The United Nations Theme Group on Environment and
Natural Resource Management, Apia, Samoa

ENERGY AUDIT OF THE UNITED NATIONS FOOD AND AGRICULTURE ORGANISATION SUB-REGIONAL OFFICE IN APIA, SAMOA

May 2002

SOPAC Miscellaneous Report 466

Community Lifelines Programme
South Pacific Applied Geoscience Commission

The United Nations Food and Agriculture Organisation Sub-regional Office in Apia, Samoa

prepared by

Rupeni Mario
Energy Project Officer
South Pacific Applied Geoscience Commission

TABLE OF CONTENTS

FIGURES

ACKNOWLEDGEMENTS

The UN Resident Representative, Samoa, and staff members of FAO, particularly to Stefano Bonezzi and Sosefina Luamanuvae are acknowledged for their invaluable assistance in providing the historical electricity bills and general coordination of activities at FAO.

The initiative by the United Nations Theme Group on Environment and Natural Resource Management to carry out an energy audit on their buildings is also commended.

Finally, the Electric Power Corporation, particularly Joseph Walter, Deputy General Manager, is gratefully acknowledged for his input and assistance provided during the course of the energy audit.

EXECUTIVE SUMMARY

Energy conservation and efficiency programmes are an essential component of the economic and environmental development for Pacific Island countries. The ultimate goal of any energy conservation and efficiency programme is the elimination of energy wastage and the minimisation of electricity bills.

But where are the areas of wastage? They may not always be immediately apparent and they can vary from one building to another and from one location to another.

This report documents the result of an Energy Audit conducted by the South Pacific Applied Geoscience Commission (SOPAC) Community Lifelines Programme at the United Nations Food and Agriculture Organisation (FAO) Sub-regional Office in Apia, Samoa. The FAO Sub-regional Office is located in the Peter Meredith Building, which also houses the Habitat for Humanity, UNDP and UNESCO offices, a Post Office and an ANZ Bank branch. The building has aged with no/very little insulation and shading of the east and north walls.

The approach taken was to identify areas where basic energy conservation and efficiency measures can be applied to demonstrate energy savings. FAO Samoa has about 20 staff members with the professional staff occasionally on in-country missions and attending to international conferences/meetings throughout the year. The energy audit considered a general approach where the calculations in this report represent a normal eight-hour workday, five days a week.

Energy used at the FAO Sub-regional Office is in the form of electricity generated from hydropower and diesel, and is supplied by the Electric Power Corporation (EPC). The average consumption of electricity at the FAO Sub-regional Office is approximately 5800 kWh per month, resulting in an electricity bill of about ST$3500.00 (US$1050.00) per month. The energy audit identified the quantities and the specific uses of electricity at the FAO Sub-regional Office and recommended approaches to reduce electricity consumption by eliminating waste and improving efficiency.

Air conditioners account for an estimated 62 % of the total electricity consumption at the FAO Sub-regional Office; lights account for 20 %, computers 8 % while 10 % is shared amongst photocopiers, printers, fax machines, urns/electric jugs, refrigerators and other appliances (water coolers, fans, etc).

The energy audit process adopted and as diagrammatically represented in Figure 1, highlights immediate opportunities and short-term actions to conserve electricity. The areas of focus for these actions are:

- management support;
- staff awareness;
- air conditioning;
- lights; and
- office equipment.

The recommendations made involve little or no cost options and essentially include housekeeping measures. These energy saving measures involve the major electricity consuming appliances such as air-conditioning and lights.

Ensuring the implementation of recommendations is usually the role of the management, however, success will depend on a collective effort by the users of the premises concerned. It is notable that an effective energy conservation and efficiency programme does not end with the identification and verification of energy and monetary potential savings. The promotion of energy conservation and efficiency habits should be ongoing and a continuation of monitoring and reporting is important so as to ensure the potential savings continue to be realised.

