FY 2015

Feasibility Study on Joint Crediting Mechanism Project For Realization for a Low-Carbon Society in Asia

The whole city low carbonization in Hai Phong City (Kitakyushu-Hai Phong Cooperation Project)

Report Summary

Kitakyushu Asian Center for Low Carbon Society

NTT DATA Institute of Management Consulting, Inc.

Nikken Sekkei Civil Engineering Ltd

Amita Corporation

Chapter 1

The background and purpose of the study

1.1 Outline of Hai-Phong City

Hai-Phong City is the Vietnam's 3rd largest city followed by Hanoi and Ho Chi Minh with a population of 1.9 million and municipalities of Vietnam. The City is located in the coastal area of about 100km east of the capital Hanoi, and is the largest maritime logistics base in the northern Vietnam where some large-scale industrial parks are accumulated. The city is connected with the capital Hanoi by a Route 5 and a new highway is scheduled to be open to the traffic in 2015. The Hai-Phong port, the largest container port in northern Vietnam, can accept up to 40,000 DWT (dead-weight tonnage). The Lack Huyen deep water port, which is under construction at the offshore of Hai-Phong port with the surface area of 1,200ha, will become able to berth 2 large ships with the size of 100,000 DWT at the same time.

Hai-Phong City is aiming for an environmentally friendly Green Port City as the largest port logistics base. The economy of the city is growing at an annual rate of 7.5% and the GDP per person has reached USD 2,500 in 2013. They have 11 industrial parks in the city, and more than 50 Japanese companies are doing the business there. The steady economic growth and the important position as a logistics base will promote further the entry of Japanese companies.

Especially, Hai-Phong City is known as an integrated area of foundries that have the history of more than 100 years. Currently, about 140 foundries are located in the area.

In addition, Cat Ba islands are located southeast about 60km of Hai-Phong City mainland. The islands belong to the administrative unit of Cat Hai prefecture of Hai-Phong City. The island is the biggest island floating in Ha Long bay which is famous as a World Heritage site. The islands also have beautiful nature and rich ecosystem which attracts approx.1.4 million of tourists throughout the year although its population is just 17 thousands.

1.2 Cooperative agreement between the City of Kitakyushu, and Hai Phong City

The City of Kitakyushu started exchanging people and culture with Hai-Phong

City after concluding a cooperative agreement in 2009. Since then, they have kept doing various exchanges, such as technology cooperation in water supply sector and civilian culture exchanges, etc. In April, 2014, after 5 years' cooperative agreement, the City of Kitakyushu tied up sister city agreement with Hai-Phong City.

In addition, in 2014, utilizing the City's environmental technology and know-how, they supported to formulate "Promotion plan of Green Growth in Hai-Phong City" which illustrated a concrete action plan to promote the project. From this fiscal year, based upon "Promotion plan of Green Growth in Hai-Phong City", Hai-Phong City has been conducting a pilot project with the support of the City of Kitakyushu.

Table 1-1. The current progress of pilot project in Promoting Green Growth Plan

Sector	Pilot project	progress／future schedule
Waste	① Segregation of Household wastes・compost-treating project	・Trial making composts in urban and rural area. ・Discussing waste generated power generation business utilizing Trang Cat facilities. ・Pending : introduction of tipping fee to realize the business.
	② Exhaust heat recover power generation and cement raw fuel business in cement factory.	・Will apply exhaust heat recover power generation and facilities of raw fuel for cement to JCM facilities subsidy 2016.
	③ E-Waste	・Started substantive test in recycling of cellular phones in Hong Bang District.
Energy	④ Promoting Energy-saving in factories and buildings	・Will apply exhaust heat recover power generation and facilities of raw fuel for cement to JCM facilities subsidy 2016.
Cat Ba Islands	⑤ Build up comprehensive resources circulation system	・Discuss projects of bio-gas and solid fuel. ・Pending: to select the best location for the above facilities. ・Pending: to introduce the system of entrance fee to Cat Ba Islands.
	⑥ Introducing EV bus and energy saving, and renewable energy in isolated islands.	・Will introduce one electric bus and make test-run in FY2016 ・Pending: to introduce the system of entrance fee to Cat Ba Islands.
Transportation	⑦ Introducing a low pollution type bus	・Based on the result of above test-run, will discuss the expansion of electric bus in the town.

