Going Green

A Blueprint for a Sustainable Secretariat

GHG Emissions Report & Recommendations
for the **Pacific Islands Forum Secretariat**

PACIFIC ISLANDS FORUM SECRETARIAT

Excelling together for the people of the Pacific

Acknowledgements

This report was prepared in early 2013 for the Pacific Islands Forum Secretariat by Nick Wardrop of Sunergy Consulting, with input from Secretariat staff including; Dr Willy Morrell, Ms Jessica Darmayan, Gibson Wekina, Sailosi Uaniceva, Sakiasi Ditoka, Joana Koroirokotuibau, Coral Pasisi, Seini O'Connor, Tavai Bale, Exsley Taloiburi, Steven Francis, Ashwin Permal, Jioji Boila, Scott Hook and Mereseini Senikau Tuivuniwai. Independent report editing services were provided by Ms Seone Smiles.

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Nicholas Wardrop, Sunergy Consulting, June 2013

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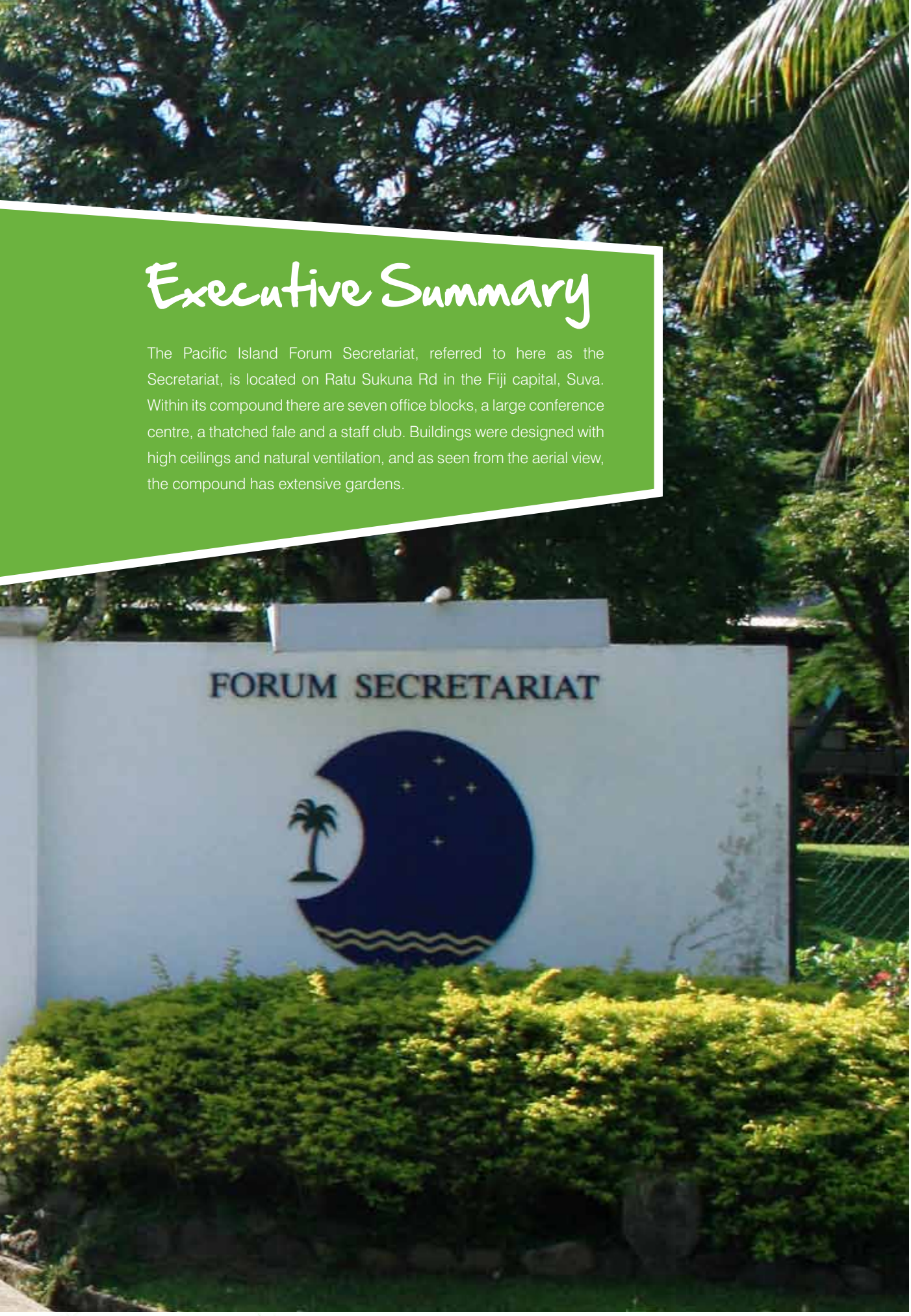
Acronyms and Abbreviations

AC	Air-Conditioner
AWT	Alternative Waste Treatment
CCA	Corporate Carbon Advisory (Australia)
CFL	Compact Fluorescent Lamp
DSM	Demand-Side Management
EC	Energy conservation
EE	Energy efficiency
FEA	Fiji Electricity Authority
FTL	Fluorescent Tube Lamp
GHG	Greenhouse Gas
GW	Green Waste (biomass)
HH	Household
LED	Light Emitting Diode
PICs	Pacific Island Countries
PIFS	Pacific Islands Forum Secretariat
PV	Photovoltaic (solar electric)
RE	Renewable Energy
TC	Tropical Cyclone
UPS	Uninterruptable Power Supply
VAT	Value Added Tax (15% in 2012)
WBCSD	World Business Council for Sustainable Development
WRI	World Resources Institute
4WD	Four Wheel Drive (vehicle)

Executive Summary

The Pacific Island Forum Secretariat, referred to here as the Secretariat, is located on Ratu Sukuna Rd in the Fiji capital, Suva. Within its compound there are seven office blocks, a large conference centre, a thatched fale and a staff club. Buildings were designed with high ceilings and natural ventilation, and as seen from the aerial view, the compound has extensive gardens.



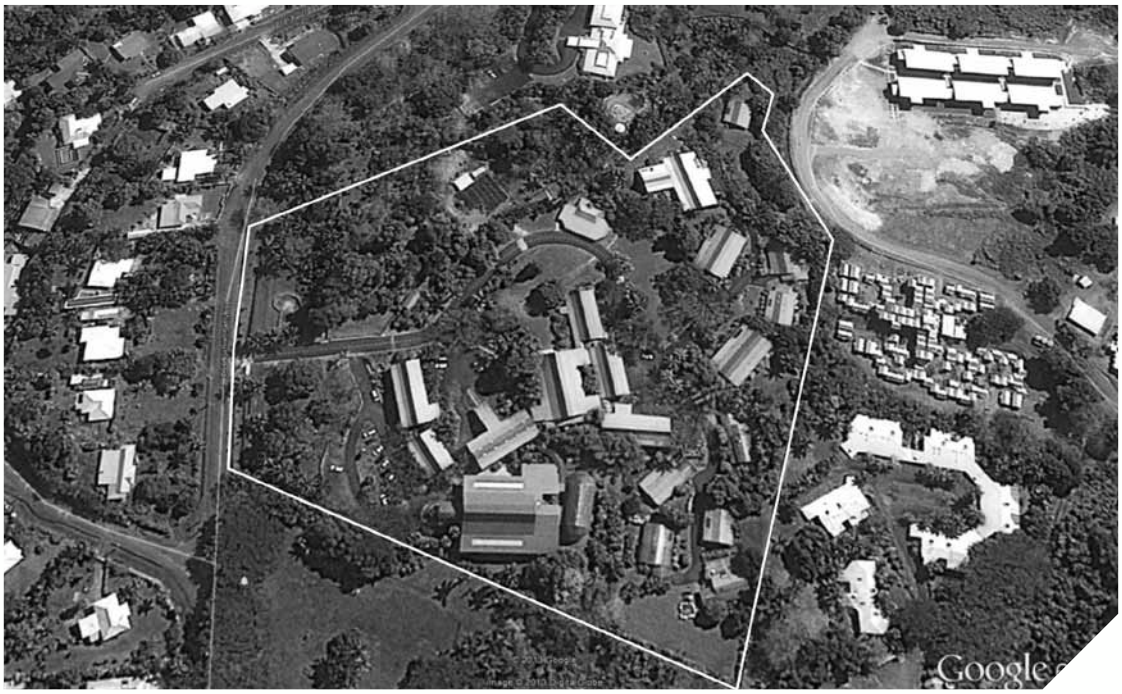


Figure 0.1: Aerial view of the Secretariat Compound (within white boundary)

Scope of the Study

The consultant was to identify, quantify and outline methods to reduce the Secretariat's Greenhouse Gas (GHG) emissions. It was considered that such action aligned with corporate responsibility, offered opportunities to reduce operating costs, and set an example for major GHG emitters, Forum member countries and other representative bodies.

The consultant has broadly quantified the Scope 1, Scope 2 and some Scope 3 GHG emissions as defined later in the report, and has developed a Green Office Policy.

The consultancy was to fulfil the following tasks:

1. Review and report on current Secretariat operational practices on resource use in collaboration with Secretariat staff. This was to include energy and resource use, and waste treatment leading to GHG emissions on-site (Scope 1), energy and water use purchased off-site with GHG emissions off-site (Scope 2), and staff air and road travel both international and domestic, and waste treated off-site (Scope 3).
2. Build on the results of a recently completed electricity audit to determine as far as possible the Secretariat's associated GHG emissions, together with recommendations to reduce them. The main report was to cover these two tasks.
3. Based on the results of this review, develop a 10 page Green Office Policy clearly mapping a series of recommendations to reduce the Secretariat's ecological footprint. This policy is published separately.

This Consultancy Report includes:

a. Current base GHG profile, showing the contribution from various sectors
b. Recommended efficiency and other measures showing expected reductions in energy consumption and GHG emissions. This includes reductions in onsite burning of fossil fuels, Energy Conservation (EC) and Energy Efficiency (EE) measures to reduce electricity and water use including Renewable Energy (RE) and rain harvesting technologies, onsite treatment of green wastes, and travel reduction measures.

Methodology

The consultant was able to have initial planning discussions with the Secretariat's newly established Green Office Working Group at the start of the GHG audit process in December 2012, but work was unfortunately hindered by Cyclone Evan. However, missing data was gathered from Secretariat accounts where possible by an intern, with guidance of senior officers of the Strategic Partnerships and Coordination Programme. In many cases, however, this was only cost data and did not include specific information about quantities, so estimates had to be made.

The Secretariat provided a base electrical energy audit (2010 and 2011) which was extended to 2012 by the consultant with the assistance of the Secretariat, with data on electricity costs and taxes added. Emissions for travel were calculated from basic travel data derived from the past four years, producing a valuable spreadsheet showing route, travel distances and GHG emissions.

