FIJI PORTS CORPORATION LIMITED

GREEN PORT MASTER PLAN 2019-2023

Towards becoming the

Smart-Green Gateway

in the Pacific

FIJI PORTS CORPORATION LIMITED

GREEN PORT MASTER PLAN

2019-2023

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Disclaimer

Fiji Ports Corporation Limited and its Consultant(s) accept no liability for any omissions, errors or faults in this report. Monetary values presented in this report are rough estimates only, and should not be viewed as firm budgetary values.

EXECUTIVE SUMMARY

This plan has been prepared to describe the approach and activities that Fiji Ports Corporation Limited (FPCL) will implement over the period 2019 to 2023 to reduce its environmental impact. This masterplan is independent from, but aligns with FPCL's Strategic Plan 2019 to 2023, and will assist with FPCL contributing to the achievement of several Sustainable Development Goals (SDGs).

As it's not possible to have zero environmental impact, a green port could also be considered as one that is continually reducing its environmental footprint.

The plan broadly aligns with the following deliverables in the Strategic Plan.

ITEM NO.	DELIVERABLES/ KPI'S
5.1	Develop plan and timeline for adoption / alignment with Port Sustainability Guideline and identification as the Green Port of the Pacific.
5.2	Implement / update Environmental Management System and plans.
5.3	Conduct environmental education / engagement processes with industry and communities within the boundary of declared ports. Work in conjunction with DoE for key waste and pollutant minimization strategies and healthy waterways plans.
5.4	Pursuit (including through other agencies) of dumpers, hull owners, etc. including prosecution for spills and unlawful releases or sinking.
5.5	Upgrade waste management practices and enforcement. Through advanced treatment (i.e. high temperature incineration) offer additional off-site health and safety benefits nationally (i.e. medical waste).
5.6	Through port use and tracking of vessel operations and reduction of collision risks (i.e. via VTMS) consider expanded national coverage via respective agencies (i.e. MSAF) to be monitored by FPCL VTMS team for national benefit and environment and safety pursuits.
5.7	Support DoE through investigation of source of key pollutants.
5.8	Promote protection of areas adjacent to port lands / operational areas (from urbanisation and pressure regarding noise and air quality, local waste issues, traffic management, etc).
5.9	Dedicated staff member focused on environment initiatives and investigations.
5.10	Dredge Monitoring.
5.11	Become carbon neutral with respect to the use of electricity and ensure that all new developments are green.
5.12	Monitor, assess and report on energy use, greenhouse gas emissions, water use, harbour water quality, air quality and port cleanliness on a regular basis.

Focussing on Stakeholder, taking actions to reduce Environmental impact and ongoing Assessment of its performance (SEA) FPCL's green port actions that will contribute to the achievement of these objectives.

This plan includes an overview of FPCLs approach, describes what a green port is, outlines its strategy and objectives, and provides broad guidance on implementation of plan activities.

An implementation activity matrix has been developed, containing all activities. This matrix is included as a spreadsheet attached to this document. This spreadsheet lists each activity, which of the twelve strategic objectives the activity will contribute to, stakeholders (if any), and estimates of costs and benefits. It also shows how the activity aligns with the Sustainable Development Goals, and alignment with SPCs Green Port concept.

This plan concludes with a brief description of the administration and financing requirements, including staffing requirements.

Annexe A to this plan contains broad details of each activity presented in the activity matrix
Annexe B to this plan is the spreadsheet containing the implementation activity matrix.

OVERVIEW

Purpose

The purpose of this Masterplan is to describe the approach and activities that FPCL will implement over the period 2019 to 2023 to reduce its environmental impact. This masterplan aligns with FPCL's Strategic Plan 2019 to 2023.

Rationale

Minimizing our environmental impact provides the following benefits:

1. A cleaner environment with less water, air and land pollution
2. Lowered greenhouse gas emissions
3. Healthier people
4. Reputational benefits
5. Long term economic benefits.

Integration with FPCL Strategic Plan 2019 to 2023

This plan will be incorporated into the 2019 to 2023 Five Year Strategic Plan. Specifically, it will integrate with Strategy 5: Environment and the deliverables tabled below.

ITEM NO.	DELIVERABLES/ KPI'S
5.1	Develop plan and timeline for adoption / alignment with Port Sustainability Guideline and identification as the Green Port of the Pacific
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5.12	Monitor, assess and report on energy use, greenhouse gas emissions, water use, harbour water quality, air quality and port cleanliness on a regular basis

Alignment with the Sustainable Development Goals

Fiji Ports Corporation Limited (FPCL) and Fiji Ports Terminal Limited (FPTL) have advised the Ministry of Economy that they will contribute to the achievement of the following Sustainable Development Goals (SDGs):

3. Good health and wellbeing
7. Affordable and clean energy
9. Industry, innovation and infrastructure
13. Climate action
14. Life below water
15. Life on land
17. Partnership for the goals

This masterplan contains activities that contribute to each of these goals, as follows.

3. Good health and wellbeing: reducing litter and air pollution in port areas: improves health and wellbeing through cleaner air, reduced sea pollution (and contamination of fish… which are eaten).
7. Affordable and clean energy: reducing energy use, moving to solar electricity.
9. Industry, innovation and infrastructure: applying innovation and "smart" technology to greening ports;
13. Climate action: reducing greenhouse gas (GHG) pollution;
14. Life below water: reducing marine pollution;
15. Life on land: reducing waste;
17. Partnership for the goals: working with users of port facilities.

Alignment with SPC Green Pacific Port concept

SPC has developed a Green Port concept which is focussed on the following areas:

- Operations: improving ports operational efficiency:
  - Quality management
  - Legal framework
  - Climate resilience
- Energy: reducing port carbon footprint:
  - Energy management
  - Energy audits
  - Energy conservation
- Environment: preventing port marine pollution:
  - Environmental management
  - Waste management
  - Pollution response

This masterplan has activities that are built on or align with activities in each of these 9 areas.

Note that FPCL is now:

- Has obtained its ISO9001 Quality Management Systems (QMS) certification.
- Has (with SPC funding) implemented an energy audit, and developed an energy management plan (the energy management plan is being superseded by Green Port Master Plan)
- Is now commencing the process of obtaining ISO14001 certification.

BACKGROUND

What is a green port?

There is no single globally agreed upon definition of a green port, but based on research into green ports and suggestions from FPCLs staff and stakeholders, a green port is one which:

1. Is clean
2. Contributes to the achievement of the SDGs
3. Measures and achieves year on year reductions in its environmental impact in the following areas:
    a) Greenhouse gas emissions
    b) Air pollution
    c) Marine pollution
    d) Waste reduction through reuse and recycling
4. Engages with stakeholders and users of the port to help reduce its environmental impact.
5. Has healthy green space within its boundary.

These attributes are summarized in the acronym SEA.

Stakeholders. Stakeholders – specifically port users - are estimated to contribute to roughly 95% of the environmental impact in port areas (with FPCL responsible for the remaining 5%), so stakeholder engagement is key to FPCL creating ports that progressively reduce their environmental impact. As a green port organisation FPCL will engage with its **s**takeholders and users, on an ongoing basis and enacts policies that drive "green growth" beyond its organisational boundary.

Environment. As a green port FPCL will have an ongoing, continued, relentless focus on reducing its **e**nvironmental impact, specifically in reducing its greenhouse gas emissions, air pollution, marine pollution and waste, as well as making its port cleaner and having healthy green space within port boundaries.

Assesses. FPCL will continually assess, measure and report on its environmental performance. It will track its greenhouse gas emissions, measure air quality, regularly measure water quality, and track how clean the port is.

As it's not possible to have zero environmental impact, a green port could also be considered as one that is continually reducing its environmental footprint.

Green Port boundary

The boundary encompasses all of FPCLs areas of direct operation and the areas it regulates. It does not directly include those areas of the ports where others have operational control – such as FPTLs operation of container handling machinery.

In this current five-year plan, the ports encompassed by this plan will be:

- Suva
- Lautoka
- Levuka.

Future masterplans may expand to cover the other regulated ports.

Sustainability regulations impacting on FPCL

Sustainability regulations in Fiji impacting on FPCL include:

- The Environment Management Act 2005
- The Litter Promulgation Act 2008
- Seaport Management Regulations 2008, Part 10 – Control of Pollution

These regulations place obligations on FPCL not to damage the environment, and also give FPCL powers to reduce environmental contamination.

Fiji has not ratified the International Maritime Organisation's (IMO) MARPOL Annexe VI, which limits the main air pollutants contained in ships' exhaust gases. However, the Maritime Safety Authority does require ships in Fiji to limit their emissions. MARPOL Annexe VI requires ships to comply with the lowered sulphur limits being introduced on 1 January 2020.

Related port policies and initiatives

The port has the following port policies and initiatives related to being a green port:

a) Energy Management Policy
b) Harbour Master Policy and Procedures: Navigational Safety and environmental protection policy
c) Health and Safety Policies and Procedures

The energy management action plan referenced by the Energy Management Policy will be superseded by this Green Port Master Plan, however energy management activities included in this plan will be separately managed

STRATEGY AND OBJECTIVES

FPCL's vision is to become the Smart, Green Gateway for trade in the Pacific region.

Its mission is to invest significantly in new and upgraded seaport and ship repair facilities to support and enhance the economic growth and prosperity of Fiji, as well as providing key economic and lifestyle linkages throughout Fiji and our Pacific region. We will provide expertise to drive regional safety and capacity in respect of maritime infrastructure.

This Green Port Master Plan aligns with this mission through reducing environmental impact, which directly and indirectly contributes to Fiji's economic growth and prosperity.

Focussing on Stakeholder, taking actions to reduce Environmental impact and ongoing Assessment of its performance (SEA) FPCL's green port actions that will contribute to the achievement of these objectives are outlined in the section below.

IMPLEMENTATION

Staffing

A member of the executive team will have overall responsibility, initially this will be the CEO, although this role may be transferred to the newly created executive role of Chief Planning and Infrastructure Officer.

The Board sub-committee for Technical Infrastructure will have its name changed to include the word "Sustainability".

The strategic plan includes a dedicated staff member focussed on environmental initiatives and investigations. This person should have overall responsibility for plan implementation and will be critical to its success.

Funding the plan

Implementation of the plan will initially be undertaken using FPCLs funds. However, grant funding will also be sought for the following activities:

- Shore power feasibility study
- Shore power implementation
- Solar deployment

Implementation of all activities in this plan would require the following budget (rough estimate):

Year	Total budget
Remainder 2019	$ 9,000
2020	$ 662,000
2021	$ 601,000
2022	$ 3,137,500
2023	$ 5,024,500
TOTAL	$ 9,434,000

These costs will be offset by savings in operational electricity and water costs, which are expected to be around $700,000 annually by 2023.

There may be additional financial benefits, but these have not been quantified. These could include the following:

- Additional savings from reduced costs associated with the removal of derelict vessels.
- Improved waste practices may lead to income from the sale of waste to recycling companies.
- Improved enforcement may lead to revenue from fines.

Review and update

This masterplan and annual action plan is to be updated annually in line with the budgetary cycle.

As a green port is one that is continually reducing its environmental footprint, this plan should be replaced with a new plan in 2023, covering activities for the 2024 to 2028 period, in line with the update of the Port's strategic plan.

Plan Activities

Stakeholder Engagement Activities

Stakeholder engagement will focus on the three areas

- Awareness Raising: Raising awareness of green port issues and environmental concerns
- Enforcement of regulations: Enforcing regulations that protect the environment
- Enabling assistance: Helping stakeholders reduce their own environmental footprints.