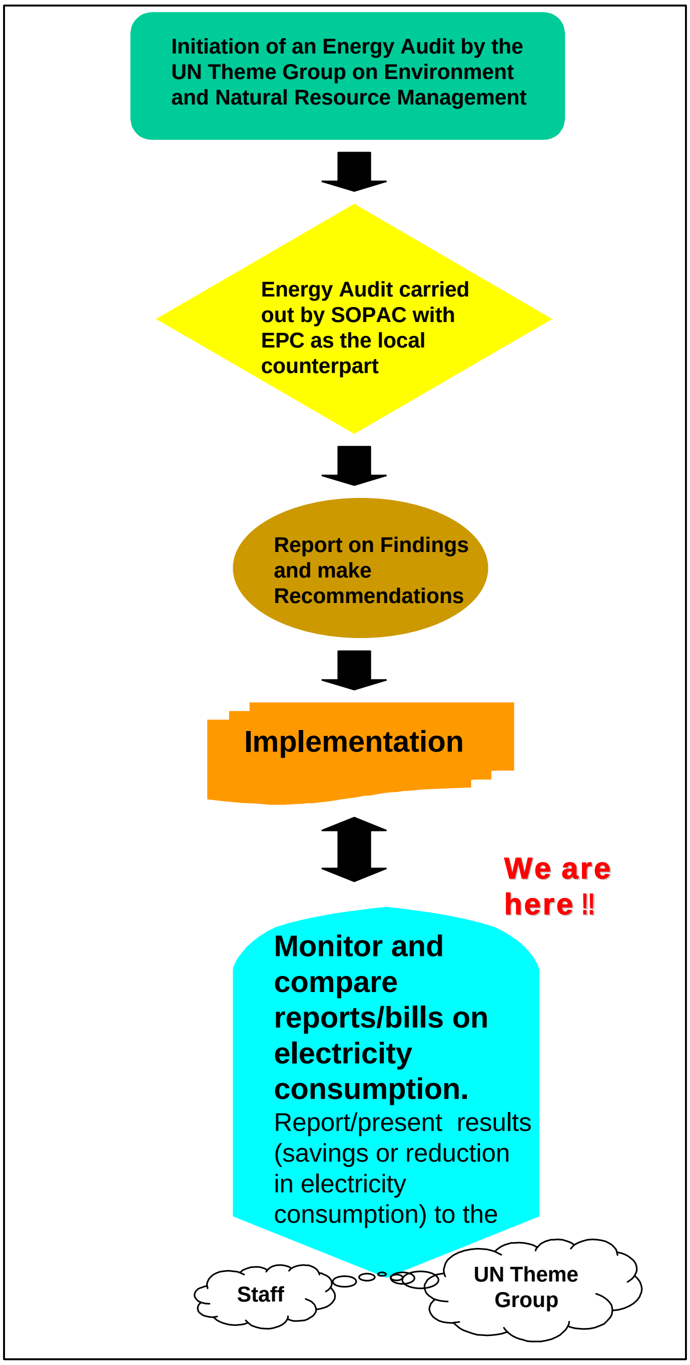

Figure 1 A summary of the stages in the energy efficiency and conservation awareness programme at FAO.

OBJECTIVES

i. to carry out an energy audit of the FAO Sub-regional Office;

ii. to identify potential energy savings within the FAO Sub-regional Office;

iii. to increase awareness and appreciation amongst the FAO Sub-regional Office staff and visitors that individual and collective efforts on energy conservation and efficiency can be beneficial; and

iv. to demonstrate that energy conservation and efficiency is a win-win strategy.

INTRODUCTION AND BACKGROUND

The ongoing impact of energy production, distribution and use on the environment is a matter of concern to the Pacific island countries, particularly the low-lying coral atolls, as they strive towards economic and environmental viability. Extreme climatic conditions such as El Niño and La Niña, partially caused by the increasing emissions from energy production and use, has adversely affected crops, livestock and the Pacific islanders in terms of food security, water and shelter.

The United Nations Theme Group on Environment and Natural Resource Management in Samoa took the initiative to promote best practices in energy (electricity) use at the four United Nations (UN) Offices in Apia. The South Pacific Applied Geoscience Commission (SOPAC) Community Lifelines Programme with the Electric Power Corporation (EPC) as the local counterpart, carried out energy audits on the four (FAO, UNDP, UNESCO and WHO) UN Offices. This report specifically presents the findings of the energy audit carried out on the UN Food and Agricultural Organisation (FAO) Sub-regional Office.

The FAO Sub-regional Office occupies an area of 1487 m^2 in the Peter Meredith Building – a layout of the FAO Subregional Office is attached as Annex 3. The building, which also houses the Habitat for Humanity, UNDP and UNESCO Offices, a Post Office and an ANZ Bank branch, has only a single EPC electricity consumption meter. All tenants pay their respective electricity bills, which are calculated from sub-meters within the complex, to the landlord.