Major Findings

The major areas of GHG emissions listed here from highest to lowest volume were:
(1) staff air travel,
(2) electricity use,
(3) emissions from ground-keeping equipment and vehicles, and
(4) offsite anaerobic composting of green waste (GW).

In calculating these emissions, where there was a range of values possible, such as for electricity generation in dry or wet years, the highest value has been taken. The time allocated for the study was limited and the data found was patchy. Accordingly, emissions calculations should be used only as indicative, as they could vary by as much as -50% to +100% in some cases, especially for vehicles and green waste. As data collection practices improve, the accuracy of these estimates will also improve. It is noted that insufficient data was available to calculate 'procurement' related emissions at this time.

Table 0.1: Secretariat GHG emissions (2010 – 2012) – Tonnes CO_2e per annumw

	Scope 1			**Scope 2**		**Scope 3**		**Total**
	Groundskeeping, Vehicles	Genset	Green Waste onsite	Electricity	Water	Air Travel	Green Waste offsite	
2010	100	3	6	190	13	440	100	852
2011	100	3	6	200	14	480	100	903
2012	100	3	6	180	12	570	100	971
Scope	**11.2%**			**19.8%**		**69.0%**		**100%**

Data was not available for the highlighted cells, so missing values for 2010 and 2011 were calculated from the average of years with data. Represented graphically, greenhouse gas (GHG) emissions for 2012 are shown in Figure 0.2 as a percentage breakdown;

PIFS GHG Emissions (2012)

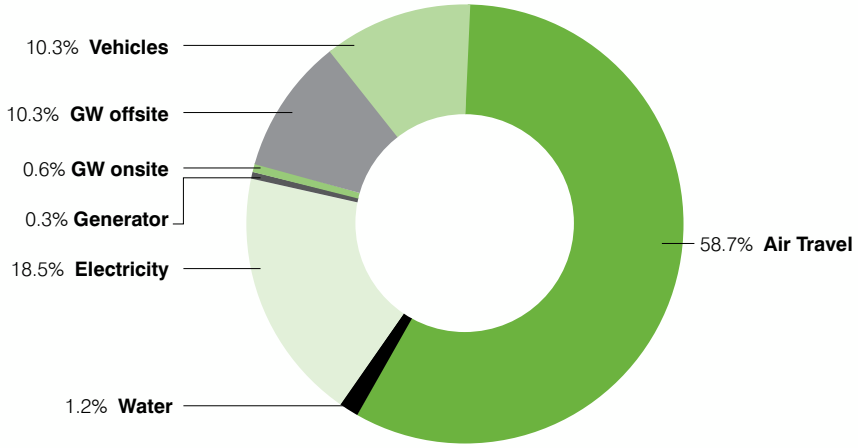


Figure 0.2: Secretariat GHG emissions by source

Conclusions and Recommendations

It should be possible to halve emissions within a few years, perhaps less than five years, provided a budget is allocated and a commitment made to the program. To check progress, procedures should be put in place to gather data in a form that can facilitate accurate tracking of key sources of emissions including:

Staff travel - record mode (including road), stop overs and distance travelled.
Electricity use – record energy use (kWh), tariff and usage zones
Water use - record volume (kL) and tariff with fire levy noted separately
Secretariat vehicles, ground keeping equipment and the emergency generator – logbooks should be used to record distance travelled (km) , hours run, fuel used in litres, service dates and details;
Waste use - record waste treated onsite (kg) and offsite (kg) on a monthly basis.

A first step to reducing GHG emissions as a matter of priority should be:

1. Using audio/ video conferencing, back to back meetings and purchasing carbon offsets for unavoidable travel
2. Facilitating building efficiency upgrades, Energy Conservation and Energy Efficiency measures, and lastly Renewable Energy additions to reduce electricity use
3. Upgrade vehicle and groundskeeping equipment at replacement to fuel efficient and/or electric/hybrid versions
4. Treat more green waste onsite

Other initiatives that would reduce GHG emissions and demonstrate greenhouse gas reduction techniques, are:

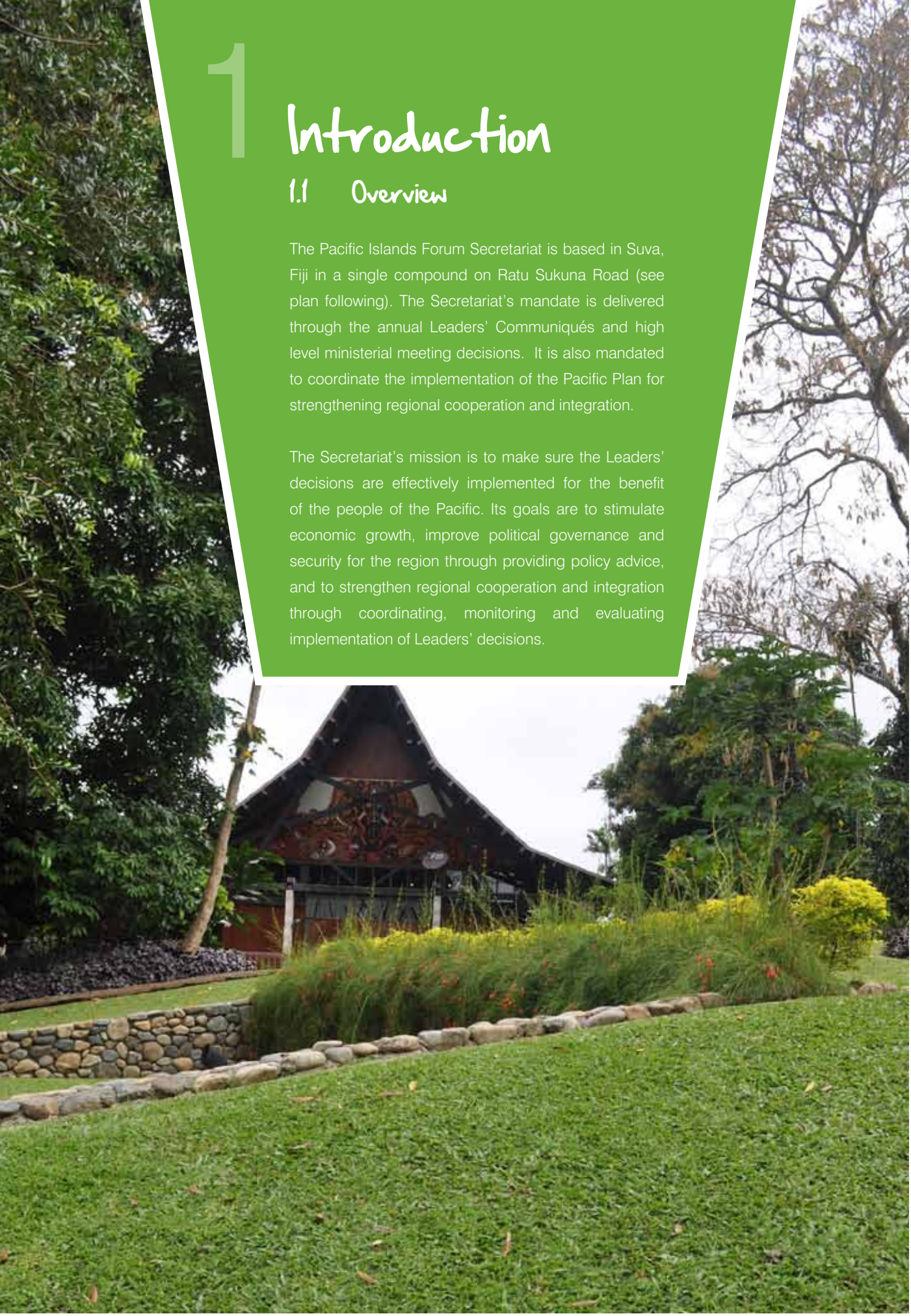
1. A stand-alone renewable energy system on the Malolo Bure for power and water in the event of cut offs.
2. Rainwater harvesting
3. Grid Connected PV on the main entrance canopy

1 Introduction

1.1 Overview

The Pacific Islands Forum Secretariat is based in Suva, Fiji in a single compound on Ratu Sukuna Road (see plan following). The Secretariat's mandate is delivered through the annual Leaders' Communiqués and high level ministerial meeting decisions. It is also mandated to coordinate the implementation of the Pacific Plan for strengthening regional cooperation and integration.

The Secretariat's mission is to make sure the Leaders' decisions are effectively implemented for the benefit of the people of the Pacific. Its goals are to stimulate economic growth, improve political governance and security for the region through providing policy advice, and to strengthen regional cooperation and integration through coordinating, monitoring and evaluating implementation of Leaders' decisions.



The Secretariat employs some 106 professional and support staff and covers the areas of Political Governance and Security, Strategic Partnerships and Coordination, Economic Governance, all supported by a Corporate Services Unit.

For many years Forum Leaders have expressed deep concern about the impacts of climate change and global warming on their countries, and are applying mitigation and adaption measures, despite their relatively small global contribution to GHG emissions (0.03%).