FPCL's stakeholders include:

Land based

- Fiji Ports Terminal Ltd, which operates the terminals at Suva and Lautoka
- Tropic woods
- Fiji Sugar Corporation
- PAFCO
- Customs
- Biosecurity
- Travelling public
- Contractors
- Haulage companies
- Oil companies

Vessels

- Fishing vessels (international and domestic)
- Interisland ferries (domestic)
- Cruise ships (international)
- Clinker ships (international)
- Container vessels (international)
- Fuel carriers/marine bunker (international)
- Bulk carriers (international)
- Naval vessels (international and domestic))
- Recreational vessels (including yachts)
- Floating dry dock
- Water taxi
- Tugboats
- Pilot boats

Government agencies:

- Maritime Safety Authority Fiji (MSAF)
- Department of Environment
- Ministry of Transport
- Ministry of Health
- Ministry of Fisheries

Stakeholder engagement will contribute to the following objectives in the Strategic Plan:

5.2	Implement / update Environmental Management System and plans
5.3	Conduct environmental education / engagement processes with industry and communities within the boundary of declared ports. Work in conjunction with DoE for key waste and pollutant minimization strategies and healthy waterways plans
5.4	Pursuit (including through other agencies) of dumpers, hull owners etc. including prosecution for spills and unlawful releases or sinkings
5.5	Upgrade waste management practices and enforcement. Through advanced treatment (i.e. high temperature incineration) offer additional off-site health and safety benefits nationally (i.e. medical waste).
5.6	Through port use and tracking of vessel operations and reduction of collision risks (i.e. via VTMS) consider expanded national coverage via respective agencies (i.e. MSAF) to be monitored by FPCL VTMS team for national benefit and environment and safety pursuits
5.7	Support DoE through investigation of source of key pollutants
5.9	Dedicated staff member focused on environment initiatives and investigations
5.11	Become carbon neutral with respect to the use of electricity and ensure that all new developments are green.
5.12	Monitor, assess and report on energy use, greenhouse gas emissions, water use, harbour water quality, air quality and port cleanliness on a regular basis

The table below lists the stakeholder engagement activities, along with approximate estimates of project costs, annual savings likely to arise, and ongoing costs.

FPCL Strategy 5 (Environment) Goal this aligns with.	*Activity*	*Rough estimate of project cost*	*Rough estimate annual savings/revenue*	*Rough estimate annual ongoing cost (excluding staff time)*
5.2	Annual workshop on green port initiatives to review progress and get additional input			$ 2,000
5.3	Annual stakeholder meetings and briefings			$ 4,000
5.3	Actively develop and update the green port section of FPCL's website			
5.3	Encouraging FPTL to upgrade yard lighting to LED, incorporating dimming controlled by guards	$ 170,000	$ 60,000	
5.3	Establish standards and enforce improved handling of cement offload at the Suva terminal.			
5.3	Establish standards around hydraulic oil leakage and leakage clean up (don't hose into sea or into drains) and enforce			
5.3	Require FPTL to collect and treat any wastewater from water blasting or cleaning of machines			
5.3	Investigation into shore power	$ 18,000		
5.3	Potential provision of shore power	$ 4,500,000		
5.3	Facilitate workshops (2) on energy efficient vessel operation	$20,000		
5.3	Investigate purchasing of environmental offsets (and selling of these to international vessels)			
5.3	Facilitation of workshop on capturing different waste streams and sorting waste	$ 15,000		
5.3	Introduce anti-idling regulation			
5.3	Facilitation of workshops (2) on eco-driving	$15,000		
5.3	Incorporate green lease requirements into new leases			
5.3	Facilitation of workshops (2) on energy efficiency for FPCL tenants	$ 15,000		

FPCL Strategy 5 (Environment) Goal this aligns with.	*Activity*	*Rough estimate of project cost*	*Rough estimate annual savings/revenue*	*Rough estimate annual ongoing cost (excluding staff time)*
5.3	Include green-ship advice and upgrade options with FSHIL booking forms			
5.3	Require destruction of refrigerants removed from vessels in dry dock			
5.3	Undertake upgrades to vessels to reduce their fuel usage, e.g. gearbox ratio change, propeller boss fitting, etc.			
5.3	Host a regional workshop on energy efficient vessel configuration	$ 150,000		
5.3	Engage with the Department of Environment in various areas to ensure FPCL is supported with its initiatives			
5.3	Green Port information on invoices			
5.4	Tighter enforcement of abandoned vessels in harbour		?	?
5.4	Engage with the Maritime Safety Authority Fiji in various areas to ensure FPCL is supported with its initiatives			
5.5	Tighter enforcement of oil/waste dumping at sea		?	?
5.5	Encourage sorting of waste on vessels into different streams			
5.5	Prepare videos on litter management, in English, Itoke and Hindi, and screen in the Muiawalu 2 waiting area and in Lautoka waiting area (need a screen in Lautoka)	$ 4,000		
5.5	Require any ferry that is transferring livestock to clean up any waste left in wharf areas			
5.5	Signage on wharfs about spills, littering, dumping and penalties that apply	$ 28,000		
5.5	Tighter enforcement of littering in port areas		?	?
5.5	Upgrade waste management practices and enforcement for international vessels.			

FPCL Strategy 5 (Environment) Goal this aligns with.	*Activity*	*Rough estimate of project cost*	*Rough estimate annual savings/revenue*	*Rough estimate annual ongoing cost (excluding staff time)*
5.6	Through port use and tracking of vessel operations and reduction of collision risks (i.e. via VTMS) consider expanded national coverage via respective agencies (i.e. MSAF) to be monitored by FPCL VTMS team for national benefit and environment and safety pursuits			
5.7	Advocate for the installation of storm water litter collection traps before discharge into the harbour, in Suva and Lautoka			
5.9	Staff engagement workshops			$ 2,000
5.9	Energy efficiency tool kit for staff	$ 2,000		
5.9	Quarterly pocket meetings			
5.11	Install solar PV systems on terminal rooftops and sell this clean energy to FPTL	$ 1,700,000	$ 200,000	
5.12	Annual-yearly reports on green-port progress.			$ 1,000

Environmental Impact Reduction Activities

Environmental Impacts from FPCLs operations will be addressed in the following ways

- Reducing greenhouse gas (GHG) pollution.
- Reducing air pollution
- Reducing water pollution
- Reducing land-based waste and litter
- Resource usage
- A cleaner port
- Well maintained green spaces in port areas.

Actions to reduce environmental impacts will contribute to the following objectives in the strategic plan:

5.1	Develop plan and timeline for adoption / alignment with Port Sustainability Guideline and identification as the Green Port of the Pacific
5.3	Conduct environmental education / engagement processes with industry and communities within the boundary of declared ports. Work in conjunction with DoE for key waste and pollutant minimization strategies and healthy waterways plans
5.4	Pursuit (including through other agencies) of dumpers, hull owners etc. including prosecution for spills and unlawful releases or sinkings
5.5	Upgrade waste management practices and enforcement. Through advanced treatment (i.e. high temperature incineration) offer additional off-site health and safety benefits nationally (i.e. medical waste).
5.7	Support DoE through investigation of source of key pollutants
5.10	Dredge Monitoring
5.11	Become carbon neutral with respect to the use of electricity and ensure that all new developments are green.
5.12	Monitor, assess and report on energy use, greenhouse gas emissions, water use, harbour water quality, air quality and port cleanliness on a regular basis

The table below lists the activities focussed on reducing environmental impacts, along with approximate estimates of project costs, annual savings likely to arise, and ongoing costs.

FPCL Strategy 5 (Environment) Goal this aligns with.	*Activity*	*Rough estimate of project cost*	*Rough estimate annual savings/revenue*	*Rough estimate annual ongoing cost (excluding staff time)*
5.1	Implementation of green purchasing guidelines.			
5.3	Improve capacity to identify litterers then using this to detect and prosecute litterers.			
5.4	Purchase of pollution boat for Lautoka	$ 120,000		
5.4	Improve capacity to detect water pollution then using this to detect and prosecute water pollution by vessels.			
5.4	Develop and use pollution detection methodologies, procedures and checklists			
5.5	Upgrade of FSHIL wastewater treatment plant.	$ 120,000		
5.5	Upgrade public toilet and bathroom facilities in wharf areas such that there are sufficient facilities for berthed boat crews, including Lautoka	$ 150,000		
5.5	Upgrade of bins in port areas (more bins, bins for different recycling streams), entering into contracts for collection of recycled waste.	$ 10,000		
5.5	Deploy segregated bins in office areas	$ 1,000		
5.5	Make the cleaners responsible for ensuring the different waste streams are properly processed		$ 2,000	
5.5	Develop a strategy and timeline for going paperless, with a suggested target of 2025. Rationalize printers accordingly.			
5.5	Roster one cleaner to work a half day on the weekend.			$ 2,500
5.5	Develop a strategy to move away from small individual water bottles to large reusable bottles.			
5.5	Meet monthly with cleaners to discuss waste collection and recycling challenges and address.			
5.5	Lautoka container yard upgrade			

FPCL Strategy 5 (Environment) Goal this aligns with.	*Activity*	*Rough estimate of project cost*	*Rough estimate annual savings/revenue*	*Rough estimate annual ongoing cost (excluding staff time)*
5.5	Run twice annual clean up days.			$ 2,500
5.5	Add green space in Muiawalu 2 waiting area and get stakeholders to maintain them.			$ 2,000
5.7	Based on water quality testing, identify main sources of harbour water pollution	$ 10,000		
5.10	Depending on the type of dredging to have an appropriate environmental impact assessment (EIA) and/or an environmental management plan (EMP), as instructed by the Ministry of Environment.			
5.11	Metering upgrades Muaiwalu 1.	$ 100,000	$ 100,000	
5.11	Commission specification and design of LED lighting upgrades and specification of solar system	$ 40,000		
5.11	LED lighting upgrades (excluding FPTL operated wharfs)	$ 100,000	$ 35,000	
5.11	Seek funding and implement rooftop solar PV	$ 1,200,000	$ 140,000	
5.11	Incorporation of NSW ports green port development guide into any expansion or port relocation			
5.11	Institute scheduled cleaning and servicing of air conditioners			$ 4,000
5.11	Energy efficiency upgrades in Lautoka, undertake further upgrades at Muaiwalu House to further reduce energy usage (eg sensor lights, UPS rationalisation, boiling hot water unit rationalisation)	$ 25,000	$ 3,000	
5.11	Vehicle procurement (more efficient vehicles matched to required duties, electric vehicles for any wharf only duties)	$ 25,000	$ 5,000	
5.11	Slow-steaming of pilot boats in Suva		$ 3,000	

FPCL Strategy 5 (Environment) Goal this aligns with.	*Activity*	*Rough estimate of project cost*	*Rough estimate annual savings/revenue*	*Rough estimate annual ongoing cost (excluding staff time)*
5.11	Upgrade of remaining FSHIL UHP water blaster from diesel to electric.	$ 350,000	$ 35,000	
5.11	Run eco driver training for FPCL drivers			
5.12	Ensure new pilot boats have fuel flow and cumulative fuel use instrumentation; deploy operational procedures that take advantage of this.	$ 5,000		
5.12	Undertake water line tracing to identify possible sources of leaks	$ 250,000	$ 40,000	
5.12	Upgrades to water metering so as to better track and reduce loss and/or theft.	$ 100,000	$ 40,000	
5.12	Install rainwater tanks on Kings wharf to be used for wharf cleaning	$ 50,000	$ 2,000	

Assessing and Reporting Activities

Assessment and reporting on its environmental performance by FPCL will cover the following areas.

- GHG pollution.
- Air pollution
- Water pollution
- Land based waste and litter
- Port cleanliness
- Port green space

It will also develop an Environmental Management System in accordance with ISO 14001.