	⑧ Promoting to use public transportation	・Will plan to formulate project to officially obtain the support from Japan Government.
Water and Sewer・Rainwater Drainage	⑨ Spreading U-BCF	・Will design in detail at An Duong purification plant in FY2016 and start construction work.
	⑩ Drainage Measures in handicraft town	・Based upon the results of ⑫ reconstruction of southwest canal, will discuss effect drainage measure.
	⑪ Introducing water and sewer ledger system	・Discuss with PMU and JICA Vietnam
Environmental conservation	⑫ Reconstruction of southwest canal	・On application during FY2015 to JICA SME Overseas Business Expansion Support Program（※result to come around late January）
	⑬ Maintaining monitoring system for air and noise.	・With the support of CAA, one of international NGO, will deliver the professional staffs to mainly port area, to analyze the current status of air pollution and to make proposal to improve the situation. ・Will do continuously in FY2016.
Green Production	⑭ Introducing high efficiency electric furnace to foundry	・Selected as JCM facilities subsidy project in FY2015. Will produce, import, and install electric furnaces.
	⑮ Promoting Green Agriculture	・On test-making compost in rural area. ・Discuss green agriculture utilizing compost in the future.

1.3 Activities and Tasks to Promote GHG reduction in Hai Phong City

(1)Activities

1) Formulation of Green Growth Strategy Action Plan(HPGGSAP)

- Hai Phong City established the "Hai Phong City Green Growth Strategy Action Plan (HPGGSAP)" for the purpose of environmental conservation and GHG reduction with sustainable economic development.

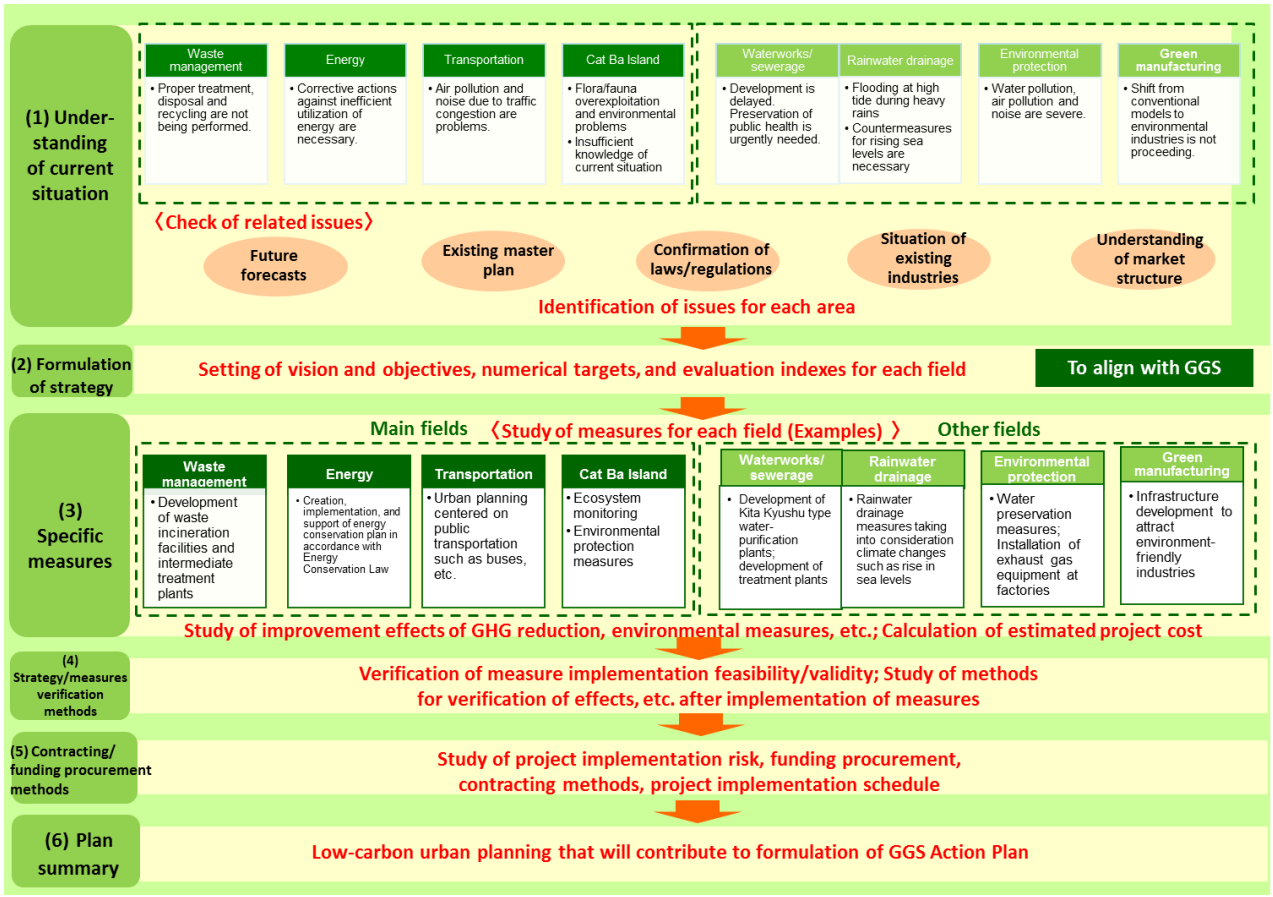
2) Formulation of Green Growth Promotion Plan in Hai Phong city (Support of Kitakyushu City)

