Fiscal 2008 CDM/JI Feasibility Investigation Tentative Report
Summary Version

Title of Feasibility Study

Investigation of Programmatic CDM on Renewable Energy Generation Utilizing Irrigation Canals in the Philippines

Main Implementing Entity

The Chugoku Electric Power Co., Inc.

1. Project Overview

(1) Host Nation and Region

The Republic of the Philippines, nationwide

(2) Description of Project Activity

[Detail]

The purpose of this project is to effectively utilize unexploited drops at agricultural dams and along irrigation canals in various parts of the Philippines and conduct small hydropower generation that completely depends on irrigation water (referred to as "irrigation small hydropower" hereinafter) while applying programmatic CDM (Clean Development Mechanism) methodology to promote additional development and CO_2 emission reduction of small hydropower, and to contribute to sustainable development of the Philippines, including its agricultural sector.

[Scale of Facilities]

The average facility scale of irrigation small hydropower per point is expected to be several hundred kW. As a result of nationwide potential investigations, however, we confirmed that there were at least 65 potential locations, total output of 40 MW, and total electrical power of 254 GWh in the Philippines.

Applying emission factors of individual areas to this condition, the expected GHG (greenhouse gas) emission reduction is 121,000 t CO_2 per year, and the reduction during the credit period (7 years x 3 = 21 years) is approximately 2.54 million t CO_2.

[Expected Project Owner]

Possible candidates include REC (Rural Electric Corporative), NPC (National Power Corporation), IPP (Independent Power Producer), and LGU (Local Government Unit), and the strongest candidate as a result of hearing investigation is expected to be REC.

[Expected Timing to Start the Project Operation]

The expected timing for the first point to start operation is in 2010 at the earliest, after establishing the implementation system in 2009 and completing CDM procedures.

2. Details of Investigation

(1) Issues of Investigation

[Understand Development Potential and Development Possibility]

In order to apply programmatic CDM to irrigation small hydropower and carry out additional and sustainable development, it is necessary to understand how many points and development scales that agree with the project concept exist.

It is also necessary to conduct economic evaluation on individual points to identify development feasibility.

[Establish Project Implementation System]

Since there are few development cases that installed small hydropower in irrigation facilities in the Philippines, it is necessary to establish a project implementation system for industrialization, such as determining roles of NIA (National Irrigation Administration in the Philippines), the owner of irrigation systems in this project and selecting development contractors.

[Collect Comments of Stakeholders on this Project]

This project may involve a wide range of stakeholders, because it is a hydropower development under a new concept, development areas are expected to be located throughout the country, and opinions of power companies and owners of existing facilities must be coordinated unless NIA becomes the developer. Therefore, it is necessary to collect comments of as many stakeholders as possible in the investigation.

(2) Investigation System

[In Japan]

- **(Main investigator) The Chugoku Electric Power Co., Inc.**
  Project management
  Consultation and coordination with counterparts
  Carries out on-site investigation and analysis
  Creates PDD and reports
- **(Supplier) Ex Corporation**
  Collects information on programmatic CDM and environmental impact assessment
  Assists preparation of project design report
- **(Contractor) Chuden Engineering Consultants Co., Ltd.**
  Assists terrain survey at development candidate points and designs

[Host Nation]

- **(Counterpart of this investigation) the National Irrigation Administration (NIA)**
  Cooperation to this investigation
  Collects local information and data
  Coordinates on-site investigations

(3) Contents of Investigation

Total of four on-site investigations, including pre-investigation, have been conducted as described below. The investigations included consultation and hearing with relevant agencies and on-site investigation (terrain survey).

i. Pre-investigation (September 7 - 11)

We collected information on points involved in this project and consulted with government agencies; we obtained responses from all agencies that they would provide full cooperation on this project investigation.

ii. The first on-site investigation (September 21 - 27)

We conducted investigation on the potentials of irrigation small hydropower in the entire Philippines in order to obtain information on agricultural dams and unexploited drops along irrigation canals located in various parts of the country.

As a result, we confirmed at least 65 locations and total power generation capacity of 40 MW as small hydropower potential in irrigation facilities. The expected amount of GHG emission reduction when all these points are developed is 121,000 t-CO_2 per year.

Figures 1 and 2 show the outlines of the result of potential investigation.

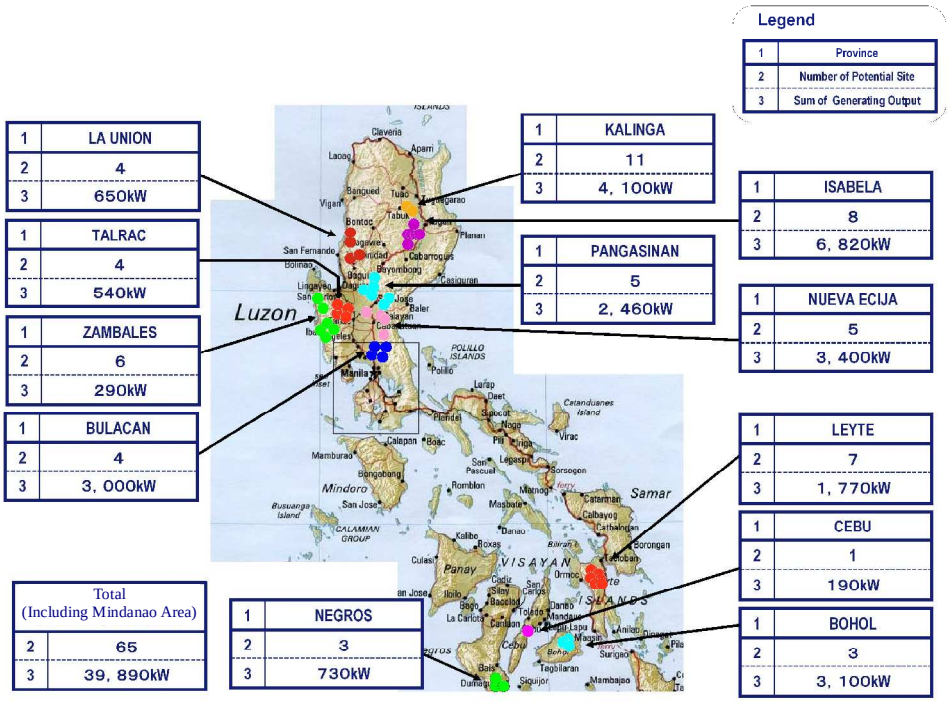

Figure-1 Distribution of Potential Points

Region	No. of Sites (%)
Region 1	9 (14%)
Region 2	19 (29%)
Region 3	19 (29%)
Region 7	7 (11%)
Region 8	7 (11%)
Region 9 to 13	4 (6%)

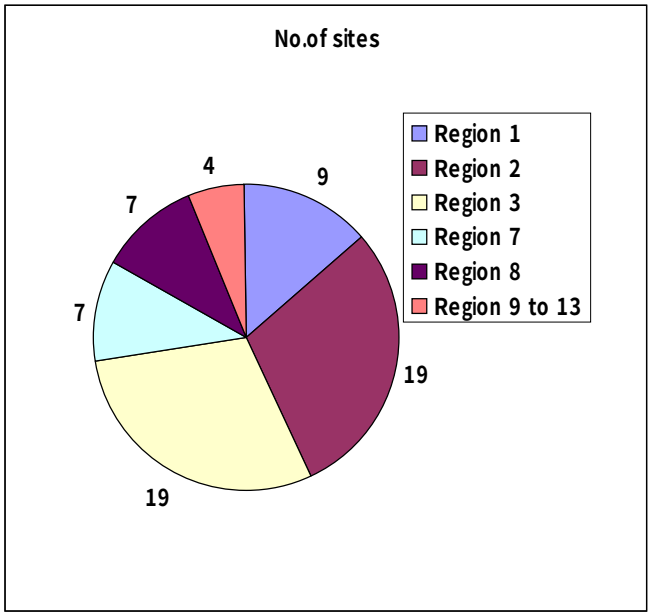

Figure-2 Distribution of Potential Points by Regions (the entire Philippines)

iii. The third on-site investigation (October 12 - 18)

In order to narrow down development candidate points to three based on the outcome of the second on-site investigation and to create power generation plans for these points, we conducted detailed on-site investigation to obtain data of drops and flow rates that will be used as fundamental information and hearing investigations and consultations with relevant agencies (see Figure-3 and Table-1).