Assessment and reporting activities will contribute to the following objectives in the strategic plan:

5.2	Implement / update Environmental Management System and plans
5.12	Monitor, assess and report on energy use, greenhouse gas emissions, water use, harbour water quality, air quality and port cleanliness on a regular basis

The table below lists assessment and reporting activities, along with approximate estimates of project costs, annual savings likely to arise, and ongoing costs.

FPCL Strategy 5 (Environment) Goal this aligns with.	*Activity*	*Rough estimate of project cost*	*Rough estimate annual savings/revenue*	*Rough estimate annual ongoing cost (excluding staff time)*
5.2	Develop Environment Management System (EMS) in accordance with ISO 14001	$ 25,000		
5.2	Follow the environment Management System (EMS) in accordance with ISO 14001	$ 25,000		
5.12	Update energy tracking spreadsheet to track fuels usage	$ 1,500		
5.12	Undertake data collection and reporting on greenhouse gas emissions			
5.12	Installation of air quality monitoring	$ 4,000		$ 500
5.12	Half yearly analysis of air quality data and reporting			
5.12	Identify key measures of water quality and develop a testing methodology			
5.12	Test water quality twice a year and produce a public report			$ 4,000
5.12	Set up spreadsheet to track amount of general waste and recycled waste and generation of regular reports	$ 1,000		
5.12	Produce regular reports on waste			
5.12	Development of water usage tracking spreadsheet and regular reporting	$ 1,500		
5.12	Monitor port cleanliness			
5.12	Monitor port green space			

ANNEXE A: Activity Descriptions

ACTIVITIES ASSOCIATED WITH STRATEGIC OBJECTIVE 5.1

Implementation of green purchasing guidelines

Purchasing processes will need to be adapted to rollout and implement the green purchasing guidelines.

ACTIVITIES ASSOCIATED WITH STRATEGIC OBJECTIVE 5.2

Annual workshop on green port initiatives to review progress and maintain momentum.

Run an annual workshop, with stakeholders invited, to review progress against this plan. Use this workshop to maintain momentum and engagement across the organisation.

Develop and follow an Environment Management System (EMS) in accordance with ISO 14001

"An ISO 14001 environmental management system (or commonly referred to as an EMS) is a structured system designed to help organisations manage their environmental impacts and improve environmental performance caused by their products, services and activities. An environmental management system provides structure to environmental management and covers areas such as training, record management, inspections, objectives and policies.

Implementation of an environmental management system requires the following steps to be completed by an organisation:

- Development of an environmental policy that reflects its commitments.
- Appointment of a person(s) responsible for its coordination.
- Identification of how the organisation interacts with the environment.
- Identification of actual and potential environmental impacts.
- Identification of relevant legal and other requirements.
- Establishment of environmental objectives, targets and programs.
- Monitoring and measurement of the progress to achieve its objectives.
- Reviewing the system and environmental performance; and
- Continuous improvement of the organisation's environmental performance."

From http://www.environmentalmanagementsystem.com.au/what-is-an-environmental-management-system.html

FPCL will need to appoint an appropriate staff member (or employ a new dedicated staff member), responsible for the EMS, who will also be responsible for following it and undertaking regular internal audits.

ACTIVITIES ASSOCIATED WITH STRATEGIC OBJECTIVE 5.3

Annual yearly stakeholder meetings and briefings

The ultimate purpose of these meetings to persuade stakeholders to take ongoing actions to reduce their environmental impacts, and to advise FPCL will be using the powers available to it to ensure that there is compliance with environmental regulations.

By explaining to stakeholders what FPCL is doing to reduce its own corporate environmental impact it will demonstrate that it is serious and is taking a leading role.

There is also an important educational and motivational role that FPCL can play. Its suggested that in the initial meetings it show a video on sustainability management, such as the Linfox C25 project (https://www.youtube.com/watch?v=DSO3dV-HIQU), and discuss the responsibility to future generations.

A suggested meeting agenda is:

1. Discussion on the overall environmental footprint of the port, and the damage this is causing to Fiji. Its suggested that each meeting a short video (up to 10 minutes) be shown about environmental impacts and corporate social responsibility.
2. Explain what FPCL is doing to reduce its environmental impact, and potentially have 1 or 2 stakeholders also present on what they are doing to reduce their environmental impact.
3. Discuss legislation, penalties for non-compliance, and highlight any recent successful compliance activities undertaken by FPCL. Warn that FPCL will use its lawful powers and will issue fines.
4. Open talanoa and discussion, including on further ideas to reduce environmental harm.

Actively develop and update a green port section on FPCL's website

Create a dedicated section on the website for the green port initiative. Post all public reports to this section of the website.

Encouraging FPTL to upgrade yard lighting to LED

Background

The 2016 energy audit identified yard lighting in Suva terminal as being inefficient and recommended that this be upgraded to LED.

In 2017 an additional energy management consultancy funded by SPC identified specific makes and models of lights to upgrade to and suggested a trial be undertaken. The entire fitting to be upgraded. An affordable dimming system, enabling light control by the guards, was also sourced.

Required works

LED lighting technology is continually evolving, and the 2017 specification is no longer valid.

Outsource the upgrade to a suitable contractor to source and supply lights that can meet the illumination levels of the existing lights whilst greatly reducing energy use, including a dimming system, adapting the specification developed in 2017 to do so, and requiring that any replacement lights have a minimum efficacy of 170 lumens/watt.

Only do this when ready to go ahead and buy and install the lights, as lighting technology is developing quickly and a specification will, at best, have a shelf life of 1 year to 18 months.

Negotiate with FPTL payment arrangements to recuperate costs, noting that FPTL will benefit from the reduce electricity costs from the upgrade.

Establish standards and enforce improved handling of clinker offload at the Suva terminal or any future clinker offload terminal.

Background

Approximately every two months a vessel carrying bulk cement berths at Suva. Cement is offloaded using a shipboard crane, which picks up roughly 6 tonnes at a time and dumps into a hopper. FPTL staff operate the cranes. It can take around 10 days to offload a ship, working around the clock.

Spillage rates are high; avoiding spillage requires careful crane operation.

Some of the spillage goes directly into the sea. There is also a lot of dust generated.

Actions

With respect to any clinker offload as is currently practiced (as of Jan 2020) at Suva port, work with FPTL, the vessel owners, and the consignee to:

(a) Quantify the market value of the spillage. If cement sells at $11.30 for a 50kg bag, one tonne spilled is $226. If 10 tonnes are spilled a day, the market value of the loss would be $2,260. Over 10 days this is $422,600. With say 7 vessels a year the market value would be $160,000.
(b) Identify the environmental damage.
(c) Identify the health impact on workers.
(d) Identify how spillage can be reduced, exploring all avenues, such as operator training, additional equipment, shorter operator shifts etc.
(e) Identify standards around spillage and set a pathway for improving these standards over time.
(f) Encourage the relevant parties to take action to reduce spillage. Additionally, establish fines for spillage, and provide say a 6-month grace period before fines are levied.

With respect to any future dedicated clinker offload terminal, an environmental assessment should be undertaken, and any necessary steps taken to minimize spillage.

Establish standards around hydraulic oil leakage and leakage clean up (don't hose into sea or into drains) and enforce

Background

At Lautoka and Suva the terminal operator and other terminal users operate machinery with oil leakage. Leakage may be hosed off into sea or drains.

This contravenes Fiji's environmental laws around water pollution, for which there are large fines.

Specifically, the Environment Management Act 2005, clause 45, states:

> 45.-(1) A person who, without lawful authority or reasonable excuse (the offender shall prove lawful authority or reasonable excuse), causes or contributes to the discharge of a waste or pollutant from any vessel, aircraft or facility commits an offence and is liable on

conviction-

(a) for a first offence, to a fine not exceeding $250,000 and to a term of imprisonment not exceeding 3 years or both.

(b) for a second or subsequent offence, to a fine not exceeding $750,000 and to a term of imprisonment not exceeding 10 years or both.

(2) A person who, knowingly or intentionally or with reckless disregard to human health, safety or the environment, causes a pollution incident that results in harm to human health or safety, or severe damage to the environment commits an offence and is liable on conviction to a fine not exceeding $1,000,000 or to life imprisonment or both.

(3) Where a body corporate is convicted under this section the maximum penalty is 5 times the fine specified for that offence.

Actions

The terminal operator and other parties using machinery on the wharfs must be clearly instructed to stop hosing off of hydraulic oils into the sea or into drains and advised of the large fines. This should be both verbally and in writing.

Parties who are causing pollution from machinery fluid leakage should be given a grace period of 3 months to change its practices and get the necessary equipment to collect oil and dispose of it in a proper way, well away from the sea and water ways.

After three months the regulation should be enforced. FPCL staff on wharf areas should be instructed to report any pollution and collect photographic evidence of this. Where the terminal operator and/or others fail to comply, FPCL should work with the appropriate authorities to prosecute.

FPCL should enforce use of the designated areas for machinery washdown and ensure that oil separators and drainage is operating effectively. FPCL could also work with machinery operators to review their machinery maintenance schedules and reports for the purpose of verifying compliance.

Require the terminal operator and other users of machinery in the port to collect and treat any wastewater from water blasting or cleaning of machines

The terminal operator and other operators of machinery in the port should be advised to only clean machines in designated wash bay areas, and to install equipment, or tanks for collecting such waste water, so at to enable its treatment either on site or offsite by a third party contractor.

Investigation into shore power; potential provision of shore power

Background

Domestic and small international vessels berthed in Suva at Princess Wharf, Muaiwalu 1 and Muaiwalu 2, and in Lautoka at the domestic wharf, are often running their gensets to supply auxiliary power for lighting, refrigeration, ventilation and other on-board electrical loads.

If lightly loaded, these gensets operate very inefficiently. An efficient genset when fully loaded can produce around 3.5 kWh per litre of diesel fuel. However, at very low loads, below 20% of full load, genset efficiency can drop to 1.5 kWh per litre of fuel, or even lower as the load drops further.

This results in high greenhouse gas emissions per kWh of fuel used, at low loads genset greenhouse gas emissions could be up to 1.7 kg CO2-e/kWh, or even higher. This is around 5 times higher than grid supplied electricity in Fiji, which has an end-use emissions factor of around 0.36 kg CO2-e/kWh.

Using grid-supplied electricity on these vessels via a shore power connection can substantially reduce overall greenhouse gas emissions, cut down air pollution in the wharf area, and decrease noise. Vessel owners can also save on their fuel usage.

For interisland ferry operators, up to 25% of the carbon footprint from auxiliary engine operation can occur when berthed.

FPCL, who owns and administers these wharfs, is not allowed, under the Fiji Electric Act, to mark-up power costs for any electricity it on-sells, at the same time it is required to issue bills and collect payment. So there is no economic incentive for FPCL to install shore power, in fact the installation of shore power would come at an operational cost (labour to manage billing). But clearly there are substantial environmental benefits from doing so.

Figure 1 FSHIL has already installed shore power (the orange boxes along the wharf)

Actions

Commission a study into shore power.

Such a study will require collecting a lot of data about the domestic and small international vessels and liaison with ship owners; the most cost effective way of undertaking the study will be to have the Harbour Masters to collect data about the vessels, over a period of say 6 months, and then have the consultant analyse the data.

The study should, as best possible with the data collected:

- Identify which vessels can be connected to shore power and identify connection type
- Establish berthing electrical loads on these vessels
- Inspect vessels to determine likely fuel efficiencies when berthed.
- Estimate the financial benefit that would accrue to vessel owners from shore power
- Determine the greenhouse gas savings
- Identify the capacity required of a shore power system at M2, M1, Princess Wharf Suva and the domestic wharf Lautoka.

- Estimate likely capital cost.

The study should not prepare detailed designs and specifications, which can be done one the decision to proceed is made.

Should the study recommend shore power, then funding would need to be sought and the project implemented.