The Peter Meredith Building is not designed for natural cooling thus essentially makes air conditioning a necessity to ensure a comfortable work environment. The FAO Office is located on the eastern end of the building with no shading of the windows. Blinds have been fitted to all windows and doors to provide shade from the sun’s rays.

FAO Samoa has about 20 staff members with the professional staff occasionally on in-country missions and attending international conferences/meetings throughout the year. The energy audit considered a general approach where the calculations in this report represent a normal eight-hour workday, five days a week.

Energy used at the FAO Sub-regional Office is in the form of electricity generated from hydropower and diesel, and is supplied by the Electric Power Corporation (EPC). The average consumption of electricity at the FAO Sub-regional Office is approximately 5800 kWh per month, resulting in an electricity bill of about ST$3500.00[1] (US$1050.00) per month. The energy audit identified the quantities and the specific uses of electricity at the FAO Sub-regional Office and recommended approaches to reduce electricity consumption by eliminating waste and improving efficiency. Prior to the energy audit, the FAO staff had been practicing housekeeping energy conservation measures. This was an internal initiative led by the Administrative Officer and included measures such as switching off all electrical appliances at the end of the working day.

Air conditioners account for an estimated 62 % of the total electricity consumption at the FAO Sub-regional Office; lights account for 20 %, computers 8 % while 10 % is shared amongst photocopiers, printers, fax machines, urns/electric jugs, refrigerators and other appliances (water coolers, fans, etc).

Energy conservation and efficiency programmes are not new for the SOPAC Community Lifelines Programme. Projects such as the Air Conditioner Efficiency Programme in the Solomon Islands, which identified potential energy and monetary savings of 61322 kWh/year (US$11700/year) or the equivalent of a reduction of 46 tonnes of CO_2/year; and the energy conservation and efficiency education and awareness programme at the SOPAC Secretariat, which achieved a savings of more than F$4000 (US$1720) over a 12-month period through introducing good housekeeping measures such as switching off lights and air conditioners when offices are not occupied, has demonstrated that energy savings can be achieved through educational and awareness programmes and teamwork.

The success of any energy conservation and efficiency initiative usually depends on the commitment and cooperation of management and staff of the premises concerned - their collaborative roles enable the programme to achieve its goals at minimum cost.

[1] This amount excludes the 5 & 10 % discounts given by EPC (reflects the actual electricity consumption costs)

The general perception about energy conservation and efficiency is that it is inconvenient – that is, many see it as going through certain adjustments in working habits to minimise energy consumption. The housekeeping measures does not restrict energy use, it is really eliminating habits that waste electricity.

The introduction of simple housekeeping attitudes in many energy audits is one of the easiest and most cost-effective energy conservation and efficiency measures. Housekeeping measures is not necessarily about minimising, reducing and changing user habits, but it is about rationalising and optimising. It would be impractical that all electrical equipment is turned off whenever they are not in use. However, it will do no harm to switch them to their power saver modes, which is simple, inexpensive and non-disruptive. Over time, these small measures show a recognisable impact on an organisation's electricity bill.

In addition, it is also worthwhile to educate users to see the importance of energy from the producers and suppliers, and end-use sectors. For instance, petroleum products used for electricity production in all Pacific island countries are imported, accounting for about 6–30 % [Pacific Regional Energy Assessment (PREA) Volume 1, 1992 – Overview] of total imports. This petroleum consumption is among the major sources of greenhouse gas emissions and therefore a major contributor to the vulnerability of our small islands and the globe. Thus it is important that both the suppliers and consumers view energy as not as a luxury, but as a necessity upon which economic growth and social development depends.

METHODOLOGY

The energy audit on the FAO Sub-regional Office was carried out through the following 3 major activities:

(i) Consultation

Various staff members of the FAO Sub-regional Office were consulted to establish any significant user activities or profiles that could influence the electricity consumption pattern.

(ii) Historical and detailed electricity consumption data

A 3-year period of historical electricity consumption records were collated to identify, quantify and establish a general trend in the electricity consumption at the FAO Sub-regional Office. Power ratings and approximate hours of use of individual electrical appliances were used in the calculation of the monthly electricity consumption. This was compared with the actual electricity consumption bills. Similarities and differences were used for further investigation into the user patterns and ratings.

(iii) Screening survey

The screening survey provided a fairly quick, low-cost preliminary investigation to identify major electricity consuming appliances and the immediate opportunities to reduce electricity consumption and costs. This was followed with the development of an action plan to implement measures to be undertaken to reduce electricity usage.