As a result, we were able to obtain necessary design data and other information for implementing F/S as well as specific comments and information for development and CDM from various people.

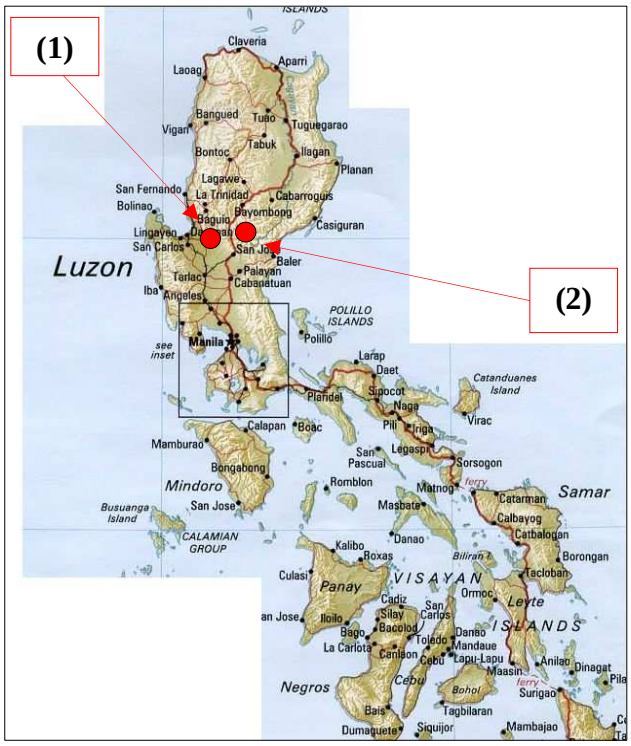

Figure-3 Location Map of Investigated Points

Table-1 List of Investigated Points

NO.	Name of Point	Province
(1)	AGNO-1	Pangasinan
	AGNO-2	Pangasinan
(2)	RIZAL	Nueva Ecija

Photograph-1 Scene of Consultation with the Local NIA

Photograph-2 Scene of Consultation with Local Government

Photograph-3 Candidate Point for Development

Photograph-4 Scene of Terrain Survey

iv. The fourth on-site investigation (January 11 - 17)

We explained the outcome of F/S at candidate point of the development (AGNO point) and conducted hearing and consultation on this project.

As a result, we obtained specific comments and information from various people about development and CDM of this project.

Photograph-5 Scene of Consultation with NIA

Photograph-6 Scene of Consultation with Local Government

3. Industrialization of the Project

(1) Project Boundaries and Baselines

a. Boundary

This project assumes implementation as programmatic CDM, and the boundaries of PoA and CPA are as described below.

- PoA boundary: the entire Philippines
- CPA boundary: Areas that include physical and geographical locations with facilities that generate renewable energy (based on AMS I.D Version 13)

b. Setting of the baseline

Small-scale methodology I.D. was applied as baseline methodology of this project. Application conditions for this methodology on this project are as described below.

Application conditions for small-scale methodology I.D. (ver. 13)	Basis of application
1. This category comprises renewable energy generation units, such as photovoltaics, hydro, tidal/wave, wind, geothermal and renewable biomass, that supply electricity to and displace electricity from an electricity distribution system that is or would have been supplied by at least one fossil fuel fired generating unit.	All CPAs implemented in this PoA are composed of small hydropower stations that provide electricity to grids.
2. If the unit added has both renewable and non-renewable components (e.g., a wind/diesel unit), the eligibility limit of 15 MW for a small-scale CDM project activity applies only to the renewable component. If the unit added co-fires fossil fuel, the capacity of the entire unit shall not exceed the limit of 15 MW.	N/A
3. Combined heat and power (co-generation) systems are not eligible under this category.	None of CPA employs combined heat and power systems.
4. In the case of project activities that involve the addition of renewable energy generation units at an existing renewable power generation facility, the added capacity of the units added by the project should be lower than 15 MW and should be physically distinct from the existing units.	All CPAs implemented in this PoA are project that produces renewable energy of lower than 15 MW using small hydropower facilities.
5. Project activities that seek to retrofit or modify an existing facility for renewable energy generation are included in this category. To qualify as a small-scale project, the total output of the modified or retrofitted unit shall not exceed the limit of 15 MW.	None of CPA retrofits or modify an existing facility.

(2) Monitoring Plan

Since the use of fossil fuel is not expected in this project, the monitoring item only includes the amount of the generated renewable energy.

Monitoring categories of PDD are as follows.

Table-2 Monitoring Item

Data / Parameter	Egy
Data unit	MWh
Description	Electricity supplied to the grid by the project
Source of data to be used	Measured value
Value of data	Values vary depending on the scale of hydropower facilities to be introduced.
Description of measurement methods and procedures to be applied	Hourly measured and monthly recording
QA/QC procedures to be applied	Gauges are regularly calibrated in accordance with international standards, and cross-check is conducted on data measured with gauges using receipts that indicate the amount of electricity sold.
Any comment	

Since this project is expected to be implemented as programmatic CDM, it is extremely important to smoothly issue CER (Certified Emission Reduction) for individual CPA (CDM program activity). Thus, we employ the method in which REC collects and manages monitored power data and transmits them to project implementation agencies as a method to guarantee proper recording and management of power generation data of individual hydropower facilities (see Figure-4).

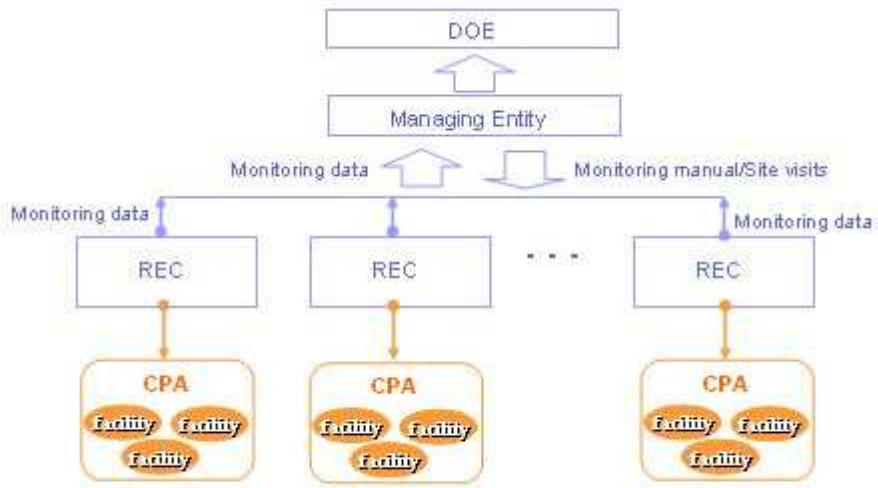

Figure-4 Monitoring Management System

(3) Amount of GHG Emission

Amount of baseline emission from grid power source can be obtained with the following formula.

