CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-SSC-PDD)
Version 03 - in effect as of: 22 December 2006

CONTENTS

Annexes

Revision history of this document

Version Number	Date	Description and reason of revision
01	21 January 2003	Initial adoption
02	8 July 2005	• The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document. • As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <http://cdm.unfccc.int/Reference/Documents>.
03	22 December 2006	• The Board agreed to revise the CDM project design document for small-scale activities (CDM-SSC-PDD), taking into account CDM-PDD and CDM-NM.

SECTION A. General description of small-scale project activity

A.1 Title of the small-scale project activity:

Electricity generation by fuel cell using biogas generated from garbage in Phi Phi island resort.

A.2. Description of the small-scale project activity:

Purpose of the project activity:

The first purpose of this project is to generate methane from garbage on site and to avoid dumping it at a solid waste disposal site(SWDS). The methane emissions from WSDS is reduced. The second purpose is to generate renewable energy from garbage on site. Using the renewable energy at the resort will reduce oil consumption of diesel engines.

Description of GHG reduction:

This project is to generate biogas containing methane from garbage at resort. The wastes like kitchen garbage, urine and so on are collected in unaerobic tank. The biogas is generated by fermentation in tank. The biogas is used by phosphoric acid fuel cell (PAFC). Electricity generated by PAFC using biogas is supplied through private grid to the resort. Using the renewable energy at the resort will reduce oil consumption of diesel engines and CO_2 emissions. Avoiding dumping the wastes at SWDS reduces methane emissions from SWDS in Phuket. In this project, there are two different ways of GHG emissions reductions. One way is to reduce methane emissions by avoiding from dumping waste. The other is to reduce CO_2 emissions discharged by oil consumption. The decision to consider the implementation of this project is influenced by the possibility obtaining revenues from the sale of Certified Emission Reduction.

Contribution of the project activity to sustainable development:

The project activity contributes to the sustainable development by:

In Thai resort island, there is a little public sewage treatment equipment and poor power grid. The wastes at resort is dumped at SWDS. The waste water flows into sea without water treatment enough. The electric power supply at resort is generated by diesel generators on site in general. The increase of visitors makes the increase of wastes and destructs environment in this area.

Electricity generated by PAFC using biogas is supplied through private grid to the resort. In this project using the renewable energy at the resort will reduce oil consumption of diesel engines. A voiding dumping the wastes at SWDS reduces methane emissions from SWDS in Phuket. The operations and maintenance of fermentation and PAFC using biogas is not a difficult work. The maintenance cost of PAFC is lower than of the engine. This system will be installed widely in this area.

A.3. Project participants:

CDM – Executive Board

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A.4. Technical description of the small-scale project activity:

A.4.1. Location of the small-scale project activity:

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A.4.1.1. Host Party(ies):

Kingdom of Thailand

A.4.1.2. Region/State/Province etc.:

The site included in the current project activity is located in Krabi province

A.4.1.3. City/Town/Community etc:

The project site, as shown in the figure A1 and detailed in the Table A1, is located in Thailand, between the large island of Phuket and the western Andaman Sea coast of the mainland.

A.4.1.4. Details of physical location, including information allowing the unique identification of this small-scale project activity :

Phi Phi island is one of famous resort islands located in southern Thailand. Many visitors from Europe and Asia come here to spend vacations. This area has serious problems caused by coming many visitors. This problems are a large amount of wastes and the destruction of the environment. In Phi Phi island, there are additionally problems that there is no power grid and no trash disposal facility. People in here has to bring oil and generate power by themselves and to bring garbage out from here. There are CO2 emissions from diesel engines for power supply and methane emissions from dumping garbage at SWDS.

A.4.2. Type and category(ies) and technology/measure of the small-scale project activity:

Category 1 and 13: “Energy industries” and “Waste handling and disposal”

A.4.3 Estimated amount of emission reductions over the chosen crediting period:

The project activity is estimated to reduce GHG emissions annually by 2,500～6,500 tCO_2e

Table 1 - Emission reductions over the crediting period

A.4.4. Public funding of the small-scale project activity:

None

A.4.5. Confirmation that the small-scale project activity is not a debundled component of a large scale project activity:

There is no debundled component of a large scale project activity in this activity.

