MOEJ/GEC JCM Feasibility Study (FS) 2014
Summary of the Final Report

"Energy Saving for Irrigation Facility by Introducing High-efficiency Pumps"

(Implementing Entity: Nippon Koei Co., Ltd. and EBARA Corp.)

1. Overview of the Proposed JCM Project

Study partners	Japan EBARA CORPORATION (EBARA) ● To study for introducing high efficiency irrigation pumps ● To prepare business plan for introducing high efficiency irrigation pump Host country EBARA VIETNAM PUMP COMPANY (EVPC) ● To collect and supply data related to pumps in Vietnam such as market share and operation test results			
Project site	Hanoi city and Bac Ninh province, Vietnam			
Category of project	Energy Saving			
Description of project	This study focuses on two projects for introducing high efficiency pumps in existing irrigation facilities managed by the Department of Agriculture and Rural Development (DARD) in Hanoi city and Bac Ninh province in Vietnam. In the following, the summary of projects are indicated, <u>Project 1:Me Linh area in Hanoi city</u> It aims to introduce high efficiency pumps produced by EBARA corp. in the existing irrigation facilities (total 26pumps, 3,500m3/h, 75kW) and to save energy. The irrigation facilities are managed by Me Linh water management company under DARD in Hanoi city. <u>Project 2:Nam Duong area in Bac Ninh province</u> It aims to introduce high efficiency pumps produced by EBARA corp. in the existing irrigation facility (total 8 pumps, 3,900m3/h, 90kW) and save energy in Gia Dao Pump Plant. The irrigation facility is managed by Nam Duong water management company under DARD in Bac Ninh province.			
Expected project implementer	Japan	EbaraCorp. (EBARA)		
	Host country	Me Linh water management company Nam Duong water management company		
Initial investment	<u>Project 1</u> JPY169,970,000 <u>Project 2</u> JPY 52,300,000		**Date of groundbreaking**	Project 1: July, 2015 Project 2: July, 2015
Annual maintenance cost	<u>Project 1</u> JPY 14,930,000 <u>Project 2</u> JPY 6,940,000		**Construction period**	Approximately 8-12 months
Willingness to investment	Yes		**Date of project commencement**	Project 1: June, 2016 Project 2: June, 2016

Financial plan of project	Project 1 This project will cost JPY 169,970,000 for the initial investment and JPY 14,930,000 for the maintenance cost. It is reserved in the budget of DARD in Hanoi city that manages Me Linh water management company. Me Linh water management company manages and supervises two renewal projects at pump stations such as Thuong Le II and Tam Bao. The company which introduces pumps is selected by tender. Project 2 This project will cost JPY 52,300,000 for the initial investment and JPY 6,940,000 for the maintenance cost. It is reserved in the budget of DARD in Bac Ninh province that manages Nam Duong water management company. It is plans to initiate the operation of the renewal pumps from 2016. Nam Duong water management company will manage and supervise both construction plan and operation plan. Originally, pump facilities are selected by tender. However, it is under discussion to apply optional contract for installation of high efficiency pumps that achieves energy saving.
GHG emission reductions	Project 1 100 (tCO2/year) 26 pumps will be installed to 2 facilities managed by Me Linh water management company. Project 2 53 (tCO2/year) 8 pumps will be installed to 1 facility managed by Nam Duong water management company.

2. Study Contents

(1) Project development and implementation

1) Project planning

Project 1: Me Linh area in Hanoi city

In the following, the members for implementing the renewal pump project are indicated. Me Linh water management company which manages and operates the target irrigation facilities has experiences to manage approximately 20 irrigation pump facilities in Hanoi city.