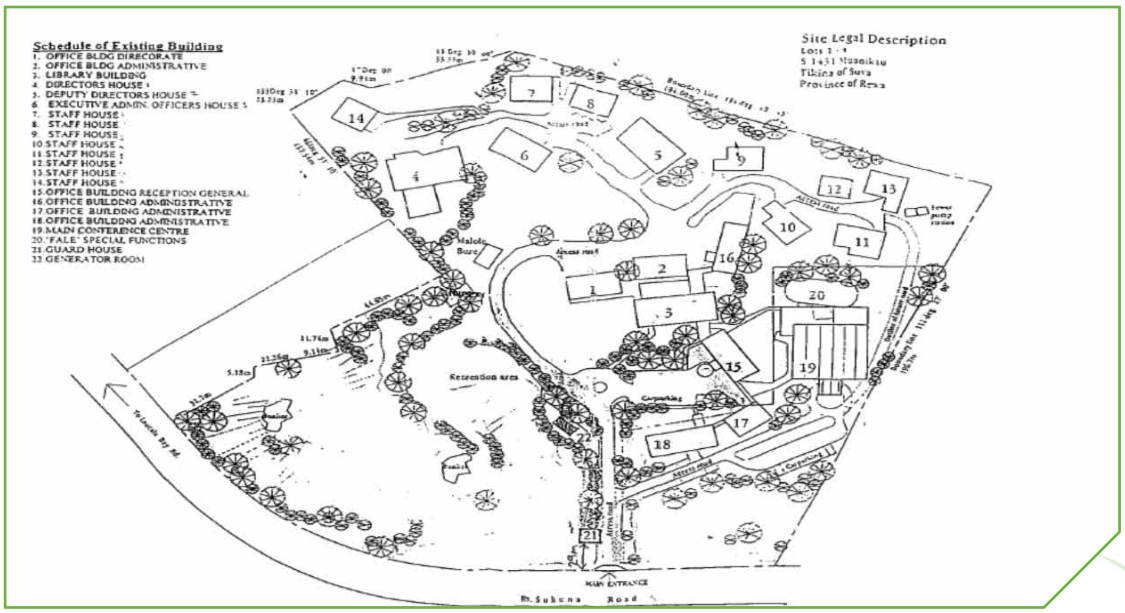


Figure 1.1: Plan of Secretariat Compound showing building layout

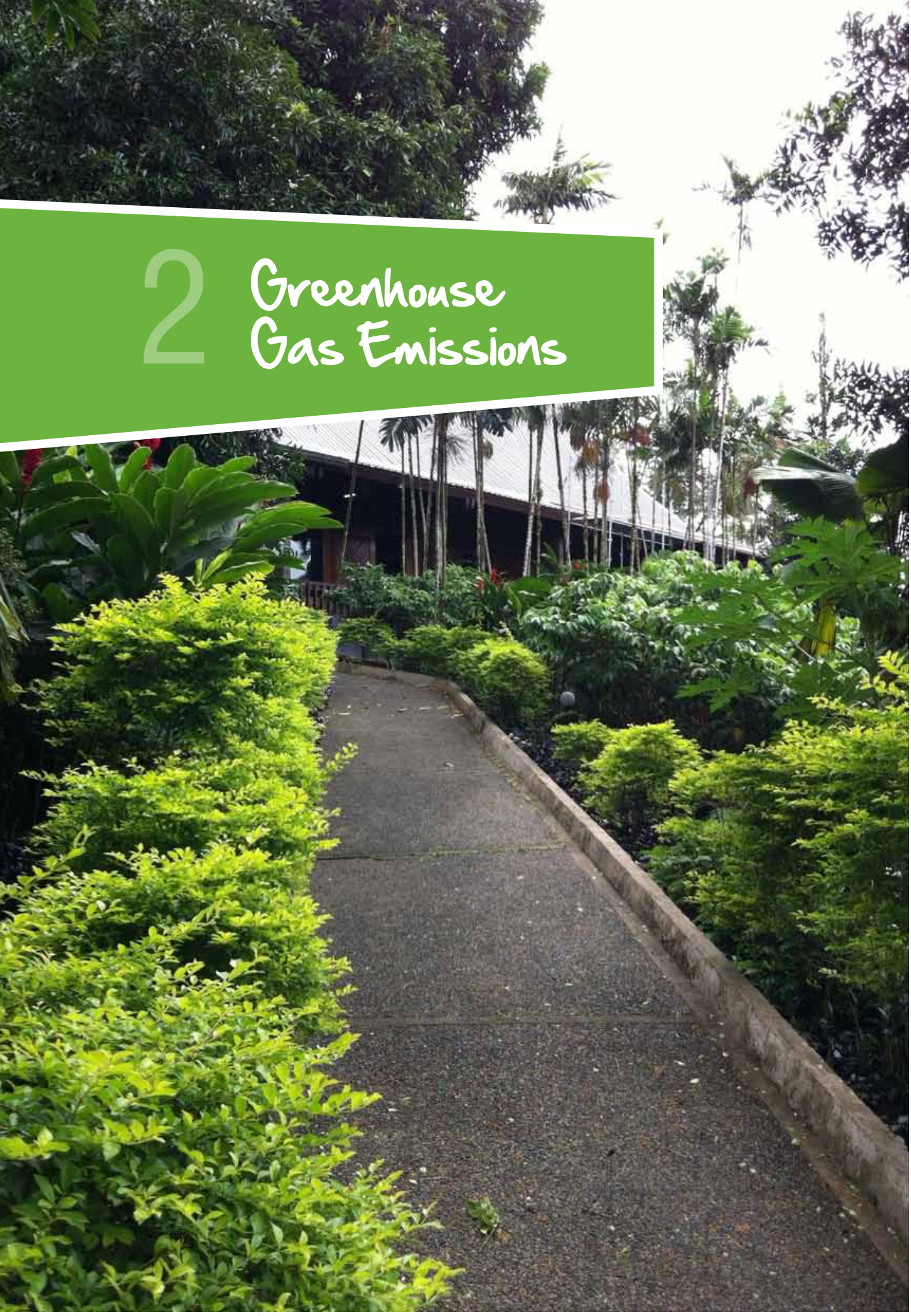
1.2 Objectives

The Secretariat's objective seeks to identify, quantify and recommend ways to reduce these greenhouse gas emissions, offers opportunities to reduce operating costs, and set an example for major GHG emitters, Forum member countries and other bodies.

1.3 Approach and Methodology

The approach and methodology was restricted by limited time and the scale of the project:

1. The consultancy was to be largely desk based and built on the previous electrical energy audit undertake by Dr. Willy Morrell in early 2012. It was to involve a comprehensive on-site visit to the Secretariat compound.
2. The proffered assistance of officers of the Secretariat, including an intern within the Strategic Partnerships and Coordination Programme was gratefully accepted and worked well.
3. Discussion of the draft Green Office GHG report and Green Office Policy with the Secretariat's staff provided useful feedback on the findings and recommendations.



2 Greenhouse Gas Emissions

2.1 Overview

Before this consultancy there was little baseline information about the main sources and magnitudes of greenhouse gas emissions from the Secretariat. They were expected to include direct energy use from electricity and fossil fuels to power services on compound, local and international travel, the use of water and other consumables such as paper, and the treatment of wastes. Most of these areas were considered, but consumables, sewerage wastes and road travel were not.

Although there are six recognised GHGs under the Kyoto Protocol, this report mainly considers Carbon Dioxide (CO_2), except where the other gases are significant, such as from small engines or the composting of biomass. The other five GHGs are Methane (CH_4), Nitrous Oxide (N_2O), Hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs) and Sulphur Hexafluoride (SF_6). There are also others such as Chlorofluorocarbons (CFCs) and Nitrogen Oxides (NOx).

Where possible, three years of data was used to reduce inaccuracies due to yearly variations. The GHG Protocol's Corporate Accounting and Reporting Standard was used as a guide (see www.ghgprotocol.org). Some data was simply not available and broad estimates were necessary.

Most Secretariat operations, apart from officers' travel, are based in the compound. Historically, other organisations have rented space in the compound and where possible their contributions to GHG emissions have been subtracted, along with household contributions from residential properties in the compound.

The report has endeavoured to follow the GHG Protocol's emission divisions as follows:

Scope 1 – direct emissions on-site such as from purchased fuels, composting of wastes
Scope 2 – indirect emissions (off-site) such as the purchase of electricity, water use
Scope 3 – other indirect emissions such as from travel, waste disposal off-site, goods.

Accounting for Scope 1 and 2 is relatively straightforward and is accepted as a minimum for GHG reporting. Scope 1 emissions are on-site and are easier to monitor directly because the organisation has control. Scope 2 emissions are from larger providers such as for electricity and water, emission factors are usually well documented. Accounting for Scope 3 emissions is more involved because it covers a myriad of small systems. Under Scope 3 only air travel and green waste disposal off-site was considered.

As the most recent complete year of data was 2012, it was chosen as the base year. Although from a Greenhouse Gas emission perspective, 2010 or 2011 were lower and would have been better as a base, but were harder to show improvements against.

2.2 Scope 1 Emissions

These GHG emissions are defined as direct emissions coming from sources owned or controlled by the organisation, and are generally on-site, such as those from the burning of fossil fuels, for example in motorised gardening equipment, the emergency generator and gas stoves, the composting of wastes and, it could be argued, the use of Secretariat owned vehicles.

2.2.1 Emissions from Vehicles and Groundskeeping Equipment

The Secretariat had only three vehicles - a 4WD, a station wagon and a light truck and distances travelled were not extensive. But it has extensive gardens covering an 18 hectare site, employing approximately six groundsmen. There were high emissions from groundskeeping equipment that could be reduced without decreasing service levels. The equipment was generally petrol powered and used two stroke fuel.

2.2.2 Emissions from Emergency Generator

The Secretariat had an emergency generator on-site used during power blackouts, such as planned line maintenance by FEA or unplanned outages.

2.2.3 Emissions from Green Wastes Onsite

At the time of this survey some green waste was composted on-site, but chipping and other equipment necessary to reduce waste going to landfill was not available, so most green waste was trucked off-site (Scope 3). Meanwhile, to maintain the compound grounds and to make potting mix and soil for the nursery, many ingredients were purchased from off-site at considerable expense when they could have been made from existing green waste.

2.3 Scope 2 Emissions

These GHG emissions are defined as indirect emissions coming from sources purchased from outside the Secretariat operational boundaries, and so are generally off-site emissions relatively easy to account for, such as purchase of electricity and water. To make future GHG audits easier, data should be captured in the form of energy use (kWh) and water use (kL).

2.3.1 Emissions from Electricity Consumption

Electricity production on the main island of Viti Levu, where Suva and the Secretariat are located, is mostly from hydro electricity with some diesel supplement, the amount of which depends on whether it is a wet or dry year, with more diesel power being used in dry periods. Emissions may vary from 0.3 kg CO_2/kWh in a “wet” year to 0.6 kg CO_2/kWh in a “dry” year. Years 2010 and 2012 were within this range at around 0.5 kg CO_2/kWh. 2010 was calculated from FEA 50:50 hydro/diesel mix, allowing 20% for transmission and distribution losses and emissions from their vehicles. 2012 information was not released at the time of writing this report, but is estimated to be similar.

2.3.2 Emissions from Water Use

Water must be stored, treated and pumped to site, and in the case of waste streams, pumped away, treated and disposed of. Potable water from the mains was used for drinking, cooking, washing, flushing and for watering. While only the first two applications really need potable water, and perhaps the third depending on the quality of non-potable water, flushing and watering can use “grey” or untreated water provided it is of reasonable quality. The emissions from waste water treatment were not considered.

2.4 Scope 3 Emissions

These GHG emissions are defined as "Other" indirect emissions coming from sources purchased from outside the Secretariat's operational boundaries, and as off-site emissions are more difficult to account for. This may include staff travel, both nationally and internationally, by road, air or sea, outsourced activity such as the use of consultants, embodied emissions in the use of manufactured products, and from disposal of wastes.

Given the limited time, only business related air travel was considered as it appears that this is the major GHG emitter for the Secretariat. Secretariat staff do not generally commute long distances, but do engage in substantial overseas travel for the work program.

2.4.1 Emissions from Travel

As in all regional organisations, Secretariat staff routinely travel within the region and internationally to represent the organisation and deliver assistance to Members. Participants from member countries and territories are also sometimes required to travel for regional activities. Estimates of the distance travelled by Secretariat staff and the corresponding GHG emissions have been calculated, but none were made for Secretariat-sponsored participants. Travel emissions depend largely on the type of aircraft, age, level of occupancy, and length of flight, noting that take-off and landing use more fuel than operation at cruising altitudes.

2.4.2 Emissions from Green Waste Trucked Offsite

Quantities of the large amount of green waste trucked off-site from the compound were estimated. Much of this waste could be composted on-site to reduce emissions (aerobic versus non-aerobic composting) and to reduce the materials groundskeeping staff need to buy to maintain the nursery and gardens.