SECTION B. Application of a baseline and monitoring methodology

B.1. Title and reference of the approved baseline and monitoring methodology applied to the small-scale project activity:

Approved SSC methodologies Version 2 of Annex 10 : Methodological tool - "Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site".

Version 12 of 1.A. – "Electricity generation by the user"

Available on the UNFCC website:
http://cdm.unfccc.int/methodologies/SSCmethodologies/approved.html

B.2 Justification of the choice of the project category:

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This project meets the applicability criteria of version 2 of Annex 10 as:

1. The solid waste disposal site where the waste would be dumped is clearly identified.
2. The waste is not hazardous wastes.

This project meets the applicability criteria of Version 12 of 1.A. as:

1. Users do not have a grid connection and uses all of electricity which is generated by the users. The capacity of these renewable energy generators dose not exceed 15 MW.
2. This system in the activity is not a combined heat and power (co-generation) system.

B.3. Description of the project boundary:

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Table1 Description of the source and gases included in the project boundary

	Source	Gas	Included	Justification/explanation
Baseline	Emissions from dumping waste at a solid waste disposal site	CH_4	Yes	The major source of emissions in the baseline
	Emissions from electricity generation	CO_2	Yes	Emission from oil consumption
Project activity	Emissions from dumping waste at a solid waste disposal site	CH_4	No	Avoided from dumping waste at a solid waste disposal site
	Emissions from electricity generation	CO_2	Yes	Emissions from oil consumption

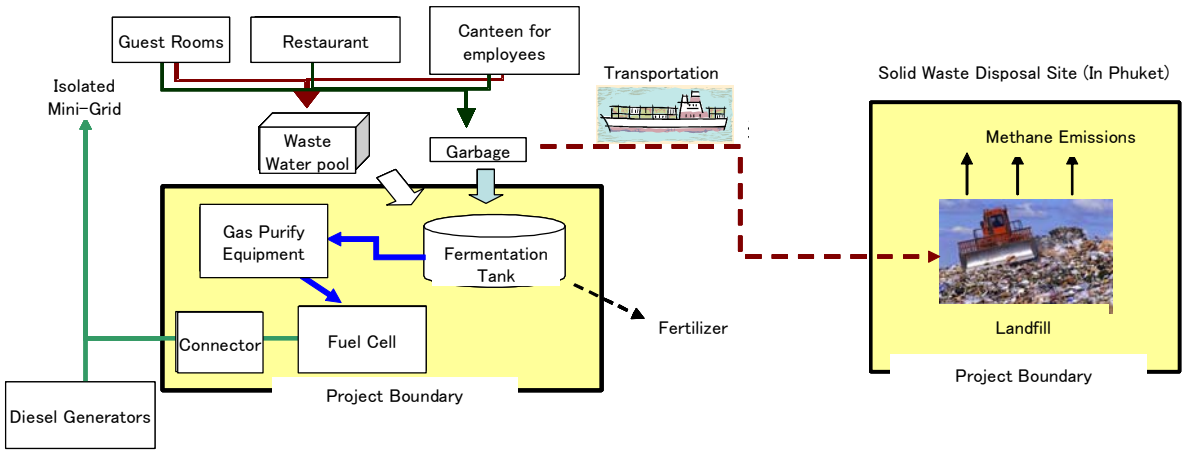

Fig.1 System Boundary of this project.

B.4. Description of baseline and its development:

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Current state of island resort in Thailand：

There are a few trash disposal facilities and a poor power grid.

Users managing resort facilities have to prepare them.

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（About the wastes from resort）

The waste water flows into sea without water treatment enough.

The Garbage at resort is brought out and dumped at SWDS.

（About electric power supply）
The electric power supply at resort is generated by diesel generators on site in general.
The capacity of these energy generators by the users is below several MW.

The demonstration and assessment of additionality about generators using biogas
Gas engine generators using biogas :
Power generation efficiency is low (below 25%)
Maintenance cost is high (above 0.06 $/kwh)
The users in here does not consider having generators using biogas

【Baseline scenario】
The waste water at the resort flows into sea without water treatment enough. The garbage collected at resort is brought out from here and dumped at SWDS in Phuket.