Facilitate workshops on energy efficient vessel operation

This activity aims to help users of FPCLs ports reduce energy use.

A consultant could be appointed to deliver this training.

FPCL could follow up after the training with messages reminding owners and captains of vessels of how they can be managed to reduce fuel use.

Facilitation of workshops on capturing different waste streams and sorting waste.

This activity would build on the awareness raising activities. It could include providing signage that can be put on bins, and informing what can and cannot be recycled. Recycling service providers in Suva could also present on their services.

Investigate purchasing of environmental offsets.

Background

In some countries, such as Australia, environmental groups will engage in tree planting or reafforestation, as carbon offsets – e.g. www.greenfleet.org.au. Airline companies such as Virgin Australia offer travellers the option to offset the carbon emissions from their flight. Virgin will then contract an organisation such as green fleet to plant trees to provide the offsets.

The theory of offsetting is that a growing tree will absorb CO2 from the atmosphere, offsetting the emissions created from the flight, or any other activity that produces greenhouse gas (GHG) emissions. Of course, to lock in these emissions the forests and trees planted need to be managed in such a way that the carbon they sequester isn't delivered back into the atmosphere, for example through a forest fire.

Underpinning offsetting is the concept of carbon accounting, which is used to calculate the amount of carbon emitted, and then determine how many trees need to be planted to offset these emissions.

FPCL could potentially offer cruise ship passengers the opportunity to purchase environmental offsets for the greenhouse gas emissions created by the cruise vessel when its berthed. Potentially it could partner with a Fijian provider of offsets. It would need to be careful to avoid the bad publicity that Fiji Water generated around its use of offsets by ensuring a strong audit trail.

Action

Investigate the viability of purchasing offsets that are easy to manage, with a strong audit trail.

Introduce anti-idling regulation

Vehicles idling when stationary waste fuel and contribute needlessly to greenhouse gas emissions and local air pollution.

Prohibit the idling of stationary vehicles in port areas.

For this to work spot fines should be issued for vehicles entering the port, the number plate recorded, and re-entry should be prohibited until the fine is paid. This can be administered by the security guards, who can be incentivized to issue the fines and limit port access where a fine has not been paid.

Facilitation of workshops on eco-driving

This activity aims to help those who regularly drive vehicles in and out of Port areas to improve their fuel economy. More specifically it would be mostly targeted at the drivers of trucks entering port areas to either pickup cargo or drop off cargo.

A consultant could be appointed to deliver this training.

FPCL could follow up after the training with messages reminding vehicle operators how they can be best managed to reduce fuel use.

Incorporate green lease requirements into new leases

A green lease is one in which the tenant is obliged to use the facility in a way that minimises its energy use, whilst at the same time the landlord also ensures that the fixtures that form part of the property are energy efficient. For example, that the lighting installed is energy efficient.

A key principle of the green lease is that everyone wins. If the landlord invests in upgrading the lighting, the rent can be increased slightly to cover this cost, however the rental increase is a bit less than the savings that the tenant will receive from reduced energy cost. The tenant benefits by having lower overall outgoings. In the long term the landlord benefits because the increased rent more than covers the cost of capital upgrades. In this example there is actually one loser, and that loser is the electricity authority! They end up selling less electricity.

The green lease is ideal for long-term rental arrangements. Under the conditions of a green lease at the start of the rental agreement the landlord agrees to undertake a range of upgrades, and the tenant agrees to pay an increased amount of rent to cover these upgrades. The paybacks to the landlord on the upgrades implemented would typically be in the range of around 3 to 5 years in aggregate. Over a 10 year lease this would mean that the landlord would essentially get a return of over twice the amount invested.

Successful implementation of a green lease involves:

- Undertaking a sustainability assessment of the facility and identifying improvements that can reduce outgoings such as energy costs, water costs, waste costs et cetera.
- Undertaking a cost benefit analysis of the upgrades.
- Identifying those upgrades which will be implemented.
- Negotiating with the tenant the amount of increased rental based on the cost benefit analysis undertaken.
- Negotiating with the tenant and stipulating requirements around usage of the facility so as to minimise its environmental impact.
- Including in the lease documents the list of works to be undertaken by the landlord and the obligations on the tenant around minimisation of environmental impact of the facility.
- Including a clause in the lease which allows the tenant, at any time during the lease term, to request for further sustainability upgrades to be undertaken by the landlord, and on the

basis that the landlord achieves at least full cost recovery during the remaining term of the lease, for the landlord to implement such upgrades.
- Having a 2nd clause similar to the one just above, but which allows the landlord to propose sustainability upgrades, and on the basis that the overall outgoings of the tenant not increase, for the tenant to permit those upgrades to be undertaken.

For larger facilities with long leases an energy auditor should be contracted to come up with a list of measures that can be implemented for the mutual advantage of both parties.

For small facilities standard upgrades that should be considered would include:

- Lighting upgrade to LED.
- Occupancy sensors on lighting circuits consuming more than 1000 watts which are intermittently occupied.
- Replacement of through wall window type air-conditioners with high efficiency split system air conditioning equipped with "manual on, auto off" controls to minimise air-conditioner runtime.
- For facilities that use a lot of energy, and have roofs with good solar access, the fitting of a grid connects solar system sized in such a way as to match typical daytime loads.
- The fitting of low flow water devices.
- Guidance on waste recycling.

Green leases are ideally introduced during lease renewals. As the facility is already occupied and there is energy and water billing data available, this makes it much easier to determine the cost benefit of any future upgrades, on the assumption that the tenant continues to use the facility in the same way as they have in the past.

Facilitation of workshops on energy efficiency for FPCL tenants

These workshops should be conducted by an energy efficiency expert, and outline the ways in which tenants can reduce their energy usage.

Include green-ship advice and upgrade options with FSHIL booking forms, provide this service.

The booking form used by ships coming into drydock can be adapted to steer clients in the direction of implementing energy efficiency upgrades.

For each upgrade proposed, there should be a brief explanation as to the benefit this provides, and ideally a link to a case study which shows the benefits and puts forward a persuasive business case for the upgrade. Initially the following options are suggested:

- lighting upgrade to LED
- high-performance/long life antifouling hull coating
- fuel metering and bridge reporting system
- hull reshaping
- fitting of propeller boss
- changing of gearbox ratios
- fitting of trim indicators

In the future, and as skills and capacity are available, the following could also be offered

- sustainable refrigeration system refurbishment
- coaching and training in the fuel saving ship operation
- battery systems to enable night-time switch off of gen sets.

Require destruction of refrigerants removed from vessels in dry dock

Refrigerants are highly potent greenhouse gases, and some older refrigerants such as R404a have extremely high global warming potentials. 1 kg of vented R404a produces the same amount of greenhouse gas emissions as driving a car 10,000 kms!

FSHIL should implement regulation that prohibits the venting of refrigerants, and the reuse of selected refrigerants with very high global warming potentials (GWPs) for which there are a suitable substitute refrigerant with lower GWPs.

Host a regional workshop on energy efficient vessel configuration

Hosting a regional workshop on energy efficient vessel configuration will help FPCL promote its services. Potentially a donor or sponsor could be sought to cover the costs of the workshop.

Engage with the Department of Environment

The Department of Environment is responsible for the administration of environmental legislation in Fiji.

As pollution detection requires the deployment of significant resources, including a dedicated vessel, FPCL should be negotiating with the Department of Environment to ensure full cost recovery for any pollution fines that are levied as a result of FPCL's activity. This should also incentivise FPCL to be more rigorous in detecting pollution.

Currently FPCL is organizing training with the Department of Environment to train its wharf staff to become pollution prevention officers. This will enable its staff to issue on the spot fines to those littering.

If necessary FPCL should seek to exert influence that results in the Department of Environment being more willing to levy fines and take action to prevent pollution.

FPCL should also seek out mechanisms that enable it to issue on the spot fines.

It can also assist the DoE by reporting on, and mapping, points in its harbours where pollution is commonplace, and where pollution appears to be coming from land-based sources.

FPCL could also work with the DoE to classify harbour areas and areas adjacent to port land as requiring environmental protection, and therefore relieving pressures arising from urbanisation and development. This could extend to actions that limit traffic in port areas, and to also ensure that there are adequate waste management facilities available.

Green Port information on invoices

One way in which FPCL can engage with its stakeholders is by including a small amount of green port information on invoices. The message on the invoice could be updated perhaps once every 6 months, to highlight recent activities or initiatives.

Improve capacity to detect litterers

Unfortunately, the fear of fines may need to be used to deter those who are littering. The levying of fines will be necessary to deter littering, and rigorous enforcement needed to stop littering altogether. Accompanied of course with the provision of an adequate number of bins.

The capacity to detect litterers will be improved by training wharf attendants, and also by providing incentives for litter detection. Part of the fine collected could be used to incentivize the wharf attendants and security staff.

ACTIVITIES ASSOCIATED WITH STRATEGIC OBJECTIVE 5.4

Tighter enforcement of abandoned vessels in harbour

Background

There is a significant number of abandoned vessels in FPCLs harbour. These may still contain fuels, oils, refrigerants and other toxic materials. Vessels appear to be dumped each year. Removing these vessels comes at high cost to FPCL.

Actions

1. FPCL will seek to exert influence to ensure that MSAF is more effective in maintaining a registry of vessels and their ownership, and in advising FPCL when a vessel in the harbor fails its annual survey. See the activity later in this plan on engagement with MSAF.
2. It will seek to make insurance (for salvage/scuttling) of vessels compulsory or alternative require vessels to pay a bond if a seaworthiness survey is failed and the vessel is moored in harbor.
3. It will seek to have Fiji ratify the Nairobi convention on the removal of wrecks.
4. It will take legal action against those dumping vessels.
5. It will ideally push for MSAF to take responsibility for derelict vessels.

Engage with the Maritime Safety Authority Fiji

Currently FPCL is facing challenges with the removal of abandoned and derelict vessels as MSAF records of vessel ownership in some cases are incomplete.

FPLC is aiming to require that, whenever a port user license is issued, vessel operators inform FPCL of the ownership of the vessel and the current contact details, providing documentation to support this. These licenses require annual renewal, so this way ownership records would be, at worst, no older than 12 months.

The vessel tracking management system (VTMS) now being deployed by Fiji ports could be used in identifying all vessels in Suva harbour. FPCL could advocate that MSAF also use the VTMS to aid in enforcement.

FPCL is looking to require all vessels that moor in its harbours to hold insurance to cover salvage costs.

Alternatively, it could request MSAF to advise FPCL when a vessel, moored at harbor in Suva or Lautoka, fails a seaworthiness survey. In this case, the owners would be required to pay a bond for their vessel to be moored in the harbour. If, after an agreed upon period of time (say 1 year), the owner fails to restore the vessel to a seaworthy state, the bond could then be used to pay for FPCL to strip the vessel, remove it from the harbor, and scuttle it. This covers the circumstances whereby vessel owners may fail to fix the vessel, then eventually abandon it 3 or 4 years later. FPCL would need to work with MSAF to create enabling legislation should it follow this approach.

There is pushback from owners of domestic vessels that insurance is expensive and they will be forced to raise their fares. A bond, on the other hand, whilst not offering cover that is as comprehensive as insurance, only represents a cost to a vessel owner if the vessel owner abandons the vessel. Owners that look after their vessels or dispose of them in a considered way that is environmentally responsible, are not penalized. This also takes away the argument that fares would need to go up.

Additionally, FPCL should advocate for enforcement of legislation that requires any vessel registered in Fiji to be less than 20 years old at the time of registration. This should reduce the number of vessels that are dumped after only a few years usage in Fiji's waters.

Fiji has yet to sign the Nairobi international convention on the removal of wrecks. This is another area of advocacy for FPCL.