- The "Green Growth Promotion Plan" was established as a practical implementation plan to promote the HPGGSAP according to the following chart in 2014.

3) Public Relations related to waste sorting and energy saving

- Hai Phong City uses outdoor loudspeakers to call on a citizen to sort waste and save energy. In addition, Department of Industry and Trade, Energy saving center distribute the brochures for the purpose of promoting energy saving at home and carry out the highly elaborated contests that the citizens compete for

knowledge about energy saving and effective energy saving methods.



(2)Current condition and tasks

1) General Reasoning

- While large-scale city infrastructure development, such as the port and harbor, airport, and highway have been implemented, development of the daily living infrastructure such as waste management, sewage, main public roads has been slow, environmental pollution has increased and public health has deteriorated. In order to work towards the improvement of the quality of life of the residents, maintenance of the daily living infrastructure is an urgent task.
- There are currently many companies from overseas which have expressed concern over the poor development of support industries (regional enterprises) in Viet Nam. Creating and improving regional enterprises in Hai Phong, by collaborating and cooperating with foreign corporations and strengthening the competitive capacity of manufacturing industries, which will lead to the

independent development of Hai Phong city itself, is important.

- Controlling the amount of greenhouse gas emissions, as well as water and energy demands, which continue to increase due to continuing rapid economic development and population expansion, is needed. Moreover, Hai Phong city is located in a coastal low-lying area which is easily affected by rising sea levels, so response to climate change is also needed.
- As observed by the example of Kitakyushu city, which overcame severe pollution and promoted green growth, improvement in the environment while continuing to encourage economical development is possible, and sustainable development that harmonizes the economy and environment can be expected.

2) Administration

- To solve various municipal issues, horizontal coordination by related departments and agencies is needed. However, this has not necessarily taken place.
- For Hai Phong city to achieve green growth, a clear urban strategy and city management based on such coordination is important, but human resources, information, and capital for such has been insufficient.

1.4 Cooperative relationship of Hai Phong city and Kitakyushu City

- Kitakyushu City concluded an agreement for friendship and cooperation with Hai Phong City and began the interchange between both cities in 2009.
- Thereafter, both cities has continued interchange and cooperation businesses in various fields including the technical cooperation in the field of water service and the people's culture interchange, and concluded a sister city agreement in April, 2014 when the agreement for friendship and cooperation expired for 5 years.
- Furthermore, Kitakyushu City supported the formulation of the "Green Growth Promotion Plan" which indicated action plans in detail to promote green growth in Hai Phong city using experience of pollution conquest, environmental technology and know-how in 2014.

1.5 The outline and purpose of the study

Japan set the goal again as “50% reduction among all over the world and 80% reduction among developed countries by 2050” at the high-level segment in COP20 held on December, 2016, to de-escalate the effects of global warming, declaring formally “our environmental technology and sciences will contribute to emission

reductions and JCM will also be a center of environmental technologies".