2.4.3 Emissions from Procurement

The major consumable at the Secretariat appears to be printing paper, but because there was a large stockpile of paper, records were unavailable to indicate annual usage.

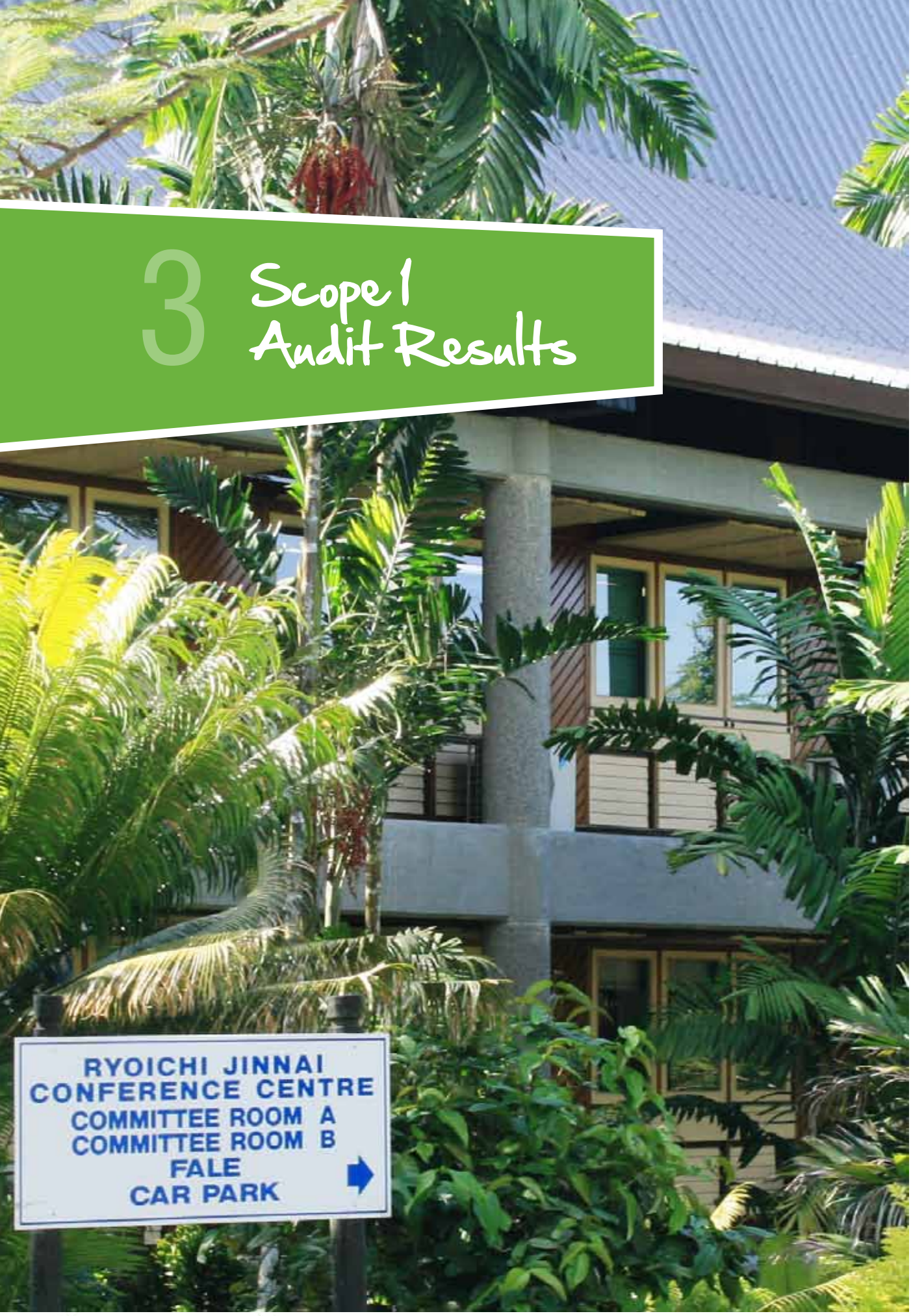
Other consumables include printer cartridges. These can be recycled, however no data on cartridge use was available at the time of this study.

Food and drink bought for Secretariat functions should be locally produced where possible, nutritious, and transported and served using recyclable or biodegradable containers.

Packaging should be minimised and be recycled or biodegradable.

Purchased goods should be considered for lowest amount of energy used for the items' useful lifecycle, they should be rebuildable or recycleable, so as to ensure GHG emissions are minimised.

All regularly used consumables should be tracked for more detailed analysis.



3 Scope 1 Audit Results

3.1 Vehicle and Gardening Equipment Emissions

The three vehicles owned by the Secretariat were:

PIFS 1 – Secretary General; Toyota Landcruiser Prado (2.9 L turbodiesel, 2011 model).
PIFS 2 – Staff Use; Toyota Corolla Station Wagon (1.8 L petrol, 2006 model).
PIFS 3 – General Use; Toyota Dyna 2 tonne truck (3.0 L turbodiesel, 2010 model).

Groundskeeping equipment that was owned, and operated by Secretariat groundsmen.

4 x Victa 460 mowers
5 x Brushcutters (3 Kawasaki TH034, 2 Champion)
2 x Chainsaws (both Stihl, one with standard cutting bar, other with pole extension cutting bar)
1 x Leaf Blower (Stihl)

3.1.1 Audit Results

Fuel used by the Secretariat was logged only by price. In future it should also be recorded by volume (litres), as prices vary widely, making it difficult to calculate volumes, and estimate emissions. Modern vehicles with catalytic converters have very little in the way of emissions other than CO_2, provided they are well maintained.

In the case of the vehicles, some estimates were made from fuel purchases. In the absence of exact data on fuel use and distance travelled per year, a broad estimate was made by noting the vehicle model year, taking the odometer reading, and assuming distances travelled were the same for each year.

Consultation with the head groundsman determined that grass is cut fortnightly, all year, and that in general, 5 x 200 L drums were used annually, with one 100 L drum of two stroke oil. It was hoped to confirm these estimates through accounting records. However, fuel records from accounts did not agree, showing 2 x 100 L drums of premix were used in 2010, with years 2011 and 2012 not showing any purchase. It was eventually confirmed that three lawnmowers and three brushcutters were used concurrently each fortnight.

It is well documented that small engines are very significant polluters due to emissions caused by lack of pollution controls, mainly unburnt Hydrocarbons, NOx and others such as Carbon Monoxide (CO), and often lack of good maintenance. The average mower can produce 40 times as much GHG as a small car in an hour of operation.

3.1.2 GHG Emissions

For the Secretariat vehicles, distance travelled and corresponding emissions were estimated at 6,750 kg CO_2/annum, or approximately 6.8 tonne CO_2/annum as follows:
PIFS 1 - 9,835 km over 2 years @ 0.25 kg CO_2/km = 1,250 kg CO_2/annum.
PIFS 2 - 72,974 km over 7 years @ 0.20 kg CO_2/km = 2,100 kg CO_2/annum.
PIFS 3 - 23,842 km over 3 years @ 0.30 kg CO_2/km = 2,400 kg CO_2/annum.

For the Secretariat groundskeeping equipment, three mowers were used for 2.5 days each fortnight, for 6 hours per day = 7.5 hours per week each. This amounts to a total of 22.5 hours per week, or 1,170 hours per year.

In the case of brushcutters, three were also used for 2.5 days per fortnight, for 6 hours per day or 15 hours per fortnight each, or 7.5 hours per week. This also amounts to a total of 22.5 hours per week, or 1,170 hours per year.

For the blower, this was used for 2 days per week, for 6 hours per day or 12 hours per week, or 624 hours per year. Assuming the blower has a similar sized engine to the brushcutters, emissions will be the same, so a total of 34.5 hours per week, or 1,794 hours per year (say 1,800).

1,170 h per year mowers @ 50 kg CO_2e/h = 58,500 kg CO_2e/annum, or 58.5 tonne CO_2e/annum
1,800 h per year brushcutters @ 20 kg CO_2e/h = 36,000 kg CO_2e/annum, or 36.0 tonne CO_2e/annum
Vehicles at 6.8 tonne CO_2e/annum

Total emissions for the Secretariat vehicles and groundskeeping equipment was 101.3 tonne CO_2e/annum (rounded to 100 tonne CO_2e/annum).

3.1.3 Recommendations

There are a number of ways GHG emissions can be reduced from internal combustion engines in vehicles and gardening equipment. In the case of vehicles;

- **Reduce** distances covered by vehicles by trip planning and wait for full loads rather than making many trips with smaller loads.
- **Service regularly,** keeping tyres inflated to the correct pressure, keeping speeds down, and avoiding hard acceleration and braking.
- **Replace** with more efficient vehicles when upgrading (smaller engines, newer vehicles).
- **Electric vehicles** upgrades, such as the General Motors/ Holden "Volt" or a small electric truck such as the e-Ride "EXV2". If charged using renewable energy, emissions are very low, below a quarter of a comparable fuel efficient vehicle.

GHG emissions were much greater from the groundskeeping equipment, as they were run for longer periods because of the large size of the compound, and since small engine emissions were so much greater per hour than a well-maintained modern vehicle.

In the case of groundskeeping equipment, GHG emissions can be reduced by;

- **4 stroke equipment** upgrades with emissions controls where possible. Bigger engines may be needed to cope with heavy cutting, and/or
- **Battery Electric Mower** upgrades such as the Hustler Zeon rideon mower, or the Black and Decker SPCM 1936 self propelled mower; and upgrades such as the Stihl cordless power system series for brushcutters, chainsaws and blowers that are now made possible by advances in lithium battery technology. Spare batteries can be kept on charge for quick exchange and increased run times. Capital costs are higher although a big advantage is lower operating noise and lower maintenance costs, as well as lower GHG emissions.

The use of **'logbooks'** in each vehicle and for each piece of groundskeeping equipment should be encouraged to assist in making future GHG auditing more accurate. These logbooks should record distances, fuel purchases and other important information including what servicing was done, odometer distance or hours run, fuel cost, volume, date and place of purchase and any equipment checks carried out.

3.2 Emergency Generator Emissions

The Secretariat Compound has an emergency generator of 160 kW capacity in case of loss of power from FEA. There was sufficient fuel tank capacity, reported to be 250 litres, to operate this generator at close to half load for more than 11 hours on a full tank. Actual possible run times on a tank may be longer, as it is unlikely that it will operate at over half load for much of the time.

3.2.1 Audit Results

On average, it was mentioned that 20 drums, (2000 L) of diesel were bought for the generator every year. This was not confirmed by purchase records which showed an estimated five 200 L drums at F$2 per litre of diesel were purchased in 2012. Accounting records would imply this is in line with around two days or 48 hours of use for the generator each year. These drums were stored in the Generator Room with other fuel and lubricants.