Clearly to be effective in reducing and eventually stopping the dumping of vessels in harbour will require strong engagement with MSAF.

FPCL should also advocate for regulation that requires bilge water record keeping, and bilge water locks that prevent discharge if oil content is greater than 15ppm, for all vessels of 100 gross tonnes or higher. (See here for some background information https://www.maritime-executive.com/magazine/compliance-challenges)

Finally, Fiji has not yet ratified MARPOL Annexe VI, with respect to air pollution from vessels, and thus there is no restriction on sulphur emissions from ships coming into Fiji. This is yet another area where FPCL should be advocating for a stronger local regulation.

Purchase of pollution boat for Lautoka

In Lautoka, the absence of a pollution boat makes it harder to detect and prosecute pollution of the harbour. Purchase of a pollution boat will make it easier to enforce regulations, and to clean up spills that occur.

Improve capacity to detect water pollution

Effort should be put into developing systems, procedures and adapting technologies that enable the easier detection of water pollution. Of course, this should then be followed up with enforcement of pollution regulations.

ACTIVITIES ASSOCIATED WITH STRATEGIC OBJECTIVE 5.5

Signage on wharfs

Signage should be erected on wharfs and entry to wharfs, which is clearly visible to all entering the wharfs, whether by land or sea, and legible from a distance.

Careful consideration should be undertaken of what to put on the sign, its legibility from distance, and location of the signs.

It may be the case that several different signs are used. E.g. a large sign stating the rules of port entry, and small pictorial signs repeated across the wharf areas warning against littering, graffiti, dumping of waste, etc.

Suggested content for including on the sign is:

- State FPCLs desire to reduce the environmental impact of ports, in a way that is hard to disagree. E.g. "Fiji Ports takes seriously its responsibility to protect Fiji's precious natural environment in port areas."
- Clearly state that littering and water pollution are prohibited, including the dumping of bilge water. Potentially accompany with pictorial signage.
- State that under the powers vested in it by the Seaport Management Regulations 2008, Part 10 – Control of pollution, that littering, water pollution and the dumping of vessels are strictly prohibited.
- Specify the fines payable. specifically:
    - $250,000 and higher for discharge of waste or pollutant into the sea and up to 3 years imprisonment (Clause 45.-(1) of the Environment Management Act, 2005)
    - $200 and higher for littering under the Litter Promulgation Act 2008.
- Offer a reward to those reporting sea pollution or littering.
- State that idling of stationary vehicles in port areas is prohibited.
- State that eating and drinking in wharf areas is prohibited.
- Have a QR code which can be scanned by a mobile phone and linked to the green port section of FPCLs website.
- Indicate that the wharf's toilets should be used (sea facing signs for berthed vessels)

Signage should be tailored to the wharf it is located on and the position its facing.

Consult with users of the wharf to determine what languages should be used on the signs. For example, at Muaiwalu 1 the signs could be in English and Mandarin Chinese.

Signage should be installed at:

Suva:

- Princess Wharf
- Kings Wharf
- Muaiwalu 1
- Muaiwalu 2
- FSHIL

Lautoka:

- Queens Wharf
- Domestic Wharf

So that the signage in unmissable, it will likely be necessary to install several signs at each wharf.

Wharf attendants, security guards and other FPCL staff working in wharf areas will need to be trained in what to do if they observe pollution or littering, or if it reported to them.

Tighter enforcement of oil/waste dumping at sea

Background

Oil spills, as shown the satellite photo below, are occurring in Suva harbour

Figure 2 Satellite image of Suva Harbour, 11 August 2019. Note the large oil spill

Oil only breaks down slowly in the environment, and is damaging to marine species, bird life, and can enter the food chain.

Oil spills are unacceptable.

Actions

FPCL will step up its actions to reduce oil spills as follows:

1. It will engage with the Department of Environment to improve enforcement and ensure cost recovery to FPCL.
2. Signage will be erected (as described above), warning of the penalties associated with pollution.
3. Annual meetings will warn against pollution.

4. It will offer rewards for the reporting of pollution.
5. Using the pollution boat, it will identify spills and take legal action against those polluting.

Tighter enforcement of littering in port areas

Background

Littering is a common habit in Fiji. Litter can end up in the sea, to the detriment of marine life. It is also unsightly and can sustain vermin.

Actions

FPCL will make greater use of its powers, including the issuing of fines, to reduce littering, in line with the Litter Promulgation Act 2008.

It will erect signage warning of littering.

Wharf attendants will be trained in how to report litterers, obtain evidence of littering, and issue fines, under the authority of the Harbour Master.

Under Litter Promulgation Act 2008 the Harbour Master, Deputy Harbour Masters, Port State Control officers and shipping inspectors appointed under Section 39 of the Sea Port Management Act 2005 are automatically deemed to be litter prevention officers, and have the power to issue fines.

Encourage sorting of waste on vessels into different streams

After implementing waste sorting facilities, itself, vessels using FPCLs wharfs should be encouraged to implement waste sorting themselves.

This could include changing charging arrangements so that it is in the financial interest of vessel owners to sort waste.

There will also need to be facilities installed on the wharfs to receive recycled waste from vessels.

Prepare videos on litter management

These videos would be prepared in English, Itoke and Hindi, which are screened at the Muaiwalu 2 waiting area and in Lautoka waiting area (once a screen is installed in Lautoka). They would be short videos explaining where to put waste, and warning of the effects of litter that is run off into the sea.

Require any ferry that is transferring livestock to clean up any waste left in wharf areas

This would require introducing a new regulation requiring clean up, advising of the regulation, then enforcing it. A fine of $400 would be appropriate, levied at the owner of the vessel.

Upgrade waste management practices and enforcement for international vessels.

Undertake more rigorous checks of waste practices on international vessels.

Through advanced treatment (i.e. high temperature incineration) offer additional off-site health and safety benefits nationally (i.e. medical waste).

Upgrade FSHIL's waste water treatment plant.

Upgrade FSHIL's waste water treatment plant to improve quality of water discharged and increase throughput, if necessary

Upgrade and maintain public toilet and bathroom facilities in wharf areas

The harbour is not a toilet or a dump for wash water. The provision of upgraded toilets and wash facilities in domestic wharf's, with the quantities sufficient for all uses of the wharf's, means that there is no excuse for boat crews or others coming into wharf areas to be using the sea as a toilet.

There will also need to be a mechanism put in place for maintaining and covering the cost of toilet maintenance.

Upgrade of bins in wharf areas

in order to make the wharf areas cleaner, and to reduce the amount of waste going into landfill, will be necessary to ensure that there are an adequate number of bins in wharf areas, and that there are also sufficient quantities of recycling bins.

Contracts should be entered into recycling services for the collection of recycled waste.

Potential suppliers include:

- Mission Pacific Fiji, for recycling of plastic PET bottles. https://missionpacificfiji.com/
- Suva City Council has on its website links to recycling providers: http://suvacity.org/waste-minimization-tips/
- South Pacific Waste Recyclers recycled office waste paper and cardboard. http://www.southpacificwasterecyclers.com.fj/about-us/

There should be specific colour coding of bins, and the colours used should match those used by Suva City Council (blue, green and yellow). So, for example, bins for recycling plastic PET bottles would be one colour, for cardboard another colour, for general garbage going to landfill one other colour.

Figure 3 FPCL is already collecting drink bottles at Muaiwalu 2. More bins and needed.

Bins should be heavy duty and have very clear signage on them, including pictures, showing what can and cannot be recycled.

Cleaners, and wharf attendants, will need to be fully briefed and engaged in the process of improving bin arrangements to help the port become cleaner and to increase recycling rates.

Wharf attendants should also be trained in engaging with members of the public about how to recycle and do this when at work.

Deploy segregated bins in office areas

In office areas, as done in the wharf, segregated bin should be used. The cleaners should be instructed to collect each waste stream and put it into central bins for each type of waste at street level.

Inexpensive colour coded corflute bins can be used. Keep the colour coding consistent with any outdoor bins used, and in line with general Fiji recycling colour coding practices. Also ensure that the bins are clearly marked and labelled.

Make cleaners responsible for ensuring that different waste streams are properly processed

The cleaners should be trained and made responsible for ensuring that waste is properly sorted, and that recycled waste is actually recycled. There should be no mingling of recycled materials with general waste collected by the city council or private general waste contractors.

Develop a strategy and timeline for going paperless

Going paperless will free up space in office areas, enable easier central sharing of information, and facilitate the streamlining of business processes, in addition to reducing paper waste.

However, it will require a major change in the way that things are done, especially for those staff who are not used to using electronic devices.

One of the downsides of going paperless could be increased e-waste, and FPCL will take action to ensure that any e-waste is appropriately recycled.

Roster one cleaner to work at domestic wharfs on one weekend day

M2 wharf is often quite untidy on a Monday, with bins overflowing, as no cleaners work on the weekend. Roster a cleaner to work on the weekend, and also ensure that bin sizes are adequate.

Figure 4 Muaiwalu 2 waiting area on a Monday

This will keep the wharf areas cleaner and reduce the likelihood of waste ending up in the sea in the case of a heavy storm on Sunday night.

Develop a strategy to move away from small individual water bottles to large reusable bottles

FPCL currently uses individual bottles of water for participants in workshops and other events. One of the key principles of environmental stewardship is to reduce usage of resources. As water bottles are a source of waste in the action that can reduce the usage of water bottles is good for the environment.

This could be achieved, for example, by using large refillable water dispenser type bottles, installing water filtering selector port can be used to drinking, using cardboard cups which have a much lower environmental impact than water bottles, encourage all staff to have their own cup, et cetera.

Meet monthly with cleaners to discuss waste collection and recycling challenges

The cleaners will play an important role in improving waste management and making wharf areas cleaner. They should be engaged from the start.

monthly meetings of the cleaners to discuss waste and recycling challenges, and taking action to address these, will help get their strong commitment to the green port program.

Lautoka Container Yard Upgrade.

The resurfacing of the Lautoka container yards 3 & 4 will reduce dust, and FPTL believe that this will also reduce the amount of hydraulic oil leakage from container handling machinery.

Twice annual clean up days

Twice a year run an annual clean up day, targeting the most polluted parts of the port. Encourage all staff to participate, potentially turn it into a family event.

Add green space in Muiawalu 2 waiting area

Add some green space in this waiting area. Ask the ferry operators to contribute to creating the space and maintaining it.

ACTIVITIES ASSOCIATED WITH STRATEGIC OBJECTIVE 5.6

Expand services provided by the VTMS

Once the Vessel Tracking Management System (VTMS) is operational, look for opportunities to expand the services it provides. E.g. consider expanded national coverage via respective agencies (i.e. MSAF) to be monitored by FPCL VTMS team for national benefit and environment and safety pursuits.

ACTIVITIES ASSOCIATED WITH STRATEGIC OBJECTIVE 5.7

Engage with the Water Authority Fiji

FPCL should advocate for the installation of storm water litter collection traps before discharge into the harbour, in Suva and Lautoka, if these are not already in place, and their regular cleaning and maintenance.

Based on water quality testing, identify main sources of harbour water pollution.

Thorough water testing will enable identification of the key types of water pollution in the harbour. Types of pollution will likely include:

- Biological pollution, for example from sewage.
- Chemical pollution, for example from oil spills.
- Heavy metal pollution, from industrial waste.

Identification of the types of pollution will make it easier to identify where the pollution is coming from, and then to take action to reduce pollution at its source.

Action can then be taken with the Department of Environment to target those who are responsible.

ACTIVITIES ASSOCIATED WITH STRATEGIC OBJECTIVE 5.9

Staff engagement workshops

This green port master plan has a large number of activities and initiatives within it. Successful implementations require excellent staff engagement and awareness. Workshops should be organized with groups of 20 to 30 staff once informing them of the plan and activities with in it, covering all staff in Suva, Lautoka and Levuka.