To half reduce GHG in 2050 in the world, it is necessary to find and formulate the projects to accelerate the movement toward for a sustainable low-carbon society. We, Japan, as mentioned above in the high-level segment, have expressed to submit a draft as early as possible, fully ahead of COP21, and you can see very high expectations for the contribution of JCM projects to reduce emission in abroad in the draft.

This feasible study is carried out based upon the results of activities in 2014, under the relationship of cooperative sister city agreement of 2014 between the City of Kitakyushu, Japan, who is environmentally advanced city, and Hai-Phong City, Vietnam.

In 2014, we have studied to formulate JCM projects in the sectors of energy, waste, Cat Ba Islands, aiming for whole city low carbonization in Hai-Phong City where people are very conscious of advanced efforts like Green Growth and low carbon society as a region in Vietnam.

As a result, we selected 4 sectors which should be feasible for business and have a high cost-effectiveness. They are "energy sector", "Cat Ba Islands", "energy+waste sector" and "follow-up project to promote green growth".

We will study and conduct continuously to formulate the concrete project to realize whole city low carbonization in Hai-Phong in 2015.

Chapter 2

Energy Sector

“Project for promoting energy-saving in factories and buildings”

NTT Data Institute of Management Consulting, Inc.

2.1 Objectives of the study and implementation structure

2.1.1 Outline of the project (objectives and the target sector)

In Vietnam where we are seeing their continuing economic growth, the electric power consumption has been increasing year by year.

Following this situation, Vietnam has formulated the policies and the systems to promote energy-saving starting in the mid-2000s and aimed for securing sustainable energy resources and the realization of development of economy.

Vietnam also shows keen interest in reduction of CO2 emission caused by high electric power consumption and it developed climate change policies around the country starting from the late 2000s,

We now see in Vietnam the development in the policies and the systems with regards to energy-saving and climate changes as above mentioned. On the other hand, speaking of the actual practices in related to the promotion of every-saving, they have various problems such as lack of technology, shortage of facilities and financials issues and that does not always going well.

Hai-Phong City, the third largest city in Vietnam, who is very conscious of Green Growth and Low Carbon emission, having implemented advanced efforts so far, even has similar problem such as serious air pollution especially in the area containing a concentration of coal-fired power plant and cement factory, etc.

The project was carried out based upon the results of activities called “JCM large scaled project feasibility study to realize Low Carbon Society in Asia FY2014”, under 2014 sister cities relationship’s cooperation agreement between City of Kita-Kyushu and Hai-Phong City of Vietnam. The outline of the study is as shown below.

Table 2-1： Survey results of last fiscal year

Category	Facilities	Technology applied	Business Feasibility
Factory	Beer plant	High efficiency compression type refrigerating machine	No feasibility for now
	Casting plant	High efficiency induction furnace	Feasibility as JCM project
Offices	Hotel	High efficiency Chiller	No feasibility for now
	Hospital	High efficiency room air-conditioner	No feasibility for now
	Commercial facilities	High efficiency refrigerated display case	Feasibility as JCM project
Infrastructure	Road	LED road lighting	Feasibility as JCM project

Based upon the last fiscal year’s survey results, this project was carried out in My Dong region in Hai-Phong City, where there is the largest casting plants hub in Vietnam. The project aimed for both reduction of energy cost and that of CO2 emission in Hai-Phong City by introducing high efficiency electric furnace made in Japan and by replacing the lighting, etc. used in the buildings except the factories for high efficiency energy-saving equipment.

In addition, to apply the model case for the project expansion, we have conducted and discussed the energy-saving business feasibility study outside Hai-Phong utilizing JCM schemes, targeting companies and factories who consume large amount of energy.

Table 2-2：Theme of the survey and target sectors

	factory		office
Theme of	① Activities for implementation of the model project	① Activities for realizing business in promoting the	② Activities for realizing business in promoting the

survey	② Activities for horizontal development of introducing high efficiency electric furnace to casting plants	introduction of energy-saving measures in commercial facilities.	introduction of energy-saving measures in commercial facilities.
Target sector	Casting	Industrial Park	Commercial facilities, lighting public corporation, etc.

