FY 2009 CDM/JI Feasibility Study (FS) Programme Report

Executive Summary

Title of the Feasibility Study

"Wind power and cogeneration CDM Project using Jatropha oil in Galapagos Islands, Ecuador"

Name of the Company Conducting the Study

Mitsubishi UFJ Securities Co., Ltd.

Study Implementation Framework

- Energías Renovables para Galápagos (ERGAL)
  ERGAL is one of the project proponents supporting the fieldwork of the Feasibility Study (the Study)

- Ministerio de Agricultura, Ganadería, Acuacultura y Pesca (MAGAP), Instituto Nacional Autónomo de Investigaciones Agropecuarias (INIAP)
  MAGAP and INIAP are the operating entities for Jatropha oil production. They, in collaboration with ERGAL, support the information and data collection for Jatropha cultivation, oil pressing technologies and harvesting methods.

1. Project Outline

The Galapagos Islands of Ecuador are located approximately 1,000km away from the coast of Ecuador. It consists of 13 main islands and more than 100 smaller islands and reefs and has approximately 30,000 residents while tourists visiting the islands number more than 120,000 annually. Almost all the resources are imported from outside the islands and electricity is generated using diesel oil shipped from the mainland. In the Project, a 6.75 MW wind power plant and 5 MW cogeneration plant using biofuel (Jatropha oil) will be installed on the Baltra Island, one of the 13 main islands, to generate electricity in Baltra Island and supply it to the neighboring Santa Cruz Island through its mini-grid. The Project is implemented under the "Zero Fossil Fuel for the Galapagos Islands" initiative of the Ecuadorian government that aims to mark its departure from petroleum dependency. The Project will displace existing fossil fuel used to generate electricity and contribute to the reduction of greenhouse gases (GHG). At the same time, heat generated by the cogeneration plant will be supplied to the desalination plant expected to be installed next to the cogeneration plant. The wind power plant will be installed in two stages; the Phase 1 (2.25 MW) and the Phase 2 (4.5MW) while the cogeneration plant will be installed at the same time as Phase 2 of the wind power plant. The operation of the wind power plant will start from January 2011 while the cogeneration plant is set to start its operation in January 2013. The wind power and cogeneration projects will reduce GHG emissions by 11,177t-CO_2/year and 10,321 t-CO_2/year respectively on average during the first

crediting period. The Project, through introducing renewable energy generation, is also expected to bring a co-benefiting effect of reduction of air pollutants due to less fossil fuel use.

Applicable Methodologies

- AMS-I.C. (revised from Version 16)
- AMS-I.D. (Version 15)

2. Study Contents

(1) Study Subjects

In order to ascertain the feasibility of the Project as CDM, it is necessary to address the following issues.

(In relation to CDM)

a) **Confirmation of the methodology applicability and revision requirement:** The methodologies deemed applicable to the Project are AMS-I.C. and AMS-I.D.. Regarding AMS-I.C., since the methodology does not take into account the baseline scenario that is appropriate for Galapagos Islands as well as biofuel usage, contents to be included in the methodology revision proposal are discussed.

b) **Confirmation of existing data:** Availability of data required for the above mentioned methodologies is assessed.

c) **Project emissions from biofuel production process and transport as well as leakage:** Biofuel will be produced in mainland Ecuador and then shipped to Galapagos Islands by tankers in the same way as diesel oil. Project emissions from biofuel production process as well as transport under the said circumstances are studied.

d) **Confirmation of the monitoring plan:** Implementation of monitoring required by the applicable methodologies is assessed.

e) **Demonstration of additionality:** Additionality of the Project is discussed.

f) **Confirmation of stakeholders' comments:** Methods to identify stakeholders and address issues and concerns raised by the stakeholders are studied.

g) **Project approval process of the DNA:** Project approval process by DNA of Ecuador and conditions for project approval are studied.

(In relation to the project implementation)

a) **Situations in Ecuador surrounding power provision:** Energy and electricity situations (government policy, regulations, incentives for renewable energy, etc.) are confirmed.

b) **Regulations particular to Galapagos:** Elements arising from regulations particular to Galapagos and affecting the Project are studied.

c) **Technologies to be used:** Technologies introduced in the Project consist of wind power, cogeneration and biofuel pressing technology. As the Project is a public project, all technologies to be introduced will be procured through tendering process. The Study will assess the tendering progress as well as confirm the technologies.

d) **Biofuel production:** Securing of the raw materials for biofuel used in the Project and pressing and

filtration technologies will be studied.

e) **Economic feasibility of biofuel production:** Economic feasibility is confirmed for the purpose of Project continuation taking into consideration the Jatropha delivery cost.

f) **Supply capacity of biofuel:** Confirm plans for Jatropha plantation development to expand biofuel supply capacity to address future increase in demand.

g) **Environmental impact assessment (EIA):** While EIA has already been approved for the wind power project, the technical study required for EIA in the cogeneration project is currently under preparation. Information required for PDD will be collected in the Study in consultation with local counterparts.

h) **Stakeholders' comments:** Comments from the stakeholders are required in EIA. Comments collected from stakeholders in the EIA of the wind power project as well as subsequent response are confirmed in the Study. For the cogeneration project, as the EIA and stakeholder comment collection are currently under preparation, the timing of such actions and methods of collecting the information required in PDD are discussed in the Study.

i) **Project feasibility and implementation schedule: S**ince the Project is a public project, its feasibility will be scrutinized considering public funding availability.

(In relation to co-benefits)

a) **Evaluation of impact on pollutant reduction:** Impact on reduction of air pollutants including SOx and NOx currently emitted from the diesel power plants will be studied.

b) **Studies on biodiversity:** The Study assesses the risk of eco-system destruction by diesel oil transportation by ship and discusses quantification of the Project's impact.