RESULTS / FINDINGS, OBSERVATIONS AND ANALYSIS

Backup Generator

FAO with UNDP and UNESCO has a diesel generator for backup services during power outages. The generator set-up currently has faults in going off-line when the mains power is restored. The fluctuations during this process can be detrimental to all electrical appliances in use at these offices.

Air Conditioners

There are 18 split air conditioner systems, which are serviced on a 3-monthly basis. At the time of the energy audit it was noted that many air conditioners were operating at temperature ranges of 18 – 21 ^{0}C.

An enormous amount of heat (at least 35^{0}C – 95^{0}F) is accumulated within the General Assembly area on the second floor due to the limited open room space. The heat enters the adjacent offices/rooms through the walls by conduction and doors adding onto the air conditioning load in these offices/rooms.

Air conditioners at the FAO Sub-regional Office consume an estimated 62 % of the total electricity consumption.

Lights

Lights account for 20 % of the electricity consumption bill in the FAO Sub-regional Office. General observation has identified some rooms/offices having too many light tubes/bulbs with lights switched on in offices/rooms when not needed.

Electrical Appliances

18 % of the electricity consumption bill of the FAO Sub-regional Office is for electrical appliances. Kitchen appliances (hot water urn, coffee maker, water cooler and refrigerator) accounts for 8 % while 10 % is attributed to computers, printers, photocopy machines, fax machines, etc.

Current Electricity Consumption at FAO

Like many of today's modern offices, the FAO Sub-regional Office uses a number of electrical appliances with air conditioning accounting for 62 % of the total electricity consumption bill. Other constituents of the electricity consumption bill are presented in Figure 2. A list of current electrical appliances with their calculated/measured monthly consumption is attached as Annex 2.

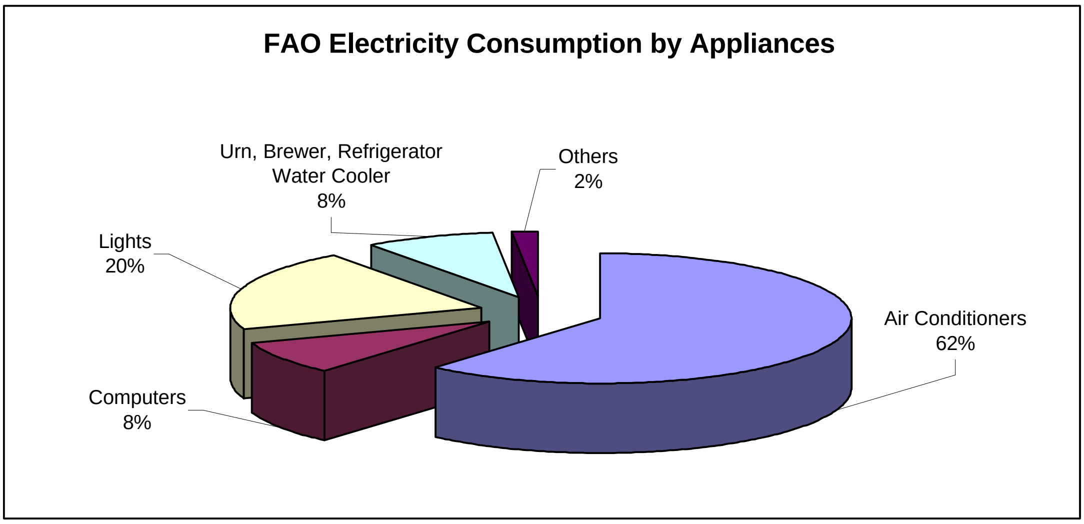

Figure 2 FAO electricity consumption by appliances

Electricity Consumption Trend

The historical records (Annex 1) of electricity consumption at the FAO Sub-regional Office were collated and presented graphically in Figure 3, below. The variation in consumption over the 12-month period was related to the following factors:

- changes in occupancy patterns (e.g. staff on duty travel and increase/decrease in staff numbers);
- variation in climate conditions;
- modification to the building structure or electricity consuming appliances (e.g. revision to air conditioning systems); and
- change in duration of use of electricity consuming appliances (e.g. extended hours of use of printers, photocopiers, lights and computers to meet deadlines).

