Study for Supporting the Establishment of the Small-scale CDM Project Design Document in South Pacific Island Countries

Executive Summary

1. Objective

The objective is to establish the small-scale CDM project design document (PDD) in Samoa based on the results of the Phase I study in 2001 fiscal year.

2. Results

2.1 Definite plan of the small-scale CDM project

2.2.1 Description of the small-scale CDM project in Samoa

(1) Project title

Installation of the photovoltaic power generation facilities into main factory, hotel, and national organizations in Samoa

(2) Objectives of the project

To promote sustainable energy use in main industries and national organizations by introducing renewable energy, and

To promote human resource development concerning renewable energy.

(3) Expected benefits

- Reduction of the GHG emission from the diesel power generation system by substituting the photovoltaic power generation for the present diesel power generation

- Reduction of the imports of the diesel oil by substituting the photovoltaic power generation for the present diesel power generation

- Reduction of the atmospheric pollution substances by substituting the photovoltaic power generation for the present diesel power generation

- Modification of the insecurity of the present power supply system in Upolu Island that consists of aging diesel power plants and seasonally fluctuating hydropower plants by introducing the photovoltaic power generation facilities

- Promotion of the technology transfer and capacity building concerning the operation and maintenance of the photovoltaic power generation facilities

- Promotion of education and awareness raising concerning the utilization of solar power which is characteristic renewable energy in Samoa

- Promotion of sustainable development of Samoan main industries such as manufacturing industry and tourist industry by introducing low GHG emission technology

(4) Project sites

- Yazaki EDS Samoa Ltd.
- Hotel Kitano Tusitala
- National University of Samoa
- National Hospital
- Parliament
- Government Building
- SPREP Training Center

(5) Specific plan

i) Yazaki EDS Samoa Ltd.

Objective: To introduce the photovoltaic power generation facilities to Yazaki EDS Samoa Ltd. that is the biggest manufacturing factory in order to accelerate sustainable development of the factory by using characteristic renewable energy in Samoa

Scale:

Photovoltaic module	300 kW
Inverter	300 kW
Lead battery	600 kWh

Notes:
- It is expected that the amount of photovoltaic power generation per year account for a quarter to one third of power consumption per year in the factory.
- Photovoltaic modules will be installed on the suitable part of the roofs that reach about 25,000m^3 in total.
- It is possible to offer opportunities to over 2,000 Samoan staffs to learn about photovoltaic power generation and acquire operation management skills of facilities.

ii) Hotel Kitano Tusitala

Objective: To introduce the photovoltaic power generation facilities to Hotel Kitano Tusitala that is the major tourism center in order to accelerate sustainable development of the hotel by using characteristic renewable energy in Samoa

Scale:

Photovoltaic module	300 kW
Inverter	300 kW
Lead battery	600 kWh

Notes:
- It is expected that the amount of photovoltaic power generation per year account for over one third of power consumption per year in the

hotel.
- Photovoltaic modules will be installed in the suitable place of the large hotel premise.
- It is possible to offer opportunities to tourists and Samoan staffs to learn about photovoltaic power generation and acquire operation management skills of facilities.

iii) National University of Samoa

Objective: To introduce the photovoltaic power generation facilities to National University of Samoa that is Samoan cultural hub supported by Japanese ODA in order to succeed the education of the practice of sustainable development by using characteristic renewable energy in Samoa

Scale:

Photovoltaic module	300 kW
Inverter	300 kW
Lead battery	600 kWh

Notes:
- It is expected that the amount of photovoltaic power generation per year account for over one third of power consumption per year in the university.
- Photovoltaic modules will be installed in the suitable place of the university premise and the roofs.
- It is possible to offer an opportunity to the students to learn about photovoltaic power generation.
- The problem of waste management of used lead batteries is able to be solved through technical transfer and capacity building in the university and National polytechnic school. In addition, this can solve the existing issue, waste management of automotive batteries in the country.

iv) National Hospital

Objective: To introduce the photovoltaic power generation facilities to the National Hospital that is the important center for human health in Samoa in order to succeed the education and awareness raising of sustainable development for Samoan people by using characteristic renewable energy in Samoa

Scale:

Photovoltaic module	100 kW
Inverter	100 kW
Lead battery	120 kWh

Notes:
- Although we have not recognized the power consumption per year in the hospital, it is expected that there is a power demand of some 100kw.
- Photovoltaic modules will be installed in the suitable place of the hospital premise.
- It is possible to offer an opportunity to the public to learn about

photovoltaic power generation.

v) Parliament

Objective: To introduce the photovoltaic power generation facilities to the Parliament that is the national landmark in Samoa in order to educate and to raise awareness of sustainable development for politician by using characteristic renewable energy in Samoa

Scale:

Photovoltaic module	20 kW
Inverter	20 kW
Lead battery	120 kWh

Notes:
- The parliament session is sometimes held at night. There will be a small power demand of some 20 kW.
- There is a potential for spread of photovoltaic power generation as an alternative for diesel power generation, if politicians get interested in it and want to introduce it to their villages.