(2) Study Contents

In the Study, in addition to two field works and literature search, information that could not be collected in the field works were obtained through ERGAL, the local partner. As regards to the cogeneration project, it is necessary to develop and submit a methodology revision proposal as the current methodology does not include the use of biofuel. Therefore, based on the literature research on existing methodologies as well as clarifications and revision requests submitted in the past, a revision request was compiled and submitted to the Small-scale CDM Working Group. The outcomes achieved for the previously mentioned issues are discussed as follows.

(In relation to CDM)

a) Confirmation on the applicability and revision of methodology

With regards to the revision of AMS-I.C., request for revision (SSC_349) that takes into account the baseline scenario applicable to the Project and that includes biofuel use was submitted in September 2009 to the Small-scale CDM Working Group. The PDD produced as part of the Study employs the revised methodology based on the Working Group's response to SSC__349.

As for the wind power project, even though GHG emissions caused by the transportation of diesel between the storage station in Baltra Island and Santa Cruz Island will be reduced by the implementation of the

Project, such emissions reduction is not taken into account by AMS-I.D.. Therefore, the amount of transport-related emissions reduced has been calculated for reference purposes.

b) Confirmation of existing data

With regards to the wind power project, the original plan was for the Project to displace electricity generated in both Baltra Island (where the Project will be located) and Santa Cruz Island. However, the Study has revealed that there is no mini-grid on Baltra Island and there are no data available on diesel usage in existing diesel power generators installed at individual facilities. Therefore, as a result of the consultation with ERGAL, the baseline of the wind power project will only take into account the amount of electricity supplied to Santa Cruz Island.

As for the cogeneration project, general data have been collected. At the same time, the emission factor calculated by Ecuadorian DNA based on 2005-2007 data is used for the mainland grid electricity meeting the in-house electricity demand of the biofuel production stage.

c) Project emissions in relation to biofuel production and transport as well as leakage

Transport between biofuel production site in Manabi region and the mainland port has been identified as the project emission source from biofuel production stage. The amount of electricity consumed at the production site has been estimated based on information obtained from interviewing experts involved in power generation projects using biofuel in Floreana Island. The possibility of increase in transport between mainland and Baltra Island due to the difference in energy contents per unit of diesel and biofuel has also been studied.

d) Confirmation of the monitoring plan

With regards to the wind power project, the amount of electricity consumed in Baltra Island has been added to the monitoring items prescribed by the methodology. Regarding the cogeneration project, potential monitoring points have been studied based on the proposed revision of AMS-I.C.

e) Demonstration of additionality

Additionality of the Project is demonstrated in accordance with the Small-Scale CDM methodology's guideline. Barrier analysis including investment analysis has been used for the demonstration. As part of the barrier analysis, factors causing the increase in initial investment cost and the economic situation causing difficulty within the Ecuadorian government to disburse additional funding have been analyzed. As an example of common practice, a similar publicly-funded project in the Galapagos that ended up being canceled despite having secured funding is raised.

f) Confirmation of stakeholders' comments

For the wind power project, the comments received for EIA and response to these comments have been used as they are. For the cogeneration project, information obtained from the pilot project in Floreana Island has been utilized.

g) DNA project approval process

The Ministry of Environment carried out an internal organizational restructuring in the beginning of 2009. However, it has been made clear that the project approval process has not changed since it was originally adopted in 2003. The approval procedure is described based on the official website of the DNA (jointly used by CORDELIM) and the interview. Ecuador has yet to establish sustainable development criteria and is still discussing their introduction.

(In relation to project implementation)

a) Situations surrounding electricity provision in Ecuador

In Ecuador, President Correa has embarked on policy initiatives that promote hydropower and other types of renewable energy. In the Galapagos Islands, a program called "Zero Fossil Fuel for the Galapagos Islands" has been in place since 2007, however, it is now apparent that that this is a purely voluntary program and not legally binding.

b) Regulations particular to Galapagos

In Ecuador, power generation projects above 1 MW in capacity require EIA and subsequent approval from the Ministry of Environment. However, in the Galapagos Islands, all power generation projects are required to submit an EIA and seek approval. Recent changes in the law have moved the jurisdiction of EIA approval from Ministry of Environment to Galapagos National Parks. It has also been made clear that one of the reasons for increase in initial investment cost is the restriction imposed by airport related laws on the height of the wind power generator which will be installed near an airport.

c) Project technologies

The tendering process is under preparation for equipment to be installed under the wind power project. For the cogeneration project, a technical feasibility study will be carried out before inviting bids. As for the oil pressing plant in the mainland, a construction plan is under way for the pilot project in Floreana Island.

d) Biofuel production

With regards to securing the supply of raw materials for biofuel, it has been clarified that the existing amount of Jatropha is theoretically sufficient to generate electricity to meet the demand of the Galapagos Islands. It is also confirmed that simple technologies will be introduced for oil pressing and filtration.

e) Economic feasibility of biofuel production

A review of economic feasibility of projects involving biofuel has been conducted referring to data on costs associated with biofuel production estimated for the pilot project on Floreana Island. The review confirms that there is no problem in continuous operation of the cogeneration project.

f) Supply capacity of biofuel

It is now clear that the Ecuadorian government is considering the development of Jatropha plantation with foresight of long-term growth of demand. A research institution in Manabi region is currently conducting a study on Jatropha including plantation development. The Ecuadorian government is careful with this plan as

a large-scale plantation may pose a negative impact on the environment.

g) EIA

With regards to the environmental impact of the cogeneration plant, the impact of construction has been discussed considering Galapagos' particular environment.

h) Stakeholders' comments

For the wind power projects, stakeholder comments collected for EIA have been used. For thecogeneration project, comments collected for the pilot project have been used as previously mentioned.

i) Project feasibility and implementation schedule

A status of requesting for an increase in the public funding for the Project has not changed since the beginning of the Study. Rather, public works projects are under scrutiny as water shortage at major hydropower stations has caused a power supply crisis in November 2009. Nevertheless, taking into account of additional revenue from CDM, the Ecuadorian government is considering a mean to disburse remaining funding (after discounting the CER revenue) so that the CDM wind power project can be implemented. Negotiations with the equipment provider for Phase 1 are at the final stage, and it is certainly preferred that the CDM status be obtained as soon as possible.