2.1.2 Technologies applied and related regulations

Technologies applied

We determined the scope for the technologies applied based upon the results of last year's research, the hearing survey of the companies and factories outside Hai-Phong City, and the results of energy-saving diagnosis, etc. The technologies selected as the candidates for introduction are as follows:

Table 2-3：Technology applied

Category	Facilities	Technology applied
Factory	Casting	High efficiency electric furnace
	Japanese company A	High efficiency burning furnace、Compressor、LED lighting
	Japanese company B	High efficiency Chiller
Offices	Commercial facilities	High efficiency refrigerated display case
Infrastructure	Road	LED road lighting

Systems for related rules

Vietnam seeks sustainable development through energy-saving program so-called VNEEP 2006 which promotes energy-saving comprehensively and also through the diversification of energy resources and its efficient utilization. VNEEP consists of 2 phases. Phase I is from 2006 to 2010 with 3-5% energy saving target. Phase II is from 2011 to 2015. It aims 5-8% energy saving target in the entire country

In addition, it implemented various policies and systems regarding every-saving such as "law related to energy-saving 2010", "the rules for the detailed of energy

saving law and the implemented method 2011" and "energy saving planning and its report of results 2012".

2.1.3 Implementation system and schedule

The below charts show the implementation structure and schedule of the project.