Usage is believed to be extremely variable, as in years where cyclones impact Suva, run times can be many days or in rare cases even weeks, as in the case with Tropical Cyclone Kina in 1993.

3.2.2 GHG Emissions

For this size of generator, running at 50% load, fuel consumption was around 22 litres/ hour, and produced around 59 kg CO_2/h (a litre of diesel produces 2.67 kg CO_2). A figure of 65 kg CO_2/h was used to allow for losses.

48 h per year @ 65 kg CO_2/h = 3120 kg CO_2/annum = 3 tonne CO_2/annum

3.2.3 Recommendations

There are many ways of improving diesel generator performance, including

- **Regular** servicing
- **Correct** sizing ensuring the diesel is not oversized, or fully utilise the output power.
- **Renewable Energy** systems could be installed for critical loads (not air conditioning or bulk heating loads), and resize to a smaller diesel generator as backup.

Improve fuel storage: The observed storage of fuel was unsafe from a number of perspectives. It was a fire hazard and the fuel should be moved elsewhere. The storage facility was not protected by a physical bund and therefore poses a potential contamination threat if a drum were to leak or rupture. It is recommended that a securely fenced and bunded storage area such as an elevated fuel tank be constructed close to the generator room. This area could also have a small shed to contain fuel and lubricants for small engine devices such as mowers and brushcutters.

Logbooks: As with vehicles, there should be a similar logbook for the emergency generator, and Accounts can assist by recording costs and volume of diesel for the emergency generator.

3.3 Green Waste Emissions Onsite

Dialogue and a tour of the gardening site with the Head Groundsman enabled a broad assessment of the biomass waste generated in the Secretariat Compound. With the unplanned visitation by Tropical Cyclone Evan, there was a large peak in green waste which had to be trucked to a waste facility offsite. Given the large size of the Secretariat grounds (18 hectares), it was surmised that green waste was the largest producer of biomass. However, green waste emissions need to be split into two categories, that treated onsite (Scope 1 emissions), and those treated offsite (Scope 3 emissions). Onsite emissions were considered here.

3.3.1 Waste Audit Results

The estimate by the Head Groundsman was that around 12,000 kg per year were composted onsite, or an average of 1 tonne per month.

It was also estimated that F$10,000 per year was spent on materials to make potting mix and other soil conditioners and mulches for the compound.

3.3.2 GHG Emissions

The emissions from green waste were extremely difficult to quantify, as the emissions depended on many variable factors which change year to year, month to month depending on the makeup of the waste (how wet it was, and how much oxygen was used during decomposition which determined the proportion of aerobic to non-aerobic composting). From a survey of the literature, it was assumed around 0.5 kg CO_2e/kg wet waste was emitted.

12,000 kg @ 0.5 kg CO_2e/kg = 6,000 kg CO_2e/annum or around 6 tonne CO_2e/annum.

3.3.3 Recommendations

Covered in detail in section 5.2 - the diversion of green wastes trucked off-site to landfill, to onsite aerobic composting on the Secretariat compound.

4 Scope 2 Audit Results

4.1 Electrical Energy related Emissions

Electricity used on the Secretariat site is generated mainly from Monasavu and Nadarivatu hydroelectric schemes, supplemented by diesel powered generators in times of high demand or low water storage during drought situations.

4.1.1 Energy Audit Results

An Energy Audit of the Secretariat compound was undertaken by the Natural Resources Adviser, Dr Willy Morrell in 2010/2011 and the results presented in early 2012. They were further refined and extended to include the year 2012. Comparison with Fiji Electricity Authority billing for the period 2010 – 2012 showed that although costs had risen due to tariff increases, energy use had fallen slightly (see Figure 4.1). Analysis showed that the major energy user was air-conditioning, followed by lighting and office equipment. Household (HH) and external agency use was subtracted from the total billing, to give Secretariat office use[1] only.

The observed energy use reduction was most likely a direct result of lower occupancy due to outside organisations leaving and office space being converted back to housing. There may have been some reductions due to conservation efforts by staff, however this is was not supported by observed staff practices.

Over the same period, tariffs increased by 62.5% for usage over 1 5 MWh = 15,000 kWh per month, including the rise in VAT from 12.5% to 15% on 1 January 2011.[2]

There were considerable opportunities to further reduce electrical power consumption within the Secretariat as covered in Annex A, including:

i) Conservation measures by staff such as keeping AC temperatures to a reasonable 25°C
ii) Efficiency measures such as replacement of old appliances with high efficiency ones
iii) Improvements in the building envelope such as improved insulation and lower infiltration
iv) Switching services, such as moving from air conditioning to fans and natural ventilation.

Secretariat Energy Use and Cost 2010 - 2012

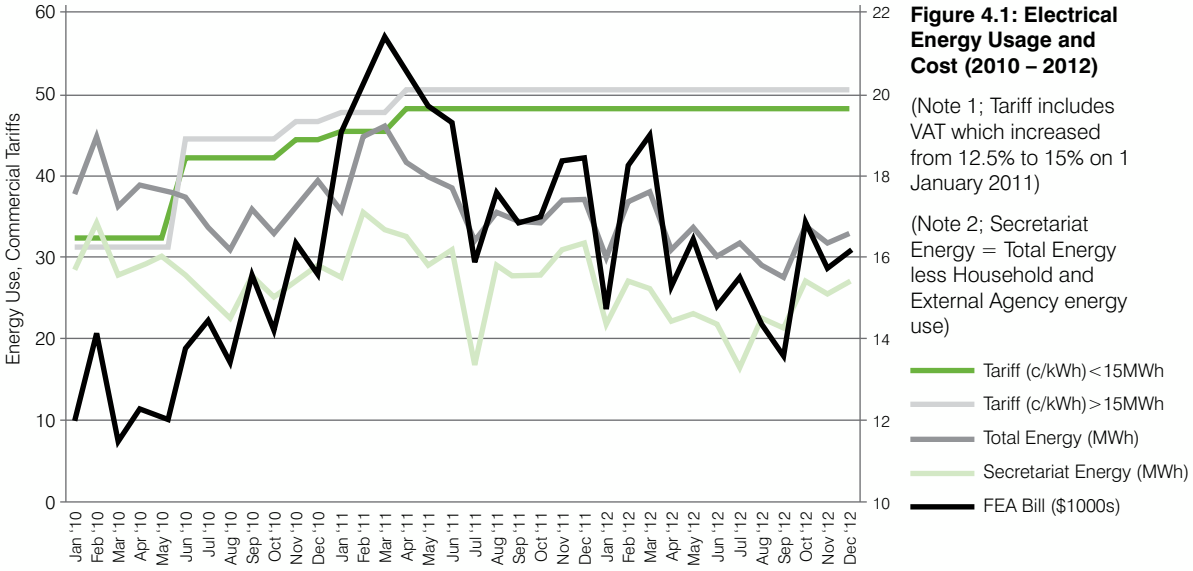


Figure 4.1: Electrical Energy Usage and Cost (2010 – 2012)

(Note 1; Tariff includes VAT which increased from 12.5% to 15% on 1 January 2011)

(Note 2; Secretariat Energy = Total Energy less Household and External Agency energy use)

[1] shown as "Secretariat Energy Use" on following graph - for 2012, 2011 HH data was used in absence of 2012 HH data.
[2] VAT was a cost to the Secretariat (as were other government taxes and charges), so tariffs used for analysis included VAT.

Commercial electricity tariffs charged by the Fiji Electricity Authority were split into tariffs below 14,999 kWh per month (14.9 MWh/m), and tariffs above 15,000 kWh/ month (15.0 MWh/m). Prior to mid 2010 the marginal cost for large users to consume more power was less than that for small users (32.23 c/kWh if <14.9 MWh and 31.13 c/kWh for >15.0 MWh). However in an effort to encourage consumers to conserve, this was reversed in mid 2010, with tariffs at the end of 2012 of 48.3 c/kWh if <14.9 MWh and 50.6 c/kWh for >15.0 MWh.

The monthly averages of the Secretariat's electricity bills calculated over the three year period from 2010 to 2012 (Figure 4.2) shows quite clearly that electrical energy consumption generally follows average annual temperature, not surprising since the energy audit identified air-conditioning as the major energy user. Consumption was highest in the warmer months from November through April, with a dip in January most likely due to low occupancy in the Christmas holiday period. The lowest consumption was in the coolest months (May - October).

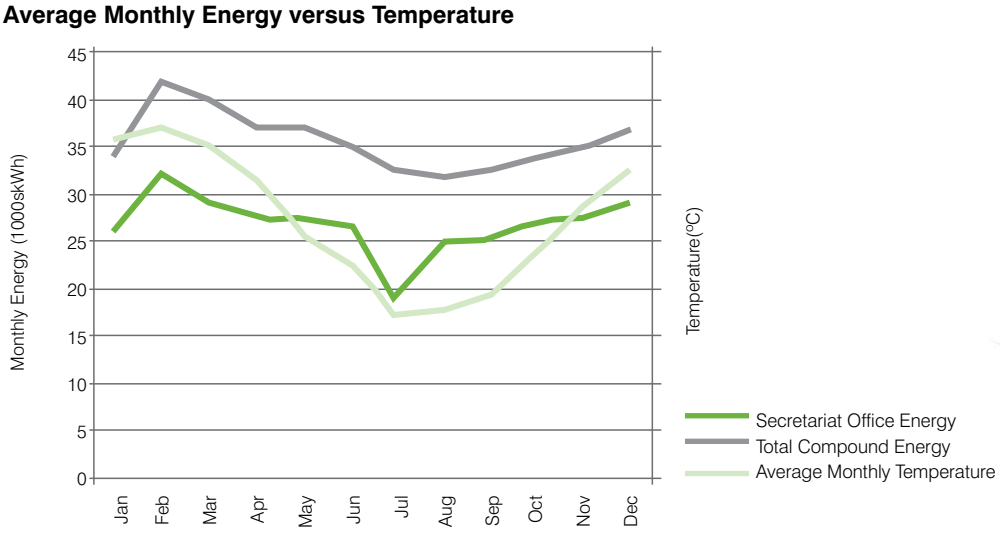


Figure 4.2: Monthly average of Energy Use vs Temperature (2010 – 2012)
(Note: Monthly Energy Average from 2010 – 2012)

Despite the slight decline in the Secretariat's overall power consumption, the electricity bills have remained high due to the electricity tariff increases over the years (see Figure 4.1). There are likely to be further increases in electricity tariff, especially if drought years result in the increased use of diesel generation to supplement Fiji's hydroelectric power, in which case electricity costs will increase further unless energy conservation and efficiency practices are implemented. Decreases in electrical energy costs will occur if savings from reduced consumption are more than the tariff increases.