(In relation to co-benefits)

a) Evaluation of environmental pollution mitigation

It has been clarified that evaluation by indices is possible using the Co-benefit Quantification Manual based on the data collected on air pollutants, such as SOx and NOx emitted from power plants in Santa Cruz Island. As for air pollutants emitted when using biofuel, estimation will be carried out once the equipment is selected.

b) Study on biodiversity

Interviews conducted during field works have revealed that there are no appropriate data that can be used as indicators of mitigation of risk to biodiversity. The Study discusses shipping accidents and leakage of fossil fuels based on existing information and risk analysis methods.

3. Outcome of the Study Aimed towards CDM Project Implementation

(1) Determination of the baseline scenario and project boundary

<Wind power>

The baseline scenario and project boundary for wind power generation are determined in accordance with AMS-I.D. "Grid connected renewable electricity generation (Version 15)". The baseline scenario originally considered was displacement of mini-grids in Baltra and Santa Cruz Islands, however, it was revealed during the first field work that there is no mini-grid in Baltra Island; therefore, electricity supply to Baltra Island is not included. Nevertheless, since there is a possibility that electricity generated by the

wind power plant is consumed within Baltra Island, it is necessary to request a deviation from methodology during the validation process. However, this should not pose a problem as the electricity supplied to Baltra Island is collectively monitored at the branch point of the transmission line.

As the only power plant in Santa Cruz Island is a 24-hour operating plant that uses diesel oil, the Project fulfills the conditions for using a simple emission factor for diesel power generation system in accordance with Clause 9 of the methodology. As such, baseline emissions are calculated using the emission factor of diesel oil, 0.0008, as described in Table 1.

Table 1: Baseline emissions calculation (First crediting period)

	2011	2012	2013	2014	2015	2016	2017
Electricity generated by power plant installed in Phase 1	4,800	4,800	5,880	5,880	5,880	5,880	5,880
Electricity generated by power plant installed in Phase 2.	--	--	11,760	11,760	11,760	11,760	11,760
(i) EG_y (estimated annual electricity generated)(MWh/year)	4,800	4,800	17,640	17,640	17,640	17,640	17,640
(ii) Emission factor(tCOe2/MWh)	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008
BEy: Baseline emissions (tCO2e) =(i)x (ii)x 10^3	**3,840**	**3,840**	**14,112**	**14,112**	**14,112**	**14,112**	**14,112**

<Cogeneration>

The cogeneration plant will be installed opposite the wind power plant. It will be installed to offset the weakness of wind power which is prone to seasonal supply variation in order to achieve stable electricity supply in line with demand for electricity. The cogeneration plant will use biofuel made of Jatropha as the raw material and the heat generated by the plant will be used at the seawater desalination plant to be built nearby as mentioned previously. As such, the Project complies with "combination of electricity to grid and thermal energy for consumption by other facilities" listed in Clause 2(c)'of AMS-I.C., "Thermal energy for the user with or without electrical energy (Version 15)", however, as the Project does not fall under any of the options for baseline determination provided in Clause 12 of the methodology, it is necessary to request a revision of the methodology.

MUS submitted the proposal for methodology revision (SSC_349) which incorporates the baseline scenario matching the Project as well as biofuel usage to Small-scale CDM Working Group in September 2009. The methodology has been updated with added description of the definition of renewable biomass based on the comments received from the Working Group.

In the draft revised methodology "SSC_349", Clause 12(h) ((i) in the latest version) has been added to provide for electricity and thermal energy generation using fossil fuel in the baseline scenario and sales of electricity to grid. Baseline emissions in this case will be calculated as the sum of emissions from electricity generation and emissions from thermal energy generation in accordance with Clause 16 of the existing methodology. In case of fuel being biofuel as in the Project, it has been proposed that sampled data are to be used as the calorific value of the biofuel.

As the source of cogeneration power in the Project is wind power hybrid, the amount of electricity generated from cogeneration is the difference between total electricity demand and electricity generated by wind power. According to the Ecuadorian government, total electricity demand of Santa Cruz Island is expected to increase by 4-5% annually on average. The Study utilizes the electricity demand forecasted by the government.

Because the electricity generated by cogeneration plant is supplied to the existing mini-grid while thermal energy is supplied to the newly established desalination plant, it is necessary to determine the appropriate baseline scenario using the "Combined tool to identify the baseline scenario and demonstrate additionality, Version 2.2" in accordance with the footnote of the methodology's Clause 12. Baseline scenarios listed in Step 1 of the Tool are as follows.

(i) The proposed project activity undertaken without being registered as a CDM project activity
(ii) The Project uses diesel oil as fuel.
(iii) The Project uses diesel oil as fuel and a diesel electricity generator. Desalination plant introduces a new boiler and uses diesel oil as its fuel.
(iv) The Project is not implemented and existing diesel power generators on Santa Cruz Island continue to supply electricity to the mini-grid. Desalination plant introduces a new boiler and uses diesel oil as its fuel.