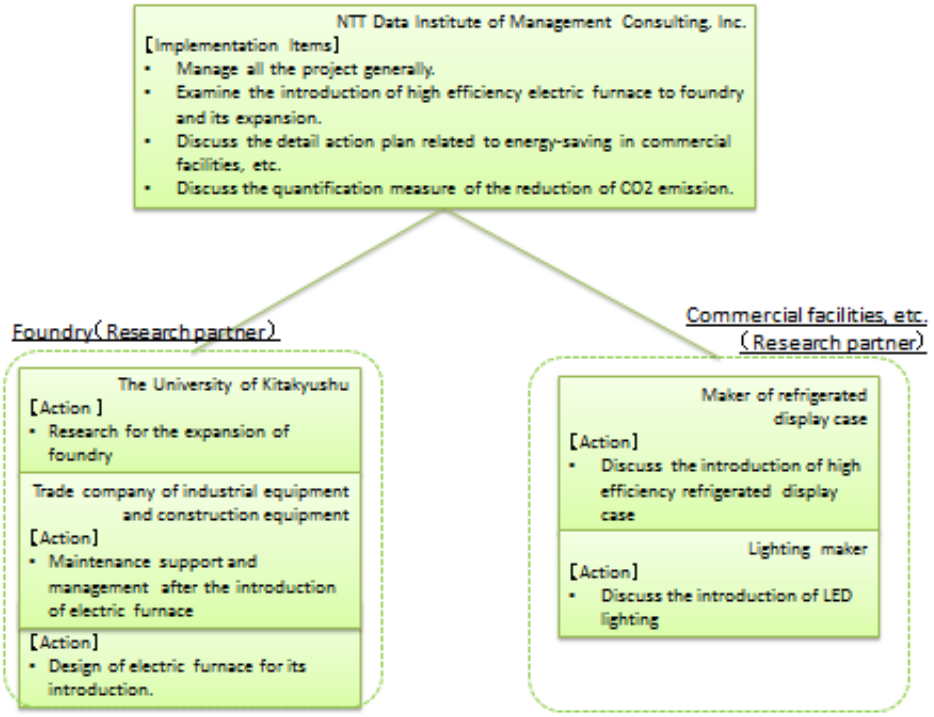


FIG 2-1: Implementation System for energy sector

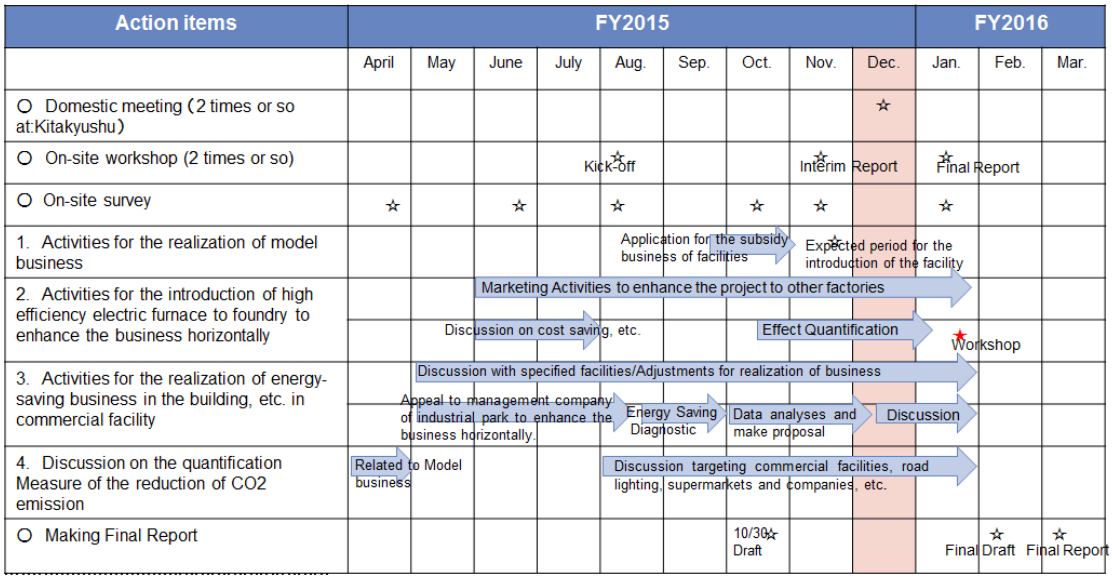


FIG2-2：Survey Schedule

We have carried out three on-site meetings, one domestic meeting and five on-site surveys. Moreover, we have conducted hearing surveys on energy saving with mainly Japanese companies (total three times) to seek for new business opportunities of energy saving business and developed or examined MRV methodologies of the reduction of CO2 emission.

2.2 Survey Results

2.2.1. Summary of the on-site survey

We have conducted on-site hearing survey for the project. The survey record is summarized as below.

Table 2-4：Results of on-site survey

On-site Survey	Period	Visited companies
1st time	June 15-19, 2015	・Investment trading company ・Hai-Phong Economic Zone Authority (HEZA) ・Japanese Industrial Park ・Public lighting company

		・Supermarkets
2nd time	August 3-7, 2015	・Thanh Phuong ・Japanese maker A ・Japanese maker B ・Japanese maker F ・TOTO Ltd.
3rd time	October 14, 2015	・Japanese maker F
4th time	November, 5-6, 2015	・Held a workshop for seeking JCM business opportunities in the Industrial Park ・Japanese maker G ・Japanese maker H
5th time	February 4-6, 2016	・Feasible study on the expansion of introduction of electric furnace to

As a result of survey, we have applied two JCM facilities subsidy projects, one is the introduction of high efficiency electric furnace to casting factory and the other is the introduction of high efficiency burning furnace to the plant of TOTO Ltd, and both of the projects were selected in the secondary recruitment of the JCM facilities subsidy projects in this fiscal year. Including other survey targets, the results are reported as below.

2.2.2 Estimation of GHG Emissions Reduction

(a) Casting factory

We continued to conduct survey aiming at full-scale introduction of Japanese electric furnaces, targeting two companies (Thanh Phuong (TP) and Ha Lan(HL)), out of five casting factories where we conducted on-site survey last fiscal year, who were showing keen interests in introducing Japanese electric furnace.

We estimated the GHG emission reduction by introducing Japanese electric furnace to the two casting factories. If they replace the current Chinese electric furnaces to Japanese ones or if they newly introduce Japanese ones, the emission reduction would be 726 ton CO2 by 2 units of 1 ton furnace in case of TH company, and 242 ton CO2 by 1 unit of 2 ton furnace in case of HL company.

(b) Supermarkets C

A supermarket C is a store of supermarket store chain of French. We visited them in June and August, 2015 and conducted a hearing survey about their energy saving measures and the potential for further energy saving.

According to the hearing survey, we could see the possibility of JCM project formulation by introducing high efficiency refrigerated display case. We have calculated GHG emission reduction potential as 142 ton CO2/year based upon energy saving effect brought by replacing the display case to high efficiency refrigerated one.