Amount of baseline emission from grid power source per year (t $_CO_{2eq}$/y) = Power generation capacity of introduced plant (MW) × Operation hours of introduced plant (h/y) × CO_2 emission factor of grid power source (t-CO_{2eg} /MWh)

a. Emission factor

CM, which is the average of OM and BM, is used in emission factor.

OM is the weighted average of power source that makes up of the current grid power source. The data from 2003 to 2007 was used as the latest power generation record of individual grids in the calculation.

Based on "Tool to calculate the emission factor for an electricity system," this project employs the following sum of yearly power production, whichever is larger.

- Recently constructed five power facilities
- Recently constructed power facilities added to a grid that accounts for 20% of power generation on the grid (include the entire power generation of the station if it becomes part of the capacity of a facility that already accounts for 20%).

Table-3 shows OM, BM, and CM obtained based on the conditions described above.

Table-3 Emission Factor of Individual Grids

	OM (tCO_2/MWh)	BM (tCO_2/MWh)	CM (tCO_2/MWh)
Luzon	0.618	0.349	0.483
Visayas	0.205	0.696	0.451
Luzon-Visayas	0.627	0.350	0.488
Mindanao	0.277	0.679	0.478

b. Leakage

There is no leakage that should be included in calculation, because facilities that are used in other projects are not expected to be used in this project, or existing facilities are not expected to be used in other projects, and this project does not use biomass.

c. Amount of emissions in the project

Amount of emissions in this project is zero because this project does not use fossil fuel as supplementary fuel.

d. Amount of emission reductions

Emission factors of this project include the Luzon grid, Visayas grid, and Luzon-Visayas grid. Based on the principle of maintainability, we obtained individual emission factors of the Luzon grid and Visayas grid so that amount of GHG emission reduction will not be overestimated. Amount of baseline emission equals the emission reductions of this project because this project does not involve leakage or project emissions. This report assumes that facilities will be in operation 256 days per year, and the amount of GHG emission reduction is calculated for each potential site. Table-4 shows the calculation outcomes.

Table-4 Amount of GHG Emission Reduction

Region	Grid	Number of points with power stations	Scale of power output (kW)	Yearly power production (GWh)	Emission factor (tCO_2/MWh)	Amount of GHG emission reduction per year (10^3 tCO_2)	Amount of GHG emission reduction (crediting period) (10^3 tCO_2)
LA UNION	Luzon	4	650	4.1	0.462	1.9	39.9
TALRAC	Luzon	4	540	3.4	0.462	1.6	33.6
ZAMBALES	Luzon	6	290	1.8	0.462	0.8	16.8
BULACAN	Luzon	4	3,000	19.1	0.462	8.8	184.8
KALINGA	Luzon	11	4,100	26.1	0.462	12.1	254.1
ISABELA	Luzon	8	6,820	43.4	0.462	20.1	422.1
PANGASINAN	Luzon	5	2,460	15.6	0.462	7.2	151.2
NUEVA ECIJA	Luzon	5	3,450	21.9	0.462	10.1	212.1
LEYTE	Visayas	7	1,770	11.3	0.161	1.8	37.8
CEBU	Visayas	1	190	1.2	0.161	0.2	4.2
BOHOL	Visayas	3	3,100	19.7	0.161	3.2	67.2
NEGROS	Visayas	3	730	4.6	0.161	0.7	14.7
MINDANAO	Mindanao	4	12,790	81.3	0.243	19.8	415.8
Total		65	39,890	253.5		88.3	1,854.3

(4) Duration of Project Activity/Crediting Period

This project is expected to start its operation in 2010, and crediting period is expected to be for 21 years (7 years x 3 times).

(5) Environmental Impact and Other Indirect Impacts

Environmental impact of implementing this project is expected to occur during construction period. The table below shows direct and indirect impacts caused by implementing this project and measures to mitigate them.

Table-5 Expected Environmental Impact and Measures to Mitigate Them

Item		Activity	Expected environmental impact	Measures to mitigate environmental impact
Construction period	Direct impact	Transportation of materials and equipments	Construction materials are transported by trucks. Expected impacts include exhaust emissions, noise, and vibration of driving trucks.	Practice efficient transportation of materials to reduce impacts associated with transportation of materials.
		Operation of civil engineering and construction machinery	Impacts on workers and neighboring areas such as noise and vibration are expected due to operation of machinery that installs facilities.	Create construction plans that efficiently utilize construction machinery. At the same time, no construction will be carried out on weekends, holidays, and late at night. Use low-noise and low-vibration construction machinery to reduce noise and vibration to the surrounding areas.
	Indirect impact	Raw materials of civil engineering and construction materials and processing them	Obtaining and processing raw materials for construction cause GHG emissions.	Create optimal plans and designs to avoid using more than enough construction materials.

(6) Stakeholders' Comments

Main comments of stakeholders collected in this investigation are shown below. Many stakeholders expressed favorable opinions on implementing this project.

Table-6 Stakeholders' Comments

Local people that we met or consulted with	Contents
DNA (The Philippines CDM Office) CDM expert Albert, etc.	We explained investigation plans of this project and confirmed procedures for CDM in the Philippines and applicability of this project. As a result, we received comments that this project was applicable as programmatic CDM, and DNA was looking forward to establishment of this project.
DOE (The Philippines Department of Energy) Assistant director Sibayan	We explained investigation plans of this project and confirmed which organizations could be accepted as a developer and a managing entity of programmatic CDM, as well as the current status of the electric power sector. As a result, we received comments that they would welcome the development because this project's environmental burden was small and the project matches the energy policy of the Philippines. We also received comments that possible candidates included NPC's Small Power Utility Group (SPUG) and REC.
NIA (The Philippines National Irrigation Authority) Secretary Salazar, etc.	We explained specific investigation plans of this project and benefits to NIA and consulted future process and cooperation system. As a result, they understood this plan and commented that they would cooperate with this project.
NEA (the Philippines National Electrification Administration) Director Rod N Pauda, etc.	We reported the outcome of the last investigation and confirmed whether NEA could be accepted as a developer and a managing entity of programmatic CDM. As a result, we received comments that it was difficult for NEA to directly become a developer, but they were prepared to take the role of managing entity of CDM as an organization that would integrate RECs.
ICLEI (environmental NGO) Director Victorino E.Aquitania, etc.	We explained about this project and investigation plan and obtained opinions on environmental aspects. As a result, we received comments that they would support active development in the future because they determined that this project would be beneficial to local LGUs where this project would be located and involve little environmental burden.
DBP (Development Bank of the Philippines) Assistant Vice President Ignasio C.Serrano, etc.	We confirmed possibility of providing loans to candidate developers. As a result, we received comments that basically there was no problem for DBP to offer financing to this project upon becoming applicable to CDM.
NPC (The Philippines National Power Corporation) President Froilan A.Tanpinco	We confirmed whether NPC could be accepted as a developer and a managing entity of programmatic CDM. As a result, we received comments that they would response after consulting with relevant executives in the end, but we expect that there is a slim chance that they would accept.
DENR local office (Department of Environment and Natural Resources) Mr. Boy Rodrigo. Jr.	We reported the outcome of F/S and conducted hearing investigation on environmental perspectives on this project. As a result, we received comments that they agreed with the scheme of this project and would cooperate with promotion of this project.