As a result of the analysis conducted according to the Tool, Option 4 requires the least amount of initial investment. Therefore, Option 4 is determined as the baseline scenario of the Project. (Refer to Table 2)

Table 2: Baseline emissions for cogeneration (First crediting period)

	2013	2014	2015	2016	2017	2018	2019
(i) $EG_{y.}$: Electricity generate bycogeneration（MWh/year）	7,060	8,171	9,333	10,412	11,534	12,701	13,914
(ii) Emissions factor of methodology （tCOe2/kWh)	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008
(iii) $BE_{y.}$: Baseline emissions for electricity generation（tCO2e)＝(i) x (ii)	5,648	6,537	7,466	8,330	9,227	10,161	11,131

As the heat generated will be supplied to the new desalination plant, the baseline scenario assumes the usage of a new boiler at the plant and baseline emissions are calculated based on the formula provided in the methodology's Clause 14. Interviews with several local equipment providers about the boiler efficiency ($\eta_{BL, Thermal}$) and the type of fuel generally used has revealed that many used diesel as fuel and the average boiler efficiency is 80%. These data are used in baseline emissions calculations. Table 3 summarizes baseline emissions estimation in relation to thermal energy generation.

Formula used : $B_{Ethermal,CO2, y} = (EG_{thermal,y} / \eta_{BL, Thermal}) * EF_{diesel, CO2}$

Table 3: Baseline emissions calculation for thermal energy generation (First crediting period)

	2013	2014	2015	2016	2017	2018	2019
(i) $EG_{thermal,y}$: Net heat supplied to desalination plant（TJ/year)	34	39	45	50	55	61	67
(ii) $\eta_{BL, Thermal}$: Diesel consumption at 80% efficiency（TJ/year)（(i)/0.8）	42	49	56	62	69	76	83
(iii) $EF_{diesel, CO2}$: Emissions factor of fossil fuel used in baseline （tCO_2/TJ－diesel)	74.10	74.10	74.10	74.10	74.10	74.10	74.10
(iv) $BE_{thermal,CO2, y}$: Baseline emissions in relation to thermal energy generation （tCO_2e)＝(ii)x (iii)	3,139	3,633	4,149	4,629	5,128	5,647	6,186

As mentioned in the draft revised methodology “SSC_349”, the Project will use Jatropha fruit grown in hedges of farms and grasslands as well as residential homes. This fruit currently falls to the ground and is left to decay. However, as sufficient anaerobic reaction is not caused by the fallen fruit, baseline emissions regarding biofuel feedstock is considered zero.

The project boundary of cogeneration project is established in accordance with AMS-I.C.(Version 13) and the draft revised methodology “SSC_349” including cogeneration plant, desalination plant to which the heat generated by cogeneration is supplied, cultivation area of biofuel’s raw material, biofuel production site as well as the deposit site of the waste generated from the production process.

<Special measures for mini-grid>

As the Project displaces mini-grid in Santa Cruz Island, it is not necessary to consider the lifetime of existing equipment. Nevertheless, as the Project displaces one power plant (owned by ELECGALAPAGOS), the life span of the equipment at this plant has been studied. When compared to the “Tool to determine the remaining lifetime of equipment” introduced at the 50th CDM Executive Board Meeting, power generators last longer on the Galapagos Islands (the one introduced in 1981 is still in operation after 29 years). The oldest among the 6 power generators installed in Santa Cruz Island was introduced in 1992. Although it will be necessary to hire an expert and confirm the accurate remaining lifetime of the equipment before validation, the number used in the Study is 14 years, which is the average remaining lifetime.

(2) Project emissions

<Wind power>

There are no project emissions or leakage considered in AMS-I.D.

<Cogeneration>

Project emissions, based on the draft revised AMS-I.C., "SSC_349", are the amount of energy consumed at the purification stage (Pressing 0.325kWh/300kg of Jatropha oil) and the amount of diesel oil used to transport biofuel from the pressing plant and mainland port. As for transport, the method to calculate emissions from biomass transport mentioned in ACM0006-"Consolidated methodology for electricity generation from biomass residues (Version 9)" is used. (Refer to Table 4)

Table 4: Project emissions from cogeneration (First crediting period)

	2013	2014	2015	2016	2017	2018	2019
(i) Jatropha oil required for cogeneration (gal/year)	415,294	480,647	549,000	612,471	678,471	747,118	818,471
(ii) Jatropha oil required for cogeneration (ton/year)*	1,449	1,677	1,916	2,137	2,367	2,607	2,856
(iii) $EC_{OFP,jatropha,y}$: Electricity consumed at oil pressing plant (MWh /year) ((ii) x 0.325/0.3)	1,546	1,789	2,043	2,279	2,525	2,781	3,046
(iv) $EF_{CO2,ELEC}$: Grid emission factor (tCOe2/MWh)	0.56053	0.56053	0.56053	0.56053	0.56053	0.56053	0.56053
(v) $PE_{OFP,jatropha,y}$: Project emissions at oil pressing plant (tCOe2/year) ((iii) x (iv))	866	1,003	1,145	1,278	1,415	1,559	1,707

*Density of Jatropha is 286.6gal/ton.

Leakage in the draft revised methodology "SSC_349" has been considered referring to AMS-III.T. AMS-III.T. takes into account the shift of pre-project activity and GHG emissions from biomass cultivation. There are no emissions in relation to the shift of pre-project activity as Jatropha fruit was left fallen on ground and there are no prior activities. At the same time, there are no emissions from cultivation of Jatropha as the Jatropha used in the Project comes from existing trees. Although there is a possibility to create new Jatropha hedges to provide more raw materials for the oil as demand increases in the future, it will be controlled to have only planting cuttings in between existing hedges. Therefore, the Study limited the sources of jatropha oil to be those collected from existing hedges.