(c) Public lighting company D

Lighting company D, which procures, operates and maintains the road lighting in Hai-Phong City, is the lighting company which was privatized in July, 2015. We discussed first the introduction of LED lighting for the road which has been in our agenda from last fiscal year. With the cooperation of a lighting maker of Japan, we calculated the amount of CO2 emission reduction as 1290 ton CO2/year in the case where we could change 1276 lightings to LED.

(d) TOTO Ltd.

TOTO Ltd. Is a manufacture of housing equipment developing their business all over the world. In Vietnam, they are located in the Industrial Park in Hanoi City. We visited TOTO in August, 2015 and conducted a hearing survey on the potential needs for energy saving. Additionally, in September, 2015, we visited their headquarters in Kitakyushu who offer manufacture technology support, and discussed more concrete energy saving measures.

After the hearing survey, we discussed the feasibility of JCM business by introducing high efficiency burning furnace, compressor, and LED lighting, as TOTO would like to consider the energy saving reduction potential by these measures. After the examination, we only adopted the introduction of high efficiency burning furnace as a JCM facilities subsidy project. The amount of CO2 emission reduction is 1413 ton CO2/year.

2.2.3 MRV methodology and monitoring system

As for MRV methodology, the selected 2 projects as JCM facilities subsidy business have no methodology with approval. Therefore, NTT Data Institute of

Management Consulting, Inc. has newly developed 2 methodologies such as “The introduction of high efficiency electric furnace to casting factories” and “The introduction of high efficiency burning furnace to sanitary ceramic manufacture factory”. Regarding other survey targets, we can apply the existing JCM methodology basically.

2.2.4 Estimation of operating cost and the cost-effectiveness

(a) Casting factory

For casting factories, we discussed the introduction of high electric furnace to Thanh Phuong (TP) and Anh Minh (AM). The operating cost is approx. JPY180 million for TP and JPY34 million for AM. The simple payback period for their investment is approx.21.4 years for TM (1 ton unit and 2 ton furnace units), approx.17.9 years for AM. Assuming that JCM facilities subsidy business will offer a half of the operating cost, TP would obtain approx.JPY54 million and AM would do JPY17 million. In this case, the simple payback year would be approx.10.7 years (1 ton unit and 2 ton furnace units) for TP and approx. 8.9 years for AM. The cost versus benefit is as follows:

	Item	**Numeric Value**	**Calculation Formula**
Case referring to Electric furnace	The cost-effectiveness by one fiscal year	TP company JPY103,325.9/tCO2（1ton furnace） JPY51,633.tCO2（2ton furnace） AM company JPY41,330.4/tCO2	The subsidy amount ÷ the amount of CO2 emission reduction for one year
	The accumulated cost-effectiveness during 15-years’ operating period	TP company JPY6,888.4/tCO2(1ton furnace) JPY3,444.2/tCO2(2ton furnace) AM company JPY2,755.4/tCO2	The subsidy amount ÷ (the amount of CO2 emission reduction for one year) x 15 years

(d) TOTO

TOTO has been discussing the introduction of high efficiency burning furnace, compressor, and LED lighting. The operating cost is approx. JPY620 million (total amount for 1 and 2 types of burning furnace), approx.JPY36 million (for LED lighting) and the payback period for the investment per one fiscal year should be approx. 4.4 years (type 1 furnace), approx.9.8 years (type 2 furnace), and approx.15 years (LED lighting) without the subsidies. Assuming that JCM facilities subsidy business will offer a half of the operating cost, the simple payback period should be approx. 2.2 years (type 1 furnace), approx. 4.9 years (type 2 furnace), and approx. 7.5 years (LED lighting) respectively. The cost versus benefit of CO2 emission reduction is as follows:

	Items	Numeric Value	Calculation Formula
High efficiency burning furnace	The cost-effectiveness by one fiscal year	Type 1 : JPY193,900/tCO2 Type 2 : JPY436,086/tCO2	The subsidy amount ÷ the amount of CO2 emission reduction for one year
	The accumulated cost-effectiveness during 15-years' operating period	Type 1 : JPY12,927/tCO2 Type 2 : JPY29,072/tCO2	The subsidy amount ÷ (the amount of CO2 emission reduction for one year) x 15 years
LED Lighting	The cost-effectiveness by one fiscal year	JPY15,175/tCO2	The subsidy amount ÷ the amount of CO2 emission reduction for one year
	The accumulated cost-effectiveness during 15-years' operating period	JPY1,012/tCO2	The subsidy amount ÷ (the amount of CO2 emission reduction for one year) x 15 years

As for Supermarket C and Public lighting company D, we have not trial-calculated yet operation cost and not formulated business scheme.