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered small-scale CDM project activity:

The garbage at resort is not dumped at SWDS. This activity makes to reduce methane emissions from there and CO2 emissions from oil consumption by using biogas as renewable energy.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

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Baseline emissions

(1) Methane emissions

$$BECH4,SWDS,y = \phi \cdot (1-f) \cdot GWPCH4 \cdot (1-OX) \cdot 16/12 \cdot F \cdot DOCf \cdot MCF \cdot \sum_{X=1}^{y} \sum_{j} Wj,x \cdot DOCj \cdot e\text{-}kj \cdot (y-x) \cdot (1-e\text{-}kj)$$

Where
BECH4,SWDS,y = Methane emissions avoided during the year *y* from preventing waste disposal at the solid waste disposal site (SWDS) during the period from the start of the project activity to the end of the year y (tCO_2e)
ϕ = Model correction factor to account for model uncertainties (0.9)
f = Fraction of methane captured at the SWDS and flared, combusted or used in another manner
GWPCH4 = Global Warming Potential (GWP) of methane, valid for the relevant commitment period
OX = Oxidation factor (reflecting the amount of methane from SWDS that is oxidised in the soil or other material covering the waste)
F = Fraction of methane in the SWDS gas (volume fraction) (0.5)
DOCf = Fraction of degradable organic carbon (DOC) that can decompose
MCF = Methane correction factor
Wj,x = Amount of organic waste type *j* prevented from disposal in the SWDS in the year *x* (tons)

DOCj	=	Fraction of degradable organic carbon (by weight) in the waste type *j*
kj	=	Decay rate for the waste type *j*
j	=	Waste type category (index)
x	=	Year during the crediting period: x runs from the first year of the first crediting period (x = 1) to the year y for which avoided emissions are calculated (x = y)
y	=	Year for which methane emissions are calculated

Where different waste types *j* are prevented from disposal, determine the amount of different waste types ($W_{j,x}$) through sampling and calculate the mean from the samples, as follows:

$$Wj,x = Wx \cdot \sum_{n=1}^{z} Pn,j,x / z$$

Where

Wj,x	=	Amount of organic waste type *j* prevented from disposal in the SWDS in the year *x* (tons)
Wx	=	Total amount of organic waste prevented from disposal in year *x* (tons)
Pn,j,x	=	Weight fraction of the waste type *j* in the sample *n* collected during the year *x*
z	=	Number of samples collected during the year *x*

(2) CO_2 emissions

The energy baseline is the fuel consumption of the technology in use or that would have been used in the absence of the project activity. The project participants may use one of the following energy baseline formulae:

EB = Σ iOi/(1-l)

Where:

EB	=	Annual energy baseline in kWh per year.
Σ i	=	The sum over the group of “i” renewable energy technologies (e.g. solar home systems, solar pumps) implemented as part of the project.
Oi	=	The estimated annual output of the renewable energy technologies of the group of “i” renewable energy technologies installed (in kWh per year)
l	=	Average technical distribution losses that would have been observed in diesel powered mini-grids installed by public programmes or distribution companies in isolated areas, expressed as a fraction.

The emissions baseline is the value that EB times EFy (CO2 emissions factor) which a small-scale project proponent may use.

EFy = 0.8 （kgCO2/kWh）

Project Emissions

（1）Methane emissions

There is no methane emissions.

（2）CO2 emissions

$Oi = G_{FC} - CE_{FT}$

Oi : Amount of power supply estimated by renewable energy
G_{FC} : Amount of power generation output by fuel cell using biogas
CE_{FT} : Power consumption of fermentation equipment

(a) Amount of power generation output by fuel cell using biogas

GFC = η FC・W1・PBG・R CH_4・365(d/year)

Where:

η_{FC}	: 38 %	Power generation coefficient of the fuel cell using biogas
W_1	: 0.9 ton/d	Amount per day of organic waste like kitchen waste
P_{BG}	: 0.74[1] m3/kg	Biogas volume generated by 1kg of organic waste
R_{CH4}	: 60 %	Fraction of methane in the biogas
T_{CH4}	: 37,180 kJ/m^3	Methane's heat of combustion

(b) Power consumption and thermal energy of fermentation equipment

Fermentation equipment is supplied enough thermal energy produced in power generation and does not need extra energy.