(7) Project Implementation System

Figure-5 shows the most feasible project implementation system at this point.

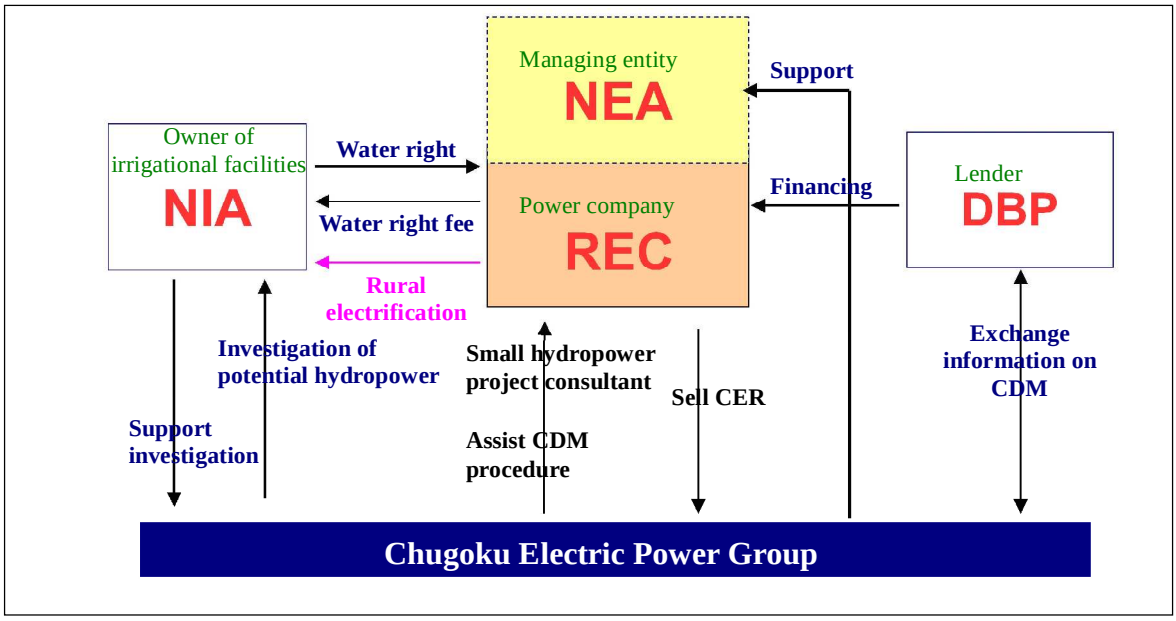

Figure-5 An Example of Project Implementation System

(8) Funding Plan

The expected candidate developers in this project include private developers (in the Philippines and Japan), NPC, and REC. Own capitals of the above developers or loans of Development Bank of the Philippines that target CDM projects are to provide funding for the development.

Developers are to appropriate revenue from selling electric power that completed hydropower stations will generate and CER revenue to paying back the development cost and also to project cost of other locations.

Table-7 shows fund raising and investment plans for candidate development points.

Table-7 Fund Raising and Investment Plan

Item		Numbers	Outline
Unit price for selling electricity		4.5 peso (9 yen)	Consignment fee for power transmission companies is subtracted from the average unit price of NPC wholesale price in 2006 to 2008.
Price of emission rights		10 euro/CO_2t	
Tax		0% 10%	Tax reduction measures under Renewable Energy Law (approved on October 8, 2008) For 7 years after starting operation Later (usually 30%)
Bank financing	Drawing period	3 years	Information from DBP
	Loan repayment grace period	3 years	Information from DBP
	Repayment period	8 years	Information from DBP
	Interest	9%	Information from DBP Estimated based on JBIC6 interest 7.7 - 10.7% (adjusted depending on project risk; hearing from DBP)
	Capital ratio	30%	When CDM is applied
		100%	When CDM is not applied

(9) Economic Analysis

As a result of examining the power generation plan, economic analysis was conducted on AGNO-2 point that was assessed as development candidate point and where F/S was conducted. Table-8 shows the conditions and results of analysis. Detailed analytical results are shown in the attachement.
FIRR (Financial Internal Rate of Return) is used as evaluation index of the economic analysis.

Table-8 Conditions and Results of Economic Analysis

○ Conditions Examined

Item	Amount	Comments
CDM period	21 years	7 years x 3 times
CO_2 reduction amount	1,029tCO_2/year	
Yearly revenue from electricity sales	19,170 thousands of yen	
Yearly CER revenue	1,338 thousands of yen	130 yen/euro
Other cost	1,065 thousands of yen	5% of yearly revenue from electricity sales
Discount rate	10 %	

○ Results Examined

Item	With loans and CER revenue	Without loans and CER revenue
IRR	15.3%	9.3%
NPV	10,138 thousands yen	-599 thousands of yen
Benefit/Cost	1.062	0.996

The IRR is about 15% if DBP Special Loan is used with an assumption that CDM will be applicable and CER revenue is included in the calculation. If not, it is shown that the project would not be feasible, because of the low IRR of 9% and the negative present value of the project revenue.

(10) Proof of Additionality

- Method to demonstrate additionality of CDM small-scale program activity
  In order to register this project as a CDM project with the United Nations, it is necessary to prove additionality that shows that this project is not on a baseline scenario. In a case of CDM small-scale project, it is required to demonstrate that the project is applicable to one of the following four barriers as a proof of additionality based on the Annex B of "the simplified modalities and procedures for CDM small-scale program activity".
  - Investment barrier:
    a financially more viable alternative to the project activity would have led to higher emissions;
  - Technological barrier:
    a less technologically advanced alternative to the project activity involves lower risks due to the performance uncertainty or low market share of the new technology adopted for the project activity and so would have led to higher emissions;
  - Barrier due to prevailing practice:
    prevailing practice or existing regulatory or policy requirements would have led to implementation of a technology with higher emissions;
  - Other barriers:
    without the project activity, for another specific reason identified by the project participant, such as institutional barriers or limited information, managerial resources, organizational capacity, financial resources, or capacity to absorb new technologies, emissions would have been higher.

- Proof of additionality
  Individual barriers to implementation of this project are described below.
  [Technological barrier]
  The hydropower facilities to be applied in this CPA consist of technology unique to Japan, and

although they can be installed within the existing irrigation canals, there are no existing examples of their use in the Philippines. Accordingly, the production, and operation and maintenance of this unique technology is restricted, thereby presenting a technological barrier to this CPA..

[Proof of barrier due to prevailing practice]

There are a large number of hydropower plants in the Philippines but there are almost no hydropower generation projects that utilize existing irrigation canals. For this reason, the technology to be applied in this CPA represents a "first-of-its-kind" for hydropower facilities, and accordingly presents a barrier due to prevailing practice.

