality data for resource assessment. -Lack of technical expertise and resources to develop projects. -No local professional training programs for hydro engineers. -Lack of awareness at the community level -lack of commitment and interest from local communities	-Training in newer micro/Pico hydro technologies. -More professional training programs with gender quotas for technical and non-technical training and skill development. -Community-level awareness programmes -Information dissemination and awareness training
Institutional	
-Limited resources for full feasibility studies. -Challenges in site monitoring and assessment. -Land tenure issues -Environment impacts are not aptly mitigated	-Increased resources for full feasibility studies. -Landowning units should be involved from the beginning. -Comprehensive ESIA to mitigate the adverse impacts.

A lack of commitment and interest from local communities in Pico/micro hydro technology has been one of the biggest barriers to the uptake of technology together with the lack of finance. The communities have limited awareness and are concerned about the damaging impact Pico/micro hydro can have on the environment. Hence, a comprehensive ESIA is imperative prior to the development of any such hydroelectricity projects. The EP2022 specifically emphasized the development and adoption of a sustainable business model for all microgrid ventures whether it is community micro/mini-grid systems, RGS, or donor-funded projects.

Actions and Activities selected for inclusion in the TAP

The actions and activities that should be included in the TAP were determined following a thorough study of the barriers and identification of the enabling framework, during the BAEF phase of the TAP project. Although many of the identified regulatory obstacles have been taken into account in the EP2022, specific steps still need to be made to put this into practice. The necessary actions and activities for micro/Pico grid technology under the proposed TAP are listed in Table 1.14.

Table 1.14: Activities to be implemented to enhance the diffusion of Micro/Pico-hydro in micro-grid configuration.

Actions	**Activities**
1. Reviving Sustainable Energy Financing Project (SEFP)	1.1 Provide robust awareness of the SEFP program. 1.2 Developing best practices from previous success stories of the SEFP Program. 1.3 Generate interest in the private sector, NGOs, and the general public.
2. Development of a clear and adoptable financial model.	2.1 Financial plan for sustainable and affordable projects for beneficiaries. 2.2 Financial model to be understood by the community who owns the project. (Awareness to be done)
3. Easy access to financing.	3.1 Enabling environment from financing agencies. 3.2 Development of a streamlined process for accessing funds.
4. Comprehensive feasibility study	4.1 Quality data collection. 4.2 Incorporation of Socio-economic activity and benefits in the project proposal and feasibility. 4.3 Inclusion of RESCOs to undertake the feasibility studies with DoE.
5. Implementation	5.1 Involve the community and secure land lease. 5.2 Tendering 5.3 Feasibility and evaluation of resource assessment 5.4 Engineering, Procurement, Project management and construction.

Project implementation requires a lot of planning and stakeholder involvement with community engagement. An important factor is the level of involvement of the community and securing of land leases well in advance for the successful implementation of the project. The investors would otherwise lose their investment due to unwarranted land disputes.

Actions to be implemented as Project Ideas

After an inclusive consultation and discussion with the stakeholders, the project ideas were evaluated based on the aforementioned actions. The DoE, EFL, and the private sector do have the human resource capacity to conduct the pre-feasibility study, feasibility study, environmental impact assessment, design, engineering, and project management of the Pico/micro hydro microgrid in Fiji. Additional training for the maintenance and operations of newer turbine systems and smart grids would be necessary. The availability of finance and a sound financial model integrated with prospects for revenue-generating opportunities are essential for remote and maritime communities.

1.1.4.4 Stakeholders and Timeline for implementation of TAP

Overview of Stakeholders for the implementation of the TAP

The involvement of the private sector, EFL, communities, and the DoE is important for the sustainability of the Pico/micro hydro projects. Table 1.15 provides a list of stakeholders required and their representatives. The DoE is the responsible organization for rural electrification and looks into managing and administering the off-grid electrification projects, assessing and developing RE resources (hydro resources for Pico/micro hydro) and projects, effective O&M of electrification projects, and maintaining the database.

Table 1.15: Stakeholders for implementation of Micro/Pico-hydro in micro-grid configuration.

Department	Representative
Climate Change Division – Ministry of Environment and Climate Change	Permanent Secretary Director of Climate Change Division
Department of Energy - MPWTMS	Permanent Secretary Director of Energy Rural Electrification Unit
Fiji Revenue and Customs Services	CEO of FRCS
Energy Fiji Limited	CEO and/or recommended rep.
Solicitor General's Office	SG
Investment Fiji	CEO and/or recommended rep.
Fiji Bureau of Statistics	CEO and/or recommended rep.
Fiji Meteorological Services	Director and/or recommended rep of the Hydrology division.
Donor Agencies	IRENA KOICA GCF

	GEF World Bank ADB UNDP
NGOs, CROP Agencies, Think-Tank Centres, and Education and training institutions	International Union for Conservation of Nature SPC SPREP MCST Pacific Centre for Environment and Sustainable Development Centre for Climate Change, Energy, Environment and Sustainable Development. The University of the South Pacific Fiji National University The University of Fiji
Private Sector	Private sector design, engineering, and construction firms. Suppliers
Community	Community leaders Landowners

Scheduling and sequencing of specific activities

The Fiji government has been actively striving to achieve a 100% rural electrification rate. Using Micro/Pico-hydro technology in a micro-grid arrangement, the TAP seeks to scale up the microgrids and support this endeavor. All stakeholders, including landowners, communities/beneficiaries, EFL, DoE, the Ministry of the Environment and Climate Change, renewable energy companies, and donors, must be included in the development from the start and pre-feasibility works. Also, the think-tank centers may play a crucial role in supporting data collection for making well-informed judgments while taking into account lessons learned and best practices.

Table 1.4 lists the suggested timelines along with the relevant stakeholders who must be involved at each step. The timelines in Table 1.16 are simply approximations. They can be used as a roadmap for attaining the NDP's objectives. The development and findings will be continuing and the timelines may alternate as new information comes in.

Table 1.16: TAP schedule and responsible stakeholders for implementation of TAP activities for Micro/Pico-hydro in micro-grid configuration.

Action/ Activities	Timeline														Stakeholders (Responsible body and focal point)
	2023		2024				2025				2026				
	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
1.1 Provide robust awareness of the SEFP program.															Ministry of Finance, Strategic Planning, National Development and Statistics and Ministry of Public Works, Meteorology Services and Transport, DoE, Institutions, Government Organisations, Donors, and financial institutions.
1.2 Developing best practices from previous success stories of the SEFP Program. DoE to write to World Bank to revive it.															Ministry of Finance, Strategic Planning, National Development and Statistics and Ministry of Public Works, Meteorology Services and Transport, DoE, Institutions, Government Organisations, Donors, and financial institutions.
1.3 Generate interest in the private sector, NGOs, and the general public.															Ministry of Finance, Strategic Planning, National Development and Statistics and Ministry of Public Works, Meteorology Services and Transport, DoE, NGOs, Climate Change Division
2.1 Financial plan for sustainable and affordable projects for beneficiaries.															Ministry of Finance, Strategic Planning, National Development and Statistics and Ministry of Public Works, Meteorology Services and Transport, SG' office, FRCS, Climate Change Division, DoE, RESCOS'
2.2 Financial model to be understood by the community who owns the project. (Awareness to be done).															FRCS, RESCOS, DoE, Investment Fiji, EFL, NGO and Private sectors
3.1 Enabling environment from financing agencies.															Ministry of Finance, Strategic Planning, National Development and Statistics and Ministry of Public Works, Meteorology Services and Transport, DoE
3.2 Development of a streamlined process for accessing funds.															Ministry of Finance, Strategic Planning, National Development and Statistics, Climate Change Division, DoE, NGO'S
4.1 Quality data collection.															Climate Change Division, DoE, NGOs, ICT, FMS-Hydrology, and Climatology.

4.2 Incorporation of Socio-economic activity and benefits in the project proposal and feasibility.															Climate Change Division, Dept. of Energy, Private Sector, Ministry of Rural and Maritime Development.
4.3 Inclusion of RESCOs to undertake the feasibility studies with DoE.															SG's office, FRCS, Climate Change Division, DoE, Private Sector, and Community representatives.
5.1 Involve the community and secure land lease.															DoE, Communities, Donor agencies, Ministry of iTaukei Affairs, Department of Lands.
5.2 Tendering															DoE, Climate Change Division, FMS
5.3 Feasibility and evaluation of resource assessment															DoE, Climate Change Division, Landowners, communities, RESCO
5.4 Engineering, Procurement, Project management and construction.															DoE, Climate Change Division, Landowners, communities, RESCO

1.1.4.5 Estimation of Resources Needed for Action and Activities

Estimation of capacity building needs

Table 1.17 provides details on the availability of local capacity and the training requirement priority for pico/micro hydro projects. Local specialists would also enable effective coordination with stakeholders, planning of visits, logistics, seminars, and consultations, as well as information provision. In fields where the nation lacks capability, local staff members must be trained adequately.

Table 1.17: Availability of local capacity and training requirements priority.

Field of expertise	Specialist/ Trades person	Role	Local Capacity									
			Local Capacity					Training Requirement Priority				
			0-1	2	3	4	5	0-1	2	3	4	5
Data and Statistics	Local Statistics specialist and data scientist	For quality data collection and compiling				☐				☐		
Energy Technology	Local Energy Specialist	Resource assessment; Concept note and project proposal development; Develop Standards				☐						☐
	Hydrology Specialist	Hydrology data collection and assessment, Hydro resource assessment.		☐								☐
Energy Economics	Finance Specialist	Feasibility assessment. Concept note and project proposal development. Tax incentive propositions and awareness; financial plan development				☐				☐		
	Finance Analyst	Developing best practices				☐				☐		
Communication	Communication Officer	Community awareness				☐						☐
Engineering	Hydroelectric Design Engineers	Micro/Pico hydro microgrid design engineers.				☐					☐	
	Operations and Maintenance Technicians	Develop O&M & financing frameworks and Align O&M and financing processes between key agencies			☐							☐
Management	Project Manager/ Officer	Construction and Logistics project assistant				☐				☐		
	Administration Officers	General office work					☐	☐				
	Environment Officer	ESIA compliance.					☐	☐				
	OHS Officer	Construction and site safety compliance.					☐	☐				
General Construction workers.	Welders, Fitters, Electricians,	Structural and site development; General wiring installations					☐	☐				
	Mason/ Concreter; Carpenters; Plumbers	General concrete foundation & structural works; General carpentry works' General plumbing installations					☐	☐				

	Control System Technician	Instrumentation & control wiring & system installation										

Local Capacity		Training Requirement Priority	
0-1	No Capacity	**0-1**	Low Priority
2	Low Capacity	**2**	Somewhat Priority
3	Moderate Capacity	**3**	Neutral
4	Functional Capacity	**4**	Moderate Priority
5	Highly Functional Capacity	**5**	High Priority

A lack of hydrology specialists is one of the key priorities identified. The specialist is needed for hydrology data collection and hydrological assessment, hydro resource assessment. Migration and brain drain has been identified as the key issue for losing the trained personnel, hence specialized training programme needs to be developed at tertiary institutions to aptly train more local personnel.

Estimations of costs of actions and activities

The Micro/Pico-hydro in micro-grid configuration microgrids systems are very site-specific and after a pre-feasibility assessment, then the approximate costs can be estimated. In addition to the availability of hydro resource, the civil works requirement at the site, remoteness, land leasing, and energy demand are the key factors driving the cost. Table 1.18 provides an estimate of the associated costs that can incur. The costs will depend entirely on the technology, size, and location of the project. These costs may change at the point in time of implementation due to the abovementioned reasons. Funding will also be required for a long-term feasibility study and other logistics.

Table 1.18: Estimated costs for TAP activities for the diffusion of solar Micro/Pico-hydro in micro-grid configuration.

Action/ Activities	**Estimated Costs (USD)**
1.1 Provide robust awareness of the SEFP program.	10,000
1.2 Developing best practices from previous success stories of the SEFP Program.	20,000
1.3 Generate interest in the private sector, NGOs, and the general public.	30,000
2.1 Financial plan for sustainable and affordable projects for beneficiaries.	30,000
2.2 Financial model to be understood by the community who owns the project. (Awareness to be done).	50,000
3.1 Enabling environment from financing agencies.	30,000
3.2 Development of a streamlined process for accessing funds.	50,000
4.1 Quality data collection.	500,000

4.2 Incorporation of Socio-economic activity and benefits in the project proposal and feasibility.	40,000
4.3 Inclusion of RESCOs to undertake the feasibility studies with DoE.	25,000
5.1 Securing land lease.	10,000 USD/20yrs
5.2 Tendering	Staff time
5.3 Feasibility and evaluation of resource assessment (Data to be used from Act. 4.1)	Equipment cost only: 4000 – 7500 USD/kW
5.4 Engineering, Procurement, Project management and construction.	

1.1.4.6 Management Planning

Risks and Contingency Planning

The micro-hydro technology has been in operation in some places in Fiji such as the Buca Bay Pico hydro scheme and the Bukuya micro hydro scheme. Proper site identification in terms of the reservoir size, flow rate, and head height needs to be determined before undertaking any hydro project. Identifying, planning and management take a higher proportion of the whole effort. For hydro projects, the construction of the weir, penstock together with installation of the turbine and grid construction to the appropriate point of need, forms the most expensive component of the project. Hence, the key risk is finding a balance between the cost and the outcome as the least-cost technology is favored by the government and investors. A proper business plan and private-public partnership initiative need to be developed in detail prior to implementation. A comprehensive resource assessment, feasibility study, load assessment, and future load requirements would also reduce the associated risks.
The availability of the hydro resource is contingent upon rainfall driven by climatic conditions. Extreme events such as tropical cyclones and droughts are key risk factors for micro/Pico hydro installations. Key climate considerations need to be taken into account for micro/Pico hydro developments.