This exercise should be repeated annually to provide an update as to green port initiatives and to get additional input from staff.

Quarterly pocket meetings

Departmental heads should, once a quarter, run pocket meetings with their staff to provide updates on the implementation of the green port master plan and to discuss and promote environmental initiatives.

ACTIVITIES ASSOCIATED WITH STRATEGIC OBJECTIVE 5.10

Require all dredging to have appropriate environmental supervision

As has been done recently in Lautoka, all dredging undertaken should have a consultant appointed to undertake appropriate environmental supervision and assessment of environmental impacts.

ACTIVITIES ASSOCIATED WITH STRATEGIC OBJECTIVE 5.11

Install solar PV systems on terminal rooftops and sell this clean energy to FPTL

Background

Fiji is one of the few Pacific Islands in which private enterprises can potentially enter into an agreement with the electricity authority for the purchase of solar energy produced by the private enterprise.

In 2017 discussions were held with EFL (then known as FEA) around the installation of solar on FPCLs rooftops in Suva port. At that time:

- A solar system of 100kW or less could, with FEA approval, be connected to the grid and receive an export tariff of $0.15/kWh exported
- For a larger system, grid connection could be negotiated on a case by case basis, and higher export tariffs were generally offered.

FPCL is currently paying a marginal rate of $0.418/kWh for electricity it uses.

In terminal areas there is 24/7 demand for electricity to power reefers, night time demand for energy for yard lighting, and daytime demand for office operations.

Actions

As FPTL pays for terminal electricity usage, FPCL should at Suva and Lautoka:

- As the landlord, install grid connect rooftop solar system, sized to match the daytime load.
- Sell FPTL the energy output of these solar systems, at a rate below the EFL rate. Fortunately, the electricity accounts are still registered in the name of FPCL, as otherwise this on selling could be legally difficult.
    - FPTL gets cheaper daytime electricity, and can claim its reduced its carbon footprint, so it both financial and
    - FPCL gets a reasonable return on its investment, likely to give an Internal Rate of Return (IRR) of 10% to 15% if it on sells energy to FPTL at say 20% less than the EFL rate, and noting the solar PV is highly reliable and could be expected to have a service life of 25 years.
- If FPCL could negotiate a much better rate than the $0.15/kWh for solar exported, it could also look into installing oversized systems that export excess energy to the grid in the daytime. An excess energy sold could be then considered by FPCL as zero carbon offsets to its corporate electricity consumption, on roughly a 1.1 to 1 basis. 1.1 kWh of energy exported, accounting for distribution losses, is equivalent to offsetting the carbon emissions from 1 kWh or energy consumed.

To do this system designs for both sites will need to be commissioned as a first step.

Total project time is likely to be in the vicinity of 1 to 2 years, with the main unknown being the negotiations with EFL.

Upgrade Muiawalu 1 metering.

Background

Muiawalu 1 is currently supplied from a distribution board located next to a EFL transformer. There are 2 meters on this board, one for FPCL and the other for one of the major fishing companies.

Supply from FPCL's meter goes to various other sub-boards and supplies several FPCL tenants.

FPCL's consumption is determined as being the difference in consumption between its master meter and the total consumption of all its sub-metered tenants.

Unfortunately, this remaining amount, which FPCL is paying for, based on the small number of lights and the small office being used by FPCL, shows consumption which is much higher than is possible.

Additionally, FPCL is, during some months, paying reactive power charges, although the source of this reactive power is the tenants. It cannot on-charge reactive power charges, and the tenant meters are not capable of measuring this.

The table below shows the estimated over payment by FPCL in 2018 for Muiawalu 1 was $120,000.

Table 1 Estimated electricity over payments for Muaiwalu 1 in 2018

	Total bill	Amount billed to tenants	Amount payable by FPCL	Estimate of value of electricity actually used by FPCL
Electricity kWh charges	$ 540,453	$ 412,223	$ 128,230	$ 14,741
Reactive power charges	$ 6,250	$ -	$ 6,250	$ -
Total charges	$ 546,703	$ 412,223	$ 134,480	$ 14,741
Estimate of FPCL over-payment				$ 119,739

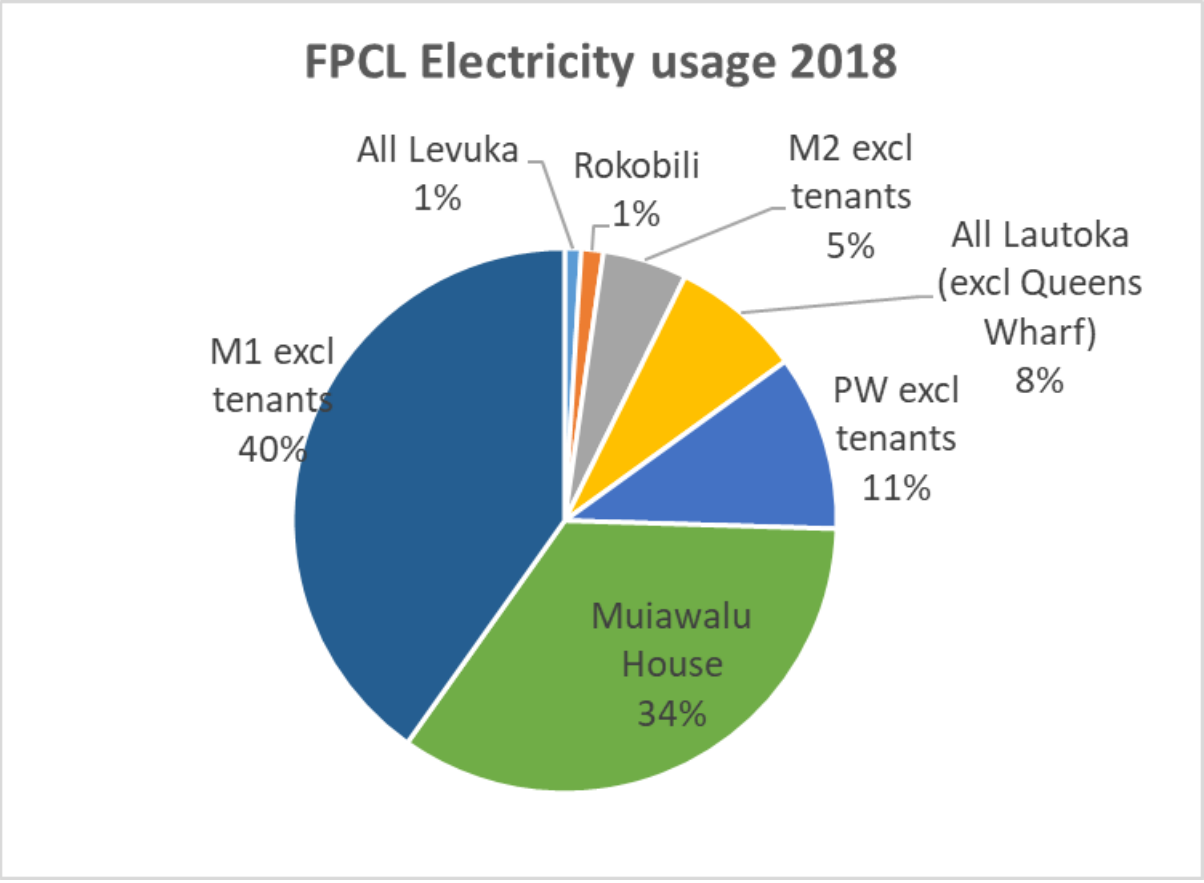

Figure 5 FPCL electricity usage (attributable directly to FPCL), 2018. How is it possible for M1 (Muraiwalu 1) to be using more electricity than Muaiwalu house?

MUAIWALU 1 - ELECTRICITY THEFT/LOSS

Month (2018)	Total kWh	Tenant kWh	Attributable to FPCL (total less tenants), kWh
1	132,379	96,745	35,634
2	106,694	70,928	35,766
3	108,104	78,997	29,107
4	95,667	71,864	23,803
5	119,432	81,316	38,116
6	99,758	72,293	27,465
7	100,351	67,565	32,786
8	109,677	81,308	28,369
9	107,052	95,880	11,172
10	115,953	88,950	27,003
11	102,335	101,744	591
12	103,728	78,590	25,138

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Electrical Load	Qty	Estimated annual elec usage (kWh)
External flood lights	9	16,729
Air conditioners	3	11,515
Office and communication Equipment	10	6,000
Kitchen equipment	4	1,966
Internal lighting	4	734
Total		**36,994**

Figure 6 Calculated annual electricity usage at M1 (right) is only a little higher than the monthly consumption that FPCL is paying for. Clearly there is something wrong.

Possible causes of this problem are:

- Theft of electricity. One or more sites, downstream of the meter, are tapping into the electricity cable without going through a submeter.
- Incorrect calibration of one or more of the sub-meters. This can happen if CT metering is used, and the wrong "K" factor for the CT meter is used.
- Earth leakage. Based on the available data this is probably unlikely, but it can't be totally ruled out.
- Incorrect calibration of FPCL meter. Based on the available data, this is highly unlikely, and not really worth investigating.

EFL would like to upgrade the transformer supplying M1, as it is in a low position which can potentially be flooded.

Figure 7 EFL substation supplying Muaiwalu 1. FPCLs meter is inside this substation building

It is therefore opportune to now also upgrade the metering and distribution arrangement.

Required works

1. Using an amp meter, take rough measurements at each of the tenant sub-meters, and compare amp meter readings with what is being recorded by the power meter. This will provide a rough idea as to if any of the submeters are incorrectly calibrated. Don't forget to be measuring currents on 3 phases to get an average current reading and using the appropriate formula to calculate power based on whether 3 phase wiring is star or delta. Also inspect the meters to see if a "K" factor is written on the meter. Where a K factor is written on the meter, the actual energy consumed is the kWh reading of the meter multiplied by the K factor. In this case historical meter readings undertaken by FPCL should be reviewed to see if the K factor has been included in the determination of usage.

    a. If a meter is incorrectly calibrated, or the K factor has not been used in calculations, fix the problem and seek to get back payments from the tenant.

    b. If this is not a problem, continue to step 2.

2. Prepare a single line diagram, showing how power is distributed from FPCLs meter, and identify if there are any unmetered supplied points, noting that it may be necessary to disconnect power when undertaking this investigation. An electrical engineer should be contracted to prepare this diagram and identify where there is loss.

    a. If there are unmetered supply points, then rectify this by installing metering and seek to get back payments.

    b. If not, continue to step 3.

3. Contract a company to undertake earth leakage detection. If there is leakage, then fix and eliminate the source of earth leakage.
4. Investigate and determine the ownership of the distribution system, ideally requesting EFL to bill each tenant directly, and to install meters on FPCLs office and lights, such that it can also be billed directly. The single line diagram will aid in undertaking this. Also discuss with EFL how it is unfair for FPCL to be paying reactive power charges when such charges are due to tenant activity and identify a fair way of managing this.

5. Based on the above activities, take action to eliminate the additional charges though, as appropriate:
    a. Fixing of incorrect metering, theft, or earth leakage.
    b. Installing additional tenant metering
    c. Installing meters on each of FPCLs loads
    d. Updating tenant meters to "smart" meters, along with FPCL meters, as needed to make it easier to read usage and reconcile usage, and to enable on-charging of reactive power charges.

Estimated budget and timeline

Its very hard to estimate costs for this project. They could be in the order of $100,000. Estimated annual savings are $120,000.

It could take 1 to 2 years to get the metering improved such that FPCL is only paying for what it uses.

Commission specification and design of LED lighting upgrades and specification of solaR PV systemS

Contract a consultant with suitable energy efficiency expertise to specify outdoor lighting and rooftop solar PV systems. These upgrades, when implemented, should be effective in making FPCL carbon neutral with respect to the use of electricity.