4.1.2 GHG Emissions

It was difficult to put an exact value on GHG emissions due to electricity consumption, as these depended largely on the mix of hydro power to diesel power. Unfortunately FEA does not publish figures on their annual CO_2 emissions. The amount of CO_2 produced per kWh generated varies from 0.3 kg CO_2/kWh in 'wet' years to 0.6 kg CO_2/kWh in 'dry' years when more electricity was generated using diesel fuel. As previously mentioned in section 2.3.1, 0.5 kg CO_2/kWh was used for 2012.

In 2012 the monthly averages for Secretariat office energy use were around 25,000kWh/month or 300,000kWh per annum. GHG emissions were therefore 150 tonnes CO_2 per annum.

4.1.3 Energy Conservation

Energy Conservation (EC) involves changing behaviour to use less energy. Given that air conditioning uses the most energy on the Secretariat compound, simple methods of reducing energy use, in order of effectiveness are:

- **Don't** use air conditioners (ACs), use fans instead. If ACs are used, turn on only when temperatures rise above 25°C.
- **Ensure** no AC is set lower than 25°C. People falsely believe that a lower temperature setting will cool faster, but in fact the AC will work at maximum rate until the room reaches the set temperature. For every degree lower than 25°C, from 3 - 10% more energy is needed. At 18°C around double the energy may be required!
- It is important to note that at temperatures lower than 25°C, this may be below **'dew point'**, which means if hot moist air infiltrates after someone has opened a door, condensation will form, promoting corrosion and mould, leading to costly equipment and building maintenance.
- **Ensure** doors and windows are closed and are not 'leaky' so there are no gaps for cold air to escape or for hot air to come in. This is 'infiltration' loss.
- **Turn off** ACs when people leave the room, especially overnight and over the weekend.
- **Use fans** with AC to improve the cooling effect. If it still feels too hot at 25°C, turn a fan on rather than lower the temperature.
- **Stay fit**, improve the body's ability to cope with heat, hydrate often, and dress sensibly in clothes suited to the season.

4.1.4 Energy Efficiency

Energy Efficiency (EE) involves upgrading equipment to reduce energy use and is more costly than Energy Conservation. Energy Efficiency in order of cost effectiveness is:

- **Improving the building envelope.** The Secretariat buildings were designed with cross flow ventilation in mind, not AC. Consequently the high ceilings on the top floor and the louvres make for a very inefficient building envelope for ACs. There is also some doubt whether the roof structure is well insulated.
- **Chose ACs with the highest energy efficiency.** Fortunately Fiji shares standards with Australia and New Zealand, and has the same electrical energy characteristics (240/415 Volt, 50 Hertz), so equipment suitable for these countries is suitable for Fiji and some models are available in Fiji. There is a star rating for Energy Efficiency, the more stars the more energy efficient. Other countries such as Japan also have star ratings.

4.1.5 Renewable Energy

The simplest form of Renewable Energy entails grid connected solar modules (PVs) to reduce energy consumed from the FEA mains. This should be done only after energy conservation and energy efficiency measures have been implemented. Good options for increasing Renewable Energy use at the Secretariat could include;

- **Installing PV arrays** on sun exposed roofs of the Secretariat, connected via inverters before the metering to reduce demand from FEA and further reduce electricity costs.
- **Creating a large Uninterruptable Power Supply (UPS)** by installing a PV system that includes an inverter with batteries that can run emergency services such as communications, water pumps, lighting, fans, phones and computers. This means that during power outages due to FEA and possible emergency generator breakdown, backup (no break) power is available, so the Secretariat can continue operations.

4.1.6 Recommendations

Measures can be taken to reduce electrical energy use without compromising services by following the steps outlined in the previous sections to:

- **Increase** Energy Conservation practices;
- **Apply** Energy Efficiency measures; and
- **Install** Renewable Energy.

4.2 Water Use Related Emissions

All water on the Secretariat compound is drawn from the Suva water supply via a high pressure main owned and operated by the Water Authority of Fiji. The roof area of the Secretariat offices alone is substantial, with a useable area of approximately 3,800 m^2, however no rainwater is harvested, at present.

4.2.1 Water Audit Results

There was much difficulty in estimating water consumption for the Secretariat compound as bills received were often erratic, especially on a month to month basis. There was also a substantial jump in quarterly billing for two of the Secretariat offices in Q2 & Q3 2011, and Q1 2012 as seen in the following table. Records from accounts did not take into account credits or debits from previous months, the fire service levy, nor any large outstanding charges or bonds that may be held as there were for electricity.

A broad estimate ignoring the big jumps was for usage of water totalling 2,200 m^3 and 1,600 m^3 for 2011 and 2012 respectively, at a cost of F$1,200 in 2011, and F$1,000 in 2012. Water was supplied at a charge of F$0.153 per kilolitre (kL = 1 m^3) for the first 50 units (m^3) and F$0.439 for every kL between 50 – 100 kL, and F$0.529 for every kL over 100 kL. Only one building was on the sliding scale, the rest were charged at the highest rate, so for ease of calculation, the higher rate was used.

The best practice guideline for water consumption in office buildings in Australia is 0.5 m^3/m^2 per year, which was used as a guide in the absence of a rate for developing countries. Applied to the Secretariat compound (about 1,200 m^2 of occupied offices), that equates to 600 kL/year. This is a lot less than the current consumption. It was suspected that a good deal of this water use was for the garden in the dry season, although this was masked by the dubious data for the dry winter period, as highlighted in Table 4.1.
As with electricity use, an in-depth audit of water use in the Secretariat Compound should be done involving installation of subsidiary water meters to accurate identify water use and losses. Only then can a targeted approach to water use reduction be made.

Q1 2011	Q2 2011	Q3 2011	Q4 2011	Q1 2012	Q2 2012	Q3 2012	Q4 2012	Building
353.87	363.42	374.76	223.94	176.36	334.78	89.00	52.00	KF1 58
48.90	44.01	2.00	5.01	2.00	31.00	234.01	132.00	KF1 69
0.00	14.01	634.12	1218.24	2386.48	0.00	0.00	0.00	KF1 4701
0.00	94.01	4254.12	8475.24	16889.47	0.00	0.00	0.00	KF1 4702
80.00	80.00	80.00	80.00	80.00	80.00	100.00	118.00	KF1 4703
482.78	**595.44**	**5345.01**	**10002.43**	**19534.31**	**445.79**	**423.01**	**302.00**	**TOTAL**

Table 4.1: Quarterly Water Use (2011 – 2012) Volumes are given in kilolitres (cubic metres)
Note that highlighted data requires future refinement.

4.2.2 GHG Emissions

The best estimate of energy use and therefore GHG emissions for a similar sized town to Suva, with similar climate and topography, was for Cairns, Australia. Here the water supply authority estimates that 10 kWh is used to pump and treat each 1000 litre of water (1 kL).

Combining this figure with the emission figures for the production of electricity by FEA gives 3 – 6 kg CO_2/kL of water delivered. Assuming an average of 2,000 kL per annum for Secretariat water use, emissions are: 2,000 kL @ 6kg CO_2e/kL = 12,000 kg CO_2e/annum or around 12 tonne CO_2e/annum.

There will be other energy inputs and GHG emissions, but this short study precludes their inclusion.

4.2.3 On Site Water Production

At the time of the survey there was no water capture from the Secretariat office roofing, nor was there any storage capacity on the Secretariat compound. The Secretariat closed down in times of prolonged power and water outage as toilets and wash basins could not be used.

The average annual rainfall[3] in Suva, Fiji is highly variable, but was given as 3,000 mm/year, since Suva is classed in the wet zone. A broad estimate of total usable roof area of the Secretariat compound buildings was about 3,800 m^2. (Table 4.2) The Fale is thatched and its 200 m^2 roof could not be used for water collection.

Assuming 70% of rainfall was collected, the usable roof area for the entire compound could yield about 8,000 m^3 of rainwater collected per year, or about four times the average usage for 2011 - 2012. The office buildings (roof area 2,000 m^2) alone would yield close to 4,000 m^3 of rainwater collected per year, or twice present average usage. If sufficient storage capacity was installed, the water consumption from the mains supply could be significantly reduced. The rainwater capture potentials for each building on the Secretariat compound are shown in Table 4.2.

If rainwater storage tanks were installed on buildings which are at high elevations, toilets at lower elevations could be gravity-fed by them, providing ablution areas in times of power outage. Storage tanks installed at suitable locations on the higher buildings (such as 1, 2 or 3) offering good sized roof areas could potentially be fed into the distribution network on the compound, or to toilets at a lower level. Collection potential for these three buildings is more than 1,200 m^3 per annum.

If a greater contribution is required, such as for 80 percent of the 2012 usage (1,600m^3), then a roof area of at least 800 m^2 is required, and several large storage tanks should be installed. If seasonal storage is required for gardening, then at least six months storage is needed to cover the dry months.

A reduction of 1,600 m^3 in consumption from the mains supply would amount to a savings at F$846 annually at the highest tariff. If tariff rates remain unchanged, an investment of F$10,000 would be recovered in 12 years, or less if tariffs increase.

This scenario does not take into account any valuation of reduced GHG emissions, nor the value of having water security, enabling the Secretariat to remain operational during power and water outages.

[3] Fiji Meteorological Service; www.met.gov.fj/page.php?id=100.