Next Steps

The National Energy Policy has been published. This was done in consultation with a number of relevant stakeholders. This policy builds on the previous ones and has addressed a number of barriers highlighted in the BAEF. Using the EP2022 as the basis, new plans and strategies are to be developed for accelerated adoption of RE technologies and better access to electricity for rural and maritime communities. The schematic below summarizes the next steps for ease of implementation.

After involving several important stakeholders, the electrification policy was developed in 2022. A number of policy barriers identified in the BAEF identified for micro/mini-grid development and implementations have been addressed in the EP2022. The immediate next steps are summarized in the schematic in Figure 1.3. The availability of finance for micro/Pico

hydro is one of the first steps required that can be achieved via the revival of the sustainable energy financing facility.

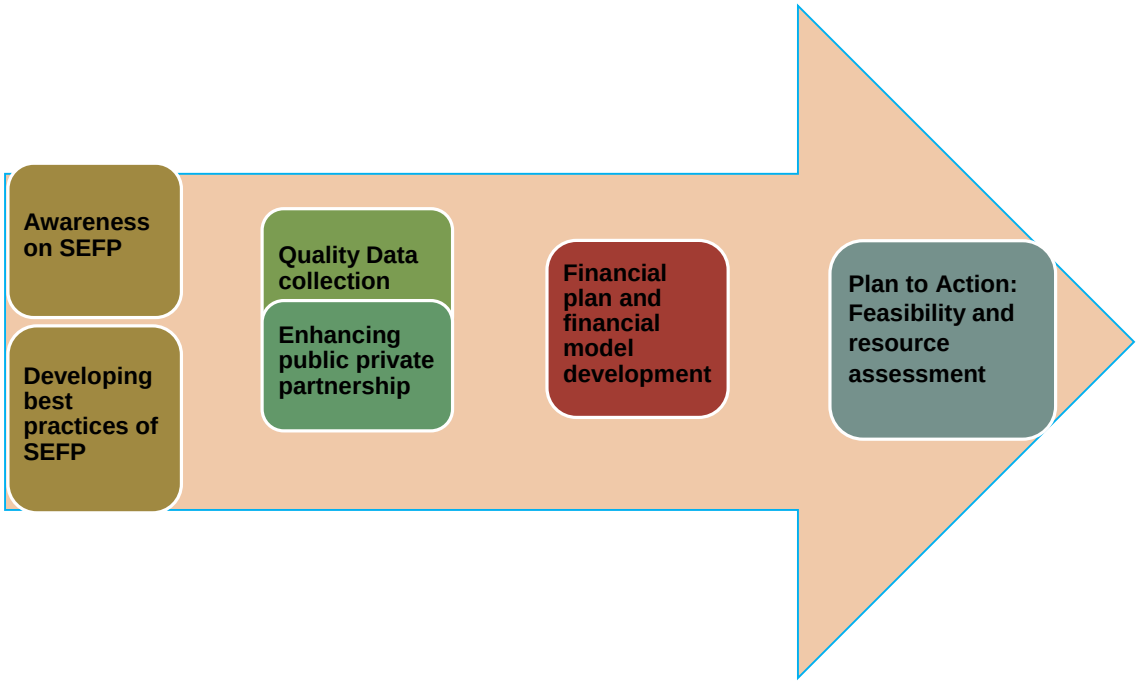

Figure 1.3: Proposed sequence of next-step activities for Solar Micro/Pico-hydro in micro-grid configuration.

1.1.4.7 TAP overview table

TAP overview table								
Sector	Energy							
Sub-sector	Rural Electrification							
Technology	Micro/Pico-hydro in micro-grid							
Ambition	The ambition of this TAP is to increase reliable electricity access to remote and maritime communities by upscaling to microgrid systems. The 20-year NDP (2017-2036) aims to have at least 10 mini hydro systems installed during this period, hence, the target of TAP is to have at least 5 micro/pico-hydro systems developed in micro-grid configuration.							
Benefits	Increased access to modern electricity in remote communities; income generation, education, and recreational activities; Provide modern health care in remote communities.							
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: Reviving Sustainable Energy Financing Project (SEFP)	**Activity 1.1** Provide robust awareness of the SEFP program.	Govt, private sector, and donor agencies	MECC, MPWTMS, and DoE.	15 months	Stakeholders are not keen.	Stakeholders are properly aware.	A SEFP is in place which the stakeholders are reaping benefits from.	10,000
	Activity 1.2 Developing best practices from previous success stories of the SEFP Program.	Govt, private sector, and donor agencies	MECC, MPWTMS, and DoE.	12 Months	Best practices are not applicable to local circumstances. The government policies are not aligned to support this.	Best practices developed and implemented.	Continuation of the SEFP programme and SMEs taking benefit of this.	20,000

	Activity 1.3 Generate interest in the private sector, NGOs, and the general public.	Govt, private sector, and donor agencies	MECC, MPWTMS, and DoE.	Ongoing from the beginning.	The private sector and NGOs are reluctant to participate.	The private sector, NGOs, and the general public are very interested and assist in the development of SEFP.	Continuation of the SEFP programme and SMEs taking benefit of this.	30,000
Action 2: Development of a clear and adoptable financial model.	**Activity 2.1** Financial plan for sustainable and affordable project for beneficiaries.	Govt, private sector, and donor agencies	MECC, MPWTMS, and DoE.	15 Months	A financial plan is unsustainable as numbers do not stack up.	The sustainable financial model developed and the projects are affordable.	Financial plans are being adopted in project implementations.	30,000
	Activity 2.2 Financial model to be understood by the community who owns the project. (Awareness to be done)	Govt, private sector, and donor agencies	MECC, MPWTMS, and DoE.	6 Months	Communities are too dependent on donor funding. Communities are not adhering to the strategies outlined in the plan.	Sustainable projects are run by communities with minimal government intervention.	More communities have upscaled microgrids for electricity generation.	50,000

Action 3: Easy access to financing.	**Activity 3.1** Enabling environment from financing agencies.	Govt, private sector, and donor agencies	MECC, MPWTMS, and DoE.	9 Months	Financial agencies are not keen to finance the Pico hydro projects.	Ample funding is available for projects with minimum equity and low-interest rates.	No. of financed projects increased every year.	30,000
	Activity 3.2 Development of a streamlined process for accessing funds.	Govt, private sector, and donor agencies	MECC, MPWTMS, and DoE.	9 Months	Financial agencies are not keen to finance the Pico hydro projects.	Ample funding is available for projects with minimum equity and low-interest rates.	SMEs and communities are able to easily access funds for respective projects.	50,000
Action 4: Comprehensive feasibility study	**Activity 4.1** Quality data collection.	Govt, private sector, and donor agencies	MECC, MPWTMS, and DoE.	18 Months	Data is not of high quality or disaggregated.	Data collation template and a repository	Stakeholder inputs	500,000

	Activity 4.2 Incorporation of Socio-economic activity and benefits in the project proposal and feasibility.	Govt, private sector, and donor agencies	MECC, MPWTMS, and DoE.	12 Months	Lack of reliable data on socio-economic potential.	Socio-economic activity and benefits being accepted in proposals and financing.	Donor funded projects	40,000
	Activity 4.3 Inclusion of RESCOs to undertake the feasibility studies with DoE.	Govt, private sector, and donor agencies	MECC, MPWTMS, and DoE.	18 Months	Lack of reliable data and investments from RESCOs	RESCOs are undertaking feasibility studies and reporting them to DoE.	Increased feasibility reports.	25,000
Action 5: Implementation	**Activity 5.1** Involve the community and secure land lease	Govt, private sector, and donor agencies	MECC, MPWTMS, and DoE.	Ongoing from the project inception.	The community has a sense of insecurity.	The land is secured during the initial stage of the project.	No. of leases for special RE projects.	10,000 USD/20yrs
	Activity 5.2 Tendering	Govt, private sector, and donor agencies	MECC, MPWTMS, and DoE.	9 Months	Lack of private sector participation. Lengthy tendering process.	Successful bidding by the private sector.	Project tenders are being executed.	Staff time

	Activity 5.3 Feasibility and evaluation of resource assessment	Govt, private sector, and donor agencies	MECC, MPWTMS, and DoE.	33 Months	Lengthy process. Data is not of high quality. High cost of feasibility studies.	Feasible sites identified.	No. of sites identified for RE projects like solar PV, wind, and micro-hydro for microgrid development.	Equipment cost only: 4000 – 7500 USD/kW
	Activity 5.4 Engineering, Procurement, Project management, and construction.	Govt, private sector, and donor agencies	MECC, MPWTMS, and DoE.	12 Months	Unavailability of skilled workers, equipment, supply chain issues, and weather.	The project is being successfully implemented.	Successful Commissioning of the project. Regular O&M	

1.2 Project Ideas for Sector A: Off-grid rural electrification sector

1.2.1 Brief summary of the Project Ideas for Sector A: Off-grid rural electrification sector

All three technologies identified for the off-grid rural electrification sector need a comprehensive resource assessment and a feasibility study. One of the project ideas that the DoE is working on is the phasing out of diesel generators in the communities. There are a number of diesel-powered microgrids in the remote and maritime zones. In order to reduce the dependence on fossil fuels and provide energy independence to these communities, the government through the DoE is trying to replace the diesel gensets with renewables such as solar PV with ESS, or Hybrid systems (Solar PV, ESS, and Biofuels gensets) or micro-hydro systems if ample hydroelectric potential is available.

1.2.2 Specific Project Idea 1

Proposed Project Title	Phasing out of diesel generators in the communities
Introduction/Background	The government through the DoE is trying to replace the diesel gensets with renewables such as solar PV with ESS, or Hybrid systems (Solar PV, ESS, and Biofuels gensets) or micro-hydro systems if ample hydroelectric potential is available
Objectives	The aim is to replace at least 5 diesel gensets in the next 5 years with renewables.
Outputs	A reliable electricity supply, reduced dependence on fossil fuels and provide energy independence.
Relationship to the country's sustainable development priorities	In line with the Electrification Policy 2022 Rural Electrification Policy-2016 NDP (2017-2036)
Project Deliverables	At least 5 diesel gensets in the next 5 years with renewables such as solar PV with ESS, or Hybrid systems (Solar PV, ESS, and Biofuels gensets) or micro-hydro systems if ample hydroelectric potential is available.
Project Scope and Possible Implementation	DoE has been able to implement a few solar PV micro-grid (e.g., 30kW - Namara village, Kadavu and 50kW Nakoro Village, Navosa) has been implemented with varying degrees of success while some resorts (e.g., Naitauba Is. Resort - 300.9 kW Mini PV-Grid) have solar PV systems with battery storage together with diesel generators as a backup. Lessons learned from these projects would be important for the success of future projects.
Project activities	The most important activities of the project include: ➢ A scoping study ➢ Land Acquisition/Leasing ➢ A comprehensive renewables resource assessment. ➢ Economic feasibility study.

	➢ Environment Impact Assessment ➢ Development of adaptable financial model. ➢ Project Implementation.
Timelines	Next 5 years
Budget/Resource requirements	A scoping study followed by economic feasibility study will outline the details of the budget requirements as the implementations are site-specific.
Measurement/Evaluation	System sizing, demand requirements, land area requirement, budgetary requirements. The O&M plan needs to be developed in advance and followed very closely. Community members need to be trained on the operations and sensitivity of solar PV microgrid technology.
Possible Complications/Challenges	Land leasing, over-reliant on diesel, financing the project deliverables, and site development as small islands have land resource constraints.
Responsibilities and Coordination	DoE

1.2.3 Specific Project Idea 2

Proposed Project Title	Community Profiling and Database
Introduction/Background	A number of initiatives in rural electrification are donor-funded and donors such as GGGI find it difficult to find pertinent information on the village or a community's electrical energy needs. These technical and social data and descriptions will be imperative for proposal development for larger climate financing opportunities. A lack of updated data has always been a drawback in getting funding.
Objectives	To gather information and prepare a living database of the social, economic, and energy status of the respective villages that need to have microgrids.
Outputs	A database with technical and social information including no. of households, electricity demand, energy resource availability, average household income, and potential income generation opportunities with a supply of electricity. The database needs to have all pertinent information related to ESIA, sea level rise inundation assessment report, future development plans, assessment on relocation, civil engineering requirements, iTaukei Landowning unit's approvals, reports on past renewable energy projects, or electrification reports. Prefeasibility reports.

Relationship to the country's sustainable development priorities	In line with the Electrification Policy 2022 Rural Electrification Policy-2016 NDP (2017-2036) SDG7 – Access to clean and affordable energy.
Project Deliverables	The key deliverable would be a living and up-to-date database of village profiles that could be easily accessed by donors.
Project Scope and Possible Implementation	DoE has the mandate in rural electrification and can lead this. It is a quite broad and cross-sectoral scope as it needs data on all aspects. It is feasible and achievable with finding as funding is available for platform development.
Project activities	The most important activities of the project include: ➢ Funding application. ➢ Tender Development. ➢ Data collection. ➢ Platform development. ➢ Deployment of the database. ➢ Periodical updating.
Timelines	12-24 months for data collection and platform development. 24-32 months for launching and implementation. Ongoing – periodical updating.
Budget/Resource requirements	A budget will be required for data collection, analysis tools, analysts, platform development, and consultants. Hosting of the database and periodical updating will be an ongoing process.
Measurement/Evaluation	The tangible outcome will be the database and this could be used as an indicator of success.
Possible Complications/Challenges	-Community buy-ins. -Land issues. -Lack of capacity. -Budget and financing. -Mindset and behaviour changes. -Understanding and challenges of greenfield vs brownfields in terms of being electrified by diesel gensets vs Renewables.
Responsibilities and Coordination	DoE and Climate Change Division.