CE_{FT} = W1・IEFT・365(d/year)

IE_{FT} : 350[2] kWh/t Power consumption of fermentation equipment for 1ton garbage

B.6.2. Data and parameters that are available at validation:

(Copy this table for each data and parameter)

Data / Parameter:	ϕ
Data unit:	—
Description:	Model correction factor to account for model uncertainties
Source of data used:	Approved SSC methodologies "Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site"
Value applied:	0.9
Justification of the choice of data or description of measurement methods and procedures actually applied :	IPCC 2006 default values are used, since there are no country specific data or region specific data available.
Any comment:	

Data / Parameter:	**OX**
Data unit:	—
Description:	Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste)
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories.
Value applied:	0
Justification of the choice of data or description of	IPCC 2006 default values are used, since there are no country specific data or region specific data available.

measurement methods and procedures actually applied :	
Any comment:	

Data / Parameter:	**F**
Data unit:	–
Description:	Fraction of methane in the SWDS gas (volume fraction)
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value applied:	0.5
Justification of the choice of data or description of measurement methods and procedures actually applied :	IPCC 2006 default values are used, since there are no country specific data or region specific data available.
Any comment:	

Data / Parameter:	**DOC_f**
Data unit:	–
Description:	Fraction of degradable organic carbon (DOC) that can decompose
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value applied:	0.5
Justification of the choice of data or description of measurement methods and procedures actually applied :	IPCC 2006 default values are used, since there are no country specific data or region specific data available.
Any comment:	

Data / Parameter:	**MCF**
Data unit:	–
Description:	Methane correction factor
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value applied:	0.4
Justification of the choice of data or description of measurement methods and procedures actually applied :	Garbage in Phi Phi island have been dumped at a unmanaged-shallow solid waste disposal site.
Any comment:	

Data / Parameter:	**DOC_j**
Data unit:	–
Description:	Fraction of degradable organic carbon (by weight) in the waste type *j*

Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Tables 2.4 and 2.5)
Value applied:	15
Justification of the choice of data or description of measurement methods and procedures actually applied :	Garbage in Phi Phi island is mainly food, food waste, beverages and tobacco (other than sludge).
Any comment:	

Data / Parameter:	**k_j**
Data unit:	—
Description:	Decay rate for the waste type *j*
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Table 3.3)
Value applied:	0.4
Justification of the choice of data or description of measurement methods and procedures actually applied :	Garbage in Phi Phi island is mainly food, food waste, beverages and tobacco (other than sludge). Mean annual temperature and mean annual precipitation in Phuket is beyond 20℃ and 1,000mm.
Any comment:	

B.6.3 Ex-ante calculation of emission reductions:

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(1) The amount of methane produced in the year *y* ($BE_{CH4,SWDS,y}$) is calculated as follows:

$$BE_{CH4,SWDS,y} = \phi \cdot (1-f) \cdot GWP_{CH4} \cdot (1-OX) \cdot 16/12 \cdot F \cdot DOC_f \cdot MCF \cdot \sum_{X=1}^{y} \sum_{j} W_{j,x} \cdot DOC_j \cdot e^{-k_j \cdot (y-x)} \cdot (1-e^{-k_j})$$

W1：Total amount of organic waste prevented from disposal in year *x* (tons)

W_1：0.9 t/d ： Information from engineer at the resort

table 5. GHG emissions in project period

Project period	GHG emissions (t-CO2e)
1st	2,047
2nd	3,419
3rd	4,339
4th	4,955
5th	5,368
6th	5,645
7th	5,831
8th	5,956
9th	6,039
10th	6,095
11th	6,132
12th	6,158
13th	6,174
14th	6,186
15th	6,193