Country	Study Implementation Scheme	Role and Responsibilities
Japan	EBARA Corp.	✓ To review and propose optimal pump capacity ✓ To sell optimal pump for the irrigation pumps ✓ To manage TPE validation for JCM methodology and PDD registration
	Nippon Koei	✓ To prepare JCM methodology and PDD for registration
Vietnam	Me Linh water management company	✓ To select pump contractor by tender and install high efficiency pumps ✓ To support monitoring after installation of pumps ✓ To cooperate validation for JCM methodology and PDD registration
	EBARA Vietnam Pump Company	✓ To design and produce high efficiency pumps ✓ To conduct monitoring and maintenance for newly installed pumps by making contract with Me Linh water management company ✓ To support validation for JCM methodology and PDD registration

< Profitability evaluation>

This project aims to save energy and GHG emission by installation of 26 pumps to 2 irrigation and drainage facilities which are managed by Me Linh water management company. This project costs JPY 169,970,000 as the initial investment and JPY 14,930,000 as the maintenance cost. It is reserved in the budget of DARD in Hanoi city that manages Me Linh water management company. By renewal of pumps, it is expected to reduce approximately 36,000kWh per year (per unit) as electricity consumption by saving energy.

< Initial investment, Maintenance, MRV cost>

The budget for the project will be prepared by DARD which manages the irrigation pump facilities. The total cost for maintenance, electricity consumption, and MRV is approximately JPY 15,200 per year. The cost is prepared by Me Linh water management company. In the case EBARA installs the high efficiency pumps, EVPC will be a contractor for MRV from Water management company. It is allowed to make an optional contract in the case of the entrusted services under USD 50,000 cost.

Cost items	Amount	Investor
Initial Investment	JPY 169,970,000	Me Linh water management company
Maintenance and management	JPY 1,180,000 /year	Me Linh water management company
Cost for electricity consumption	JPY 13,760,000 /year	Me Linh water management company
MRV	JPY 283,000 /year	Me Linh water management company

<Risk analysis>

Originally, the constructor is selected by tender in public works. In the case of Hanoi city, it is difficult to make optional contract since it has never been conducted. The following risk analysis is considered when the project is conducted through the public tender process.

Issues for consideration	Countermeasures
Issue1: Need for Adjustment of schedule for public tender to the subsidiary project	It is under discussion with DARD in Hanoi city for the tender schedule.
Issue 2: Need for management in the case EBARA win a bit or not for installation of pumps	It is to discuss with Japanese side for policies depends on the result of tenders.
Issue 3: Price setting for tender	Price setting depends on timing of the tender. If the tender is before the subsidiary project, it is not to consider the subsidiary fund. On the other hand, if the tender is after the subsidiary project, it is necessary to consider how to set the price for bidding.

Project 2: Nam Duong area in Bac Ninh province

In the following, the members for implementing the renewal pump project are indicated.

Country	Study Implementation Scheme	Role and Responsibilities
Japan	EBARA corp.	✓ To review and propose optimal pump capacity ✓ To sell optimal pump for the irrigation pumps ✓ To manage TPE validation for JCM methodology and PDD registration
	Nippon Koei	✓ To prepare JCM methodology and PDD for registration
Vietnam	Nam Duong water management company	✓ To select pump contractor by tender and install high efficiency pumps ✓ To support monitoring after installation of pumps ✓ To cooperate validation for JCM methodology and PDD registration
	EBARA Vietnam Pump Company	✓ To design and produce high efficiency pumps ✓ To conduct monitoring and maintenance for newly installed pumps by making contract with Me Linh water management company ✓ To support validation for JCM methodology and PDD registration

<Profitability evaluation>

This project aims to save energy and GHG emission by installation of 8 pumps to an irrigation and drainage facility in Bac Ninh province in the suburbs of Hanoi city. The project costs JPY 52,300,000 as initial investment and JPY 6,940,000 as maintenance cost. it is reserved in the budget of DARD in Bac Ninh province that manages Nam Duong water management company. By installation of high efficiency pumps, it contributes to reduce approximately 610,000kWh per year (per unit) as electricity consumption by saving energy.