1.2.3 Specific Project Idea 3

Proposed Project Title	Incentivising Private Sector Programme
Introduction/Background	Private sector investment and independent power producers in rural electrification projects are important drivers. A programme is required to bring on board these private sectors and IPPs into Fiji and invest in rural electrification projects.

Objectives	To develop a programme to incentivize private sector participation and IPPS in rural electrification in Fiji.
Outputs	The key output would be to have IPPs in rural electrification in Fiji.
Relationship to the country's sustainable development priorities	In line with the Electrification Policy 2022 Rural Electrification Policy-2016 NDP (2017-2036) SDG7 – Access to clean and affordable energy.
Project Deliverables	The project will require a multi-sectoral approach as economic and fiscal policies are designed for the rural electrification sector.
Project Scope and Possible Implementation	It is quite broad and cross-sectoral. The programme needs to have consultations with the stakeholders, private sectors, and other IPPS to see what their needs are for them to invest in rural electrification. All relevant guidelines, policies, and economic and fiscal incentives need to be properly designed.
Project activities	The most important activities of the project include: ➢ Funding application. ➢ Tender Development. ➢ Stakeholder consultations. ➢ Design of incentive package. ➢ Pilot project with close monitoring. ➢ Periodical updating and broader implementations.
Timelines	24-48 months for stakeholder consultations and design of the incentive package. Ongoing–periodical updating and broader implementations.
Budget/Resource requirements	A budget will be required for data collection, economists, revenue specialists, and consultants.
Measurement/Evaluation	The tangible outcome will be the incentive package and this could be used as an indicator of success. Yet, the stakeholder consultations will bring about a whole lot of information and periodical updating can be used for monitoring.
Possible Complications/Challenges	-Lack of capacity. -Budget and financing. -Lack of interest from the stakeholders. -Insufficient revenue generation potential.
Responsibilities and Coordination	DoE and Climate Change Division.

Chapter 2 Technology Action Plan and Project Ideas for Domestic Maritime Transportation

2.1 TAP for Domestic Maritime Shipping Sector

2.1.1 Sector Overview of Domestic Maritime Shipping Sector

The domestic maritime sector was the other sector selected for the TNA process for mitigation in Fiji. Maritime transportation is important as it connects the islands and provides a means of travel, trade, and tourism. The inter-island sea-transport network provides health and other services. The initial NDC developed in 2015 aims to achieve a 30% reduction in CO_2 emissions from the energy sector by 2030 in comparison to the BAU condition. The modelling scenarios in Fiji's LEDS showed a 100% carbon-free shipping sector by 2050, while under the High Ambition Scenario, a 70% decrease in emissions from the sector by 2050 was projected. On the other hand, a 100% decrease in emissions by 2050 was projected under the Very High Ambition scenario. In 2020, Fiji's updated NDC was communicated whereby a 40% emission reduction from the domestic maritime shipping sector was targeted

Fiji's 5-Year and 20-year National Development Plan (NDP 2017-2036) clearly outlines the importance of inter-island transportation for commerce and income-generating opportunities in the 110 permanently inhabited islands in the Fijian archipelago spanning over 1.3 million km^2 of ocean.

A number of policies have been developed to support the domestic maritime shipping sector; Fiji's Updated NDC-2020; National Climate Change Policy 2018-2030 (NCCP); Fiji NDC Implementation Roadmap; Maritime and Land Transport Policy (2015); National Energy Policy (NEP-2013); Low Emission Development Strategy (LEDS). Aligned to the LEDS-2018 and NDC-IR, Fiji's NDC Investment Plan-2020 aimed at identifying investments required in the maritime transport sector (NDC Investment Plan-2022). In particular, the Climate Change Act 2021 aims to develop and implement a detailed Transport Decarbonisation Implementation Strategy to reduce Fiji's GHG emissions with the aim of achieving long-term emissions reduction targets subsequently building upon the LEDS for the transport sector.

The TNA for the domestic maritime shipping sector was revisited after the updated NDC-2020 in order to consider high GHG mitigating technologies to meet the 40% targeted GHG reductions. The identification of newer technology options and subsequent BAEF is in support of the above policies and the updated NDC-2020. The MCA rankings for the domestic maritime transportation sector were re-conducted with a new set of technologies. These all were conducted with the stakeholders. The technologies identified in the re-visited TNA for the domestic maritime transport sector were;

1. Sail-powered Passenger/Cargo Ship
2. Low Carbon/Zero Carbon Passenger Ferry Trials
3. Eco-Flettner Rotor – retrofit and new-build technology

Deviation of technology names

After another series of consultations for the TAP, the stakeholders proposed to have a more generalized version for Technology 3 and the rankings remain the same:

1. Sail-powered Passenger/Cargo Ship.
2. Low Carbon/Zero Carbon Passenger Ferry Trials
3. Advanced Wind Propulsion Technologies: Eco-Flettner Rotor – retrofit and new-build technology

2.1.2 Action Plan for Sail-powered Passenger/Cargo Ship

2.1.2.1 Introduction

Sail-powered technology is not new as it has been used by many in the past, yet it faded away due to the development of engine-powered technology. Traditional sail-propelled ships such as Camakau and Drua have been used in Fiji and the Pacific. The revival of traditional sail-propelled ships is a challenge as the growing Fijian economy does require reliable and faster transportation options.

Recently, there has been a number of studies in the international arena for hybrid sail-powered ships with advanced engineering. One such example is the Neoline vessel. This wind-powered sailing RoRo/cargo ship offers significant fuel savings with subsequent carbon abatement. Studies suggest that over 80% of savings are expected through a whole-of-ship design approach whereby advanced hull and propulsion design, waste heat recovery, wind-hybrid drive, etc. are all included (Hakirevic, 2020, 2021; Neoline, 2021a, b). The current shipping fleet is very old and these newer ships with reliable shipping services for inter-island routes can bolster trade and tourism for the maritime communities.

2.1.2.2 Ambition for the TAP

The Domestic Maritime Shipping sector has been the Government's priority. The maritime sector greenhouse gas emissions (GHG) emissions are modelled under the Business as Usual (BAU) scenario in Fiji LEDS that shows an increase to over 600kt by the year 2050. The reduction of GHGs from the domestic maritime sector is also mentioned in the 5-year and 20-year NDP. The Target 1 of Fiji's 2015 NDC is to reduce 30% of BAU CO_2 emissions from the energy sector by 2030 and achieve net-zero by 2050. In the updated NDC-2020, Fiji also committed to an additional target of reducing domestic maritime shipping emissions by 40% as a contribution to Target 1. To support this ambition in reducing the targeted GHG emission, the ambition of the TAP is to have at least 5 advanced sail-powered ships to be trialled.

2.1.2.3 Actions and Activities selected for inclusion in the TAP

Summary of barriers and measures to overcome barriers

A summary of barriers and measures identified for Sail-powered Passenger/Cargo Ships is provided in Table 2.1. These are derived from the TNA BAEF Report. Economic and financial, regulatory, capacity and infrastructural barriers were the crucial ones. The subsequent potential measures for these barriers have been identified and listed.

Table 2.1: Summary of barriers and respective measures for Sail-powered Passenger/Cargo Ships.

Barriers	Measures
Economic and Financial	
• Higher upfront CAPEX • Unaffordable maritime financing • No insurance underwriters • Unclear return on investment • High-risk financing	• A clear return on investment needs to be established • High-quality, timely, and reliable data on shipping routes and fuel usage, etc. Needs to be available. • Proper scientific studies • Easier financing • Affordable interest loans • Concessional loans specific to investment in low-carbon shipping technology • Vessel Insurance Scheme
Regulatory	
• Gaps in policy and regulations • No emissions regulations • No Ship Energy Efficiency Management Plan (SEEMP) • Marine Transportation Act is outdated	• Inclusion of emission reduction regulations with incentives and/or penalties • Regulates shipboard incineration, and the emissions • Development and adoption of SEEMP
Capacity	
• Lack of interest or conflicting interests amongst the shipowners • Old-fashioned business practices • Lack of understanding of the newer technology • Lack of local research and scientific studies • Lack of research funding • Data unavailability • Technology is perceived as inefficient • No on-ground training • Inefficient weather routing	• Attract more shipowners to invest in low-carbon sail-powered shipping technology • An increased understanding of the technology in the local context • Capacity building for modernized business practice • Recording and availability of high-quality, timely, and reliable data • Development of a proof of concept • Appropriate training and development • Training and skills development for women

• No dedicated wind and wave forecasting and early warning systems	• Use of traditional sailing knowledge and boat-building knowledge • Efficient weather routing • Dedicated wind and wave forecasting and early warning systems • Route analysis
Infrastructural	
• No commercial sail-powered shipbuilding • No backup and maintenance industry • The inactive commercial shipbuilding industry	• Revival of shipbuilding • Development of the maintenance industry • Cargo handling and passenger transit infrastructure

Actions and Activities selected for inclusion in the TAP

After a comprehensive identification of barriers and systematic analysis whilst identification of enabling framework all driven by relevant stakeholders, the actions and activities were identified for inclusion in the TAP. Table 2.2 presents the actions and activities that need to be implemented under the proposed TAP for **Sail-powered Passenger/Cargo Ships**.

Table 2.2: Activities to be implemented to enhance the diffusion of Sail-powered Passenger/Cargo Ships.

Actions	Activities
1. Feasibility Study of sail-powered vessels	1.1 Establishment of Terms of Reference 1.2 Consult World Maritime University (WMU) for existing research or facilitate new research on sail-powered ships for credible data collation and verification (contact Class NKK to provide new build regulations for sailing ships) 1.3 Reporting to the Cabinet and Publishing outcomes.
2. Purchasing existing sail-powered vessels (Pilot Project)	2.1 Market assessment/Data collation and verification. 2.2 Procurement of pilot vessel. 2.3 Government incentives to attract ship owners to invest in sail-powered vessels. 2.4 Business plans/schemes with existing and potential ship owners. 2.5 Courses for seafarers' training and certification for the use of new technology. 2.6 Monitoring and Evaluation of projects.
3. Revival of local Shipbuilding particularly sail-powered vessels	3.1 Feasibility Study on the Revival of the Shipbuilding Industry in Fiji.

	3.2 Capacity Building- local and overseas training of shipbuilders (naval architects & crew qualifications/certification) 3.3 Capacity Building for traditional sailing knowledge- appropriate training and development. 3.4 Implementation of policies and regulations to set standards and monitoring of shipbuilding. 3.5 Seeking finance and provision of incentives to investors. 3.6 Shipbuilding infrastructure upgrade and construction of new ones.

Actions to be implemented as Project Ideas

A paradigm shift in the domestic maritime industry is required to achieve the targets. There is a general lack of stakeholder consensus and an enormous in-country technical capacity gap for new technology implementations. The DoT is well staffed with the development of regulations and can easily develop new regulatory requirements for the shipping industry, while the MSAF is the compliance arm of the industry that ensures that the ships are following the set rules and guidelines. A pre-feasibility study, feasibility study, followed by sea trials can be conducted by the Government Shipping and Fiji Navy. Once these are successful, the private it would be easier to get the private sector on board. The key requirement is to have finances readily available with a proper financial model. Hence, Actions 1, 2, and 3 are further considered for project ideas with pilot studies.

2.1.2.4 Stakeholders and Timeline for implementation of TAP

Overview of Stakeholders for the implementation of the TAP

The organization responsible for policy-making for domestic maritime transportation is the Department of Transport (DoT) while the enforcement agency is the Maritime Safety Authority of Fiji (MSAF). Table 2.3 provides a list of stakeholders and their representatives as any implementation will require all actors and stakeholders for effective and efficient implementation of the sail-powered passenger/cargo ships.

Table 2.3: Stakeholders for implementation of Sail-powered Passenger/Cargo Ships.

Department	Representative
Climate Change Division – Ministry of Environment and Climate Change	Permanent Secretary Director of Climate Change Division
Department of Transport - Ministry of Public Works, Transport and Meteorology Services (MPWTMS)	Permanent Secretary Director of Transport

Fiji Revenue and Customs Services	CEO of FRCS
Fiji Maritime Academy	CEO and/or recommended rep.
Solicitor General's Office	SG
Maritime Safety Authority of Fiji	CEO and/or recommended rep.
Fiji Bureau of Statistics	CEO and/or recommended rep.
Donor Agencies	GCF GEF World Bank ADB UNDP
NGOs, CROP Agencies and Think-Tank Centres	SPC SPREP Pacific Centre for Environment and Sustainable Development Centre for Climate Change, Energy, Environment and Sustainable Development. Sailing for Sustainability Fiji Micronesian Centre for Sustainable Transportation (MCST)
Private Sector	Fiji Ships and Heavy Industries Limited (FSHIL) Industrial and Maritime Engineering Limited (IMEL) Local Ship Owners and Operators
Training Institutions	Fiji Maritime Academy (FMA) Australia Pacific Training Coalition (APTC) National Training and Productivity Centre (NPTC) The University of the South Pacific Fiji National University The University of Fiji

Scheduling and sequencing of specific activities

The sequencing of activities and the timelines are important as the target set is timebound. The proposed timelines with respective stakeholders that need to be involved at each stage are summarised in Table 2.4. The timelines provided are estimates only and serve as a guideline for achieving the goals set in the NDP. The timelines can be amended as new information is available at hand. All relevant stakeholders need to be involved in the development and deployment of new technologies. The DoT, MSAF, Department of Waterways and Environment, ship operators, and donors are critical. In addition, the think-tank centers will be appropriate for quality data collection in making informed decisions and analyzing the best practices.

Table 2.4: TAP schedule and responsible stakeholders for implementation of TAP activities for Sail-powered Passenger/Cargo Ships.