iv) Government Building

Objective: To introduce the photovoltaic power generation facilities to the Government Building that is the national landmark in Samoa in order to educate and to raise awareness of sustainable development for governmental people by using characteristic renewable energy in Samoa

Scale:

Photovoltaic module	20 kW
Inverter	20 kW

Notes:
- The areas of premises and roof are limited. The scale of photovoltaic modules installed will be limited in small scale, some 20kW.
- It is expected to offer an opportunity to educate the public who visit the Government building.

iiv) SPREP Training Center

Objective: To introduce the photovoltaic power generation facilities to the SPREP Training Center that is the base of the environmental protection for South Pacific island countries in order to educate and to raise awareness of sustainable development for South Pacific island countries by using characteristic renewable energy in South Pacific

Scale:

Photovoltaic module	20 kW
Inverter	20 kW

Notes:
- There is no air conditioner in the training center at present. The photovoltaic power generation facilities can be used as an electric power source for air conditioners.
- SPREP is an international organization. The case of SPREP Training Center will be a good advertisement for assistance by Japan, because

a number of stakeholders visit SPREP from developed donor countries as well as South Pacific island countries.

2.1.2 Estimation of the GHG emission reductions

The following table shows the results of the estimation of GHG emission reductions by introducing the photovoltaic power generation facilities.

Table 1 The results of the estimation of the GHG emission reductions

Introduction Site	Capacity	Annual Power Generation	Emission Factor	Emission Reduction
	A	B	F	ER
Yazaki EDS Samoa Ltd.	300 kW	394,200 kWh/year	0.80 kg/CO_2/kWh	315 tCO_2/year
Hotel Kitano Tusitala	300 kW	394,200 kWh/year	0.80 kg/CO_2/kWh	315 tCO2/year
National University of Samoa	300 kW	394,200 kWh/year	0.80 kg/CO_2/kWh	315 tCO2/year
National Hospital	100 kW	131,400 kWh/year	1.00 kg/CO_2/kWh	131 tCO2/year
Parliament	20 kW	26,280 kWh/year	1.10 kg/CO_2/kWh	29 tCO2/year
Government Building	20 kW	26,280 kWh/year	1.10 kg/CO_2/kWh	29 tCO2/year
SPREP Training Center	20 kW	26,280 kWh/year	1.10 kg/CO_2/kWh	29 tCO2/year
Total	1,060 kW	1,392,840 kWh/year		1,164 tCO2/year

The estimations of the CERs and the conversion of the CERs into yen are as follows:

CER:
Annual amount of the CERs : 1,164 CERs/year
Total amount of the CERs (10 years) : 11,640 CERs

Conversion of the CERs into yen
Annual amount of yen : 727,628 yen/year
Total amount of yen (10 years) : 7,276,280 yen

note: 1 CER = 5 US$, 1 US$ = 125 yen

The estimations of the reduction of the electricity bill by the project are as follows:

Annual reduction of the electricity bill : 21,560,000 yen/year
Total reduction of the electricity bill : 215,600,000 yen

note: 1kWh = 15 yen(from actual performance)

2.1.3 Estimated cost

The estimated cost is as follows:

Yazaki EDS Samoa Ltd.

Items	Scale	unit cost	Total	
Photovoltaic module	300 kW	400,000 yen/kW	120,000,000	yen
Inverter		100,000 yen/kW	30,000,000	yen
Array stand		50,000 yen/kW	15,000,000	yen
Construction cost		100,000 yen/kW	30,000,000	yen
Lead battery	600 kWh	100,000 yen/kWh	60,000,000	yen
Total			255,000,000	yen

Hotel Kitano Tusitala

Items	Scale	unit cost	Total	
Photovoltaic module	300 kW	400,000 yen/kW	120,000,000	yen
Inverter		100,000 yen/kW	30,000,000	yen
Array stand		10,000 yen/kW	3,000,000	yen
Construction cost		100,000 yen/kW	30,000,000	yen
Lead battery	600 kWh	100,000 yen/kWh	60,000,000	yen
Total			243,000,000	yen

National University of Samoa

Items	Scale	unit cost	Total	
Photovoltaic module	300 kW	400,000 yen/kW	120,000,000	yen
Inverter		100,000 yen/kW	30,000,000	yen
Array stand		50,000 yen/kW	15,000,000	yen
Construction cost		100,000 yen/kW	30,000,000	yen
Lead battery	600 kWh	100,000 yen/kWh	60,000,000	yen
Total			255,000,000	yen

National Hospital

Items	Scale	unit cost	Total	
Photovoltaic module	100 kW	400,000 yen/kW	40,000,000	yen
Inverter		100,000 yen/kW	10,000,000	yen
Array stand		50,000 yen/kW	5,000,000	yen
Construction cost		100,000 yen/kW	10,000,000	yen
Lead battery	120 kWh	100,000 yen/kWh	12,000,000	yen
Total			77,000,000	yen

Parliament

Items	Scale	unit cost	Total	
Photovoltaic module	20 kW	400,000 yen/kW	8,000,000	yen
Inverter		100,000 yen/kW	2,000,000	yen
Array stand		10,000 yen/kW	200,000	yen
Construction cost		100,000 yen/kW	2,000,000	yen
Lead battery	120 kWh	100,000 yen/kWh	12,000,000	yen
Total			24,200,000	yen