(2) GHG emission reduction by renewable energy

$O_i = G_{FC} - CE_{FT}$

O_i : Amount of power supply estimated by renewable energy

G_{FC} : Amount of power generation output by fuel cell using biogas

CE_{FT} : Power consumption of fermentation equipment

(a) Amount of power generation output by fuel cell using biogas

$G_{FC} = \eta_{FC} \cdot W_1 \cdot P_{BG} \cdot R_{CH4} \cdot 365(d/year)$

η_{FC} : 38 % Power generation coefficient of the fuel cell using biogas

W_1 : 0.9 ton/d Amount per day of organic waste like kitchen waste

P_{BG} : 0.74[1] m3/kg Biogas volume generated by 1kg of organic waste

R_{CH4} : 60 % Fraction of methane in the biogas

T_{CH4} : 37,180 kJ/m^3 Methane's heat of combustion

$G_{FC} = 0.38 \cdot 0.9 \cdot 0.74 \cdot 0.6 \cdot 37,180 \cdot 365$

$= 2,061$ GJ $=$ 572 MWh

(b) Power consumption and thermal energy of fermentation equipment

Fermentation equipment is supplied enough thermal energy produced in power generation and does not need extra energy.

$CE_{FT} = W_1 \cdot IE_{FT} \cdot 365(d/year)$

IE_{FT} : 350[1] kWh/t Power consumption of fermentation equipment for 1ton garbage

$CE_{FT} = 0.9 \cdot 350 \cdot 365$

$=$ 115 MWh

$O_i = G_{FC} - CE_{FT} =$ 457 MWh

Baseline GHG emissions

$GHG_B = \Sigma_i O_i/(1-l) \cdot EF_y =$ 457 t-CO_2

[1] According to a report “Renewable energy by garbage fermentation” Ministry of environment in Japan

B.6.4 Summary of the ex-ante estimation of emission reductions:

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Years	Emission reduction of methane (tons of CO_2e)	Emission reduction by using renewable energy (tons of CO_2e)	Annual estimation of emission reductions
1st	2,047	457	2,504
2nd	3,419	457	3,876
3rd	4,339	457	4,796
4th	4,955	457	5,412
5th	5,368	457	5,825
6th	5,645	457	6,102
7th	5,831	457	6,288
8th	5,956	457	6,413
9th	6,039	457	6,496
10th	6,095	457	6,552
11th	6,132	457	6,589
12th	6,158	457	6,615
13th	6,174	457	6,631
14th	6,186	457	6,643
15th	6,193	457	6,650
Total (tons of CO_2e)	80,537	6,855	87,392

B.7 Application of a monitoring methodology and description of the monitoring plan:

B.7.1 Data and parameters monitored:

Data / Parameter:	**f**
Data unit:	—
Description:	Fraction of methane captured at the SWDS and flared, combusted or used in another manner
Source of data to be used:	Written information from the operator of the solid waste disposal site and/or site visits at the solid waste disposal site
Value of data	—
Description of measurement methods and procedures to be applied:	Monitoring frequency :Annually
QA/QC procedures to be applied:	—
Any comment:	

Data / Parameter:	**GWP_{CH4}**
Data unit:	tCO_2e / t CH_4
Description:	Global Warming Potential (GWP) of methane, valid for the relevant commitment period
Source of data to be used:	Decisions under UNFCCC and the Kyoto Protocol
Value of data	21
Description of measurement methods and procedures to be applied:	Monitoring frequency :Annually
QA/QC procedures to be applied:	—
Any comment:	

Data / Parameter:	**W_x**
Data unit:	tons
Description:	Total amount of organic waste prevented from disposal in year *x* (tons)
Source of data to be used:	Decisions under UNFCCC and the Kyoto Protocol
Value of data	—
Description of measurement methods and procedures to be applied:	Monitoring frequency : Continuously, aggregated at least annually
QA/QC procedures to be applied:	—
Any comment:	

Data / Parameter:	**$p_{n,j,x}$**
Data unit:	—
Description:	Weight fraction of the waste type *j* in the sample *n* collected during the year *x*
Source of data to be used:	Measurements by project participants
Value of data	—
Description of measurement methods and procedures to be applied:	The size and frequency of sampling should be statistically significant with a maximum uncertainty range of 20% at a 95% confidence level. As a minimum, sampling should be undertaken four times per year.
QA/QC procedures to be applied:	—
Any comment:	