Action/ Activities	Timeline																												Stakeholders (Responsible body and focal point)
	2023		2024				2025				2026				2027				2028				2029				2030		
	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	
1.1 Establishment of Terms of Reference																													DoT, Ministry of Public Works, Transport and Meteorology Services.
1.2 Consult World Maritime University (WMU) for existing research or facilitate new research on sail-powered ships for credible data collation and verification (contact Class NKK to provide new build regulations for sailing ships)																													Ministry of Public Works, Transport and Meteorology Services, DoT, MSAF, and FMA
1.3 Reporting to the Cabinet and Publishing outcomes.																													DoT, Ministry of Public Works, Transport and Meteorology Services
2.1 Market assessment/Data collation and verification																													DoT, Ministry of Public Works, Transport and Meteorology Services
2.2 Procurement of pilot vessel																													Ministry of Public Works, Transport and Meteorology Services, DoT, Investment Fiji, NGOs, Private sectors
2.3 Government incentives to attract ship owners to invest in sail-powered vessels.																													Investment Fiji, Ministry of Finance, Strategic Planning, National Development, and Statistics, Ministry of Public Works, Transport and Meteorology Services, DoT
2.4 Business plans/schemes with existing and potential ship owners																													Investment Fiji, Ministry of Finance, Strategic Planning, National Development, and Statistics, Ministry of Public Works, Transport and Meteorology Services, DoT, and Local Shipowners

2.5 Courses for seafarers' training and certification for the use of new technology.																												MSAF, FMA, NPTC, APTC.
2.6 Monitoring and Evaluation of projects.																												Ministry of Finance, Strategic Planning, National Development and Statistics, Ministry of Public Works, Transport and Meteorology Services, DoT, FBO's
3.1 Feasibility Study on the Revival of the Shipbuilding Industry in Fiji.																												MECC, Ministry of Public Works, Transport and Meteorology Services, DoT
3.2 Capacity Building- local and overseas training of shipbuilders (naval arch & crew qualifications/certification)																												Ministry of Public Works, Transport and Meteorology Services, MSAF, FMA, NPTC, APTC.
3.3 Capacity Building for traditional sailing knowledge- appropriate training and development																												Ministry of Public Works, Transport and Meteorology Services, MSAF, FMA, NPTC, APTC.
3.4 Implementation of policies and regulations to set standards and monitoring of shipbuilding.																												MECC, Ministry of Public Works, Transport and Meteorology Services, DoT
3.5 Seeking finance and provision of incentives to investors.																												Ministry of Public Works, Transport and Meteorology Services, DoT, MECC
3.6 Shipbuilding infrastructure upgrade and construction of new ones.																												Ministry of Public Works, Transport and Meteorology Services, MECC, DoT, MSAF, FSHIL, FMA

2.1.2.5 Estimation of Resources Needed for Action and Activities

Estimation of capacity building needs

Human capacity needs development and availability is very important for the implementation of sail-powered passenger ferry trials. Table 2.5 provides details on the availability of local capacity and the training requirement priority for this technology. For deployment and sea trials, well-trained seafarers will be required for efficient use of the technology. With the revival of shipbuilding in Fiji, additional capacity in strategic areas of engineering (Civil, Mechanical, and Electrical Engineering and general construction) and Naval architects is a must.

Table 2.5: Availability of local capacity and training requirements priority.

Field of expertise	Specialist/ Trades person	Role	Local Capacity									
			Local Capacity					Training Requirement Priority				
			0-1	2	3	4	5	0-1	2	3	4	5
Data and Statistics	Local Statistics specialist and data scientist	For quality data collection and compiling			□					□		
Sailing Technology	Technical Expert	Feasibility assessment and development of Standards, sea trials.		□								□
Economics	Finance Specialist	Feasibility assessment. Concept note and project proposal development. Tax incentive propositions and awareness; Business model development.				□				□		
Capacity Building	Trainers	New courses for seafarers' training and certification for the use of new technology			□							□
	Trainers	Local and overseas training of shipbuilders (naval architect & crew qualifications/certification)		□								□
	Trainers	Traditional sailing knowledge-appropriate training and development				□						□
Engineering	Naval architect	Ship design and construction	□									□
	Civil and Electrical Engineering and general construction	Structural and site development; General wiring installations, General concrete foundation & structural works; General carpentry works, General plumbing installations			□					□		
Management	Project Manager/ Officer	Construction and Logistics project assistant				□				□		
	Administration Officers	General office work					□	□				
	Environment Officer	ESIA compliance.					□	□				
	OHS Officer	Construction and site safety compliance.					□	□				

Local Capacity		Training Requirement Priority	
0-1	No Capacity	**0-1**	Low Priority
2	Low Capacity	**2**	Somewhat Priority
3	Moderate Capacity	**3**	Neutral
4	Functional Capacity	**4**	Moderate Priority
5	Highly Functional Capacity	**5**	High Priority

Estimations of costs of actions and activities

This is a very new technology for Fiji and the Pacific and the cost estimate would be possible after a pre-feasibility study. Table 2.6 provides an estimate of the associated costs. The actual cost of implementation of Sail-powered Passenger/Cargo Ships is contingent upon the type of sailing technology and the ship.

Table 2.6: Estimated costs for TAP activities for the diffusion of Sail-powered Passenger/Cargo Ships

Action/ Activities	Estimated Costs (USD)
1.1 Establishment of Terms of Reference	20,000/TOR
1.2 Consult World Maritime University (WMU) for existing research or facilitate new research on sail-powered ships for credible data collation and verification (contact Class NKK to provide new build regulations for sailing ships)	80,000
1.3 Reporting to the Cabinet and Publishing outcomes.	Staff time
2.1 Market assessment/Data collation and verification	100,000 (Consultants)
2.2 Procurement of pilot vessel (New-built)	$35m
2.3 Government incentives to attract ship owners to invest in sail-powered vessels.	80,000
2.4 Business plans/schemes with existing and potential ship owners	50,000
2.5 Courses for seafarers' training and certification for the use of new technology.	50,000
2.6 Monitoring and Evaluation of projects.	Staff time
3.1 Feasibility Study on the Revival of the Shipbuilding Industry in Fiji.	100,000 (Consultants)
3.2 Capacity Building- local and overseas training of shipbuilders (naval arch & crew qualifications/certification)	250,000 (scholarships)
3.3 Capacity Building for traditional sailing knowledge- appropriate training and development	60,000
3.4 Implementation of policies and regulations to set standards and monitoring of shipbuilding.	Staff time
3.5 Seeking finance and provision of incentives to investors.	Staff time
3.6 Shipbuilding infrastructure upgrade and construction of new ones.	$35m over 5 years

2.1.2.6 Management Planning

Risks and Contingency Planning

Sail-powered ships with new technology are mature, yet in Fiji and the Pacific, the usage of traditional sail-powered shipping has declined. The inclusion of new sail-assisted shipping technology for commercial shipping and passenger ferries has not been trialed and is considered not viable. A private-public integrated partnership approach with the adoption of this technology would be beneficial. To avoid all these, a proper business plan and private-public partnership initiative need to be developed in detail prior to implementation. A comprehensive resource assessment and feasibility study would also reduce the associated risks. Another risk is the delays in the development of proposals and terms of references for new technology deployment that could risk timely outcomes.

The shipping industry is considered to be high-risk financing by commercial banks and other financial institutions. Donor agencies with assistance from local shipping companies and operators working in a cohesive manner have the potential for faster implementation and adoption of this new technology. Additionally, well-trained naval architects would greatly assist in the designing and building of ships greatly reducing the risk.

In the Pacific and Fiji, the greatest risk is imposed by tropical cyclones and storms damaging the ships and the shipbuilding infrastructure. Climate-resilient infrastructural development is necessary to minimize the risks.

Next Steps

A comprehensive review of the operations of the domestic maritime sector including current fleet, infrastructure, and policy is necessary as a means of the first next step. Quality data collection and a feasibility study for the implementation of sail-powered ships are necessary. The details of the next steps for the entire domestic maritime shipping are provided in Subsection 2.1.5.

2.1.2.7 TAP overview table

TAP overview table								
Sector	Transport							
Sub-sector	Domestic Maritime Transportation							
Technology	Sail-powered Passenger/Cargo Ships							
Ambition	The aim of the TAP is to support the GHG emission reduction efforts. In the updated NDC-2020, Fiji also committed to an additional target of reducing domestic maritime shipping emissions by 40% as a contribution to Target 1[3]. To support this ambition in reducing the targeted GHG emission, the ambition of the TAP is to have at least 5 advanced sail-powered ships to be trialled.							
Benefits	Reliable maritime transportation; increased economic growth in the maritime islands, reduction in GHG emissions.							
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: Feasibility Study of sail-powered vessels	**Activity 1.1** Establishment of Terms of Reference	Govt, private sector, and donor agencies	OPM, MPWTMS, and DoT.	6 Months	TOR is not developed within the timeframe.	TOR is successfully developed and approved.	EOI has been called for feasibility studies.	20,000/TOR

[3] Target 1 of Fiji's 2015 NDC is to reduce 30% of BAU CO_2 emissions from the energy sector by 2030 and achieve net-zero by 2050.

	Activity 1.2 Consult World Maritime University (WMU) for existing research or facilitate new research on sail-powered ships for credible data collation and verification (contact Class NKK to provide new build regulations for sailing ships)	Govt, private sector, and donor agencies	MECC, MPWTMS, and DoT.	6 Months	Unreliable local data. WMU is unable to provide support. Lack of local experts available.	Reliable feasibility has been conducted.	Feasibility report being collated.	80,000
	Activity 1.3 Reporting to the Cabinet and Publishing outcomes.	Govt, private sector, and donor agencies	MECC, MPWTMS, and DoT.	3 Months	The feasibility report is not developed within the time frame. Government priorities are revisited.	The feasibility reports are presented to the cabinet.	Projects are being approved by the Cabinet.	Staff time
Action 2: Purchasing existing sail-powered vessels (Pilot Project)	**Activity 2.1** Market assessment/Data collation and verification.	Govt, private sector, and donor agencies	MECC, MPWTMS, and DoT.	9 Months	Lengthy process. Data is not of high quality.	Quality data has been collated.	Continuation of the MRV after the CBIT project	100,000 (Consultants)

	Activity 2.2 Procurement of pilot vessel.	Govt, private sector, and donor agencies	MECC, MPWTMS, GSS, and DoT.	15 Months	High costs. Unavailability of finance, no private sector support, no insurance.	The vessel is successfully procured by GSS.	GSS initially procures one vessel and then slowly increases its fleet.	$35m
	Activity 2.3 Government incentives to attract ship owners to invest in sail-powered vessels.	Govt, private sector, and donor agencies	MECC, MPWTMS, and DoT.	12 Months	Lack of stakeholder interest and private sector participation.	The private sector is keen to invest.	The private sector and private operators have planned to invest in this technology.	80,000
	Activity 2.4 Business plans/schemes with existing and potential ship owners.	Govt, private sector, and donor agencies	MECC, MPWTMS, and DoT.	9 Months	Lack of stakeholder interest and private sector participation.	The private sector is keen to invest.	The private sector and private operators have planned to invest in this technology.	50,000
	Activity 2.5 Courses for seafarers training and certification for the use of new technology.	Govt, private sector, and donor agencies	MECC, MPWTMS, MSAF, FMA, and DoT.	12 Months	Lack of local trainers; no support or scholarships available.	New courses developed and offered.	No. of graduates trained.	50,000
	Activity 2.6 Monitoring and Evaluation of projects.	Govt, private sector, and donor agencies	MECC, MPWTMS, MSAF, and DoT.	Ongoing	Unreliable data; lack of support of stakeholders.	A monitoring and evaluation plan is in place and strictly adhered to.	Successful project implementation with regular reporting.	Staff time

Action 3: Revival of local Shipbuilding particularly sail-powered vessels	**Activity 3.1** Feasibility Study on the Revival of the Shipbuilding Industry in Fiji.	Govt, private sector, and donor agencies	MECC, MPWTMS, MSAF, FMA, and DoT.	21 Months	Lengthy process. Data is not of high quality. High cost of feasibility studies.	Feasibility study completed.	The site has been earmarked with the finance and expertise requirement.	100,000 (Consultants)
	Activity 3.2 Capacity Building- local and overseas training of shipbuilders (naval architects & crew qualifications/certification)	Govt, private sector, and donor agencies	MECC, MPWTMS, MSAF, FMA, and DoT.	12 Months	Lack of local trainers; no support or scholarships available.	New courses developed and offered.	No. of graduates trained.	250,000 (scholarships)
	Activity 3.3 Capacity Building for traditional sailing knowledge- appropriate training and development.	Govt, private sector, and donor agencies	MECC, MPWTMS, FMA, and DoT.	12 Months	Lack of local trainers; no support or scholarships available.	New courses developed and offered.	No. of graduates trained.	60,000
	Activity 3.4 Implementation of policies and regulations to set standards and monitoring of shipbuilding.	Govt, private sector, and donor agencies	MECC, MPWTMS, Ministry of iTaukei Affairs, MSAF, and DoT.	12 Months	Policies are not reviewed on time. Lack of stakeholder participation.	Policies and regulations are drafted.	Standards are being developed; the MnE plan is developed.	Staff time

	Activity 3.5 Seeking finance and provision of incentives to investors.	Govt, private sector, and donor agencies	MECC, MPWTMS, and DoT.	12 Months	Lack of interest from financial institutions and donor agencies. Natural Disasters. Change in government priorities.	Capital funding is available.	Donors and the private sector investment in the shipbuilding industry.	Staff time
	Activity 3.6 Shipbuilding infrastructure upgrade and construction of new ones.	Govt, private sector, and donor agencies	MECC, MPWTMS, MSAF, Fiji Ports, GSS, and DoT.	Gradually over 4 years.	Lack of interest from financial institutions and donor agencies. Natural Disasters.	Planned stage-wise infrastructure development in place.	The new infrastructure is being developed and old ones are being upgraded.	$35m over 5 years

2.1.3 Action Plan for Low Carbon/Zero Carbon Passenger Ferry Trials

2.1.3.1 Introduction

Fast ferries for passenger commute are vital for Fiji's growing economy. Technology 2- Low Carbon/Zero Carbon Passenger Ferry Trials are required to reap the full economic and environmental benefits. The low-carbon/zero-carbon vessel could be built locally after the revival of the shipbuilding industry or will have to be acquired from overseas such as Australia (Butcher, 2021) and Norway (Al-Falahi, 2019)). The Low Carbon/Zero Carbon Passenger Ferry Trials would require support mechanisms in place including charging stations with electricity being generated from renewable sources. Ample battery storage with service and maintenance support is also a prerequisite.