[Barrier due to financial resources]

Due to the fact that the scale of hydropower facilities installed in irrigation canals, which is the subject of this CPA, is extremely small, it would be extremely difficult to obtain financing from banks unless it is developed as a CDM project. Accordingly, this presents a barrier due to financial resources in that not being a CDM restricts the financial resources.

Above conditions exhibit that implementation of this project involves three types of barriers, thus demonstrating additionality of this project.

(11) Perspectives and Issues of Industrialization

This project does not involve alteration of the natural environment, new land procurement, or invasion of existing rights because it is a power generation plan that utilizes unexploited energy in existing irrigation canals. In addition, since this power generation plan completely depends on irrigation waters, the hurdle for the development of this project is deemed to be low in terms of the aspects of natural environment and social environment. There should be no major obstacle for implementing the project in a large frame, but it is necessary to ascertain the following issues to put the project into effect in the future.

[Establish project implementation system]

In this investigation, we confirmed willingness of NEA that organize RECs, the candidates for electric power generation company, and NIA, the owner of irrigation facilities, to provide active involvement in this project, but we were unable to determine a developer in the end. We need to determine participants, operation systems, and assignment of roles in the process of industrialization in the future.

[Set up proper fees for using facilities (water)]

NIA that will loan irrigation facilities to power companies is expecting revenues from fees for using waters and facilities that power companies will be paying. The fee setting must be reasonable to both NIA and power companies while maintaining its economics.

[Capacity Building of managing entities involved in programmatic CDM]

CDM that involves hydropower is not very common in the Philippines, and no project has been registered as programmatic CDM project. Thus, it is necessary for the Japan-side to nurture managing entities.

[Examine details of the application of programmatic CDM]

Implementation of programmatic CDM seems to be the best option in this project, because it consists of individual small-scale hydropower companies and not all possible areas for the project in the Philippines are covered at this point. Nonetheless, certification procedures and setting up the period to start the project are expected to cause delays if programmatic CDM is employed. Thus, we must carefully compare advantages and disadvantages of “programmatic CDM” and “CDM that combines multiple points of project feasibility” upon industrialization.

[Implementation of F/S at other points with high development potentials]

In order to determine whether this project can be materialized as a programmatic CDM project, it is vital to at least conduct detailed F/S at multiple points where the economics is expected to be similar to points selected in the secondary screening of this investigation.

4. Implementation of Co-benefit for the Host Nation

(1) Assess Pollution Prevention for the Host Nation

If the hydropower development in this project replaces fossil-fuel-based power generation that causes air pollution, the reduction amount of NO_X and SO_X as air pollutants can be calculated based on the amount of the development and the type of replaced thermal power generation.

Calculation method is shown below.

Amounts of NO_X and SO_X emissions per kWh at each grid can be calculated using the following formulas, based on the ratio between the amount of NO_X and SO_X emissions and types of power generation at each grid. In regards to basic units of NO_X and SO_X emissions for individual types of power generation, the median is used based on the values shown in Table-9.

$$NOx\text{-}EF = NOx\text{-}EF_{coal} * P_{coal} + NOx\text{-}EF_{oil} * P_{oil} + NOx\text{-}EF_{gas} * P_{gas}$$

$$SOx\text{-}EF = SOx\text{-}EF_{coal} * P_{coal} + SOx\text{-}EF_{oil} * P_{oil}$$

where,
- $NOx\text{-}EF$: Amount of NO_X emission per kWh
- $SOx\text{-}EF$: Amount of SO_X emission per kWh
- $NOx\text{-}EF_i$: Amount of NO_X emission per kWh at power generation type i
- $SOx\text{-}EF_i$: Amount of SO_X emission per kWh at power generation type i
- P_i : Ratio of power generation type i at each grid

Table-9 Amount of NO_X and SO_X emissions per kWh

Type of power generation	SOx (g/kWh)	NOx (g/kWh)
Coal	0.3 - 6	0.5 - 3
Oil	0.4 - 6	0.5 - 1. 4
Gas	-	0.2 - 1. 1

Reference: Current Conditions of Environmental Problems in Asia (JICA Research Institute)

For example, Table-10 shows emission reductions, if we assume that thermal power generation is replaced when AGNO-2, one of the candidate points of development, goes on line, and the amount of NO_X and SO_X emissions are reduced.

Table-10 Amount of NO_X and SO_X emission reductions at AGNO-2 Point

Item	Amount	Comments
Power output	320 kW	
Yearly power production	2,130 MWh	
Amount of CO_2 emission reduction	1,029 t/year	Emission factor 0.483 CO_2t/MWh
Amount of NOx emission reduction	1,957 kg/year	Emission factor 0.919 kg/MWh
Amount of SOx emission reduction	2,628 kg/year	Emission factor 1.234 kg/MWh

(2) Proposal of Co-benefit Index

Based on the concept described so far, obtain co-benefit index as the relationship between CO_2 emission factor and the amount of NO_X and SO_X emission reductions per kWh at each grid

Figure-6 shows distribution of the relationship between the amount of CO_2 emission reduction per kWh and the amount of NO_X emission reduction per kWh, and Figure-7 shows the relationship between the amount of CO_2 emission reduction per kWh and the amount of SO_X emission reduction per kWh.

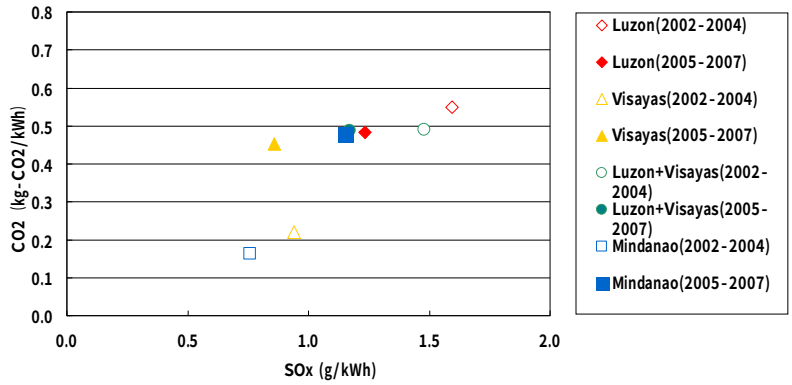

Figure-6 Relationship between amount of CO_2 emission reduction and NO_X reduction per kWh

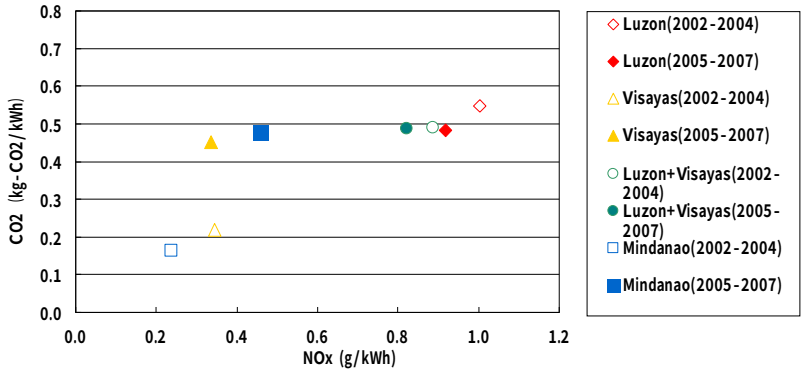

Figure-7 Relationship between amount of CO_2 emission reduction and SO_X reduction per kWh

These figures show a trend that areas with higher CO_2 emission factors have higher reduction effects of NO_X and SO_X. Specifically, the Luzon area has the highest co-benefit effect, followed by Visayas area and Mindanao area.