Other leakage possibilities include emissions in case transport by ship from the mainland increases as a result of changing to the biofuel. Based on the studies conducted on maritime shipping, general information obtained indicates that while Jatropha contains 8% less energy than diesel, its density may become higher depending on its quality. The Study suggests that there may be possibly increase in shipment caused by the Project may contribute to increasing the fuel consumption for shipping. However, since only estimated values have been obtained for emissions calculation, leakage is not considered in the PDD.

(3) Monitoring plan

<Wind power>

According to AMS-I.D., monitoring of net electricity supply to the grid and cross-checking of the measured value with sold value are required. The amount of electricity supplied to the mini-grid of Santa Cruz Island will be monitored in the monitoring room to be set up at the wind power station. Electricity

supplied to Baltra Island will also be monitored at the same office.

<Cogeneration>

Monitoring items required in AMS-I.C. are measurement of electricity and heat generated. Heat is required to be directly monitored by measuring the inflow and its temperature. Monitoring procedure of the Project will be updated after the equipment is selected taking into account the newest version of the methodology. The methodology also requires monitoring of biomass and fossil fuel consumption.

The draft revised version of the Methodology also proposes additional monitoring items associated with biofuel with reference to AMS-III.T. Table 5 lists such proposed monitoring items and monitoring methods to be applied to the Project.

Table 5: Proposed monitoring items and monitoring methods for the Project

Proposed monitoring items	Proposed monitoring methods
(i) Plant oil consumption by project activities	Invoice for purchasing biofuel at the cogeneration plant
(ii) Oil content of seeds and amount of plant oil produced per crop source per production location. The extent of the area where plant oil is produced should be consistent with the yield of the cultivation and/or harvesting and the plant oil extraction, if they are from a plantation	• Samples from three oil processing plants will be sent to a laboratory analysis for measuring the oil content of seeds • Weights and the amount of oil production per fruit will be checked at each oil processing plant
(iii) The energy use (electricity and fossil fuel) for the production of plant oil and the amount of fertilizer applied for the cultivation of plant oil per crop source per production location. The occurrence of shift of pre-project activities and the competing uses of biomass shall be monitored and verified.	Not applicable. However, in case a new jatropha hedge is planted, the amount of fertilizer applied will be registered
(iv) NCV of plant oils are determined based on direct measurements of a representative sample	Samples from three oil processing plants will be sent to a laboratory analysis for measuring NCV
(v) Emissions from the transportation of biomass or biofuel	Monitoring the transportation method from the hedges to the oil processing plants and a number of trips made between the processing plants to La Libertad port (and its fuel consumption)
(vi) The contract between the producer and the user of the plant oil (project participants) states clearly who is entitled to claim emission reductions resulting from its consumption, if the producer and the user of the plant oil are not the same.	Jatropha oil will be supplied from three oil processing plants expected to be installed. The supplier of the biofuel will be the individual communities, and each community will sign a contract with the Ecuadorian government or ELECGALAPAGOS to ensure that the project participants listed in the draft PDD will be the CER owners.
(vii) Final waste treatment and/or use and/or disposal site	It has not been decided yet whether to use the wastes as organic fertilizer or use as fuel source after pelletizing. However, it is

	expected that there will be no GHG emission sources that need to be taken into accounted.
(viii) Emissions from the transportation of waste.	Though means of transportation of fertilizers or pellets is still not being decided yet, another study will be conducted to review the transportation means and estimate the project emissions.

(4) Greenhouse gas emissions reduction

The estimated GHG emissions reduction of the Project based on the baseline and project emissions previously stated are summarized in Table 6 and Table 7.

Table 6: GHG emissions reduction in wind power project

		Baseline emissions BE_y	Project emissions PE_y	Leakage LE_y	Emissions reduction ER_y
1	2011	3,840	0	0	3,840
2	2012	3,840	0	0	3,840
3	2013	14,112	0	0	14,112
4	2014	14,112	0	0	14,112
5	2015	14,112	0	0	14,112
6	2016	14,112	0	0	14,112
7	2017	14,112	0	0	14,112
8	2018	14,112	0	0	14,112
9	2019	14,112	0	0	14,112
10	2020	14,112	0	0	14,112
11	2021	14,112	0	0	14,112
12	2022	14,112	0	0	14,112
13	2023	14,112	0	0	14,112
14	2024	14,112	0	0	14,112
	Total	177,024	0	0	177,024

(Unit: CO_2 ton)

Table 7: GHG emissions reduction in cogeneration project

		Baseline emissions BE_y	Project emissions PE_y	Leakage LE_y	Emissions reduction ER_y
1	2013	8,787	894	0	7,893
2	2014	10,170	1,035	0	9,135
3	2015	11,615	1,182	0	10,433

4	2016	12,959	1,319	0	11,640
5	2017	14,355	1,461	0	12,894
6	2018	15,808	1,609	0	14,199
7	2019	17,317	1,762	0	15,555
8	2020	18,890	1,923	0	16,967
9	2021	20,318	2,068	0	18,250
10	2022	21,798	2,219	0	19,579
11	2023	23,329	2,374	0	20,955
12	2024	24,914	2,535	0	22,379
13	2025	26,555	2,702	0	23,852
14	2026	35,328	3,595	0	31,733
	Total	**262,143**	**26,678**	**0**	**235,465**

(Unit: CO_2 ton)

(5) Project operation period and crediting period

Although this still requires confirmation from experts, the crediting period of wind power project is set at 14 years (7 years and one renewal) as the average remaining lifetime of the equipment is 14 years. The start date of the wind power project is the date of contract with equipment provider and the current negotiation aims at concluding the contract in the beginning of 2010. The start date of the crediting period is expected to be in January 2011.