2.1.3.2 Ambition for the TAP

The Domestic Maritime Shipping sector has been operating with very old ships beyond their service lifetimes. The reduction of GHG emissions from the domestic maritime sector has been the aim of the NDP. In the updated NDC-2020, Fiji committed to an additional target of reducing domestic maritime shipping emissions by 40% as a contribution to Target 1 (to reduce 30% of BAU CO_2 emissions from the energy sector by 2030 and achieve net zero by 2050). To support this, the ambition of the TAP is to have a successful proof of concept of a zero-carbon passenger ferry trial on a selected route initially and by 2030 have at least five successful trials on five selected routes in Fiji.

2.1.3.3 Actions and Activities Selected for Inclusion in the TAP

Summary of barriers and measures to overcome barriers

A summary of barriers and measures identified for Low Carbon/Zero Carbon Passenger Ferry Trials is provided in Table 2.7. These are derived from the TNA BAEF Report. The economic and financial barriers with a lack of capacity and infrastructure would make it difficult for accelerated deployment of the technology. However, some measures have been suggested to overcome these barriers.

Table 2.7: Summary of barriers and respective measures for Low Carbon/Zero Carbon Passenger Ferry Trials.

Barriers	Measures
Economic and Financial	
• Higher upfront Capex • Unaffordable maritime financing • No insurance underwriters • Unclear return on investment • High-risk financing • Previous bad experiences • Difficult for shipowners and operators to undertake large investments	• Realignment of maritime sector financing and loaning policies • Effortless finance mechanism • Concessional loans with easy financing and lower interests, fees, and charges • Tailor-made fiscal incentives • Insurance facilities for all marine vessels • An increased understanding of the technology

• Lack of investor confidence • High-risk financing • Lack of fiscal incentives	• Capacity building for modernized business practices • Recording and availability of high-quality, timely, and reliable data • Specialized concessional loan facilities
Regulatory	
o Gaps in policy and regulations o No emissions regulations o No Ship Energy Efficiency Management Plan (SEEMP) o Marine Transportation Act is outdated	o Inclusion of emission reduction regulations with incentives and/or penalties o Ratify MARPOL Annex VI o Regulates shipboard incineration, and the emissions o A progressive reduction in NOx emissions o Development and adoption of SEEMP o Policies to influence the shipowners and operators to look into alternative low-carbon maritime shipping technology.
Capacity	
• Lack of understanding of the newer technology • No on-ground training	• Appropriate training and development • Recruiting the right crew • Develop specialized training for operators and crew. • Training and skills development for women
Infrastructural	
▪ No charging stations ▪ There is around 50-60% renewable electricity in the grid, yet will have to increase this for low carbon electric ferry. ▪ No dedicated passenger pick-up/drop-off points for electric passenger ferry	▪ Tailor-made infrastructure ▪ Increased renewable electricity generation mix in the grid ▪ Dedicated passenger pick-up/drop-off points ▪ Cargo handling and passenger transit infrastructure.

Actions and Activities selected for inclusion in the TAP

The identification of barriers followed by systematic analysis in the identification of enabling framework were all driven by stakeholders. After this, the actions and activities were identified for inclusion in the TAP. Table 2.8 presents the actions and activities that need to be implemented for the adoption of Low Carbon/Zero Carbon Passenger Ferry Trials in this proposed TAP. The actions included a detailed scoping study, financial planning and availability, policy and regulation upgrade, and training and implementation. The subsequent actions are presented in Table 2.8.

Table 2.8: Activities to be implemented to enhance the diffusion of Low Carbon/Zero Carbon Passenger Ferry Trials.

Actions	Activities
1. Scoping study	1.1 Develop scoping study. 1.2 Establish a steering committee and working group. 1.3 Hire consultants for technical and vessel design. 1.4 Develop TOR.
2. Financial Planning and availability	2.1 Realign maritime sector financing and loaning policies 2.2 Govt to provide financial incentives for zero-carbon passenger ferries. 2.3 Insurance Facilities for marine vessels. 2.4 Recording and availability of high-quality, timely, and reliable data.
3. Policy and regulation upgrade	3.1 Review current regulations to include emission reduction, shipboard incineration emissions, NOx emissions, etc. 3.2 Development and adoption of Ship Energy Efficiency Management Plan (SEEMP). 3.3 Develop policies to influence the shipowners and operators to look into alternative low-carbon maritime shipping technology.
4. Training and capacity development	4.1 Hire consultants for the needs assessment. 4.2 MOU with Maritime Technical Institutes for accredited/specialized training. 4.3 Develop a technical training programme for electric equipment (maintenance & repairs) 4.4 Training and skills development for women (gender mainstreaming)
5. Implementation	5.1 Install shore-power facilities 5.2 Improve cargo handling and pax transit infrastructure. 5.3 Increase renewable electricity generation mix in the grid 5.4 Deployment of Low carbon ships with proper monitoring and evaluation

Actions to be implemented as Project Ideas

For domestic maritime transportation in Fiji, an enormous in-country technical capacity gap exists for new technology implementations. The industry is largely profit-driven by private ship operators, yet it is considered a marginal business. In terms of a project idea, after a pre-feasibility study, and feasibility study, the Government Shipping Services needs to conduct sea trials. The success and lessons learned from the sea trials would encourage the private sector to adopt this new Low Carbon/Zero Carbon Passenger Ferry technology. Finance availability is a key requirement with a proper financial model. The abovementioned actions are further considered for project ideas with pilot studies.

2.1.3.4 Stakeholders and Timeline for Implementation of TAP

Overview of Stakeholders for the Implementation of the TAP

The Department of Transport (DoT) is responsible for policy-making for domestic maritime transportation. The DoT is well staffed with the development of regulations and can easily develop new regulatory requirements for the shipping industry. The MSAF is the compliance arm of the industry that ensures that the ships are following the rules and guidelines. For effective deployment of the technology, the GSS and private sector needs to come on board as well with support from donor agencies. Table 2.9 provides a summary of stakeholders.

Table 2.9: Stakeholders for implementation of Low Carbon/Zero Carbon Passenger Ferry Trials.

Department	Representative
Climate Change Division – Ministry of Environment and Climate Change	Permanent Secretary Director of Climate Change Division
Department of Transportation - Ministry of Public Works, Transport and Meteorology Services (MPWTMS)	Permanent Secretary Director of Energy Rural Electrification Unit
Fiji Revenue and Customs Services	CEO and/or recommended rep.
Fiji Maritime Academy	CEO and/or recommended rep.
Solicitor General's Office	SG
Maritime Safety Authority of Fiji	CEO and/or recommended rep.
Fiji Ports	CEO and/or recommended rep.
International Maritime Organization (IMO)	Technical Expert. Integrated Technical Cooperation Programme Rep.
Energy Fiji Limited	CEO and/or recommended rep.
Donor Agencies	GCF GEF World Bank ADB UNDP FDB AusAID NZAid USAID UK-AID
NGOs, CROP Agencies and Think-Tank Centres	SPC SPREP

	Pacific Centre for Environment and Sustainable Development Centre for Climate Change, Energy, Environment and Sustainable Development. Sailing for Sustainability Fiji Micronesian Centre for Sustainable Transportation
Private Sector	Fiji Ships and Heavy Industries Limited (FSHIL) Industrial and Maritime Engineering Limited (IMEL) Local Ship Owners and Operators
Insurance Companies	Representatives of Local and international insurance companies. Insurance underwriters.
Training Institutions	Fiji Maritime Academy (FMA) Australia Pacific Training Coalition (APTC) National Training and Productivity Centre (NPTC) The University of the South Pacific Fiji National University The University of Fiji

Scheduling and sequencing of specific activities

Table 2.10 outlines the proposed timelines with respective stakeholders that need to be involved at each stage. The timelines provided in Table 2.10 are estimates only. These can serve as a guideline for achieving the goals. The progress and findings will be ongoing and the timelines can be amended as new information becomes available. All relevant stakeholders need to be involved in the development and deployment of new technologies. The DoT, MSAF, Department of Waterways and Environment, GSS, ship operators, and donors are a critical part of the equation.

Table 2.10: TAP schedule and responsible stakeholders for implementation of TAP activities for Low Carbon/Zero Carbon Passenger Ferry Trials.

Action/ Activities	Timeline																												Stakeholders (Responsible body and focal point)
	2023		2024				2025				2026				2027				2028				2029				2030		
	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	
1.1 Develop scoping study																													DoT, Ministry of Public Works, Transport and Meteorology Services, GSS.
1.2 Establish a steering committee and working group.																													DoT, Ministry of Public Works, Transport and Meteorology Services, MSAF, and FMA
1.3 Hire consultant for technical and vessel design.																													DoT, Ministry of Public Works, Transport and Meteorology Services.
1.4 Develop TOR.																													DoT, Ministry of Public Works, Transport and Meteorology Services.
2.1 Realign maritime sector financing and loaning policies																													DoT, Ministry of Public Works, Transport and Meteorology Services, Investment Fiji, NGOs, Private sectors
2.2 Govt to provide financial incentives for zero-carbon passenger ferries.																													Investment Fiji, MECC, Ministry of Public Works, Transport and Meteorology Services, DoT
2.3 Insurance Facilities for marine vessels.																													MECC, Ministry of Public Works, Transport and Meteorology Services, DoT, Local Ship owners, and Insurance companies.
2.4 Recording and availability of high-quality, timely, and reliable data.																													MSAF, FMA, DoT
3.1 Review current regulations to include emission reduction, shipboard incineration emissions, NOx emissions, etc.																													MECC, Ministry of Finance, Strategic Planning, National Development and Statistics, Ministry of Public Works,

																												Transport and Meteorology Services, DoT, GSS
3.2 Development and adoption of Ship Energy Efficiency Management Plan (SEEMP).																												MECC, Ministry of Public Works, Transport and Meteorology Services, DoT, FMA, Think-tank centers, GSS
3.3 Develop policies to influence the shipowners and operators to look into alternative low-carbon maritime shipping technology.																												Ministry of Public Works, Transport and Meteorology Services, MSAF, FMA, DoT
4.1 Hire consultants for needs assessment																												Ministry of Public Works, Transport and Meteorology Services, MSAF, DoT.
4.2 MOU with Maritime Technical Institutes for accredited/specialized training.																												MECC, Ministry of Public Works, Transport and Meteorology Services, DoT
4.3 Develop a technical training programme for electric equipment (maintenance & repairs)																												Ministry of Public Works, Transport and Meteorology Services, DoT, GSS
4.4 Training and skills development for women (gender mainstreaming)																												Ministry of Public Works, Transport and Meteorology Services, DoT, MSAF, NTPC, APTC, CROP agencies.
5.1 Install shore-power facilities																												Fiji Ports, EFL, DoT, Ministry of Public Works, Transport and Meteorology Services, FMA, GSS
5.2 Improve cargo handling and pax transit infrastructure.																												Fiji Ports, EFL, DoT, Ministry of Public Works, Transport and Meteorology Services, FMA
5.3 Increase renewable electricity generation mix in the grid																												EFL, DoE, MCTTT, Think-tank centers
5.4 Deployment of Low carbon ships with proper monitoring and evaluation.																												DoT, Ministry of Public Works, Transport and Meteorology Services, GSS, Fiji Ports, MSAF, Think-tank centers

2.1.3.5 Estimation of Resources Needed for Action and Activities

Estimation of capacity building needs

The details on the availability of local capacity and the training requirement priority for the Low Carbon/Zero Carbon Passenger Ferry trials project are displayed in Table 2.11. Similar to Technology 1, for deployment and sea trials well-trained seafarers will be required for efficient use of the technology. With the revival of shipbuilding in Fiji, additional capacity in strategic areas of engineering (Civil and Electrical Engineering and general construction) and Naval architects is a must. Renewable Energy System Design Engineers will also be required for charging station development and shore power development.

Table 2.11: Availability of local capacity and training requirements priority.

Field of expertise	Specialist/ Trades person	Role	Local Capacity									
			Local Capacity					Training Requirement Priority				
			0-1	2	3	4	5	0-1	2	3	4	5
Policy review	Local Policy analyst	Realign maritime sector financing and loaning policies. Development and adoption of Ship Energy Efficiency Management Plan (SEEMP) Develop policies to influence the shipowners and operators to look into alternative low-carbon maritime shipping technology. Govt to provide financial incentives for zero-carbon passenger ferries.			☐					☐		
Low carbon Technology	Technical Expert	For know-how of technical and vessel design, pre-feasibility assessment, and development of Standards, sea trials.		☐								☐
Economics	Finance Specialist	Feasibility assessment. Concept note and project proposal development. Tax incentive propositions and awareness.				☐				☐		
Capacity Building	Trainers	Accredited and specialized training for the use of new technology. Technical training programmes for electric equipment (maintenance & repairs). Training and skills development for women (gender mainstreaming)			☐							☐
Engineering	Naval architect	Ship design and construction expertise.	☐									☐
	Renewable Energy System Design Engineers	Renewable energy design engineers, charging station development, shore power development.			☐						☐	
Management	Project Manager/ Officer	Construction and Logistics project assistant				☐				☐		
Energy Technology	Local Energy Specialist	Resource assessment; Concept note and project proposal development; Develop Standards				☐				☐		

Local Capacity		Training Requirement Priority	
0-1	No Capacity	**0-1**	Low Priority
2	Low Capacity	**2**	Somewhat Priority
3	Moderate Capacity	**3**	Neutral
4	Functional Capacity	**4**	Moderate Priority
5	Highly Functional Capacity	**5**	High Priority

Estimations of costs of actions and activities

An estimate of the associated costs for the implementation of Low Carbon/Zero Carbon Passenger Ferry Trials is provided in Table 2.12 yet the actual costs would depend on the type of technology and the ship. The Low Carbon/Zero Carbon Passenger Ferry Trials is a very new technology for Fiji and the Pacific and a proper cost estimate would be possible after a pre-feasibility study.