Thus, based on the perspective of co-benefit, if we are to continue irrigation small hydropower development in the future, it will be most effective to do so in the Luzon area.

Attachment 1

Report on On-site Investigation

(1) On-site Pre-coordination

(Consultation with relevant organizations in Manila)

Date	Parties visited and people consulted with on site	Contents
September 8	DBP (Development Bank of the Philippines) Deputy Vice President Ignasio C. Serrano, et al.	We explained investigation plans and other information of this project, and checked possibilities of loan financing for this CDM scheme. As a result, we obtained approval for this project and agreed to continue exchange of information in the future.
	NEA (National Electrification Administration of the Philippines) Director Rod N Pauda, et al.	We explained investigation plans and other information of this project, and verified whether NEA could accept Programmatic CDM as a coordinating and managing entity, and whether the subordinate organizations, EC (local electric cooperatives), could become the developers of this project. As a result, we received comments that this project agreed with the policy of the electric power sector in the Philippines, and the NEA was able to become a coordinating and managing entity as long as the Japanese parties would provide support.
September 9	NIA (National Irrigation Administration of the Philippines) Director Payawal, et al.	We explained investigation plans and other information of this project, and requested cooperation with our investigation as a counterpart. We also discussed practical matters such as schedule and cost allocation. NIA said they would basically provide support for this project.
	NPC (National Power Corporation) Vice President Chiu, et al.	We explained investigation plans and other information of this project, and confirmed whether NPC could be accepted as a developer and managing entity of the programmatic CDM. As a result, the NPC said they were selling its assets under the current Electric Power Industry Reform Act (EPIRA), and they would like to respond after obtaining opinions of the executives including the president.
September 10	NIA (National Irrigation Administration of the Philippines) Secretary Salazar, et al.	We explained investigation plans and other information of this project, and requested cooperation with our investigation as a counterpart. As a result, the NIA said they would like to provide support after they identified the merits of this project for NIA.
	DNA (Designated National Authority for CDM in the Philippines) Albert, expert of CDM, et al.	We explained investigation plans of this project and confirmed procedures for CDM in the Philippines, and applicability of this project. As a result, we received comments that this project was applicable as a programmatic CDM, and the DNA was looking forward to the establishment of this project.

Date	Parties visited and people consulted with on site	Contents
	DOE (Department of Energy in the Philippines) Deputy director Sibayan, et al.	We explained investigation plans of this project, and confirmed which organizations could be accepted as a developer and managing entity of the programmatic CDM, as well as the current status of the electric power sector. As a result, we received comments that they would welcome the development because this project has low environmental impact and it matches the energy policy of the Philippines. We also received comments that possible candidates included the NPC's Small Power Utility Group (SPUG) and Regional Electric Cooperatives (REC).
September 11	NIA (National Irrigation Administration of the Philippines) Secretary Salazar, et al.	We explained specific investigation plans of this project and benefits to the NIA, and discussed future procedures and a cooperative framework. As a result, the NIA gained an understanding of this plan and commented that they would cooperate with this project.

(2) First On-site Investigation
(First Group: Investigation of Hydropower Potential in the Northern Part of the Island of Luzon)

Date	Parties visited and people consulted with on site	Contents
September 22	NIA UPRIIS office Office Head Carlito M. Gapasin, et al.	We conducted potential investigation in Region 2 (northern part of the island of Luzon), obtained information on development points, and gained an understanding of the number of development points and development scale in this area. All local offices were supportive, introduced potential points and provided relevant data.
September 23	NIA UPRIIS DRD office Office Head Freddie M. Toquero, et al.	
	NIA UPRIIS District I office Office Head Eugenio O. Conde, et al.	
September 24	NIA MRIIS office Office Head Porfino V. Reyes, et al.	
	NIA MRIIS DRD office Office Head, et al.	
	NIA MRIIS District III office Office Head Jaime G. Carag, et al.	
September 25	NIA Kalinga PIMO office Office Head John L. Socalo, et al.	
September 26	NIA Kalinga PIMO office Office Head John L. Socalo, et al.	

(Second Group: Investigation of Hydropower Potential in the Central Part of the Island of Luzon)

Date	Parties visited and people consulted with on site	Contents
September 22	NIA Region III office Office Head Leonardo S. Gonzales, et al.	We conducted potential investigation in Region 1, 3 (central part of the island of Luzon), obtained information on development points, and gained an understanding of the number of development points and development scale in this area. All local offices were supportive, introduced potential points and provided relevant data.
	NIA Camiling RIS Management Office Office Head Marcelino P. Manalo, et al.	
September 23	NIA Zambales office Office Head Juan L. Anagaran, et al.	
September 24	NIA Region I office Office Head John N. Celeste, et al.	
September 25	NIA Ambyurayan RIS management office Office Head Dennis de Veta, et al.	
September 26	NIA Ambyurayan RIS management office Office Head Dennis de Veta, et al.	

(Third Group: Investigation of Hydropower Potential in the Visayas Islands Region)

Date	Parties visited and people consulted with on site	Contents
September 22	NIA Leyte office Mr. Santos Meracap, et al.	We conducted potential investigation in Region 7, 8 (Visayas Islands region), obtained information on development points, and gained an understanding of the number of development points and development scale in this area. All local offices were supportive, introduced potential points and provided relevant data.
September 23	NIA Cebu office Mr. Diosdado Rosales, et al.	
September 24	NIA Bohol office Bohol Province Development Office Ms. Lonilita Bunado NIA Ubay Office Mr. Modesto G. Membrebe, et al.	
September 25	NIA Ngros Oriental office Mr. DexterG. Ptrocinio, et al.	
September 26	NIA Ngros Oriental office Mr. DexterG. Ptrocinio, et al.	

(3) Second On-site Investigation
(First Group: Consultation with Relevant Organizations in Manila)

Date	Parties visited and people consulted with on site	Contents
October 13	NPC (National Power Corporation of the Philippines) Vice President Chiu, et al.	We explained the outcome of the last investigation and checked whether NPC could become a developer, and coordinating and management entity of a Programmatic CDM. As a result, we received comments that they would like to respond after consulting with the executives including the president.
October 14	NEA (National Electrification Administration of the Philippines) Director Rod N Pauda, et al.	We explained the outcome of the last investigation and checked whether the NEA could become a developer, and coordinating and management entity of Programmatic CDM. As a result, we received comments that it was difficult for the NEA to become a direct developer, but it was ready to take a role as the coordinating and management entity as an organization that would integrate individual Regional Electric Cooperatives (REC).
	ICLEI (environmental NGO) Director Victorino E. Aquitania, et al.	We explained this project and investigation plans, and obtained opinions from the environmental perspectives. As a result, we received comments that they would support active development in the future because this project would be beneficial to Local Government Units (LGU) where the project would be located and cause little environmental impact.
October 15	NIA (National Irrigation Administration) Deputy Secretary Alexander A. Reuyan, et al.	We explained the outcome of the last investigation, discussed future investigation progress, and requested to be provided with data. As a result, they understood out explanations and said they would provide support to this project.
	DBP (Development Bank of the Philippines) Deputy Vice President Ignasio C. Serrano, et al.	We explained the outcome of the last investigation and checked the possibility of providing loans to the current developer candidates. As a result, we received comments that there would basically be no problem for the DBP to provide financing when the CDM is applied to this project.
October 16	NPC (National Power Corporation of the Phililppines) President Froilan A. Tanpinco	We explained the outcome of the last investigation and checked whether the NPC could become a developer, and coordinating and management entity of the Programmatic CDM. As a result, we received comments that they would respond after consulting with relevant executives for a final answer. However, we expect that there is a slim chance that they will accept our suggestions.