Government Building

Items	Scale	unit cost	Total	
Photovoltaic module	20 kW	400,000 yen/kW	8,000,000	yen
Inverter		100,000 yen/kW	2,000,000	yen
Array stand		50,000 yen/kW	1,000,000	yen
Construction cost		100,000 yen/kW	2,000,000	yen
Lead battery	- kWh	100,000 yen/kWh	0	yen
Total			13,000,000	yen

SPREP Training Center

Items	Scale	unit cost	Total	
Photovoltaic module	20 kW	400,000 yen/kW	8,000,000	yen
Inverter		100,000 yen/kW	2,000,000	yen
Array stand		50,000 yen/kW	1,000,000	yen
Construction cost		100,000 yen/kW	2,000,000	yen
Lead battery	- kWh	100,000 yen/kWh	0	yen
Total			13,000,000	yen

Total

Items	Scale	unit cost	Total	
Photovoltaic module	1080 kW	400,000 yen/kW	432,000,000	yen
Inverter		100,000 yen/kW	108,000,000	yen
Array stand		- yen/kW	40,200,000	yen
Construction cost		100,000 yen/kW	108,000,000	yen
Lead battery	- kWh	100,000 yen/kWh	216,000,000	yen
Total			904,200,000	yen

2.2 Future issues

2.2.1 The items and implementation methods of the necessary technical transfer/capacity building

(1) Maintenance of the photovoltaic power generation facilities

The maintenance of the photovoltaic power generation facilities is comparatively easy, however, it is necessary to establish a system of maintenance prior to introduction of the facilities of totally about 1MW scale on seven sites. The maintenance costs include the cost necessary to exchange lead batteries. It is desirable to establish the routine maintenance system using three key sites, Yazaki EDS Samoa Ltd., Hotel Kitano Tusitala and National University of Samoa, as a core. The maintenance costs will be covered by profit from possible CERs and reserve funds of a part of reduced electricity rate.

(2) Disposal of used lead batteries

In developing countries, waste management of used lead batteries is the most important issue in introducing photovoltaic power generation facilities. If we install them without considering the problem, introduction of renewable energy may cause new fatal environmental pollution. Therefore we have to consider adequately this matter in advance.

As the technology of waste management of lead battery has already been established in developed country, it is able to transfer it and build capacity in Samoa. However, if the project participants hold responsibility to do them without technical and financial support, they will be confronted with technical and financial difficulties to cope with the matter. This CDM project will be an opportunity for Samoa to promote the introduction of photovoltaic power generation facilities. Therefore, it is necessary that the development assistance agencies such as JICA will develop a waste management project as a part of assistance to Samoa's efforts. The project participants should participate in the waste management project and contribute human and financial resources.

For the lead waste management, there are some possible technical methods such as insoluble salts-chemical clarification. This method generates sludge, and if sludge is thrown out, it will cause more serious environmental pollution than we directly discard wasted lead batteries. We should examine a treatment system which prevents environmental pollution such as collecting and reusing lead as a valuable resource.

2.2.2 Financial issues on the project implementation

The critical issue in implementing this CDM project is the availability of funds. The introduction of is less attractive for investors because there is not much amount of CERs from the project. The saved electricity rate is thirtyfold as the amount of CERs. If the project operators will bear the costs in proportion to their reduced electricity rate, the funds will be still insufficient. Thus, following efforts are necessary to secure funds:

- to promote development of subsidiaries by the Government of Japan for CDM projects implemented by private companies,
- to promote funding by private companies in Japan and individual investors who recognize the advertising effect of a clean image of CDM projects in South Pacific island countries.

We should make extra efforts than ordinary CDM projects to attract the investors, such as giving some benefits in addition to CERs.

2.2.3 Cooperation with SPREP

SPREP is an organization to deal with environmental issues including climate change in South Pacific island countries. As SPREP has strong influence on the governments of these countries, it is desirable for making this CDM project success to work in close cooperation with SPREP from its begging stage. Samoa is the best country for assuring cooperation with SPREP when we implement CDM projects in South Pacific island countries, because there is the SPREP headquarters in Samoa. When this CDM project will be succeeded, close cooperation with SPREP will make the success story spread out in the region. As a matter of fact, it is better to keep close contact with JICA experts in SPREP and to hold meetings with the Climate Change Officer as appropriate.

2.2.4 Other issues

Besides the introduction of photovoltaic power generation facilities, it is possible to implement DSM projects improving energy efficiency of electric equipments in Hotel Kitano Tusitala, Yazaki EDS Samoa Ltd. and Kitano Mendana Hotel. Although their GHG emission reductions are little, the implementation of the projects will be reasonable to consider in Samoa whose electricity rate is expensive. As in Annex 2, it will be effective for implementing them as small scale CDM projects to bundle agencies and companies who have a lot of electric equipments, such as the Government of Samoa, Aggie Grey’s Hotel as well as Hotel Kitano Tusitala and Yazaki EDS Samoa Ltd.