Table 2.12: Estimated costs for TAP activities for the diffusion of Sail-powered Passenger/Cargo Ships.

Action/ Activities	**Estimated Costs (USD)**
1.1 Develop scoping study	500,000
1.2 Establish a steering committee and working group.	
1.3 Hire consultant for technical and vessel design.	
1.4 Develop TOR.	
2.1 Realign maritime sector financing and loaning policies	200,000
2.2 Govt to provide financial incentives for zero-carbon passenger ferries.	
2.3 Insurance Facilities for marine vessels.	
2.4 Recording and availability of high-quality, timely, and reliable data.	
3.1 Review current regulations to include emission reduction, shipboard incineration emissions, NOx emissions, etc.	350,000
3.2 Development and adoption of Ship Energy Efficiency Management Plan (SEEMP).	
3.3 Develop policies to influence the shipowners and operators to look into alternative low-carbon maritime shipping technology.	
4.1 Hire consultants for needs assessment	450,000/yr for 3 years
4.2 MOU with Maritime Technical Institutes for accredited/specialized training.	
4.3 Develop technical training programmes for electric equipment (maintenance & repairs)	
4.4 Training and skills development for women (gender mainstreaming)	
5.1 Install shore-power facilities	New build - FJD 40 - 50 million Refurbished - FJD 10 - 15 million
5.2 Improve cargo handling and pax transit infrastructure.	
5.3 Increase renewable electricity generation mix in the grid	
5.4 Deployment of Low carbon ships	

2.1.3.6 Management Planning

Risks and Contingency Planning

Low/zero carbon shipping trials are a new technology concept for Fiji and the Pacific. The technology is capital intensive having high capital costs, hence is considered not viable at a smaller scale since the economy of scale takes a toll on the feasibility. Stakeholders recalled that many failures in the past were due to failure at the concept level and lack of private sector and donor interest. A private-public integrated partnership approach with the adoption of this technology would be beneficial and looking at mitigation options with the private sector is essential.

Stakeholder engagement from shipping companies ranges from minimum to lack of or no interest in the adoption of newer proposed technologies. The method of business operations currently in use by ship owners is also a major risk for the adoption of newer low-carbon technologies as the businesses are profit driven. To avoid all these, a proper business plan and private-public partnership initiative need to be developed in detail prior to implementation.
The shipping industry is considered to be high-risk financing by commercial banks and other financial institutions. Donor agencies with assistance from local shipping companies and operators working in a cohesive manner have the potential for faster implementation and adoption of this new technology.

Additionally, the lack of trained professionals is another risk, and not being able to get the professionals trained on time would become a challenge. To avoid this, the training institution such as FMA needs to be well equipped and the trainers to be trained on time to deliver the necessary training for the crew.

Next Steps

A comprehensive review of the operations of the domestic maritime sector including current fleet, infrastructure, and policy is necessary as a means of the first next step. Quality data collection and a feasibility study for the implementation of sail-powered ships are necessary. The details of the next steps for the entire domestic maritime shipping are provided in Subsection 2.1.5.
The Government Shipping Services with the aid of donors and the private sector could conduct a feasibility study for the implementation of Low carbon shipping trials. Followed by procurement, sea trials, and evaluations with subsequent adoption by the private sector. The private sector could have a proof-of-concept once the trials are conducted to be adopted easily. Another method could be that the newer ships are procured by the Government Shipping Services and once the initial trial is completed over 5 years, these low-carbon ships could be sold to the private ship operators at a lower to allow for a buffer in terms of high costs. The schematic below summarizes the next steps for ease of implementation.

2.1.3.7 TAP overview table

TAP overview table								
Sector	Transport							
Sub-sector	Domestic Maritime Transportation							
Technology	Low Carbon/Zero Carbon Passenger Ferry Trials.							
Ambition	The aim of the TAP is to support the GHG emission reduction efforts. In the updated NDC-2020, Fiji committed to an additional target of reducing domestic maritime shipping emissions by 40% as a contribution to Target 1 (to reduce 30% of BAU CO_2 emissions from the energy sector by 2030 and achieve net zero by 2050). To support this, the ambition of the TAP is to have a successful proof of concept of a zero-carbon passenger ferry trial on a selected route initially and by 2030 have at least five successful trials on five selected routes in Fiji.							
Benefits	Reliable maritime transportation; increased economic growth in the maritime islands, reduction in GHG emissions.							
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 (USD)**
Action 1: A scoping study	**Activity 1.1** Develop scoping study.	Govt, private sector, and donor agencies	MECC, MPWTMS, and DoT.	6 Months	Insufficient local capacity.	Scoping study completed in time.	Scoping study report presented to MECC, MPWTMS, and DoT.	500,000
	Activity 1.2 Establish a steering committee and working group.	Govt, private sector, and donor agencies	MECC, MPWTMS, and DoT.	6 Months	Lack of stakeholder participation. Not enough consultations.	Effective consultations and stakeholder concerns are taken into consideration.	Ongoing Steering Committee and consultations.	

	Activity 1.3 Reporting to the Cabinet and Publishing Outcomes.	Govt, private sector, and donor agencies	MECC, MPWTMS, and DoT.	9 Months	Reports are not ready on time and in the required format. Delay in a scoping study.	Reports were presented to the cabinet.	Cabinet endorsement and approval of the scoping study report.	
	Activity 1.4 Develop TOR.	Govt, private sector, and donor agencies	MECC, MPWTMS, and DoT.	6 Months	TOR is not developed within the timeframe.	TOR is successfully developed and approved.	EOI has been called for feasibility studies.	
Action 2: Financial Planning and Availability	**Activity 2.1** Realign maritime sector financing and loaning policies	Govt, private sector, and donor agencies	MECC, MPWTMS, and DoT.	12 Months	Policies not realigned on time	Timely review and update of policies.	Updated policies are being published.	200,000
	Activity 2.2 Govt to provide financial incentives for zero-carbon passenger ferries.	Govt, private sector, and donor agencies	MECC, MPWTMS, GSS, and DoT.	12 Months	Financial incentives are not accepted by the private sector.	Innovative Financial incentives outlined.	Private sectors take advantage of the finances and invest in technology.	

	Activity 2.3 Insurance facilities for marine vessels.	Govt, private sector, and donor agencies	MECC, MPWTMS, and DoT.	24 Months	Insurance companies are not keen to participate.	Insurance policy products are available.	Investors, operators, and private sectors are buying insurance products.	
	Activity 2.4 Recording and availability of high-quality, timely, and reliable data.	Govt, private sector, and donor agencies	MECC, MPWTMS, GSS, and DoT.	24 Months	Data is not of high quality or disaggregated.	Data collation template and a repository	Stakeholder inputs	
Action 3: Policy and regulation upgrades	**Activity 3.1** Review current regulations to include emission reduction, shipboard incineration emissions, NOx emissions, etc.	Govt, private sector, and donor agencies	MECC, MPWTMS, GSS, MSAF, and DoT.	21 Months	Policies not reviewed on time	Timely review and update of policies.	Updated policies are being enacted.	350,000
	Activity 3.2 Development and adoption of Ship Energy Efficiency Management Plan (SEEMP).	Govt, private sector, and donor agencies	MECC, MPWTMS, MSAF, and DoT.	12 Months	The increased financial burden on operators in SEEMP implementations.	SEEMP implementation plan in place.	Gradual improvement of ship efficiencies with regular monitoring.	

	Activity 3.3 Develop policies to influence the shipowners and operators to look into alternative low-carbon maritime shipping technology.	Govt, private sector, and donor agencies	MECC, MPWTMS, and DoT.	12 Months	The increased financial burden on operators. Ship operators and the private sector is not keen.	Win-win policies for all interested parties.	Increased uptake of alternative low-carbon maritime shipping technologies.	
Action 4: Training and implementation	**Activity 4.1** Hire consultants for needs assessment.	Govt, private sector, and donor agencies	MECC, MPWTMS, and DoT.	9 Months	Unavailability of local capacity	Experts hired on-time	Training needs assessment conducted and reported.	450,000/yr for 3 years
	Activity 4.2 MOU with Maritime Technical Institutes for accredited/specialised training.	Govt, private sector, and donor agencies	MECC, MPWTMS, and DoT.	12 Months	Lack of finance and staffing with FMA.	MOUs developed and signed.	Number of MOUs developed and signed.	
	Activity 4.3 Develop technical training programmes for electric equipment (maintenance & repairs)	Govt, private sector, and donor agencies	MECC, MPWTMS, FMA, and DoT.	24 Months	Lack of finance and staffing with FMA. Lack of scholarships for students	New training programmes developed.	Number of graduates completed the training.	
	Activity 4.4 Training and skills development for women (gender mainstreaming)	Govt, private sector, and donor agencies	MECC, MPWTMS, MSAF, FMA, and DoT.	24 Months	Gender consideration is not prioritized in training.	Gender-sensitive training programmes developed.	Gender-based graduate data.	

Action 5: Implementation	**Activity 5.1** Install shore-power facilities	Govt, private sector, and donor agencies	MECC, MPWTMS, MSAF, Fiji Ports, GSS, EFL, and DoT.	24 Months	Lack of finance available. Lack of shore infrastructure.	Successful installation of shore-power facilities.	Number of ports having this facility.	
	Activity 5.2 Improve cargo handling and pax transit infrastructure.	Govt, private sector, and donor agencies	MECC, MPWTMS, MSAF, Fiji Ports, GSS, and DoT.	18 Months	Lack of finance available. Lack of shore infrastructure.	Successful implementation of cargo handling and passenger transfers.	Passenger and cargo transit times.	New build - FJD 40 - 50 million Refurbished - FJD 10 - 15 million
	Activity 5.3 Increase renewable electricity generation mix in the grid	Govt, private sector, and donor agencies	MECC, MPWTMS, DoE, EFL, and DoT.	27 Months	Lack of finance available. EFL is not able to secure financing; IPPs are not on board.	Increased RE as the demand increases.	Percentage of RE in the EFL grid.	
	Activity 5.4 Deployment of Low carbon ships	Govt, private sector, and donor agencies	MECC, MPWTMS, MSAF, Fiji Ports, GSS, EFL, and DoT.	Gradual Implementation over 36 Months	Lack of finance, insurance, infrastructure, and private sector involvement.	Successful sea trials with MnE.	Gradual increase in uptake of Low carbon ships.	

2.1.4 Action Plan for Advanced Wind Propulsion Technologies: Eco-Flettner Rotor – retrofit and new-build technology

2.1.4.1 Introduction

Advanced Wind Propulsion Technologies are very essential for the maritime sector as it has huge potential. One such technology is the Flettner rotors that harness the power of the wind for auxiliary propulsion. These rotors are rotating cylinders mounted on the deck of the ship. When rotating, one side of the rotor forms a low-pressure area while the other experiences high pressure called the Magnus effect that generates lift similar to a sail of a ship (Li et al., 2021). With cost-effective engineering, these Flettner rotors can be retrofitted across a broad design of vessels. The advantage is that the operations of these rotors do not require additional crew and require only minimal maintenance over their lifetime. Experts estimated that on a local scale, retrofitting can bring about savings of up to 5% while incorporating it into new build could have savings from 15-40%+ (Nuttall et al., 2016). As a result, the new build vessels with Flettner rotors are preferred over retrofitting. However, sea trials are necessary to learn about carbon abatement, fuel savings, and economic benefits at a local scale.

2.1.4.2 Ambition for the TAP

To support the government's efforts in curbing GHG emissions from the domestic maritime sector, newer and large carbon abating technologies are required. In the updated NDC-2020, Fiji committed to an additional target of reducing domestic maritime shipping emissions by 40% as a contribution to Target 1 (to reduce 30% of BAU CO_2 emissions from the energy sector by 2030 and achieve net zero by 2050). Hence, the aim of the TAP is to have a successful proof of concept of ships with Flettner rotors. At least 10 ships need to have the initial Flettner rotor installations to achieve sizeable results.

2.1.4.3 Actions and Activities Selected for Inclusion in the TAP

Summary of barriers and measures to overcome barriers

A summary of barriers and measures identified for Advanced Wind Propulsion Technologies: Eco-Flettner Rotor – retrofit and new-build technology is provided in Table 2.13. These are derived from the TNA BAEF Report. Economic and financial, regulatory, capacity and infrastructural barriers were the main barriers. The subsequent potential measures for these barriers have been identified and listed.

Table 2.13: Summary of barriers and respective measures for Advanced Wind Propulsion Technologies: Eco-Flettner Rotor – retrofit and new-build technology.