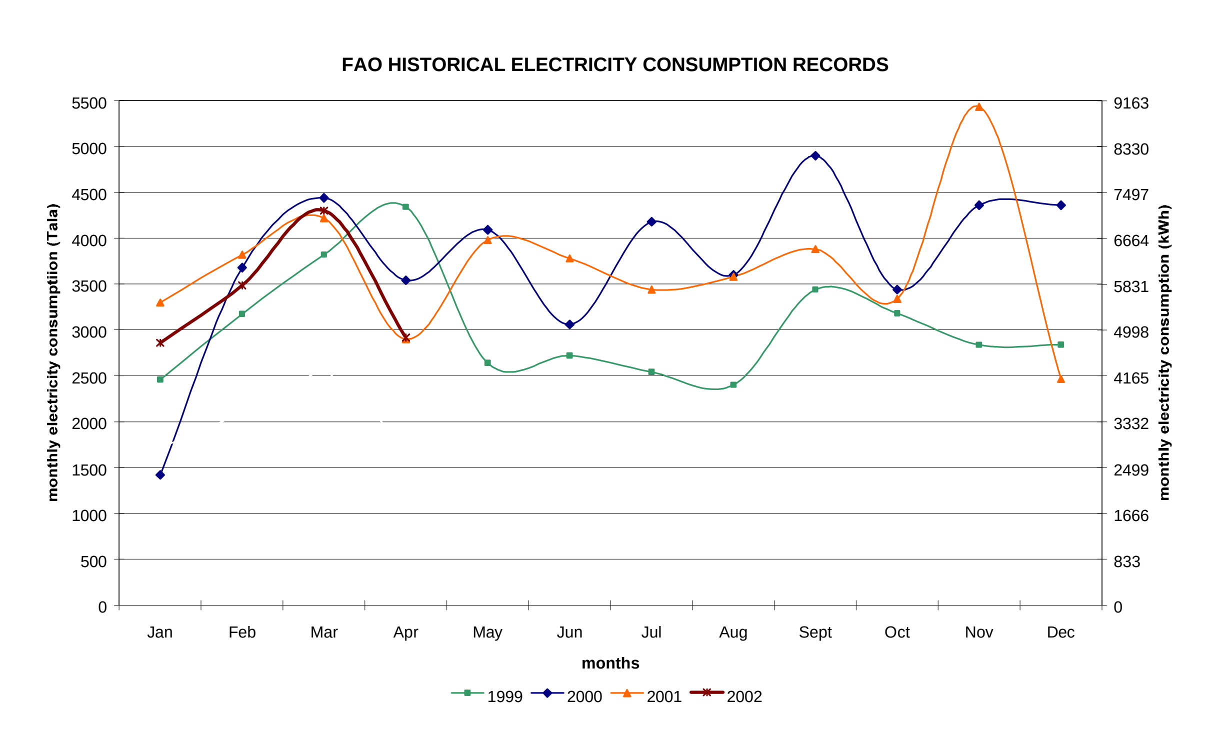

Figure 3 FAO historical electricity consumption records

The variation in the electricity consumption in Figure 3 does not appear to resemble that of the climate condition variations. However, when general trends in electricity consumption were established and graphed, and compared with the monthly variation in Apia's average ambient temperature, Figure 4, a relatively good correlation is obtained (details attached in Annex 1).