Data / Parameter:	z
Data unit:	—
Description:	Number of samples collected during the year *x*
Source of data to be used:	Project participants
Value of data	—
Description of measurement methods and procedures to be applied:	Monitoring frequency :Continuously, aggregated annually
QA/QC procedures to be applied:	—
Any comment:	

1. An annual check of all systems or a sample thereof to ensure that they are still operating (other evidence of continuing operation, such as on-going rental/lease payments could be a substitute).
2. The amount of biomass and fossil fuel input shall be monitored.

B.7.2 Description of the monitoring plan:

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B.8 Date of completion of the application of the baseline and monitoring methodology and the name of the responsible person(s)/entity(ies)

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SECTION C. Duration of the project activity / crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

>>01/January/2009

C.1.2. Expected operational lifetime of the project activity:

>>15 years

C.2 Choice of the crediting period and related information:

C.2.1. Renewable crediting period

C.2.1.1. Starting date of the first crediting period:

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C.2.1.2. Length of the first crediting period:

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C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

>>01/January/2009

C.2.2.2. Length:

>>15 years

SECTION D. Environmental impacts

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D.1. If required by the host Party, documentation on the analysis of the environmental impacts of the project activity:

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An enforcement site and environmental effect to the environs are analyzed by carrying out this project. It is it with transduction by 2011, and, with a sea bream, an RPS system to oblige electric power utility to the use of renewable energy with constant percentage is going to promote transduction of renewable energy, and this project is an undertaking along a governmental policy.

(1) An influence to a local environment

"Garbage" occurring in a resort establishment by enforcement of this project in large quantities can be developed into resources. The region concerned is sea bream, but it is an eminent resort, and there are lot of accommodations in Phi Phi Don Island. The geographical convenience is the accommodations to grind, but it is thought that similar energy system is adopted around that purpose. We depend, and, as of the result, an enhancement of more sewage treatment plan it about fouled sewage drained in minimum processing in each establishment, and antipollution of neighboring sea can be planned. In addition, by navigation of the cargo boats which carries waste so that landfill does waste such as garbage, biomass powerr generetion; of Diesel power generation; because light it, and it is it with decrease of the fuel ability, can reduce navigation of a tanker.

(2) An effects to transfer of skill / development

By this project, garbage methane fermentation facility, recovery / purification facility of biogas, fuel cell power generation facilities are introduced. CH4 fermentation facility and technique to relate to gas recovery / purification facility are not the technique that it is basically difficult.

In addition, about production of fuel cell stack, high technique is necessary, but, judging from the user side generating electricity, it is watched remoteness by manufacturer, and there is little turnover region about maintenance, and, about fuel cell, straw mat open market operations are comfortable facility than internal combustion engine such as an engine.

Because conventional fossil energy was cheap, judging from an aspect of diffusion, the these equipment did not advance to the transduction up to these days without percent being correct with an aspect of a cost wholly.

In businessman administering a resort establishment, transduction is not planned in particular almost because it is not facility inducing a lodging visitor directly.

However, surge of interest for global environment affects a tourism industry, and environment consideration becomes a theme in a European and American famous hotel chain.

Therefore it is expected if this technical effect is recognized by this project when the movement that a lot of high quality resorts adopt voluntarily in sea bream doing a store location appears.

D.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

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SECTION E. Stakeholders' comments

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E.1. Brief description how comments by local stakeholders have been invited and compiled:

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E.2. Summary of the comments received:

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E.3. Report on how due account was taken of any comments received:

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Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	
Street/P.O.Box:	
Building:	
City:	
State/Region:	
Postfix/ZIP:	
Country:	
Telephone:	
FAX:	
E-Mail:	
URL:	
Represented by:	
Title:	
Salutation:	
Last Name:	
Middle Name:	
First Name:	
Department:	
Mobile:	
Direct FAX:	
Direct tel:	
Personal E-Mail:	

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

Annex 3

BASELINE INFORMATION

Annex 4

MONITORING INFORMATION

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