Barriers	Measures
Economic and Financial	
▪ High initial capital cost ▪ Unaffordable maritime financing ▪ High loan interest rates ▪ No insurance underwriters ▪ Unclear return on investment ▪ Lack of interest or conflicting interests ▪ Shipowners are reluctant to adopt energy-saving devices. ▪ Old-fashioned business practices ▪ Old Shipping Fleet ▪ Lack of understanding of the newer technology ▪ Lack of local research and scientific studies ▪ Data unavailability ▪ Unclear return on investment	▪ Easy Financing ▪ Affordable interest loans ▪ Concessional loans schemes ▪ Proper insurance products ▪ Increased understanding of the technology in the local context ▪ Training and capacity building for modernized business practices ▪ Recording and availability of high-quality, timely, and reliable data ▪ Proper local research and scientific studies.
Regulatory	
• Gaps in policy and regulations • No emissions regulations • No Ship Energy Efficiency Management Plan (SEEMP) • Marine Transportation Act is outdated	• Inclusion of emission reduction regulations with incentives and/or penalties • Ratify MARPOL Annex VI • Regulates shipboard incineration, and the emissions • A progressive reduction in NOx emissions • Development and adoption of SEEMP
Capacity	
✓ Lack of local capacity ✓ No on-ground training ✓ Few naval architects are available	✓ Appropriate training and development ✓ Training and skills development for women ✓ Training more naval architects ✓ Retain the capacity within the country
Infrastructural	
✓ Lack of infrastructure for rotor assembly ✓ Lack of docking facility ✓ Lack of qualified heavy industry engineers	✓ The Commercial Flettner Rotor industry is to be developed ✓ Qualified heavy industry engineers ✓ More maintenance crews ✓ The robust shipbuilding industry is to be developed.

✓ Lack of maintenance crew for retro-fitting proper ✓ The inactive commercial shipbuilding industry ✓ Lack of localized research and building of bespoke ships	

Actions and Activities selected for inclusion in the TAP

Identification of barriers and the enabling framework led to the formulation of actions and activities for the implementation of Advanced Wind Propulsion Technologies: Eco-Flettner Rotor – retrofit and new-build technology. Table 2.14 presents the actions and activities that need to be implemented under the proposed TAP.

Table 2.14: Activities to be implemented to enhance the diffusion of Advanced Wind Propulsion Technologies: Eco-Flettner Rotor – retrofit and new-build technology.

Actions	Activities
1. Feasibility Study	1.1 Hire consultant for technical and vessel design. 1.2 Collect vessel specification data 1.3 Evaluate new build and retrofitting rotor technology. 1.4 Compiling data and reporting
2. Private sector engagement	2.1 Establishing a technical and steering committee. 2.2 Engage and consult local and international maritime companies. 2.3 Government to provide financial incentives.
3. Business plan development	3.1 Create a business plan to attract investors and shipowners 3.2 Introducing O&M Standards 3.3 Develop technical training programmes for operating and maintenance of the plant and equipment.
4. Training of Engineers and Technicians and implementation	4.1 Tendering 4.2 Build or purchase the rotor technology-equipped vessel accompanied by training of engineers and technicians. 4.3 Run sea trails with monitoring and evaluation.

Actions to be implemented as Project Ideas

The development and implementation of Flettner rotors will require enormous in-country technical capacity and active private-sector participation. The key requirement is to have finances readily available with a proper financial model. In terms of a project idea, after a pre-feasibility study, and feasibility study, the Government Shipping Services needs to conduct sea trials. The success and lessons learned from the sea trials would encourage the private sector to adopt Flettner rotor-propelled ships. A summary of stakeholders is provided in Table 2.15.

2.1.4.4 Stakeholders and Timeline for Implementation of TAP

Overview of Stakeholders for the Implementation of the TAP

Table 2.15: Stakeholders for implementation of Advanced Wind Propulsion Technologies: Eco-Flettner Rotor – retrofit and new-build technology.

Department	Representative
Climate Change Division – Ministry of Environment and Climate Change	Permanent Secretary Director of Climate Change Division
Department of Transportation - Ministry of Public Works, Transport and Meteorology Services (MPWTMS)	Permanent Secretary Director of Energy Rural Electrification Unit
Fiji Revenue and Customs Services	CEO and/or recommended rep.
Fiji Maritime Academy	CEO and/or recommended rep.
Solicitor General's Office	SG
Maritime Safety Authority of Fiji	CEO and/or recommended rep.
Fiji Ports	CEO and/or recommended rep.
Government Shipping Services	CEO and/or recommended rep.
International Maritime Organization (IMO)	Technical Expert. Integrated Technical Cooperation Programme Rep.
International Shipping Companies	Technical experts
Donor Agencies	GCF GEF World Bank ADB UNDP FDB AusAID NZAid USAID UK-AID
NGOs, CROP Agencies and Think-Tank Centres	SPC SPREP Pacific Centre for Environment and Sustainable Development Centre for Climate Change, Energy, Environment and Sustainable Development. Sailing for Sustainability Fiji

	Micronesian Centre for Sustainable Transportation
Private Sector	Fiji Ships and Heavy Industries Limited (FSHIL) Industrial and Maritime Engineering Limited (IMEL) Local Ship Owners and Operators
Insurance Companies	Representatives of Local and international insurance companies. Insurance underwriters.
Training Institutions	Fiji Maritime Academy (FMA) Australia Pacific Training Coalition (APTC) National Training and Productivity Centre (NPTC) The University of the South Pacific Fiji National University The University of Fiji

Scheduling and sequencing of specific activities

The timelines to guide the technology adoption are presented in Table 2.16 with respective stakeholders that need to be involved at each stage. The timelines provided in Table 2.16 are as a guide only and as the actions and activities progress, the timelines can be amended.

Table 2.16: TAP schedule and responsible stakeholders for implementation of TAP activities for Advanced Wind Propulsion Technologies: Eco-Flettner Rotor – retrofit and new-build technology.

Action/ Activities	Timeline																												Stakeholders (Responsible body and focal point)
	2023		2024				2025				2026				2027				2028				2029				2023		
	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	
1.1 Hire consultant for technical and vessel design.																													DoT, Ministry of Public Works, Transport and Meteorology Services, GSS.
1.2 Collect vessel specification data																													DoT, Ministry of Public Works, Transport and Meteorology Services, MSAF, and FMA
1.3 Evaluate new build and retrofitting rotor technology.																													DoT, Ministry of Public Works, Transport and Meteorology Services, MSAF, GSS
1.4 Compiling data and reporting																													DoT, Ministry of Public Works, Transport and Meteorology Services, MSAF, GSS
2.1 Establishing a technical and steering committee.																													DoT, Ministry of Public Works, Transport and Meteorology Services, Investment Fiji, NGOs, Private sectors
2.2 Engage and consult local and international maritime companies.																													MECC, Ministry of Public Works, Transport and Meteorology Services, DoT
2.3 Government to provide financial incentives.																													MECC, Ministry of Public Works, Transport and Meteorology Services, DoT, Local Ship owners,
3.1 Create a business plan to attract investors and shipowners																													MECC, MSAF, FMA, DoT
3.2 Introducing O&M Standards																													Ministry of Public Works, Transport and Meteorology Services, DoT, MSAF
3.3 Develop a technical training programme for operating and maintenance of the plant and equipment.																													Ministry of Public Works, Transport and Meteorology Services, DoT, FMA, Think-tank centers, NTPC, APTC

4.1 Tendering																											Ministry of Public Works, Transport and Meteorology Services, MSAF, FMA, DoT
4.2 Build or purchase the rotor technology-equipped vessel accompanied by training of engineers and technicians.																											Ministry of Public Works, Transport and Meteorology Services, MSAF, DoT, GSS
4.3 Run sea trails with monitoring and evaluation.																											MECC, Ministry of Public Works, Transport and Meteorology Services, DoT, Crop agencies.

2.1.4.5 Estimation of Resources Needed for Action and Activities

Estimation of capacity building needs

Table 2.17 provides the details on the availability of local capacity and the training requirement priority for Flettner rotor project implementations. Capacity needs availability is important for the effective delivery and implementation of a project. Unlike Technology 1 & 2, for deployment and sea trials, additional seafarers will not be required for Flettner Rotor technology. With the revival of shipbuilding in Fiji, additional capacity in strategic areas such as naval architects, marine engineers, and technical experts in Flettner rotor technology is a must. Local personnel needs to be trained in areas where the country lacks expertise.

Table 2.17: Availability of local capacity and training requirements priority.

Field of expertise	Specialist/ Trades person	Role	Local Capacity									
			Local Capacity					Training Requirement Priority				
			0-1	2	3	4	5	0-1	2	3	4	5
Flettner Rotor Technology	Technical Expert	For know-how of technical and vessel design, pre-feasibility assessment, and development of Standards, sea trials.	☐									☐
Economics	Finance Specialist	Feasibility assessment. Concept note and project proposal development.				☐				☐		
	Finance Analyst	Tax incentive proposition assessment and awareness.			☐					☐		
Capacity Building	Trainers	Accredited and specialised training for the use of new technology. Technical training programme for rotor maintenance & repairs. Training and skills development for women (gender mainstreaming)			☐							☐
Engineering	Naval architect	Ship design and construction expertise.	☐									☐
	Marine engineers	For all aspects of engineering requirements from retrofitting to building a new one	☐									☐
Management	Project Manager/ Officer	Construction and Logistics project assistant				☐				☐		
Technology	Local Energy Specialist	Resource assessment; Concept note and project proposal development; Develop Standards				☐				☐		

Local Capacity		Training Requirement Priority	
0-1	No Capacity	**0-1**	Low Priority
2	Low Capacity	**2**	Somewhat Priority
3	Moderate Capacity	**3**	Neutral
4	Functional Capacity	**4**	Moderate Priority
5	Highly Functional Capacity	**5**	High Priority

Estimations of costs of actions and activities

The actual cost of implementation of Advanced Wind Propulsion Technologies: Eco-Flettner Rotor – retrofit and new-build technology is contingent upon the type of sailing technology and the ship. Table 2.18 provides an estimate of the associated costs and a proper cost estimate would be possible after a pre-feasibility study.

Table 2.18: Estimated costs for TAP activities for the diffusion of Advanced Wind Propulsion Technologies: Eco-Flettner Rotor – retrofit and new-build technology.

Action/ Activities	**Estimated Costs (USD)**
1.1 Hire consultant for technical and vessel design.	500,000
1.2 Collect vessel specification data	
1.3 Evaluate new build and retrofitting rotor technology.	
1.4 Compiling data and reporting	
2.1 Establishing a technical and steering committee.	80,000
2.2 Engage and consult local and international maritime companies.	
2.3 Government to provide financial incentives.	
3.1 Create a business plan to attract investors and shipowners	250,000
3.2 Introducing O&M Standards	
3.3 Develop technical training programmes for operating and maintenance of the plant and equipment.	
4.1 Tendering	4 units at costs of USD 800,000 per unit
4.2 Build or purchase the rotor technology-equipped vessel accompanied by training of engineers and technicians.	
4.3 Run sea trails with monitoring and evaluation.	

2.1.4.6 Management Planning

Risks and Contingency Planning

The Advanced Wind Propulsion Technologies: Eco-Flettner Rotor – retrofit and new-build technology is a new technology concept for Fiji and the Pacific. The technology is very new and has not been trialed in Fiji or the Pacific. Hence, the ship operators lack confidence in the technology and are reluctant to invest. It also requires huge capital costs. To mitigate the risks, a proof-of-concept is essential with a full evaluation report. The Government Shipping Services could trial on one of its vessels. After a series of sea trials and evaluations, the lessons learned could be used to replicate the Flettner Rotor technology on more GSS vessels. The private shipping companies later adopt the technology.

The understanding of new technologies for domestic maritime shipping is lacking amongst the stakeholders and operators. Training institutions such as FMA can have their trainers trained on the applications, operations, and maintenance of new technologies. For retrofitting

specialized engineers will be required that can perform the correct retrofitting. Currently, it is not available locally and expatriates will have to be engaged from the beginning of the project.

Next Steps

A comprehensive review of the operations of the domestic maritime sector including current fleet, infrastructure, and policy is necessary as a means of the first next step. Quality data collection and a feasibility study for the implementation of sail-powered ships are necessary. The details of the next steps for the entire domestic maritime shipping are provided in Subsection 2.1.5**.**

2.1.4.7 TAP overview table

TAP overview table								
Sector	Transport							
Sub-sector	Domestic Maritime Transportation							
Technology	Eco-Flettner Rotor – retrofit and new-build technology							
Ambition	The purpose of the TAP is to support the GHG emission reduction efforts. In the updated NDC-2020, Fiji committed to an additional target of reducing domestic maritime shipping emissions by 40% as a contribution to Target 1 (to reduce 30% of BAU CO_2 emissions from the energy sector by 2030 and achieve net zero by 2050). Hence, the aim of the TAP is to have a successful proof of concept of ships with Flettner rotors. At least 10 ships need to have the initial Flettner rotor installations to achieve sizeable results.							
Benefits	Reliable maritime transportation; increased economic growth in the maritime islands, reduction in GHG emissions.							
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 (USD)**
Action 1: Feasibility Study	**Activity 1.1** Hire consultant for technical and vessel design.	Govt, private sector, and donor agencies	MECC, MPWTMS, and DoT.	18 Months	Unavailability of local capacity	Experts hired on-time	Training needs assessment conducted and reported.	500,000
	Activity 1.2 Collect vessel specification data	Govt, private sector, and donor agencies	MECC, MPWTMS, and DoT.	18 Months	Vessel data is not of high quality.	Data collation template and a repository	Inputs from ship operators and owners.	