<Initial investment, Maintenance, MRV cost>

The total cost for maintenance, electricity consumption, and MRV is approximately JPY 7,200,000 and Nam Duong water management company bears the cost. The water management company pays JPY 283,000/year as MRV cost to entrusted services. In the case that EBARA installs the high efficiency pumps, EVPC is supposed to make a contract for MRV supporting work with water management company since optional contract is allowed in the case that the contract cost is under approximately USD 95,000.

Cost items	Amount	Investor
Initial investment	JPY 52,300,000	Nam Duong water management company
Maintenance and management	JPY 590,000 /year	Nam Duong water management company
Electricity consumption	JPY 6,350,000 /year	Nam Duong water management company
MRV	JPY 283,000 /.year	Nam Duong water management company

<Risk analysis>

Originally, as for installation of equipments, the contractor is selected by tender in public works. As for renewal pump project in Bac Ninh province, optional contract is under consideration with the condition of case for installation of high efficiency pump which contributes to save energy. The risk analysis for optional contract is indicated in the following table.

Issues for consideration	Countermeasures
Consideration for timing between financial subsidy and optional contract	It is under discussion with DARD in Bac Ninh province for schedule for initiation of the project and timing considering subsidiary project.

2) Permits for the project development and implementation

This study focuses on the project for renewal irrigation and drainage pumps in the existing facility. Therefore, it is not necessary to get approval and authorization for implementation of this project. Also it is not planned to install other equipment and facilities that needs for approval and authorization before and after installation of high efficiency pumps.

3) Advantage of Japanese technology

The target technology of the project is high efficiency irrigation pump produced by EBARA corp. As for share of irrigation pumps by type which are installed in northern Vietnam, the type for 1,000 m^3/h is approximately 50%, 4,000 m^3/h, 2,500 m^3/h, and 800 m^3/h are approximately 10 % in each as the share. The Advantage of Japanese technology is that EBARA corp. can supply high efficiency pump with customized design considering customer's requirement such as angle of pump wings comparing to the other companies. Also, EBARA corp. can provide customer care service since it has the local company and factory which are set in Hanoi and Hai Duong area. However, small scale pump under 1,000 m^3/h which is the mainstream in north of Vietnam is low unit price, so it costs high expenses for customization relatively. The range of pumps which EBARA can pull its best strength should be over the middle size of pumps, so the target pumps for the project is set as scale of around 3,000 m^3/h～4,000 m^3/h in the suburbs of Hanoi city.

The hearing survey was conducted to collect information for the pump market in northern Vietnam. As a result of the survey, it turned out that EBARA's pump get 10 percent share and, Company A which is a Vietnamese company, occupies 70～80 percent share. It is clear that Company A is the major pump company in northern Vietnam. Another pump manufacturer is Company B which is also a Vietnamese company and produces irrigation pumps but less than 5 percent share. Some foreign companies (e.g. American, Chinese and Korean company) have low market share. Therefore, competitive production in northern Vietnam is the pump produced by the two Vietnamese companies. In the following, comparison of spec, efficiency and cost in each company are described.

High Efficiency Pump

Impeller

	EBARA	Company A	Company B
Type	Horizontal shaft and diagonal flow	Horizontal shaft	Horizontal shaft
Share	Approximately 10 %	70～80 %	Less than 5 %
Price (Rate)	100	80	60
Efficiency	77.5～82.5 %	57.4～79.6 %	67.0～74.0 %

Reference: Prepared by the study team based on hearing and obtained information from each companies
※1: Comparison to price in each company base in 100, EBARA
※2: Mention about efficiency range in the case of that pump output is within 3,000 m3/h

As for price, Company A is 80 and Company B is 60 compared to EBARA's pump which is set as 100. This data indicates that EBARA's pump is the most expensive among the three companies. Japanese product is better in technology but more expensive than the other product made by Vietnamese companies. Therefore the situation is that Japanese company cannot get large share.