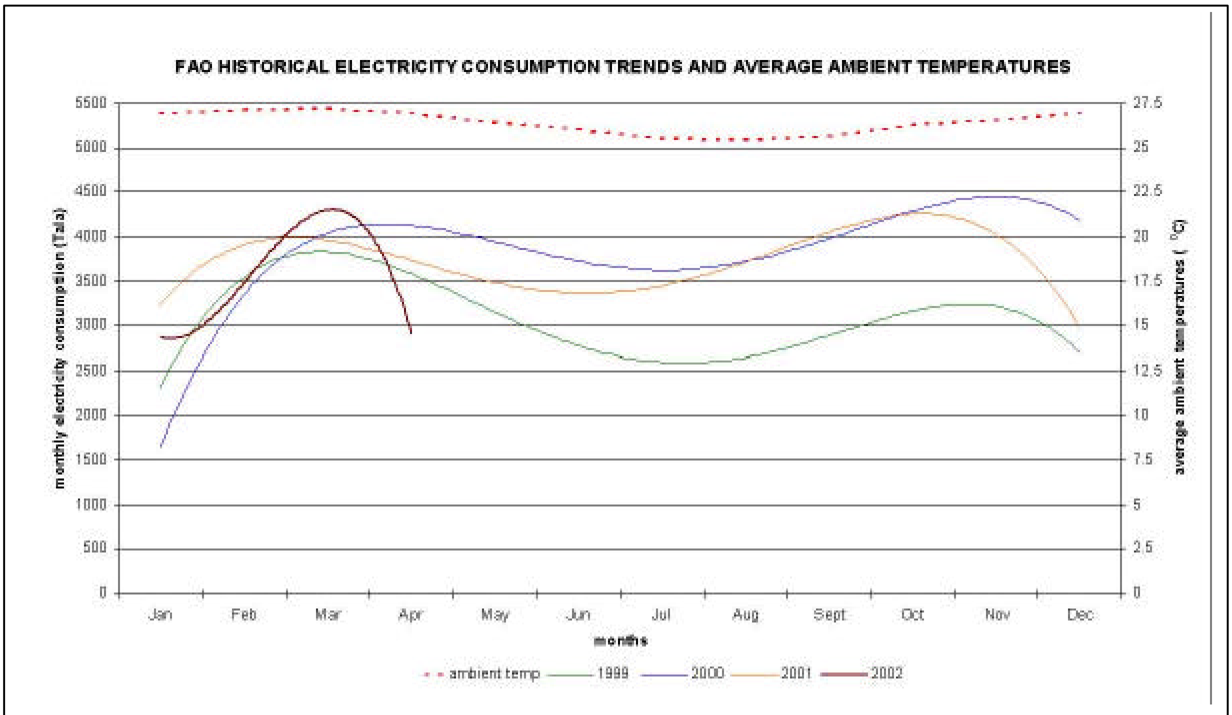

Figure 4 FAO electricity consumption trends and ambient temperatures

The general trends in the electricity consumption for 1999, 2000 and 2001 have similar patterns to that of the average ambient temperature - an indication that the load cycles of the air conditioners are determined by ambient conditions. This is attributed to the poor insulation and improper shading of the east and north walls of the building.

RECOMMENDATIONS

The energy audit recommendations focuses on immediate and short-term actions, which can reduce current electricity consumption by 10 %. This involves minimal costs and includes essentially housekeeping measures. This is considered the easiest and most cost-effective approach, as FAO is a temporary tenant in the Peter Meredith Building.

The following suggestions are drawn from observations of user activities and analysis of the energy audit findings.

Subject	*Action*
Management Support	• The involvement and commitment of Management in the programme is vital as it provides and enhances the decision making process.
Staff Awareness	• Objective of the programme – it is important that the staff is aware of the primary objective(s) of the programme. These are: (i) to minimize wastage in electricity use; and (ii) save money through reducing electricity bills. • Keep staff informed of ways they can assist in reducing electricity consumption and of progress in achieving these reductions. • Publicize the programme by placing energy saving tips in posters or reminder stickers/notices at appropriate locations. • Have a staff suggestion scheme and encourage staff to participate by suggesting possible ways of saving electricity. A prompt feedback to the suggestions is required.
Air Conditioning	• Switch off air conditioners at the end of the working day. • Keep doors (to the outside) and windows closed when the air conditioner is switched on. • Adjust the air conditioner thermostat to a minimum temperature of 23^0C. • Draw or lower curtains when sunlight is penetrating through the windows/doors (consider changing the current blinds on the east wall windows to proper curtains).

Subject	*Action*
Lights	• Clean all light reflectors, covers and tubes/bulbs regularly. • Encourage staff to turn off lights, which are not needed (e.g. when leaving for lunch, meetings, etc). • Replace failed lights tubes/bulbs with energy efficient ones. • Use natural lighting where applicable. • Consider removing some light tubes/bulbs from some of the offices/rooms (delamping).
Office Equipment	• Ensure that electrical appliances are switched off at the end of the day (note that there a few exceptions such as the servers and fax machine(s)).
General	• Open windows to ventilate the General Assembly area when the air conditioner in this area is switched off. • Consider switching on the coffee maker and the hot water urn only during/close to tea and lunch breaks.

IMPLEMENTATION AND MONITORING

The implementation and monitoring stages are important in any energy efficiency and conservation programme. To inspire energy efficiency and conservation attitude to office staff and visitors, it is essential that the management take a lead role in the implementation phase. However, it is equally important that everyone participates.

Implementing housekeeping measures needs a collaborative role amongst management, staff and vistors to the premises. Success (savings) is measured by comparing monthly electricity bills, with corresponding months of previous years.