As for the cogeneration project, further information on the lifetime of the equipment to be installed is required. However, interviews with equipment providers have suggested a minimum 15 years of lifetime with operation of 9,760 hours/year and proper maintenance. For the purpose of the Study, the Project period is set at 14 years with one renewal after 7 years in accordance with CDM rules. As for the starting of the cogeneration project, technical study was supposed to start in autumn last year but is delayed due to internal administrative issues. Currently, a possibility of conducting the technical study and EIA at the same time is considered on order to speed up the project development process. If an internal approval is smoothly obtained for this, the technical study and EIA will start from spring 2010. CDM process of the Project will be facilitated in close communication with the local partner ERGAL bearing in mind the optimal timing for the submission of request for revision of the methodology. The operation start date currently envisaged is January 2013.

(6) Environmental impact and other indirect impacts

<Wind power>

Studies involving environmental impact assessment (EIA) for the wind power project were conducted during 7 months between September 2007 and March 2008. The EIA was approved by the Ministry of Environment in August 2009 and an environmental license has already been obtained. The biggest issue for the wind power project has been the impact of its construction and building site location on the

ecosystem of the Galapagos Islands. Particularly, locations and flying heights of birds, bats and terrestrial iguanas have been studied in detail by Charles Darwin Foundation, the word's authority in ecosystem protection. The results of these studies have been carefully considered in the EIA and a detailed post-implementation monitoring plan of environmental indicators has been developed with advice from Galapagos National Park Authority.

<Cogeneration>

Currently, the Ecuadorian government is preparing to conduct an investigation on the EIA of the cogeneration project while details are being confirmed with EIA experts. As the cogeneration plant will be built near the storage station, the possibility of significant environmental impact regarding biofuel handling is to be considered. One of the predicted environmental impacts is the impact of construction on the ecosystem. Like in the wind power project, reptiles of Baltra Island (especially terrestrial iguanas) are endangered species and a detailed monitoring plan similar to the one for wind power will be required.

(7) Stakeholders' comments

<Wind power>

In the interviews conducted during the first field work with government agencies (Ministry of Environment, Ministry of Livestock, Agriculture and Fisheries, Santa Cruz Island government, Galapagos National Parks) , NGOs (WWF, Charles Darwin Foundation, Fundar Galápagos) and private businesses (PetroComercial), all parties expressed supporting comments for the Project. This is likely the result of successful public outreach at the time of the EIA involving meetings, information dissemination and promotional campaigns. Although there were some negative comments in the first meeting held for EIA, most were based on misunderstanding.

<Cogeneration>

As the stakeholder meeting in accordance with the EIA procedure for cogeneration is still in planning stage, the Study discusses stakeholder comments received for the biofuel pilot project on Floreana Island. As seen in the following excerpts of comments, all have already been considered at the project development stage and 1, 2, 4 are technically not possible. As for 3, since it is generally reported that NOx emission is increased by biofuel usage, it is necessary to study the monitoring method.

1. Possibility of promoting Jatropha cultivation in Galapagos Islands
2. Promotion of single crop cultivation to meet energy demands of Galapagos
3. Possibility of biofuel usage to cause increase in air pollutants
4. Possibility of using only wind power and solar energy instead of biofuel for power generation

(8) Project implementation framework

The Project is implemented with involvement by various parties with ERGAL as the coordinator. Figure 1 demonstrates the implementation framework.

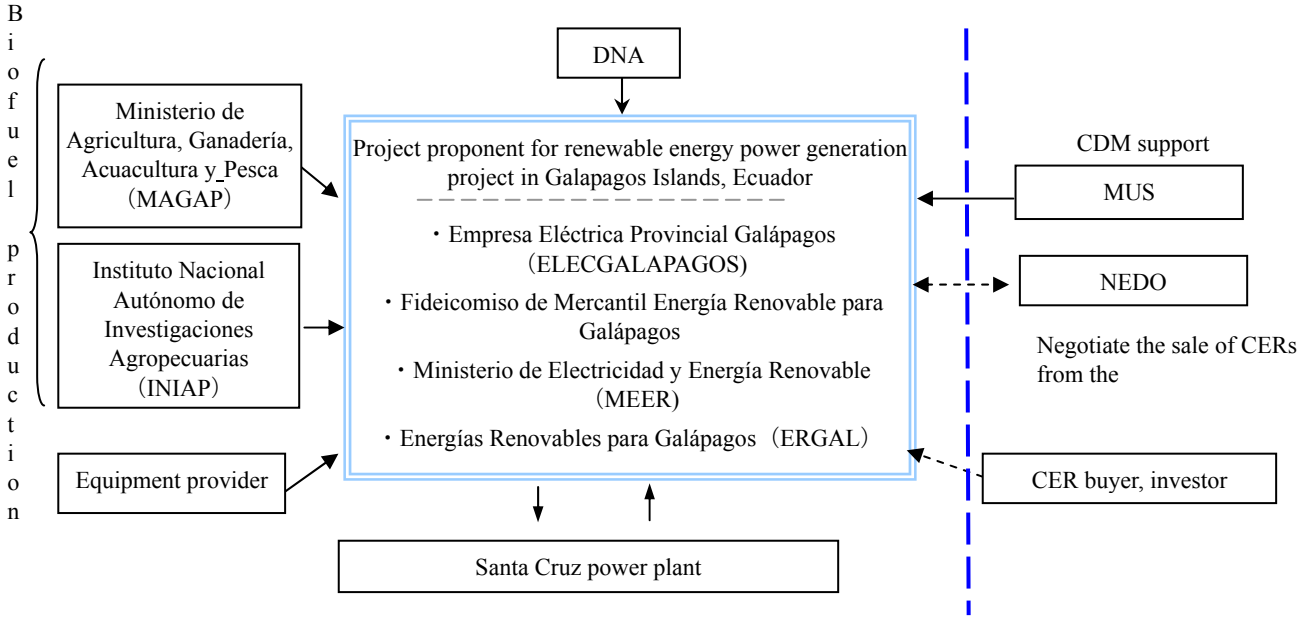

Figure 1: Project implementation framework

(9) Financial plan

According to the current project plan, three power generators at 750 kW capacity and transmission line will be installed during Phase 1. 77. 4% of initial investment cost for Phase 1 has already been secured by the Ecuadorian government. The remaining 22.6% is expected to be met by private investment from potential CER buyers. It is also estimated that in addition to initial investment costs, USD 272,000 is required annually for operation and maintenance cost.