(Second Group: On-site Investigation of Candidate Points for Development and Consultation with Relevant Organizations)

Date	Parties visited and people consulted with on site	Contents
October 13	NIA Upper Pampanga RIS office Mr. Renesto D. Ponce, et al.	We explained the outcome of the last investigation and requested to be provided with information on candidate points for development. They were very supportive and provided guides to potential sites and relevant data.
	NECCO II Area 1 office (power distribution company) Mr. Lorenzo R. Vazino, et al.	We explained investigation plans and other information of this project, and obtained information on connections to distribution lines. All distribution companies were supportive and provided relevant data.
October 14	NECCO II Area 2 office (power distribution company) Office Head Lorenzo R. Vazino, et al.	
	LGU (RIZAL) (Local Government Units) Deputy Mayor Bonifacio D. Soliven, et al.	We explained investigation plans and other information of this project, provided information on the investigation of this project, and requested cooperation with this project's investigation. As a result, we received comments that they would provide complete support for this project.
	Barangay (village near the site) Village Head Hol Bent P. CO, et al.	
October 15	NIA Agno RIS office Mr. Isidro C. Acangel, et al.	We explained the outcome of the last investigation and requested to be provided with information on candidate development points. They were very supportive, and provided guides to potential sites and relevant data.
October 16	PANERCO III office, et al. (power distribution company) Mr. Silvino R. Villegas	We explained investigation plans and other information of this project, and obtained information on connection to distribution lines. They were very supportive and provided relevant data.
	LGU (Sun Manuel) (Local Government Units) Secretary Bonifacio D. Soliven	We explained investigation plans and other information of this project, and provided information on this project investigation. As a result, we received no negative comments on implementing this project.
	Barangay (village near the site) Village Head Danilo S. Sabater	

(4) Third On-site Investigation

Date	Parties visited and people consulted with on site	Contents
January 13	NIA (National Irrigation Administration) Secretary Salazal, et al.	We explained the outcome of the F/S, discussed the course of future investigation, and requested to be provided with data. We explained the project scheme, including investment targets of the project, and obtained their approval.
	DNA (Designated National Authority for CDM) Manager Joycekine A. GOCO, et al.	We explained the outcome of the F/S, discussed the course of future investigation, and exchanged information on the current status of CDM within the Philippines. We explained our company's project scheme and project implementation systems, and received their approval.
	NEA (National Electrification Administration) Manager Roderick N. Padua	We explained the outcome of the F/S, and discussed whether the NEA could become the coordinating and management entity of Programmatic CDM.
January 14	NIA AGNO-RIS (Local office of NIA) Mr. Isidro C. Acangel, et al.	We explained the outcome of the F/S and requested to be provided with information on candidate development points. They were very supportive, and provided guides to potential sites and relevant data.
	SAN MANUEL town Town Head Salvador Perez, et al.	We explained the outcome of the F/S, provided information of this project investigation, and requested support for this project investigation. As a result, we received comments that they would provide complete support for this project.
	Kagawad Barangay (village) Deputy Village Head Loreto Sampilo	
January 15	DENR Local Office Mr. Boy Rodrigo. Jr	We explained the outcome of the F/S, and conducted an interview investigation into opinions on this project from environmental perspectives. As a result, we received comments that they approved the scheme of this project and would provide support for implementation of this project.
	PANELCO III (local power distribution company) Mr. Ferdinand M. Cerezo	We explained the outcome of the F/S and conducted interview investigation into information regarding grid connection and sales of electric power. We received comments that they were very interested in this project.
January16	JICA Office in the Philippines	We exchanged information on the current status of the electric power sector in the Philippines and received advice on implementing this project.

Attachment 2

Attachment: Economic Analysis

1. Conditions Examined

Item	Amount		Comments
Maximum output (P)	320	kW	
Annual power production (E)	2,130	MWh/year	
Construction costs	141,384	Thousands of yen	
Power station operation and maintenance costs		Thousands of yen	See separate sheet.
Operating period	20	Years	From start of operations
Bank loan drawing period	3	Years	
Bank loan repayment grace period	3	Years	
Bank loan repayment period	8	Years	
Bank loan interest rate	9	%	
Self-financing ratio 1	30	%	CDM is applicable
Self-financing ratio 2	70	%	CDM is not applicable
Discount rate	10	%	
Exchange rate			
Electricity sales units	4.5	Pesos/kWh	
Emission factor	0.483	tCO2/MWh	
CER units	10	Euros/tCO2	
CO2 reduction amount	1,029	tCO2/year	
Yearly revenue from electricity sales	19,170	Thousands of yen/year	
Yearly CER revenue	1,338	Thousands of yen/year	
Administrative costs	959	Thousands of yen/year	5% of yearly revenue from electricity sales
Income tax	0/10	%	7-year period from start of operations/After that period

2. Results Examined

Item	Amount		Comments
IRR (With CER, use of bank loans)	15.3%		
IRR (Without CER, not using bank loans)	9.3%		

3. Breakdown: Economic Factors Examined

IRR Calculations (Considered with CER (10 euro/tCO2), use of bank loans, operational costs, and taxes)