In addition to the implementation process it is imperative that everyone is updated on progress and success. The FAO finance section would be most appropriate to keep track of the monthly electricity bills.

Any savings made should be channelled towards investing into energy efficient and conservation measures that have a reasonable pay-back period of not more than 12 months.

Although it may take one to two years to eliminate wastage altogether and practice energy conservation and efficiency habits, it is most important that this programme is ongoing.

REFERENCES

- Commonwealth of Australia and Australian Consumers' Association; "Energy Guide for New Appliances 1993"; Department of Primary Industries and Energy, Canberra, Australia; 30 October 1992.
- Commonwealth of Australia; "Energy Conservation: Checklists – Advisory Booklet 4"; Department of Primary Industries and Energy, Canberra, Australia; 1989.
- Commonwealth of Australia; "The Energy Audit – Advisory Booklet 3"; Canberra, Australia; 1983.
- Commonwealth of Australia; "National Energy Management"; Canberra, Australia; October 1990.
- Forum Secretariat Energy Division; "Energy Efficiency for Commercial Buildings in the South Pacific"; August 1994.
- Energy Services Department, State Electricity Commission of Victoria (SEC); "Saving Your Energy Dollar"; July 1991.
- Mario, R. T; "Energy Audit of the South Pacific Applied Geoscience Commission"; SOPAC Miscellaneous Report 393; June 2000.

ANNEX 1 HISTORICAL ELECTRICITY CONSUMPTION BILLS FOR THE FAO SUB-REGIONAL OFFICE AND AMBIENT TEMPERATURES FOR APIA

Historical & Current Electricity Bills (Samoan Tala) - actual consumption

Year / Months	Unit Cost	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
2002	0.60	2861	3486	4301	2918								
2001	0.60	3300	3820	4220	2900	3980	3780	3440	3580	3880	3340	5433	2466
2000	0.60	1420	3680	4440	3540	4090	3060	4180	3600	4900	3440	4360	4360
1999	0.60	2460	3173	3820	4340	2640	2720	2540	2400	3440	3180	2838	2840
3-year monthly mean		*2393*	*3558*	*4160*	*3593*	*3570*	*3187*	*3387*	*3193*	*4073*	*3320*	*4210*	*3222*

Historical & Current Electricity Bills (kWh)

Year / Months	Unit Cost	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
2002		4768	5811	7168	4863								
2001		5500	6367	7033	4833	6633	6300	5733	5967	6467	5567	9056	4109
2000		2367	6133	7400	5900	6817	5100	6967	6000	8167	5733	7267	7267
1999		4100	5289	6367	7233	4400	4533	4233	4000	5733	5300	4730	4733

Ambient Temperature for Apia (^{0}C)

Months	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
average max temp (^{0}C)	31.9	32.0	31.9	31.7	31.6	31.1	30.7	30.5	30.9	31.1	31.5	31.7
average min temp (^{0}C)	21.9	22.3	22.4	22.0	21.2	20.9	20.4	20.3	20.4	21.4	21.5	22.1
average monthly temp (^{0}C)	26.9	27.1	27.2	26.9	26.4	26.0	25.5	25.4	25.6	26.3	26.5	26.9