For Phase 1 financial planning, USD 11.6 million can be procured while there is shortage of USD 3.4 million. For the next phase, Table 11 demonstrates the result of financial analysis, but details can be found in the final report.

(10) Financial analysis

The Project will be implemented in two phases. Initial investment costs for each phase are demonstrated in Table 8 and Table 9 while assumptions used for the purpose of investment analysis are listed in Table 10.

Table 8: Initial investment needed in Phase 1

	USD
Wind power plant	
Initial investmnet	10,000,000
Annual O&M cost	272,000/year
Development cost (overhaul)	500,000
（Year 2020）	500,000
（Year 2022）	1,000,000

Table 9: Initial investment needed in Phase 2

	USD
Wind power plant	
Initial investmnet	18,000,000
Annual O&M cost (includes operation of Phase1)	544,500/year
Development cost (overhaul)	
(overhaul)	800,000
（Year 2022）	800,000

Transmission line	
Transmission line constructoin	5,000,000
Total	**15,000,000**
Annual O&M cost	**272,000/yr**

（Year 2027）	
Cogeneration plant	
Initial investmnet	12,350,000
Annual O&M cost	420,000/yr
Total	**30,350,000**
Annual O&M cost	**964,500/yr**

Table 10: Other assumptions

Index	Assumption
Wind power lifetime (assumed)	Minimum 20 years
Cogeneration lifetime (assumed)	Minimum 15 years
CDM crediting period	14 years (with thermal power plant lifetime of 14 years minimum)
Electricity tariff (CONELEC data)	
Wind power	USD 0.122/kWh
Cogeneration	USD 0.1196/kWh
Biofuel price (assumed from DED survey)	USD 3/ gallon

As the result of the Study has revealed that it is necessary to develop individual PDDs for wind power and cogeneration projects, investment analysis has been conducted again for each PDD and the outcome is demonstrated in Table 11.

Table 11 summarizes IRR indices and the outcome of sensitivity analysis. As the table indicates, the Project is public works project, not something that can generate profit. The only secured funding for the Project is that promised by the Ecuadorian government for Phase 1 of wind power project. Requests for disbursement for other portions of the Project is currently under coordination, however, it is difficult to implement the Project without the financial benefits of CDM.

Table 11: Sensitivity Analysis (IRR%)

		Wind power			Cogeneration
		Phase 1 only	Phase 2 only	Phase 1 & Phase 2	
Baseline (10% increase)	With CER	8.45%	-2.85%	1.65%	N/A
	W/out CER	10.96%	-0.27%	2.69%	7.99%
(i) Electricity tariff (10% increase)	With CER	11.12%	-1.12%	3.58%%	N/A
	W/out CER	13.51%	1.25%	4.47%	9.44%
(ii) Lifetime of thermal power plant (until 2027)	With CER	9.46%	-0.62%	1.65%	N/A
	W/out CER	11.13%	1.60%	2.83%	8.28%
(iii) CER price ($15->$18)	With CER	11.46%	0.04%	3.02%	8.30%

(11) Demonstration of additionality

Barriers in project implementation

<Common barriers for wind power and cogeneration projects>

1) Financial difficulty of the Ecuadorian government

As Ecuador needs to import petroleum products despite it being a petroleum producing nation, its economy cannot generate a large profit from oil export even with the high price of crude oil. Meanwhile, importation of petroleum products with added value take up more than 20% of annual expenditure of the national budget and almost all this expenditure cannot be recovered due to the subsidy program that entails significant economic cost. Although politics had been stable owing in part to escalating crude oil price in 2008, the fall in crude oil price in 2009 has exacerbated the fiscal balance. Moreover, the country is experiencing a serious energy crisis due to drying-up of major hydro power dams caused by water shortage. As a result, the budget is being rearranged to fund major power projects in the mainland. Under these financial and political circumstances, it is extremely unclear whether enough public funding can be secured for renewable energy projects in the Galapagos Islands.

2) Barrier in infrastructure development in Galapagos Islands

Although most development projects in the Islands are public works projects, they are not always implemented according to plan. The situation is caused by not only political issues, but also inconveniences caused by the remote location of the islands, such as difficulty to secure bare minimum logistics and lack of basic service provision as well as by barriers brought upon by various restrictions for the purpose of environmental protection. Learning from the past experience where the development project under planning was stopped, it is important to procure funding for the Project from external sources, such as CDM.

<Barriers particular to wind power project >

3) Shortage of wind turbin supply and price hike

Due to a boost in the wind market worldwide in recent years, there is currently an excess demand for wind turbines. Many manufacturers prefer orders of large turbines and very few manufacturers have shown interest in producing small turbines, such as 1MW or less in case of the Project. The lack of interest by manufacturers has slowed down the tender process. In addition to the unfavorable geographical conditions, various restrictions due to ecosystem protection have made power plant development an even more technologically difficult challenge.