Item		Construction Costs (Loans and Repayment Amounts)					Expenditure Items					Income Items				Cash Flow	Taxes	Cash Flow After Taxes	Investment Recovery	Present Value			
		(1) Yearly loan value	(2) Basic repayment amount	(1)-(2)	(3) Interest (1)×9%	Repayment amount (2)+(3)	Construction costs	O & M costs	Admin. costs	Operational costs	Total	Annual power production	Revenue from electricity sales	CER	Total	CF			Total CF	PV factor	Expenditures (C)	Income (B)	Net flow
Year		Thousands of yen	Thousands of yen	Thousands of yen	Thousands of yen	Thousands of yen	Thousands of yen	Thousands of yen	Thousands of yen	Thousands of yen	Thousands of yen	MWh	Thousands of yen	Thousands of yen	Thousands of yen	Thousands of yen	Thousands of yen	Thousands of yen	Thousands of yen		Thousands of yen	Thousands of yen	Thousands of yen
1		98,969		98,969	8,907		42,415			959	43,374				0	-43,374		-43,374	-43,374	1.000	43,374	0	-43,374
2	1	107,876		107,876	9,709			500	600	959	2,059	2,130	19,170	1,338	20,508	18,450	0	18,450	-24,924	0.909	1,871	18,644	16,772
3	2	117,585		117,585	10,583			500	600	959	2,059	2,130	19,170	1,338	20,508	18,450	0	18,450	-6,475	0.826	1,701	16,949	15,248
4	3	128,168		128,168	11,535			500	600	959	2,059	2,130	19,170	1,338	20,508	18,450	0	18,450	11,975	0.751	1,547	15,408	13,861
5	4	139,703		139,703	12,573			800	600	959	2,359	2,130	19,170	1,338	20,508	18,150	0	18,150	30,125	0.683	1,611	14,007	12,396
6	5	152,276		152,276	13,705			500	600	959	2,059	2,130	19,170	1,338	20,508	18,450	0	18,450	48,574	0.621	1,278	12,734	11,456
7	6	165,981	20,748	145,233	14,938	35,686	35,686	3,000	600	959	40,244	2,130	19,170	1,338	20,508	-19,736	0	-19,736	28,838	0.564	22,717	11,576	-11,141
8	7	145,233	20,748	124,485	13,071	33,819	33,819	500	600	959	35,877	2,130	19,170	1,338	20,508	-15,369	0	-15,369	13,468	0.513	18,411	10,524	-7,887
9	8	124,485	20,748	103,737	11,204	31,952	31,952	500	600	959	34,010	2,130	19,170	1,338	20,508	-13,502	0	-13,502	-34	0.467	15,866	9,567	-6,299
10	9	103,737	20,748	82,989	9,336	30,084	30,084	800	600	959	32,443	2,130	19,170	1,338	20,508	-11,935	0	-11,935	-11,969	0.424	13,759	8,697	-5,062
11	10	82,989	20,748	62,241	7,469	28,217	28,217	500	600	959	30,276	2,130	19,170	1,338	20,508	-9,768	0	-9,768	-21,736	0.386	11,673	7,907	-3,766
12	11	62,241	20,748	41,493	5,602	26,350	26,350	5,000	600	959	32,908	2,130	19,170	1,338	20,508	-12,400	0	-12,400	-34,137	0.350	11,534	7,188	-4,346
13	12	41,493	20,748	20,745	3,734	24,482	24,482	500	600	959	26,541	2,130	19,170	1,338	20,508	-6,033	0	-6,033	-40,170	0.319	8,457	6,534	-1,922
14	13	20,745	20,745	0	1,867	22,612	22,612	500	600	959	24,671	2,130	19,170	1,338	20,508	-4,163	0	-4,163	-44,332	0.290	7,146	5,940	-1,206
15	14							500	600	959	2,059	2,130	19,170	1,338	20,508	18,450	1,845	16,605	-27,728	0.263	542	5,400	4,858
16	15							800	600	959	2,359	2,130	19,170	1,338	20,508	18,150	1,815	16,335	-11,393	0.239	565	4,909	4,345
17	16							500	600	959	2,059	2,130	19,170	1,338	20,508	18,450	1,845	16,605	5,211	0.218	448	4,463	4,015
18	17							3,000	600	959	4,559	2,130	19,170	1,338	20,508	15,950	1,595	14,355	19,566	0.198	902	4,057	3,156
19	18							500	600	959	2,059	2,130	19,170	1,338	20,508	18,450	1,845	16,605	36,171	0.180	370	3,689	3,318
20	19							500	600	959	2,059	2,130	19,170	1,338	20,508	18,450	1,845	16,605	52,775	0.164	337	3,353	3,017
21	20							800	600	959	2,359	2,130	19,170	1,338	20,508	18,149	1,815	16,334	69,109	0.149	351	3,048	2,698
Total							275,617	20,700	12,000	20,129	328,446	42,600	383,400	26,760	410,160	81,714	12,605	69,109			164,458	174,596	10,138

FIRR	**15.3%**	
NPV(B-C)	**10,138**	Thousands of yen
NPV(B/C)	**106.2%**	

IRR Calculations (Without CER and not using bank loans)

Item		Expenditure Items					Income Items				Cash Flow	Taxes	Cash Flow After Taxes	Investment Recovery	Present Value			
		Construction costs	O & M costs	Admin. costs	Operational costs	Total	Annual power production	Revenue from electricity sales	CER	Total	CF			Total CF	PV factor	Expenditures (C)	Income (B)	Net flow
Year		Thousands of yen	Thousands of yen	Thousands of yen	Thousands of yen	Thousands of yen	MWh	Thousands of yen	Thousands of yen	Thousands of yen	Thousands of yen	Thousands of yen	Thousands of yen	Thousands of yen		Thousands of yen	Thousands of yen	Thousands of yen
1		141384			959	142,343				0	-142,343		-142,343	-142,343	1.000	142,343	0	-142,343
2	1		500	600	959	2,059	2,130	19,170		19,170	17,111	0	17,111	-125,232	0.909	1,872	17,427	15,555
3	2		500	600	959	2,059	2,130	19,170		19,170	17,111	0	17,111	-108,121	0.826	1,702	15,843	14,141
4	3		500	600	959	2,059	2,130	19,170		19,170	17,111	0	17,111	-91,010	0.751	1,547	14,403	12,856
5	4		800	600	959	2,359	2,130	19,170		19,170	16,811	0	16,811	-74,199	0.683	1,611	13,093	11,482
6	5		500	600	959	2,059	2,130	19,170		19,170	17,111	0	17,111	-57,088	0.621	1,278	11,903	10,625
7	6		3,000	600	959	4,559	2,130	19,170		19,170	14,611	0	14,611	-42,477	0.564	2,573	10,821	8,248
8	7		500	600	959	2,059	2,130	19,170		19,170	17,111	0	17,111	-25,366	0.513	1,057	9,837	8,781
9	8		500	600	959	2,059	2,130	19,170		19,170	17,111	1,711	15,400	-8,255	0.467	961	8,943	7,982
10	9		800	600	959	2,359	2,130	19,170		19,170	16,811	1,681	15,130	8,556	0.424	1,000	8,130	7,130
11	10		500	600	959	2,059	2,130	19,170		19,170	17,111	1,711	15,400	25,667	0.386	794	7,391	6,597
12	11		5,000	600	959	6,559	2,130	19,170		19,170	12,611	1,261	11,350	38,278	0.350	2,299	6,719	4,420
13	12		500	600	959	2,059	2,130	19,170		19,170	17,111	1,711	15,400	55,389	0.319	656	6,108	5,452
14	13		500	600	959	2,059	2,130	19,170		19,170	17,111	1,711	15,400	72,500	0.290	596	5,553	4,956
15	14		500	600	959	2,059	2,130	19,170		19,170	17,111	1,711	15,400	89,611	0.263	542	5,048	4,506
16	15		800	600	959	2,359	2,130	19,170		19,170	16,811	1,681	15,130	106,422	0.239	565	4,589	4,024
17	16		500	600	959	2,059	2,130	19,170		19,170	17,111	1,711	15,400	123,533	0.218	448	4,172	3,724
18	17		3,000	600	959	4,559	2,130	19,170		19,170	14,611	1,461	13,150	138,144	0.198	902	3,793	2,891
19	18		500	600	959	2,059	2,130	19,170		19,170	17,111	1,711	15,400	155,255	0.180	370	3,448	3,078
20	19		500	600	959	2,059	2,130	19,170		19,170	17,111	1,711	15,400	172,366	0.164	337	3,134	2,798
21	20		800	600	959	2,359	2,130	19,170		19,170	16,811	1,681	15,130	189,177	0.149	351	2,849	2,499
Total		141384	20,700	12,000	20,139	194,223	42,600	383,400	0	383,400	189,177	21,454	167,723	500,807		163,804	163,205	-599

FIRR	**9.3%**	
NPV(B-C)	**-599**	Thousands of yen
NPV(B/C)	**99.6%**	