Source:
Apia Observatory / Samoa Meteorology, Climate Section

ANNEX 2 LIST OF ELECTRICAL APPLIANCES AND THEIR MONTHLY CONSUMPTION

LOCATION	Equipment / Appliance	Ratings		hours in idle	Load Ratings[4]		hours of use	Consumption	Consumption
		Amps	Wattage	mode per day	Amps	Wattage	(loaded)/day	per day (kWh)	per month (kWh)
Library	Air Conditioner (1)	0.15	36.00	5.60	10.00	2400.00	2.40	5.96	178.85
	Air Conditioner (2)	0.15	36.00	5.60	10.00	2400.00	2.40	5.96	178.85
	Lights - switch 1 (12 x 36W)				1.80	432.00	8.00	3.46	103.68
	- switch 2 (12 x 36W)				1.80	432.00	0.50	0.22	6.48
	Computer				0.63	151.20	8.00	1.21	36.29
Reception & Admin Staff	Lights (30 x 36W)				4.50	1080.00	4.00	4.32	129.60
	Computer				0.63	151.20	8.00	1.21	36.29
	Air Conditioner (floor)	0.27	64.80	3.20	10.00	2400.00	4.80	24.21	726.22
	Printer	0.10	24.00	7.50	2.50	600.00	0.50	0.48	14.40
	Computer				1.00	240.00	8.00	1.92	57.60
Program Assistant	Air Conditioner (old model)	0.30	72.00	5.20	10.00	2400.00	2.80	7.09	212.83
	Computer				0.63	151.20	8.00	1.21	36.29
	Lights (6 x 36W)				0.90	216.00	8.00	1.73	51.84
Admin Clerk - Accounts	Computer				0.63	151.20	8.00	1.21	36.29
	Lights (6 x 36W)				0.90	216.00	8.00	1.73	51.84
	Printer	0.10	24.00	7.50	2.50	600.00	0.50	0.18	5.41
Admin Officer	Lights (6 x 36W)				0.90	216.00	8.00	1.73	51.84
	Computer				0.63	151.20	8.00	1.21	36.29
	Photocopier	0.10	24.00	7.80	3.00	720.00	0.20	0.33	9.94
	Air Conditioner	0.15	36.00	4.80	10.00	2400.00	3.20	7.85	235.58
General Assembly	Lights (48 x 36W)				7.20	1728.00	0.56	0.97	29.03
	Air Conditioner	0.15	36.00	3.20	10.00	2400.00	4.80	11.64	349.06
Kitchen / Bar	Urn	3.10	744.00	6.50	6.70	1608.00	1.50	7.25	217.44
	Refrigerator (190) litre	0.10	24.00	20.40	1.00	240.00	3.60	1.35	40.61
	Desk Fan				0.19	45.00	0.30	0.01	0.41
	Coffee Brewer	3.00	720.00	6.40	9.68	2324.00	1.60	8.33	249.79
	Lights (6 x 36W)				0.90	216.00	0.50	0.11	3.24
Conference Rooms (1 & 2)	Lights (168 x 36W)				25.20	6048.00	0.56	3.39	101.61
	Air Conditioners (x 3)	0.45	108.00	0.11	30.00	7200.00	0.16	1.16	34.92
Upstairs Reception &	Lights (24 x 36W)				3.60	864.00	8.00	6.91	207.36
Secretaries	Computers x 2				1.26	120.00	8.00	0.96	28.80
	Water cooler/filter				0.60	144.00	1.20	0.17	5.18
	Server Computers				1.26	120.00	8.00	0.96	28.80
Consultants (2 rooms)	2 Computers				1.26	302.40	1.30	0.39	11.79
	12 x 36W lights				1.80	432.00	1.30	0.56	16.85
Professionals (Technical)	36 x 36W lights (6 per room)				5.40	1296.00	5.00	6.48	194.40
6 Rooms	6 Computers				3.78	907.20	5.00	4.54	136.08
	6 Air Conditioners	0.90	216.00	5.60	60.00	14400.00	2.40	35.77	1073.09
Registry	Computer				0.63	151.20	8.00	1.21	36.29
	Printer	0.10	24.00	7.50	2.50	600.00	0.50	0.48	14.40
	Scanner				0.52	124.80	0.20	0.02	0.75
	Air Conditioner	0.15	36.00	5.60	10.00	2400.00	2.40	5.96	178.85
	Photocopier	0.20	48.00	7.84	6.50	1560.00	0.16	0.63	18.78
Registry Filling Room	Lights (27 x 36W)					972.00	8.00	7.78	233.28
	Air Conditioner	0.30	72.00	5.20	10.00	2400.00	2.80	7.09	212.83
	Fax/Phone	0.40	95.00	7.50	0.80	192.00	0.50	0.81	24.26
Residential Rep	Computer				0.63	151.20	8.00	1.21	36.29
	TV 32 inch				0.56	135.00	0.10	0.01	0.41
	TV deck				0.10	24.00	0.10	0.00	0.07
	Printer	0.10	24.00	7.60	1.10	264.00	0.40	0.29	8.64
	Air Conditioner	0.30	72.00	6.40	10.00	2400.00	1.60	4.30	129.02
Secretary	Computer				0.63	151.20	8.00	1.21	36.29
	Printer	0.10	24.00	7.50	2.50	600.00	0.50	0.48	14.40
	Lights (8 x 36W)				1.20	288.00	8.00	2.30	69.12
	Air Conditioner	0.15	36.00	5.20	14.58	3500.00	2.80	9.99	299.62

ANNEX 3 A LAYOUT OF THE UNITED NATIONS FOOD AND AGRICULTURE ORGANISATION SUB-REGIONAL OFFICE