<Barriers particular to cogeneration project >

4) Escalation of Jatropha oil price caused by speculators

As there is currently no market for Jatropha seeds, it is possible to maintain uniform pricing. However, there is a price escalation risk because it is possible that some large-scale Jatropha oil producers will speculate with expectation of increase in Jatropha oil demand. The Ecuadorian government is discussing measures to contain price escalation due to such speculation; however, it is apparent at this point that such risk is a barrier to the implementation of the cogeneration project.

(12) Outlook towards project implementation

As for the wind power project, the bidding has already begun and project implementation is already in sight. With regards to the cogeneration project, bidding is expected to take place after the completion of EIA. In order to secure additional funding with CDM taken into consideration, further consultation with local partners will be held towards the realization of the Phase 1 activity.

4. Outcome of the Study on Co-benefits

(1) Evaluation of effects, such as environmental preservation measures in host country

The co-benefit gained in the Project is the reduction of air pollutant emission from the power plant in Santa Cruz Island caused by the use of diesel oil as fuel. In Santa Cruz, there are 6 diesel generators currently in operation and these generators undergo gas analysis at least once a year as requested by the electricity authority. According to the conditions of the request, amount of exhaust gas emitted must be measured from each generator's tailpipe by an independent monitoring entity.

Studies on quantified evaluation have been carried out as follows in accordance with the Co-benefit quantification manual, version 1.0.

The Project was categorized in "air quality improvement" as the exhaust gas from the tailpipe is emitted directly into the atmosphere. Apart from CO2, SOx, NOx and dust have been included in evaluation indices. The evaluation method has been established in accordance with Tier 3 of the Manual. When carrying out the evaluation, attempts were made to apply the actual monitored data by a third party to a new formulate established independently.

In the baseline scenario, the amount of air pollutants likely to be emitted from the 6 diesel power generators has been estimated based on the electricity demand forecast data applied in the CDM project. In the project scenario, it is estimated that the operation of the wind power plant will reduce the emissions of SOx, NOx, dust and CO2 by 50% in 2011 and 2012 and subsequently reduce them to zero when all 6 generators cease operation. Nevertheless, some project emissions will be present as the Project will use biofuel.

(2) Proposed co-benefit indices

There are no indices to propose under this Study. Section 5 covers the reduction of air pollutants and Section 3 covers the reduction of the GHG emissions.

5. Outcome of the Study on the Project's Contribution to Sustainable Development

(i) Evaluation of ecosystem destruction risk in host country

Galapagos Islands are seeking ways to balance economic development and environmental protection based on the "Ley Especial para la Provincia de Galapagos" introduced in 1998. The law prescribes strict conditions for residing in Galapagos and tries to limit the impact of population increase on environment. Studies have been conducted on whether the Project can mitigate the ecosystem destruction risk or prevent it as well as whether such risk can be evaluated quantifiably using indices, however, interviews with Galapagos Park Authority and environmental NGOs have revealed the lack of adequate data to implement a proper risk analysis. As such, in this Study, only interviews and literature research have been conducted on ecosystem destruction possibility by use of maritime transport.

(ii) Additional CO2 reduction by decrease in fuel consumption by land transport in Santa Cruz Island

The Project will eliminate land transport of petroleum products between Santa Cruz shore and Puerto Ayora. However, the small-scale methodology does not take into account any emission reduction for decrease or termination of usage of diesel oil associated with land transport of fuel. It is estimated that in 2008, approximately 1.8 billion gallons of fuel were used at power stations, meaning 10,000 gallons (app. 35 tons) of diesel were consumed by land transport. Reduction of such diesel consumption by land transport leads to 111 tons of CO2 emission reduction.

(iii) Improvement of soil contamination in Santa Cruz Island

At power plants in Santa Cruz, diesel oil used for power generation is stored in storages tanks inside the plant. However, fuel is leaking from aging tanks to the soil and soil contamination has recently become an issue. Implementing the renewable energy project in Baltra Island will lead to avoidance of soil contamination in Santa Cruz.

(iv) Improvement of water pollution in Santa Cruz Island

The soil contamination problem mentioned in the previous clause is closely related to water pollution problem as the power plant is located near a reservoir for water supply. The reservoir supplies water to Puerto Ayora which boasts the biggest population in Galapagos. The water is a mixture of brackish water and

groundwater. Soil contamination at the power plant may possibly impact groundwater quality as Galapagos' geological condition makes the soil permeable by pollutants. The Project implementation will indirectly contribute to mitigation of negative environmental impact on water supply (groundwater).

(v) Improvement of reduction of air pollutants

The amount of emission reduction of air pollutants is the difference between baseline and project emissions. Emissions from each source in the baseline are calculated using actual data as previously stated. Project emissions will not only consider emission sources listed for baseline, but also emissions from cogeneration. However, because it is not possible to measure the actual concentration of air pollutants from the cogeneration tailpipe before the cogeneration plant starts operation, it will be evaluated based on the monitoring data.

(vi) Supply of desalinated water

Water is one of the infrastructures in Santa Cruz most requiring improvement for Galapagos residents who are subject to consuming brackish water instead of fresh water. Many sightseeing boats collect water supply from Santa Cruz when after refueling at the storage terminal in Baltra Island and then cruise around other islands.

(vii) Economic contribution to Manabi farming area

The raw material for biofuel used in the Project will be harvested from Jatropha hedges growing in Manabi region. Among the many low-income areas along the coast of Ecuador, the quality of life in Manabi is especially low as it is in the country. Although lots of Jatropha are being used as hedges in farms, ranches or private homes, as it has no market value to date, locals hold high expectations for the Project. One of the conditions for selecting the oil pressing site is a high level of social contribution including anti-poverty measures. It is hoped that by using Jatropha strategically, it can become a trigger to bring about improvement of quality of life in the local communities as well as the creation of job opportunities.