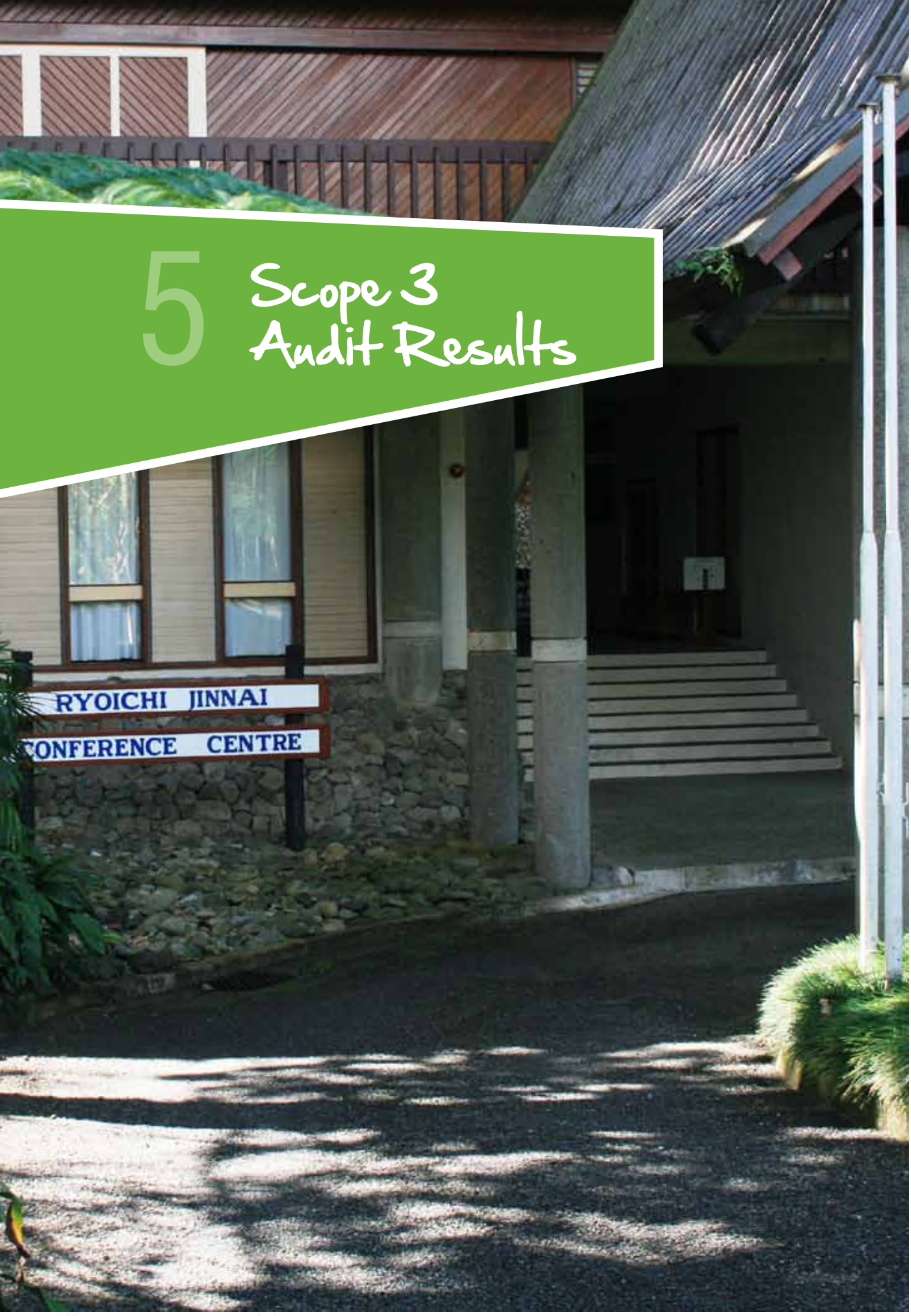
Table 4.2: Rainwater collection potential by building			
	Building	Estimated roof area (m^2)	Annual Collection potential (m^3)
1	SG and Offices	160	336
2	Office Building	160	336
3	Library/ Info Services	270	567
4	SG House	350	735
5	DSG House	200	420
6	DSG House Hse	200	420
7	Staff House	150	315
8	Staff House	150	315
9	Staff House	160	336
10	Staff House	160	336
11	Staff House	160	336
12	Staff House	100	210
13	Staff House	120	252
14	Staff House	100	210
15	Reception /Offices	160	336
16	Office Building	140	294
17	Office Building	110	231
18	Office Building	200	420
19	Conference Centre	600	1260
20	Fale Function (unused)	200	420
21	Guard House	30	63
22	Generator Shed	40	84
23	Malolo Bure	100	210
	TOTAL	4020	8442

4.2.4 Recommendations

Measures that can be taken to reduce water use and improve services are to:

- **Install** water metering equipment and conduct a water use audit
- **Implement** water conservation practices
- **Apply** water efficiency measures
- **Install** water harvesting equipment.

5 Scope 3 Audit Results



5.1 Travel Related Emissions

Secretariat staff travel routinely within the region and beyond. Estimates of the distance travelled by staff and corresponding GHG emissions have been calculated. However none have been made for Secretariat-sponsored participants from member countries and territories whom are also sometimes required to travel.

5.1.1 Travel Audit Results

As with electricity use, it is difficult to put an exact value on the GHG emissions for international travel as this depends largely on routing, the type and age of aircraft, and upon how full the plane is. The amount of CO_2 produced per km travelled generated varies from 0.167 kg CO_2/km (usually for long flights) to 0.367 kg CO_2/km (usually for shorter flights). For this study, the emission calculator at www.carbonneutral.com.au/carbon-calculator/air-travel.html was used.

5.1.2 GHG Emissions

A travel audit of the Secretariat staff for the period 2009 – 2012 showed that emissions had risen steadily in recent years (Figure 5.1). Analysis showed the major emission is from international air travel, mainly due to more people travelling and greater distances covered.

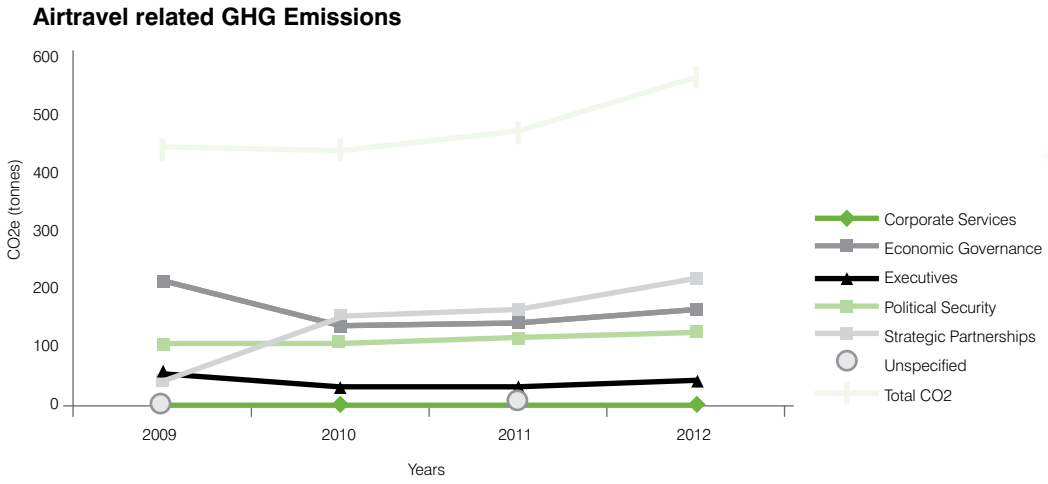


Figure 5.1: Annual emissions from Air Travel (2009 – 2012)

What was not considered with the air travel calculation was the emissions from the road travel to and from the airport at the place of embarkation and the destination.

There was little in the way of records for car travel, but in future this should be recorded.

5.1.3 Recommendations

There are many ways to decrease emissions from travel. Some of these include:

- **Consider audio/ video conferencing where it is practical.** This has been used by many large organisations as a way to keep in contact with stakeholders across a country and globally
- **Combine workshops** back to back to reduce the number of times travel is needed;
- **Purchase of carbon offsets** to reduce or negate emissions from air travel when it is unavoidable

- **Use of small bus or taxi** instead of plane for travel to and from Nadi and Suva. When many staff need to attend a conference, the use of a shared vehicle from the Secretariat to the venue in Nadi removes a short plane trip and two taxi rides, one at each end. It may not take any longer than by air, once the car travel and airport waits are factored in
- **Cycle, run or walk to work** and encourage staff to take alternative transport within Suva by providing shower and locker facilities
- **Car pooling** has been tried successfully by many, where a number of people club together and take turns using their car. This was done in the days when cars and fuel were expensive, which is again the case
- **Telecommuting,** allowing employees to work a day or two a week from home, provided they can access the internet, their Secretariat files and have a telephone.

5.2 Green Waste Emissions Offsite

Emissions of green waste treated offsite are Scope 3 and considered here.

5.2.1 Waste Audit Results

The Head Groundsman estimated that in non cyclone years around 48,000 kg was trucked out, or an average of 4 tonne per month. The waste facility is 23 km away, and there was a charge of F$300 for every 2 tonne load (2 to 3 trucks per month). Total cost of trucking waste was in the range F$7,000 – F$10,000 per annum. It was also estimated that F$10,000 per year was spent on materials to make potting mix and other soil conditioners and mulches for the compound.

5.2.2 GHG Emissions

The emissions from taking green waste away to landfill were difficult to quantify, as the emissions depended on many variable factors which changed year to year, month to month depending on the makeup of the waste, how wet it was, and how much oxygen was available during decomposition (proportion of aerobic to non-aerobic). From a survey of the literature, it was assumed that if methane and oxides of nitrogen were produced and released, then around 2 kg CO_2e/kg wet waste was emitted;

48,000 kg @ 2 kg CO_2e/kg = 96,000 kg CO_2e/annum or around 96 tonne CO_2e/annum.
In addition to the emissions at the landfill, there were vehicle emissions from trucking the waste. Usually a truck was hired at a cost of F$180 per load, and around 7m^3 or two tonne taken to the waste facility per trip. The return trip including travel from the hire truck depot was estimated at around 50km.
50 km x 24 trips = 1200 km/ year @ 0.50 kg CO_2/km = 600 kg CO_2/ annum

This was quite small relative to the emissions from landfill.
The total emissions were around 100 tonne CO_2e/annum.

5.2.3 Emission Reduction Measures

Studies undertaken in Australia (see references) point to the desirability of aerobic composting of green wastes in the Secretariat compound rather than trucking them to the off-site landfill.

The landfill of putrescible waste materials, for example food, garden, sludge, and nappy wastes, generates methane which is a potent greenhouse pollutant 21 times worse than carbon dioxide. The processing of materials through an aerobic composting Alternative Waste Treatment (AWT) facility in the Secretariat compound would permanently prevent the generation of methane emissions from the anaerobic decay of organic waste materials in landfill.

Using the AWT facility provides a triple dividend of avoiding trucking emissions off-site, landfill emissions, and results in value added recovered resources.

Specifically this abatement activity comprises:

- diversion of putrescible waste from landfill and into a purpose built composting AWT facility
- processing of the putrescible waste to manufacture a range of fit for purpose end products such as, but not limited to, inputs into soil conditioners, potting mixes, landscape mulches, blended top soils and spill absorbents.

As an alternative to aerobic composting, it has been found that properly maintained vermi-composting systems that use special earthworms have a greater potential for reducing N_2O emissions whilst producing more neutral compost products compared to aerobic or anaerobic composting. Vermicomposting also results in more efficient digestion of the carbon content in organic waste. The compost products from these processes should have lower carbon/nitrogen ratios and be better quality.

Lastly, there are savings to be had in both monetary and GHG emissions by treating on site. An on-site chipper of reasonable capacity costs about F$15,000. If two thirds of the green waste is composted on-site, some F$13,000 per year can be saved on the purchase of mulch, potting and fertiliser materials as well as trucking costs, so that without extra manpower, a less than two year payback is possible. However, as composting is labour intensive, added manpower may be required.

5.2.4 Recommendations

Measures that can be taken to reduce green waste emissions and reduce consumption of gardening inputs are:

- **Install** chipping and composting equipment
- **Reduce** green wastes being shipped off-site
- **Replace** imported fertilisers, mulch and potting materials
- **Increase** composting and use of green wastes on-site.

5.3 Procurement Related Emissions

One of the major GHG emissions was thought to be paper and print cartridges.
Lack of time during the survey precluded the consideration of this sector.

5.3.1 Audit Results

No data was available on the annual use of A4 paper, as there was a stockpile from previous years which was still being used. No data was collected on the use of printer cartridges.