4) MRV structure

This project plans to conduct MRV for the installation of pumps to irrigation and drainage facilities. The water management companies which will be in charge of the project agreed with some duties for monitoring (e.g. collection, arrangements, storage, and submission of the monitoring data). EBARA will comply these data with EVPC.

Measurement instruments for monitoring will be updated from analog ones to digital ones. EBARA will offer on-the-job training how to storage the monitoring records.

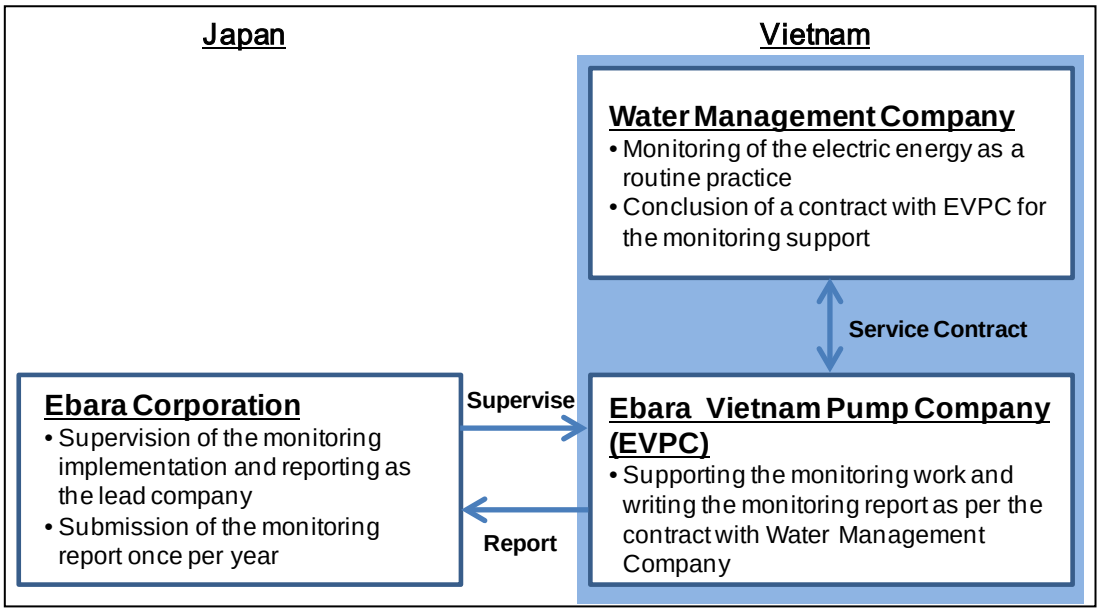

Figure 1 MRV Implementation Structure

5) Environmental integrity and Sustainable development in host country

This project aims to renew existing pumps to high efficiency pumps in the irrigation and drainage pump facility. It is not the project for constructing new facilities, so it is not necessary to get new approval and authorization about environmental impact assessment referring government ordinance (Decree No. 80/2006/ND-CP).

Moreover, the project contributes to reduce environmental load as follows.

[i] To use paints with low heavy metals

[ii] To reuse casting sand made from pump production.

As the results of the hearing surveys, the major pump manufacturers in Vietnam do not take measurements for reduction of environmental load in the manufacturing process. Therefore, the diffusion of EBARA's pumps can contribute to reduce the environmental load in Vietnam.

Contribution of sustainability development	Description
1) Stable performance of high efficiency pump	It is expected to reduce flooding caused by outbreak of pumps in the irrigation facility because the advantage of EBARA's pump is tolerant and low failure rate.
2) Quick maintenance system for high efficiency pump	The maintenance system which EBARA provide in northern Vietnam is systematized utilizing EVPC's staff and technology. If some trouble are occur, EVPC can correspond these trouble quickly. It is expected for good use of the pump due to the maintenance system.

6) Toward project realization (planned schedule and possible obstacles to be overcome)

The following schedule for implementing the project is considered.