The consultant will specify LED lighting upgrades to match or exceed existing lighting levels, across all lights in Suva and Lautoka.

The consultant will identify where solar can be deployed, and to ensure that solar systems are appropriately sized to enable complete offsetting of electricity usage.

Upgrade all lighting to LED

LED lighting is now a mature and cost-effective technology. FPCL should upgrade all lighting, indoor and outdoor, across all its operations to LED.

Importantly, for lights that are in use for more than 30 hours a week, high-efficiency LEDs should be selected. LEDs do not all have equal efficiency. In fact a high efficiency LED could provide the same amount of light as a low efficiency LED, using only a little more than half the energy!

As LED efficiency is continually improving, any upgraded light should only be specified just before purchase, and based on the latest products available.

Seek funding and Install rooftop solar PV to offset all electricity usage

As FPCL aims to become carbon neutral with respect to its use of electricity it will need to offset its consumption of grid generated electricity, some of which comes from fossil fuel sources, through the installation of rooftop solar PV systems.

Grid connect systems that produces excess energy in the daytime, exporting this to the grid, then importing energy at night time, can help the port become carbon-neutral with respect to its use of electricity. Emissions from energy used at night would be offset by the avoided carbon emissions in the grid from energy exported in the daytime.

Agreement will need to be reached with EFL as to the feed in tariffs that apply for energy that is exported.

Figure 8 The rooftop of Muaiwalu House, and the rooftop of Muiawalu waiting area are suited to the installation of solar PV.

Incorporate NSW Ports green port development guide into any expansion or port relocation

This measure applies to both expansion of the port and any development or construction of a new drydock facility.

NSW Ports have developed a green port development guide which should be followed in any such project.

The guide can be found here: https://www.portauthoritynsw.com.au/media/2363/green-port-guidelines.pdf

These guidelines are focussed on the following ten environmental issues:

1. Materials selection
2. Waste management
3. Water consumption
4. Energy use
5. Transportation
6. Indoor environment
7. Emissions
8. Water quality

9. Land use
10. Environmental management

Institute scheduled cleaning and servicing of air conditioners

Air-conditioners should be regularly cleaned and serviced. Specifically, the indoor unit should have its filter regularly inspected and cleaned. The outdoor unit, should have the condenser, that is the finned coil, kept clean. Cleaning needs to be undertaken with care so as to not damage the fins.

Air-conditioner efficiency decreases with dirty coils and dirty filters.

The frequency of cleaning will depend on where the outdoor unit is located. Units located in dusty conditions outdoors may need to be cleaned on a monthly basis. Note again the need for great care when cleaning so as to not damage the coils. A low pressure water spray may be effective, or a vacuum cleaner with a soft brush attachments on the end of it.

Undertake energy efficiency upgrades at Lautoka and further upgrades at Muaiwalu House to further reduce energy usage

Muaiwalu house is, in reality, FPCL's largest energy user. There is still scope for further energy reduction in the building. Suggested projects are:

- Installation of sensor lighting all pushbutton timed lighting circuits in rooms that are rarely accessed
- Installation of pushbutton runouts timers on air-conditioners, requiring activation every couple of hours.
- Adoption of a 24°C temperature policy, with air-conditioners set to cool to no lower than 24°.
- 7 daytime clocks on all boiling water units, such that they are switched off outside of operational hours.
- Rationalisation and reduction in the number of printers.
- Rationalisation and reduction of the number of UPS units.
- A move away from desktop computers to high-efficiency laptop computers.

The same measures can be replicated in the Lautoka office, which could also benefit from a LED lighting upgrade.

Efficient vehicle procurement

Every time a new vehicle is purchased, the aim should be for it to consume 20% less fuel per kilometre than the previous vehicle.

Vehicles should be purchased to match typical use conditions. For example, a runabout vehicle which typically only has a couple of people in it and is not leaving the city, can be a small vehicle.

The Renault City K-ZE could be a suitable all electric vehicle costing no more than a conventional vehicle and with more than enough range for daily activities around Suva:

https://www.greencarreports.com/news/1125190_renault-city-k-ze-goes-on-sale-in-china-for-8-700

As electric vehicles become more commonplace, FPCL should aim to become an early adopter of such vehicles. It could potentially become one of the first companies in Fiji to own an electric car, and would do well to add signage to the vehicle advertising this.

Even now, there are small relatively affordable electric vehicles made in China or India that are suited to city only operation, with a total distance travelled per day is less than 50 or 60 km.

Eg. https://www.youtube.com/watch?v=4BScBOEwm68

Slow-steaming of pilot boats in Suva

Slow steaming is a proven way for saving energy usage. Work I've done with several port authorities has involved testing of pilot boats in order to establish the relationship between vessels speed and fuel consumption. The graph below, from one such test, clearly shows that large fuel savings can be achieved just by slowing down the vessel a little by reducing engine speed.

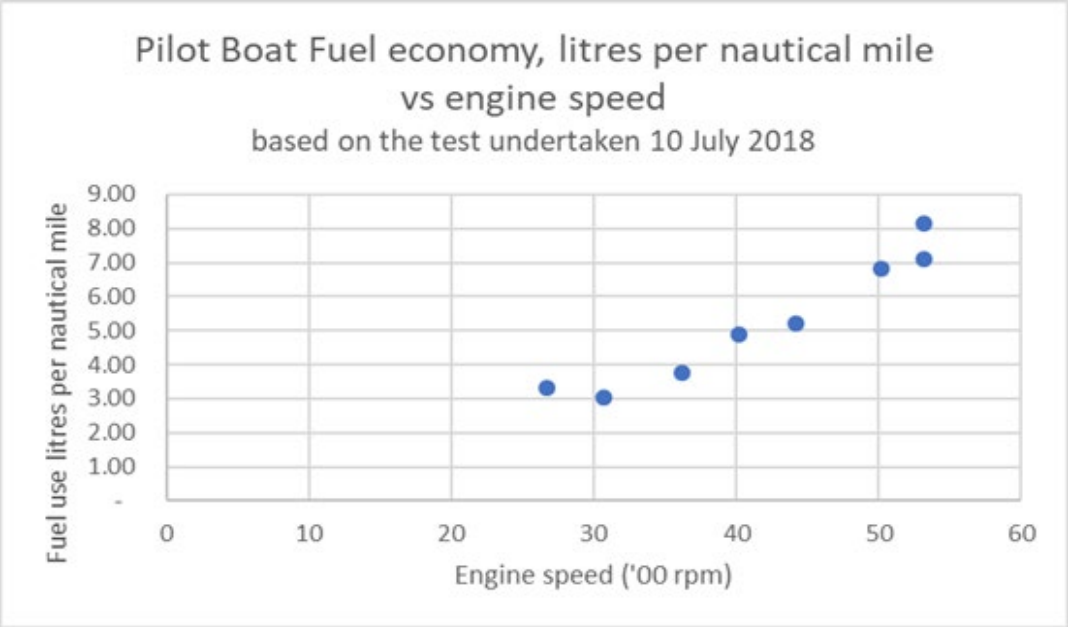

Figure 9 – fuel efficiency testing of a pilot boat at a Pacific Island port. Increasing engine speed from 4000 rpm to 5000 rpm only makes the boat go a little faster. But fuel use per litre increases for 5 litres per nautical mile up to 7 litres per nautical mile! 40% more fuel is being used to travel the same distance!

In Suva the pilot Station is close to the wharf and slow steaming can be easily implemented.

In Lautoka the pilot Station is a long way from the wharf, and slow steaming would add quite a bit of extra time to the journey. However, if the port is not busy and there is time available, slow steaming should also be adopted.

Upgrade of remaining FSHIL UHP water blaster from diesel to electric

FSHIL already has upgraded one water blaster from diesel to electric. The remaining ultrahigh pressure water blaster should also be upgraded from diesel to electric.

Run eco-driver training for FPCL drivers

Applying the principles of eco-driving – such as accelerating gently – can lead to fuel savings as high as 15%. Run eco-driver training for FPCL staff.

ACTIVITIES ASSOCIATED WITH STRATEGIC OBJECTIVE 5.12

Annual reports on green-port progress.

Once a year, FPCL should issue a green port report. The main audience this report will be port stakeholders and users. The report should include information on environmental indicators, including greenhouse gas emissions, air quality, water quality, cleanliness and green space. It should list the activities undertaken by FPCL, and known actions by any stakeholders, over the period covered by the report, to improve its environmental performance. It can also include a summary of activity undertaken by FPCL to ensure compliance with environmental legislation, including lists of fines issued.

It is important that this report is produced and released regularly and in a timely fashion. The aim should be to produce and publish the report in no more than one month after the period which is being reported on.

Printed copies of the report should be distributed at stakeholder meetings, and a softcopy should be available on the green port section of FPCL's website.

Ensure new pilot boats have fuel flow and cumulative fuel use instrumentation

Currently 2 new pilot boats are being built. These boats are fitted with diesel engines. The construction contract should be amended now to include the provision of fuel flow metering which enables real-time determination of fuel usage (litres per hour) and cumulative tracking of total fuel consumption. This data should be displayed on the dashboard of the boat.

The pilots of the boats should be trained in how to use this data to operate the boat will in a way that minimises its fuel consumption. By tracking boat speed as well as the rate of fuel consumption, it's possible to determine the savings from slow steaming, which is recommended for the operation of the pilot boat in Suva.

Undertake water line tracing to identify possible sources of leaks

With apparently high levels of water leaks or theft, water line tracing at Suva and Lautoka should help reduce water usage and costs by identifying where leaks are. Leaks can then be repaired.

Where an entire pipeline is old and requires frequent repairs, consideration should be given to replacing it in its entirety, rather than just patching it.

Upgrade water metering to better track loss and/or theft

At present water meters are read manually. Wharf attendants take meter readings whenever water is used for filling vessels. However water charges are high, and it appears as though there may be theft of water, although this is not fully confirmed.

Water charges in 2018 were $220,000 higher than in 2017.