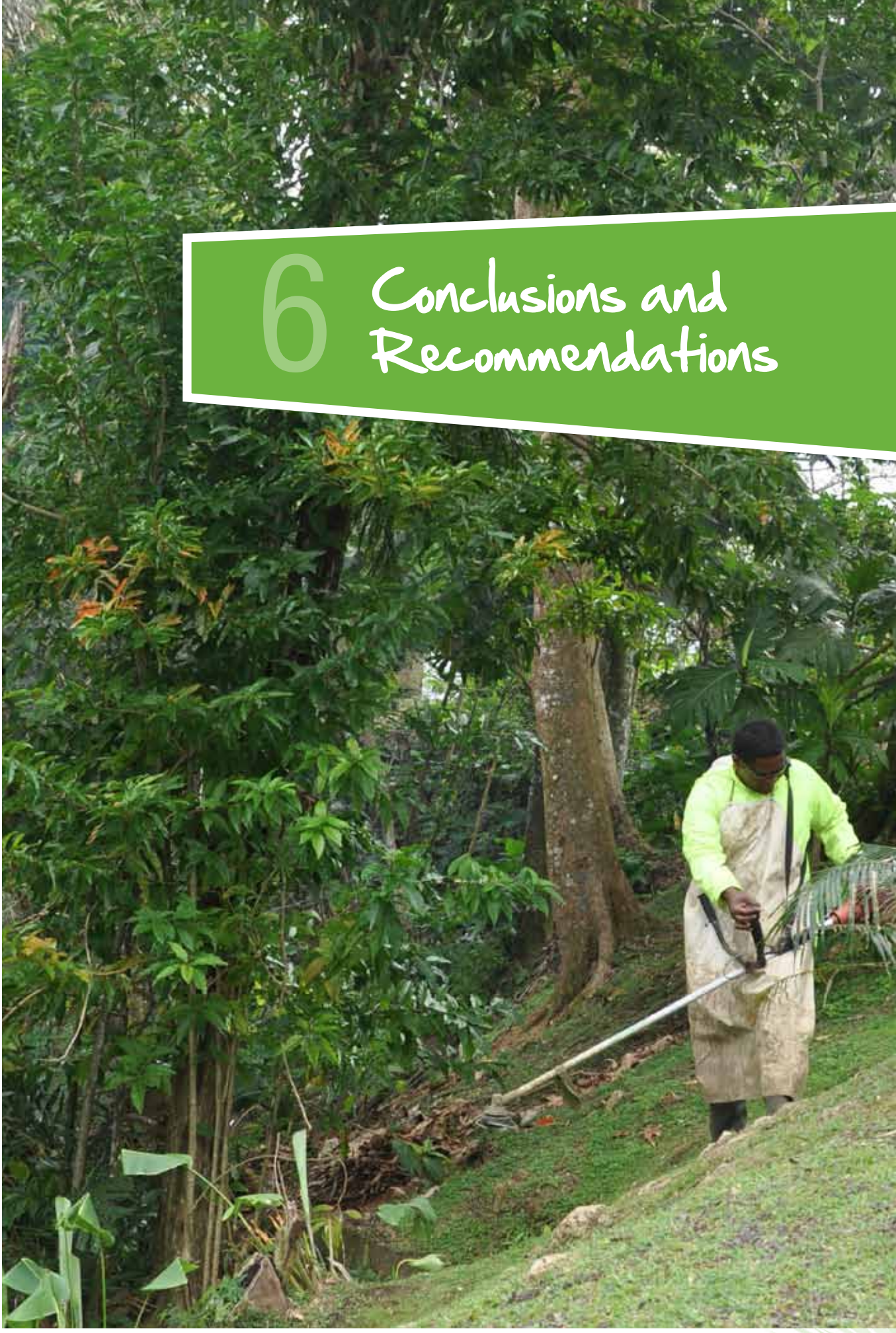
5.3.2 GHG Emissions

This was not able to be calculated.

5.3.3 Recommendations

Procurement should be considered in future audits, meanwhile some basic guidelines are possible for office supplies and catering:

- **Minimise** paper use, read onscreen, use both sides, use one sided paper to print drafts
- **Reduce** packaging where possible
- **Non bleached, recycled paper** should be purchased where appropriate
- **Recycle** all paper and packaging where possible
- **Consider** whether the need for office supplies can be met another way
- **Evaluate equipment rental** options or possibility of sharing with another department
- **Evaluate the GHG impact** of any new products intended for purchase
- **Environmentally friendly** and efficient products to be favoured where possible
- **Consider reuse** and recycling for everything, for example print cartridges
- **Buy local food** for catering, which also has the potential advantage of higher nutritional value
- **Washable or biodegradable** containers, cutlery and crockery should be a priority.



6 Conclusions and Recommendations

6.1 Conclusions

Of the areas targeted for this GHG audit, the most significant contributors were air travel, followed by electricity use, then vehicle and groundskeeping equipment, and lastly emissions from green waste. Less significant contributors were water use and emergency generator operation. Procurement emissions were not quantified in this report but recommendations have been made.

Greenhouse Gas emissions at the Secretariat had grown in the three years to 2012, mostly because of increased international air travel. In the sectors considered, GHG emissions reached 1005 tonnes of CO_2e in 2012, of which air travel was 59%, electricity 18%, vehicles and groundskeeping 10%, and offsite green waste 10%.

This was unsurprising for a regional organisation with responsibilities to its 16 member countries scattered across the vastness of the Pacific Ocean.

The good news is that there are many ways to reduce emissions.

6.2 Recommendations

It should be possible to halve emissions within a few years (<5) provided there is a budget and a commitment to do so.

Procedures need to be put in place to gather the necessary information in a more useful form than at present to track emissions reductions. Improved data is requested for:

1. **Staff travel**, including distances and routes both by air and road, and sea if this is applicable
2. **Electricity use** by Division, separating out non Secretariat use and recording monthly energy use (kWh) and tariff
3. **Water use** (as for electricity), with quarterly volume (kL) and tariff (fire levy noted separately)
4. **Logbooks** for all Secretariat vehicles, groundskeeping equipment and the emergency generator
5. **Weight estimation and logging** of all green wastes treated onsite and trucked offsite each month

As a matter of priority a first step to reducing GHG emissions should be:

1. **Reducing travel** by using audio/ video conferencing, multiple meetings, carbon offsets
2. **Reducing electricity use** through building efficiency upgrades, energy conservation and energy efficiency measures, and lastly, renewable energy additions
3. **Upgrading vehicle and groundskeeping equipment** with fuel efficient and/or electric/ hybrid versions at the time of replacement, charged using onsite with RE or green electricity from FEA
4. **Increasing the amount of green waste treated onsite** to reduce the amount going to landfill.

Other areas that would reduce GHG emissions and demonstrate GHG reduction techniques are:

5. **A stand-alone RE system and water tank** on the Malolo Bure using a PV battery system to allow access to power and water should outside services be cut off
6. **Rainwater harvesting,** first at the Malolo Bure and then extended to the rest of the Secretariat
7. **Grid Connected PV** to be installed on the main entrance canopy at the Secretariat reception
8. **Fuel storage** to be installed for the emergency generator to the correct standards for convenience, spill and fire safety.

7 Annexes

7.1 Annex A: Steps to Reduce Electrical Energy Use

Typical steps in reducing electrical energy use and hence GHG emissions are described as follows. These steps can also be used for reducing GHG emissions in other areas, such as for vehicles.

7.1.1 First Step: Set Up Baseline Energy Use.

This is done using an energy audit, with checks against billing (FEA metering). In addition the following monitoring should be installed as a first step in the implementation phase:

- Individual appliances identified as large energy users should have energy monitoring permanently installed, such as ACs with the SiCleanEnergy Power Usage Meter.
- Various buildings, departments or sections can have recording energy meters fitted to their switchboards, such as the Efergy E2 Classic 2 energy meter, to give indicative feedback on energy use.
- Lighting levels can be determined using a light intensity meter.
- Temperature settings for air conditioners can be noted and if necessary, temperature logging can be undertaken using a recording Temperature/ Humidity meter such as an Extech RHT20.

7.1.2 Second Step: Implement Energy Conservation Measures

Energy Conservation is about how existing equipment is used and does not incur a large capital cost, since it is more about behavioural change. Examples of this include;

- Keep air conditioner temperatures at 25°C or above.
- If this is not cool enough, use fans as well to add about a 3°C cooling effect.
- Make sure ACs and lights are turned off when no one in the room, especially overnight and on weekends.
- Shut down computers overnight and on weekends, or at least hibernate overnight. A shutdown each weekend is good policy to allow for updates.
- Installation of power strips so a suite of equipment can be turned off with one switch.

7.1.3 Step Three: Upgrades to Building Envelope

The envelope which is being cooled, lit and worked in should be as efficient as possible to avoid unnecessary use of energy. Most people can readily understand that you would not fix a leaky water tank by adding another water source. Similarly a bad building design should not be fixed by adding more air conditioning or lighting. The types of areas that should be considered include:

- Improvements to roof and ceiling insulation.
- Ensuring roof colour is light, or if upgrading roof, use reflective surfaces.
- Ensure east and especially west walls are shaded.
- Ensure good air flow through ventilation and fans, especially if the building is not airconditioned.
- If air conditioned make sure the building is well sealed against infiltration.
- Use natural lighting where possible, for instance by installing skylights.

7.1.4 Fourth Step: Implement Energy Efficiency measures

Energy Efficiency is about replacing inefficient equipment with modern efficient equipment with a high number of energy stars. This incurs a capital cost, but payback if often less than 2–3 years and almost always <5 years. For comparing of energy use, see www.energyrating.gov.au

- ACs are usually the largest energy consumer and could be replaced with inverter ACs
- Computers, printers and servers are usually next largest, replacable with laptops and equipment with energy star ratings

- Lighting is significant, use CFLs or LED lighting
- Energy efficient fans should be used in preference or in addition to ACs
- UPSs are not needed for computers if they are laptops, use small stand alone RE for printers, servers.

7.1.5 Fifth Step: Implement Renewable Energy measures

A demonstration stand alone RE system for Malolo Bure will not reduce GHG much, but with water storage and a pump gives the compound restrooms, water and laptop power in case of emergency, as well as serving as a good demonstration of this technology.

A larger demonstration Grid Connected PV system above the Secretariat reception driveway roof. It is suggested that if a solid PV canopy is installed, around 10 kWp could be installed. This is a high profile area which is where visitors first approach the Secretariat.

Should these smaller demonstrations prove economic and practical, there is ample roof area to expand the use of PV generated electricity to supplement Secretariat electricity use.

7.1.6 Sixth Step: Evaluate the Programme

It is recommended that a more detailed electrical energy audit be undertaken in 2013, to plug holes in the data to give a more accurate record of GHG emissions. This needs to be replicated in other areas also. Thereafter, annual audit checks should be then carried out to track GHG emission reductions for electricity and other areas.

7.2 Annex B: References

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