	Activity 1.3 Evaluate new build and retrofitting rotor technology.	Govt, private sector, and donor agencies	MECC, MPWTMS, and DoT.	24 Months	Local data is not available. Experts are not available locally.	Reporting on rotor technology	Reports submitted to MECC and DoT.	
	Activity 1.4 Compiling data and reporting.	Govt, private sector, and donor agencies	MECC, MPWTMS, and DoT.	24 Months	Data is not of high quality or disaggregated.	Data collation template and a repository	Stakeholder inputs	
Action 2: Private sector engagement	**Activity 2.1** Establishing a technical and steering committee.	Govt, private sector, and donor agencies	MECC, MPWTMS, and DoT.	6 Months	Lack of stakeholder participation. Not enough consultations.	Effective consultations and stakeholder concerns are taken into consideration.	Ongoing Steering Committee and consultations.	80,000
	Activity 2.2 Engage and consult local and international maritime companies.	Govt, private sector, and donor agencies	MECC, MPWTMS, GSS, and DoT.	15 Months	Lack of interest from international companies.	MOUs developed and signed.	Number of MOUs developed and signed.	
	Activity 2.3 Government to provide financial incentives.	Govt, private sector, and donor agencies	MECC, MPWTMS, and DoT.	6 Months	Financial incentives are not accepted by the private sector.	Innovative Financial incentives outlined.	Private sectors take advantage of the finances and invest in technology.	

Action 3: Business plan development	**Activity 3.1** Create a business plan to attract investors and shipowners	Govt, private sector, and donor agencies	MECC, MPWTMS, MSAF, FMA, and DoT.	12 Months	Lack of stakeholder interest and private sector participation.	The private sector is keen to invest.	The private sector and private operators have planned to invest in this technology.	250,000
	Activity 3.2 Introducing O&M Standards	Govt, private sector, and donor agencies	MECC, MPWTMS, MSAF, and DoT.	6 Months	Lack of stakeholder participation.	O&M standards are drafted.	Standards being developed and approved by DoT.	
	Activity 3.3 Develop technical training programmes for operating and maintenance of the plant and equipment.	Govt, private sector, and donor agencies	MECC, MPWTMS, FMA, and DoT.	24 Months	Lack of finance and staffing with FMA. Lack of scholarships for students	New training programmes developed.	Number of graduates completed the training.	
Action 4: Training of Engineers and Technicians and implementation	**Activity 4.1** Tendering	Govt, private sector, and donor agencies	MECC, MPWTMS, and DoT.	9 Months	Lack of private sector participation. Lengthy tendering process.	Successful bidding by the private sector.	Project tenders are being executed.	4 units at costs of USD 800,000 per unit
	Activity 4.2 Build or purchase the rotor technology-equipped vessel accompanied by training of engineers and technicians.	Govt, private sector, and donor agencies	MECC, MPWTMS, and DoT.	24 Months	Unavailability of technical workers, equipment, supply chain issues, and weather.	Successful adoption of Rotor technology.	Number of retrofitted or new-built ships with rotor technology.	

	Activity 4.3 Run sea trails with monitoring and evaluation.	Govt, private sector, and donor agencies	MECC, MPWTMS, FMA, and DoT.	Ongoing: 33 Months	Lack of finance, insurance, infrastructure, and private sector involvement.	Successful sea trials with MnE.	Gradual increase in uptake of rotor technology.	

2.1.5 Next Steps domestic maritime sector

The domestic maritime sector requires a paradigm shift. To achieve this big shift in its operations, a comprehensive review of the operations including current fleet, infrastructure, and policy is necessary as a means of the first next step. Quality data collection and a feasibility study for the implementation of any technology are necessary. In order to implement any new technology in the domestic maritime sector, a series of important steps need to be undertaken with relevant stakeholders. This will provide the much-needed baseline data to make informed decisions. Table 2.19 outlines the immediate actions and activities with a list of relevant stakeholders.

Table 2.19: Immediate actions and activities required for the implementation of any new technology for the domestic maritime sector.

Immediate Action/ Activities for the next steps	Stakeholders (Responsible body and focal point)
Collation of fuel data	DoT, MSAF, MPWTMS
Repository of emissions data	DoT, MPWTMS, MSAF, and FMA
Freight movement data	DoT, MPWTMS
Passenger movement data	DoT, MPWTMS
Existing Fleet specification	DoT, MPWTMS, Investment Fiji, NGOs, Private sectors
Calculation of current local carbon footprint- data from the Capacity-building Initiative for Transparency (CBIT).	MECC, MPWTMS, DoT
Feasibility Studies for proposed low carbon technologies (long-term priority)/fuels (short-term priority).	MECC, MPWTMS, DoT, MTCC-SPC, SPREP, and Local Ship-owners
Technology, economics, and regulations.	MSAF, FMA, NPTC, APTC, MTCC-SPC, SPREP,
Route analysis and feasibility of options.	MECC, MPWTMS, DoT
Roadmap development for the target accomplishment.	MPWTMS, MSAF, FMA, NPTC, APTC, MTCC-SPC, SPREP.
Consultation with industries and international partners (IMO, WMU, GLOMEEP, etc.)	MPWTMS and DoT.
Regulation on data monitoring, reporting, and verification. (CBIT Project by 2024)	MECC, MPWTMS, DoT
Policy review on emission reduction.	MECC, MPWTMS, DoT
Regulations aligned to MARPOL Annex XI	MECC, MPWTMS, DoT, MSAF, FSHIL, FMA
SEEMP	MPWTMS, DoT, MSAF, FSHIL, FMA
Reporting to the Cabinet and Publishing outcomes.	MPWTMS, DoT, MSAF,
Feasibility Study on the Revival of the Shipbuilding Industry in Fiji.	MPWTMS, DoT, MSAF, FSHIL, FMA
Capacity Building- local and overseas training of shipbuilders (naval architects & crew qualifications/certification)	MPWTMS, DoT, MSAF, FSHIL, FMA
Capacity Building for traditional sailing knowledge-appropriate training and development.	MPWTMS, DoT, MSAF, FSHIL, FMA
Implementation of policies and regulations to set standards and monitoring of shipbuilding.	MPWTMS, DoT, MSAF

Seeking finance and provision of incentives to investors in shipbuilding	MECC, MPWTMS, DoT
Shipbuilding infrastructure upgrade and construction of new ones.	MECC, MPWTMS, DoT, MSAF, FSHIL, FMA
Data Collation and Verification – Research	MPWTMS, DoT, MSAF, FSHIL, FMA, Think-tank centers
Prefeasibility of new technologies for the local maritime sector	MPWTMS, DoT, MSAF, FSHIL, FMA, Think-tank centers
Sea-trials	MPWTMS, DoT, MSAF, FSHIL, FMA, Think-tank centers

The recent stakeholder consultations revealed a number of high-priority capacity requirements including the need for Ship engineers, Ship masters, Vessel Superintendents, Shipbuilding Trainers, naval architect & crew qualifications/certification, trainers for training in traditional sailing knowledge with appropriate training and development, Marine Electrical Engineers. These are identified as high-priority immediate areas before any feasibility study for any new technology could be conducted.

2.2 Project Ideas for Domestic Maritime Sector

2.2.1 Brief Summary of the Project Ideas for Sector B: Domestic Maritime Shipping

The Fijian archipelago consists of 110 inhabited islands from the 300 or so islands dispersed in the greater Pacific Ocean. Maritime transportation would allow for increased trade and economic activities within the group in addition to access to education and medical services. Revival of shipbuilding in Fiji is one way to increase job opportunities locally as well as to design ships that are tailor-made for local situations and needs.

2.2.2 Specific Project Idea 1

Proposed Project Title	Revival of shipbuilding in Fiji
Introduction/Background	Revival of shipbuilding in Fiji is one way to increase job opportunities locally as well as to design ships that are tailor-made for local situations and needs. Maritime transportation would allow for increased trade and economic activities within the group in addition to access to education and medical services.
Objectives	Revival of the Shipbuilding Industry in Fiji and also the construction of ships that adapts to the changing global maritime environment.
Outputs	Increased economic activity, job creation, tailor-made ships, and shipping solutions.
Relationship to the Country's sustainable development priorities	In line with 5-year and 20-year NDP (2017-2036).

Project Deliverables	The project will begin with the Renovation and Extension of the Old Government Shipyard as an immediate next step followed by the project activities listed below.
Project Scope and Possible Implementation	The shipbuilding industry predates the times when Fijian Drua was built locally. Between 1962-1969 boat building section was established in Fiji and in 1989, the building of Reef Endeavour commenced. The Reef Endeavour sailed in 1996, yet the industry did not prosper. Revival is essential to have tailor-made solutions.
Project activities	The most important activities of the project include: ➢ A scoping study ➢ Call for EOI ➢ Call for donor agencies. ➢ Feasibility study ➢ Stakeholder engagement and consultations ➢ Capacity building – naval architects and engineers via education and training.
Timelines	Next 5 years
Budget/Resource requirements	A scoping study followed by economic feasibility study will outline the details of the budget requirements. The feasibility study alone may cost around USD 100,000 and the total cost of the project could be around USD 50 M.
Measurement/Evaluation	Demand for ships in Fiji and the Region, budgetary requirements: CAPEX and OPEX, R&D, government subsidy, tax rebate, no of jobs, the profitability of the industry.
Possible Complications/Challenges	– Unpredictable Weather conditions – Lack of certified Naval Architects locally – Difficulty in breaking competitive market as developing country in regards to the field of advanced equipment/technology
Responsibilities and Coordination	DoT

2.2.3 Specific Project Idea 2

Proposed Project Title	Automated fuel usage gauge and recording system.
Introduction/Background	The international safety management (ISM) code is important for all vessels. With that the emission measuring and recording for all vessels is necessary. Developing, implementing, and adopting an Automated fuel gauge and recording system will make this a bit easy in terms of measuring and recording all pertinent data.
Objectives	Identify the GHG emission baselines to assist in finding the places that require interventions. Development and implementation of automated fuel gauge and recording system.
Outputs	The project will allow us to get precise baseline emissions data by recording the fuel usage of each vessel and the respective emissions. Implementations of the ISM code will allow the regulatory body to regulate and ensure that the vessels are compliant and a maintenance schedule is in place. In addition, this will support preventative maintenance and reduce vessel down times.
Relationship to the Country's sustainable development priorities	This will support the NDC target of reducing 30% of BAU CO_2 emissions from the energy sector by 2030 and achieving net zero by 2050 whilst reducing domestic maritime shipping emissions by 40% (Updated NDC-2020).
Project Deliverables	The project will allow the State and the enforcing agency (MSAF) to have accurate emissions data. An emissions database can be developed to determine the ship's efficiency, maintenance plan, and technical interventions required to reduce the emissions.
Project Scope and Possible Implementation	The automated fuel gauge needs to be mandated by law so that all vessels have this and the usage is properly reported. Initially, all vessels above 500 grt need to implement this, and later could be expanded to smaller vessels.
Project activities	The most important activities of the project include: ➢ Funding application. ➢ Drafting, vetting, and consulting on legislation. ➢ Installation in all vessels above 500 grt. ➢ Broader implementations.
Timelines	2-3 years.

Budget/Resource requirements	The budget is expected to be around $1M and will be required for staff costs, consultations, preparation of legislations, strategic plans, and initial installations in all vessels above 500 grt.
Measurement/Evaluation	Currently, Fiji lacks emissions data from the domestic maritime shipping sector. The project will allow for the automated recording of data and emissions. The implementation of working automated gauges and recording of data will be a testament to the success of the project. Monitoring and valuation of vessel performance and emission reduction interventions can be planned subsequently.
Possible Complications/Challenges	-Lack of interest from the stakeholders and private operators. -Lack of capacity. -Budget and financing.
Responsibilities and Coordination	DoT and MSAF.

Chapter 3 Conclusion

This Technology Action Plan has been developed for these three prioritized technologies for two sectors. The three prioritized technologies for the off-grid rural electrification sub-sector are:

1. Standalone Ground Mount Solar PV with ESS (Community Based Electrification - Micro-Grids);
2. Ground Mount PV with Biofuel (CNO/Diesel) Generator Hybrid systems with ESS; and
3. Micro/Pico-hydro in microgrid configuration.

The three prioritized technologies for the domestic maritime shipping sub-sector are:

1. Sail-powered Passenger/Cargo Ship;
2. Low Carbon/Zero Carbon Passenger Ferry Trials; and
3. Advanced Wind Propulsion Technologies: Eco-Flettner Rotor – retrofit and new-build technology.

The actions and activities in the action plan originated from BAEF and showed that off-grid rural electrification sub-sector the barriers were largely economic and financial, regulatory, technological, capacity, and institutional. While for the domestic maritime shipping sub-sector, the main barriers were economic and financial, regulatory capacity, and infrastructural. 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 actions for respective technologies were demarcated into specific activities with specific stakeholder responsible bodies and the scheduling and sequencing of respective activities to achieve the technology deployment. The TAP also entailed the estimation of capacity building needs, estimations of costs, identification of risks, and contingency planning for respective actions and activities followed by immediate next steps required.

For the off-grid rural electrification sub-sector, the implementation of technology requires immediate strategies in terms of data collation compilation. This data will assist in the business model development and the feasibility assessment. A gradual change to transition from a diesel genset microgrid to a renewables-based hybrid source is necessary. The availability of finance is one of the first steps required that can be achieved via the revival of the sustainable energy financing facility and renewables insurance to protect the investors and the communities from the risks of frequent extreme weather events.

In terms of the proposed project idea, the transition to a renewable-based hybrid source to power the microgrids would be the gradual phasing out of diesel generators in remote non-electrified maritime zones and remote communities.

For the domestic maritime shipping sub-sector, a comprehensive review of the operations of the domestic maritime sector including current fleet, infrastructure, and policy is necessary as a means of moving forward. Quality data collection and a feasibility study for the

implementation of any technology are imperative with private sector buy-ins. Reliable data for fuel usage, passenger movement, freight movement, existing fleet specifications, and route analysis is required. Proper feasibility studies for proposed low-carbon technologies (long-term priority)/fuels (short-term priority) can then be carried out. In terms of the proposed project idea, a Feasibility Study on the Revival of the Shipbuilding Industry in Fiji has been proposed to develop tailor-made solutions for the local maritime shipping sector.

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Annex I List of stakeholders involved and their contacts

No.	Name	Organisation	Designation	Email
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