Project 1: Me Linh area in Hanoi city

The target project in Me Linh area in Hanoi city is managed by DARD in Hanoi city. The major issue to apply for JCM subsidiary project is that this is a public project which is usually conducted by tender process. It is under discussion with DARD in Hanoi city how and when to conduct the tender considering JCM subsidiary project.

In the following, the tentative schedule of JCM subsidiary project is planned in case of applying JCM

scheme in April.

Period	Description	Implementer
January - March 2015	・Adjustment of schedule for starting of the project in July ・Final check whether the tender is necessary of not.	Department of agriculture in Hanoi city
April 2015	・Apply for the installation subsidiary project	
July 2015	・Contract for the implementation	Department of agriculture in Hanoi city
July - 2015	・Design of equipment and manufacture	
May 2016	・Construction of equipment and trial running	
June 2016	・Operation	

Project 2: Nam Duong area in Bac Ninh province

The target project in Nam Duong area in Bac Ninh province is managed by DARD in Bac Ninh Province. The project is also a public project and needs tender process to install high efficiency pumps. However, it is under consideration to conduct the project with optional contract by putting the specification on the contract such as the renewal project is to install high efficiency pumps. Currently it is under discussion how and when the optional process can be preceded.

In the following, the tentative schedule of JCM subsidiary project is planned in case of applying JCM scheme in April.

Period	Description	Implementer
January - March 2015	・Adjustment of schedule for starting of the project in July・Adjustment of schedule for starting of the project in July ・Consideration about extraordinary private contract	Department of agriculture in Bac Ninh province
April 2015	・Apply for the installation subsidiary project	
July 2015	・Contract for the implementation	Department of agriculture in Bac Ninh province
July - 2015	・Design of equipment and manufacture	
May 2016	・Construction of equipment and trial running	
June 2016	・Operation	

(2) JCM methodology development

1) Eligibility criteria

Following eligibility criteria are considered for JCM methodology.

Criterion 1	Project pump is installed to irrigation and drainage facility which uses middle size pump.
Criterion 2	Project pump is a pump with a efficiency of more than80% within a specified range of flow.
Criterion 3	Pump product maker has testing facility for product efficiency in its factory and pump system engineering facility for after-care-service.
Criterion 4	Project pump uses environmental friendly paints such as paints with 0.1 % or less lead, cadmium and tar during the production process.

In the following table, the reasons for selection of criteria are described.

Matter	Selecting reasons
【Criterion 1】 Project pump is installed to irrigation and drainage facility which uses middle size pump.	The scale, efficiency and types of pump depend on use and types of plants. The high efficiency pump which is installed in this project is irrigation and drainage pump. And the project focus on a plant which use the middle scale (3,000～4,000m^3/h) and Horizontal shaft pump. This new method is applied the installed irrigation pump to this project.
【Criterion 2】 Project pump is a pump with a efficiency of more than80% within a specified range of flow.	In generally, the pump made from Japanese company is high efficiency and high energy saving the installed pump should be high efficiency for eligibility of the JCM project. The efficiency rate is defined over 80% by hearing and data collection from pump manufacturing company and water management company which manages irrigation and drainage plants.
【Criterion 3】 Pump product maker has testing facility for product efficiency in its factory and pump system engineering facility for after-care-service.	EBARA Cop. and HPMC have factory in Vietnam and manufacture and sale the pump by themselves. The equipment for performance test needs to grasp the pump performance in clearly before supplies. The pump system engineering function needs to implement the diagnosis of the existing pump equipment for after services and making a plan for update high efficiency pump. Therefore, matter 3 is decided as one of the eligibility criteria.
【Criterion 4】 Project pump uses environmental friendly paints such as paints with 0.1 % or less lead, cadmium and tar during the production process.	The EBARA pump which will be installed in the project is manufactured in EBARA own factory in Vietnam. EBARA uses environmental friendly paints such as paints with 0.1 % or less lead, cadmium and tar during the production process. Therefore, matter 4 is decided as one of the eligibility criteria.