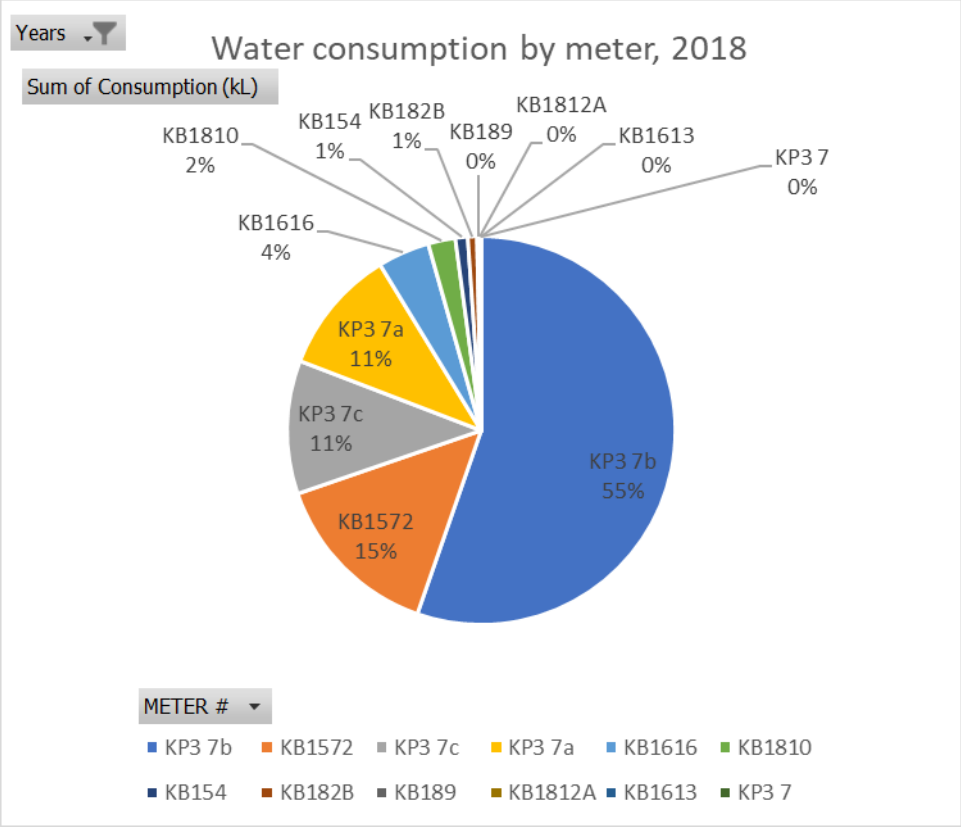

Figure 10 Graph of water consumption by meter, Suva, 2018

Table 2 Water consumption and cost by meter, Suva, 2018

Row Labels	LOCATION	Sum of Consumption (kL)	Sum of Cost
KP3 7b	RENOWN ST-SUV(LOCAL CONSUMPTION)	356,676	$ 449,420
KB1572	RONA ST, M-1	92,660	$ 116,759
KP3 7c	RENOWN ST-SUV(OVERSEAS)	71,611	$ 90,237
KP3 7a	RENOWN ST-SUV(GENERAL)	67,293	$ 84,796
KB1616	2 NARAIN JETTY, M-2	27,838	$ 29,516
KB1810	MUAIWALU WHARF, M-2	14,609	$ 15,493
KB154	MUAIWALU COMPLEX, M-1	6,648	$ 7,055
KB182B	Tofua Street, Suva Food Stall	4,958	$ 6,255
KB189	NEPTUNE HS	1,167	$ 1,478
KB1812A	FOODSTALL-FIRE HYDRANT	678	$ 862
KB1613	NIAGARA ST, M8-2	294	$ 319
KP3 7	RENOWN ST(SPECIAL METER READING)	31	$ 47
Grand Total		**644,464**	**$ 802,236**

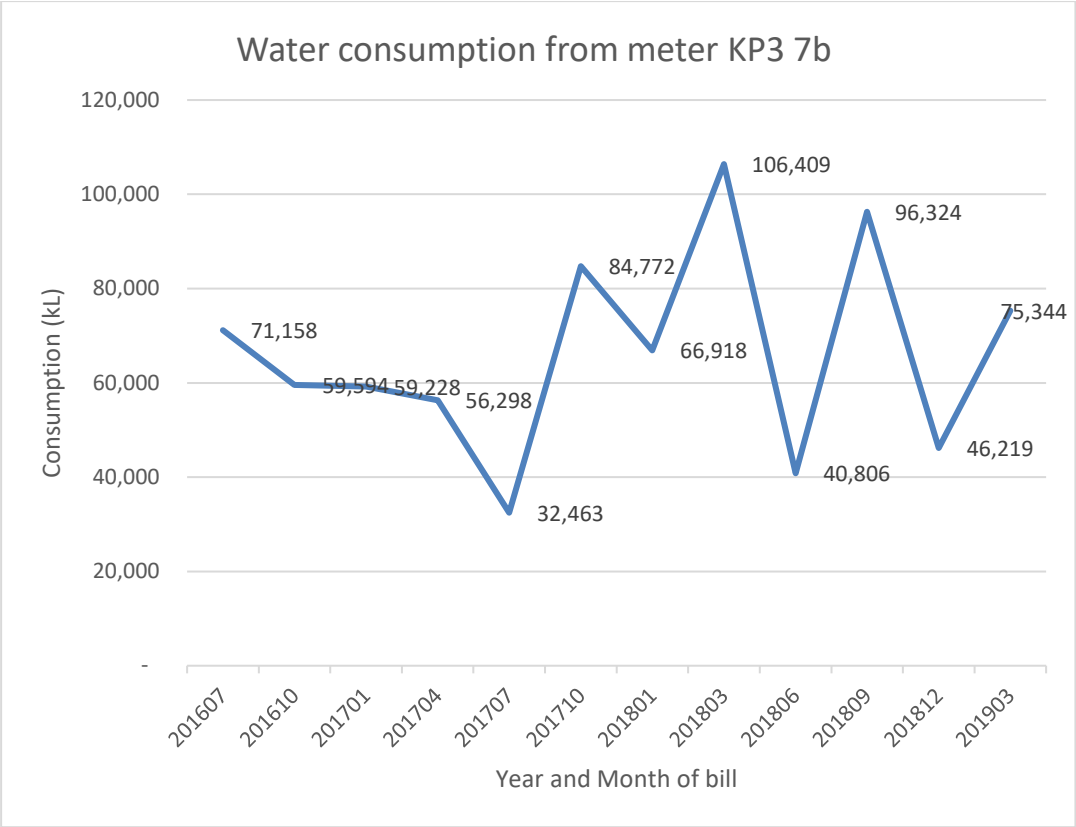

Figure 11 Water consumption from meter KP3 7b, RENOWN ST-SUV(LOCAL CONSUMPTION).

Water theft can be reduced with the installation of smart water meters that record usage at regular intervals (eg every 15 minutes), and enable the determination of when water is used by collecting data from the meter. It may even be possible to retrofit such sensing into the existing meters. When correlated with records kept by wharf attendants, it could be used to detect when theft may be occurring.

I would advise upgrading of all meters that have annual costs in excess of $3,000 to smart meters.

It may also be possible to use pre-paid water meters. With these meters those with a pre-paid card can obtain water at any time, with usage charged against their pre-paid card. An advantage of this system is that it requires no supervision, as those without a card simply cannot get water. Systems such as this which have integral smart water metering may also be able to generate reports on usage by user; further investigation may be required.

Install rain water tanks on King's wharf, for wharf cleaning

With the wharf cleaned daily, rainwater tanks on King's wharf will reduce the need to purchase potable water.

Assuming that the contents of the 20,000 litre tanks installed can be cycled once a week (Suva's high rainfall, and the large roof area, should make them fast to refill), annual water savings will be around 1,000 kL, worth approximately $1,200.

Update tracking spreadsheet to track fuels usage

The existing data spreadsheet tracks electricity usage only, but has the capacity to be also used to track fuel usage.

Add fuel usage, covering all plant and equipment that uses fuel, including vehicles, portable equipment powered with fuel, vessels, generators and incinerators. All FPCL operations in Suva, Luatoka and Levuka should have this data recorded.

Ideally historical data going back to 2017 will also be entered, so as to enable tracking of performance over time.

The adoption of more fuel efficient vehicles and streamlining of operations should result in fuels usage, and associated air pollution and carbon dioxide emissions, decreasing.

Data collection and reporting on greenhouse gas emissions

This activity involves inputting data on a monthly basis into the existing energy data spreadsheet, and using it to generate monthly reports for internal circulation, and annual public reports.

The spreadsheet should be configured to allow easy generation of these reports.

Installation of air quality monitoring

Air quality monitoring stations, monitoring particulates (PM 2.5) should be installed in wharf areas. As air quality measurements are highly dependent on local conditions, it is recommended that 6 monitoring points be established. These should be at:

- Suva: Kings wharf, Muaiwala 1, Muaiwalu 2, FSHIL;
- Lautoka: Queens wharf, domestic wharf.

These sensors should be configured to post data to a website which is password protected and accessible by FPCL staff.

Half yearly analysis of air quality data and reporting

Air quality in any location will depend on what pollution sources there are nearby as well as the direction of prevailing winds.

A monthly report should examine daily air quality measurements and ideally would track these against movements of vessels. At Kings wharf and Queens wharf this should be fairly easy to undertake. At the other wharfs this may not be practical.

Air quality could be expected to improve over time as the following is implemented:

- In larger vessels, a switch to low sulphur and cleaner fuel
- Adoption of fuel efficient operational practices by vessels
- Anti-idling policy for vehicles in port areas
- Introduction of shore power.

Monthly reports should be generated and circulated internally, and a annual report appeared for public release.

Identify key water quality measures and undertake regular monitoring

Sea water quality can be determined in a number of dimensions:

- Impact on swimmers: Bacterial indicators can be measured. Such as E.coli, faecal coliforms and enterococci. (any others?)
- Nutrient indicators (nitrogen and phosphorus), stimulating growth of phytoplankton, microscopic ocean plants, and reducing dissolved oxygen.
- Heavy metals, particularly mercury, lead and copper

In the past FNU has undertaken water quality testing and reporting, however the results have not been presented in a way that is meaningful to the port. There has been no commentary on whether the values reported are within acceptable limits or not.

Water quality monitoring is only valuable if it provides information as to whether the water quality, in the various dimensions outlined above, is within acceptable standards.

An example of a very good port water quality assessment can be found here: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5731693/ "Water quality assessment of Australian ports using water quality evaluation indices". This includes a detailed testing methodology, and the results are reported in the following way:

- Water quality index
- Contamination index
- Heavy metal evaluation index
- Environmental assessment
- Environmental water quality index

FPCL should start undertaking regular water quality testing, preferably twice a year, but at least annually. Ideally it would partner with a University which has the necessary equipment to undertake the testing at reasonable cost. Alternatively, it could seek to identify affordable instrumentation that enables it to at least report on basic measures of water quality, which could be expected to improve with better control and minimisation of pollution into harbour waters.

A staff member with a scientific background would need to undertake such testing.

Set up spreadsheet to track amount of general waste and recycled waste and generation of regular reports

To be able to determine whether improved waste management practices are delivering results, it will be necessary to establish a tracking spreadsheet, very similar to the energy tracking spreadsheet. This spreadsheet should track the following, recording both weights, volumes or bins as well as costs:

- general waste sent to landfill
- recycled plastic
- recycled cans
- recycled cardboard and paper
- recycled glass.

Effective waste management should result in the quantities of general waste sent to landfill decreasing, with recycling rates increasing. Additionally, costs should decrease, as the number of bins that needs to be picked up to go to landfill drops, while the revenues from selling recycled materials increases.

A monthly report should be generated for internal usage, comparing month on month performance. Annual reports for the public can also be produced, highlighting improvements and identifying the actions taken by FPCL to reduce waste.

Development of water tracking spreadsheet and regular reporting

To be able to determine whether improved water management practices, including smart metering, are delivering results, it will be necessary to establish a tracking spreadsheet, very similar to the energy tracking spreadsheet. This spreadsheet should track both water consumption and water costs. As with the energy spreadsheet, it would also be appropriate to show the consumption by tenants, and FPCL's net consumption.

And appropriately configured smart water meter network, with communications facilities inbuilt into the meters, should enable easy tracking and reporting, online, and it may not be necessary to set up a spreadsheet.

Monitor port cleanliness

In order to determine if efforts to reduce litter being effective, and to assess whether the public perceives the port has being clean, a survey should be undertaken regularly of port users. Such a survey should cover each wharf individually. The survey could be administered by the wharf attendees, following training.

A very simple survey suggested, with just one question, "how clean do you think this wharf is", with a rating scale from 1, being very dirty, through to 10, being very clean.

The survey should be undertaken before any efforts are made to reduce litter, and can form a baseline.

It is recommended that the survey be undertaken twice a year, and the results support reported on publicly.

Monitor port green space

The square metres of green space in each wharf area should be measured on an annual basis, and reported on. Additionally the health of the green space should be assessed: "Are the plants in the green space healthy?" A rating scale, say from 1 to 5, could be used to rate the health of the green space.

This can be reported on annually in a public report.

ANNEXE B: Activity Spreadsheet

Refer to the accompanying spreadsheet, GreenPortActivityList.xlsx

Use filters and/or pivot tables to sort and arrange data in it.