2) Calculation of GHG emissions (including reference and project emissions)

In the following, the methods of reference and project emissions are described.

1. Identification of the reference scenario

The reference scenario for the JCM methodology is defined that “If the project is not implemented, the newest pump produced by the largest company will be applied.”

The major pump companies are three companies, such as two Vietnamese companies, EBARA in northern Vietnam. Company A is established in 1960 and a leading company in Vietnamese pump market since that time. EBARA entered into the Vietnamese pump market from 2000. Company B focuses on researches more than production of the pump, so the sale business is dealt by the agency.

There are no official data which show the market share for pumps. Therefore, hearing surveys were conducted to collect information of the market share with water management companies which manage irrigation and drainage facilities, and pump manufacturers. As a result of the surveys, it is turned out that EBARA has 10 percent of the market share for middle-scale pumps, whereas Company A has 70～80 percent and Company B has less than 5 percent.

Company A which was established in 1960’s has monopolized the market share for pumps by taking over the technique from Soviet Union. Considering this point, it is defined conservatively that the reference scenario is to install Company A’s newest products which require lower initial investment costs than Japanese products do.

2. Calculation of reference emissions

$$\mathbf{RE_{i,p}} = \sum_{\mathbf{i}} \left\{ \mathbf{EC_{PJ,i,p}} \times \left(\boldsymbol{\eta}_{\mathbf{PJ,i}} \div \boldsymbol{\eta}_{\mathbf{RE,i}} \right) \times \mathbf{EF_{elec}} \right\}$$

$RE_{i,p}$: Reference emissions during the period p [tCO2/p]
$EC_{PJ,i,p}$: Power consumption of project pump i during the period p [MWh/p]
$\eta_{PJ,i}$: Pump efficiency of project pump i [-]
$\eta_{RE,i}$: Pump efficiency of reference pump i [-]
EF_{elec} : CO2 emission factor for consumed electricity [tCO2/MWh]

3. Calculation of project emissions

$$\mathbf{PE_{i,p}} = \sum_{\mathbf{i}} \left(\mathbf{EC_{PJ,i,p}} \times \mathbf{EF_{elec}} \right)$$

$PE_{i,p}$: Project emissions during the period p [tCO2/p]
$EC_{PJ,i,p}$: Power consumption of project pump i during the period p [MWh/p]
EF_{elec} : CO2 emission factor for consumed electricity [tCO2/MWh]

4. Calculation of emissions reductions

$$\mathbf{ER_p} = \mathbf{RE_{i,p}} - \mathbf{PE_{i.p}}$$

ER_p : Emission reductions during the period p [tCO2/p]
$RE_{i,p}$: Reference emissions during the period p [tCO2/p]
$PE_{i,p}$: Project emissions during the period p [tCO2/p]

3) Data and parameters fixed *ex ante*

The JCM methodology of this project uses the default values as follows for calculation of reference emissions and project emissions.

(a) CO2 emission factor for consumed electricity (EF_{elec}) [tCO2/MWh]

Grid emission coefficient is set by Ministry of Natural Resources and Environment in Vietnam. The newest value is 0.5408. The value will be changed when the Grid emission coefficient is updated.

(b) Pump efficiency of reference pump I ($\eta_{RE,i}$) [-]

Pump efficiency of reference is calculated by the ratio of water power to reach shaft power that the motor reach to pump shaft. Pump efficiency of reference did not appear in the maker catalog. Therefore, the pump efficiency of reference is set by results of performance test and performance date from the maker.

(c) Pump efficiency of project pump I ($\eta_{PJ,i}$) [-]

Pump efficiency of project pump is set to fulfill the eligibility criteria.
More conservative date is selected as checking the following data.

i) The spec data which the pump maker (or the agency) supplies into the plants when the pump maker prepare the estimation.
ii) The performance test data which is attached when the pump is supplies from the factory.