2.2.5 Co-benefit effect

We have investigated on the replacement from Chinese electric furnace to high efficiency electric furnace in casting factories. There are so many casting factories which still uses coal-fired furnaces. By introducing high efficiency electric furnace, we can reduce not only CO2 emission but air pollutants like Sox and NOx. Also, quality of products, amount of production, and the amount of export goods to abroad should be increasing. As a result, it is highly possible to contribute to realize sustainable economic growth in the casting factory industry.

The implementation of energy saving activities in Japanese companies and other facilities will bring a sharp cut of CO2 emission in addition to the reduction of co-operative energy power consumption and co-operative load.

2.3 Discussion for the JCM project formulation

2.3.1 Commercialization Plan (Implementation System, fund support scheme, and schedule for commercialization, etc.)

(a) Casting factory

The introduction of electric furnace to 2 casting factories was selected as JCM facilities subsidy project in the secondary recruitment 2015. The total operating cost is approx. JPY150 million for 2 companies. We show below the outline of introduction of facilities and the figure of the implementation system. The introduction to the casting factories is to be around July, 2016.

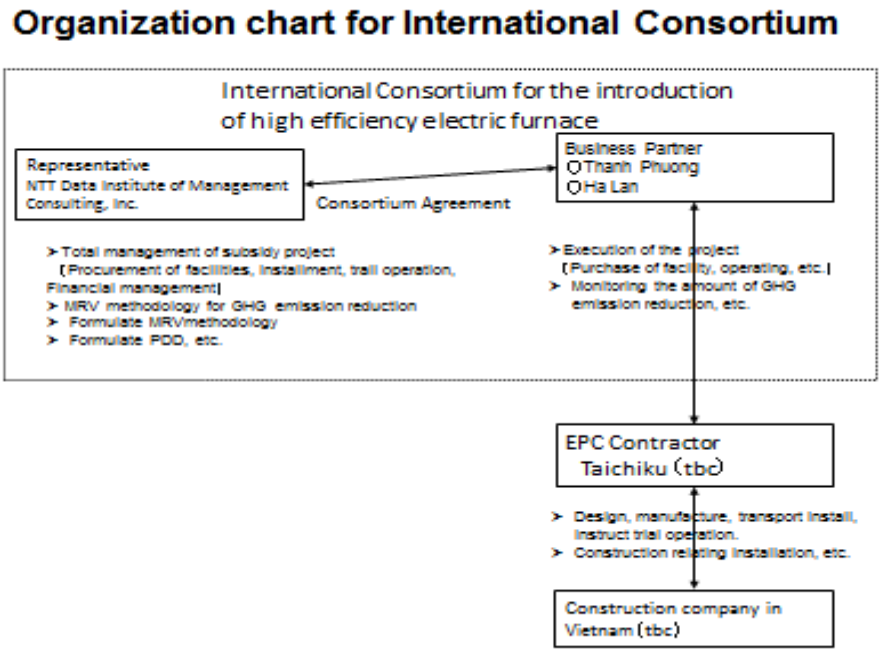


FIG 2-3 Figure of Implementation systems (casting factory)

(d) TOTO Ltd.

The project called "energy saving in the sanitary ceramic factories by introducing high efficiency energy saving facilities" by TOTO, Ltd. has been selected as JCM facilities subsidy project in the secondary recruitment 2015. The size of the business is expected to be approx. JPY 130 million. We show below the outline of introduction of facilities and the figure of the implementation system.

Facilities to be introduced	**Unit**
Burning furnace	・ Tunnel kiln (1 unit) ・ Shuttle kiln (1 unit)

FIG 2-4：Outline of the introduction of energy saving facilities to the sanitary ceramic factory

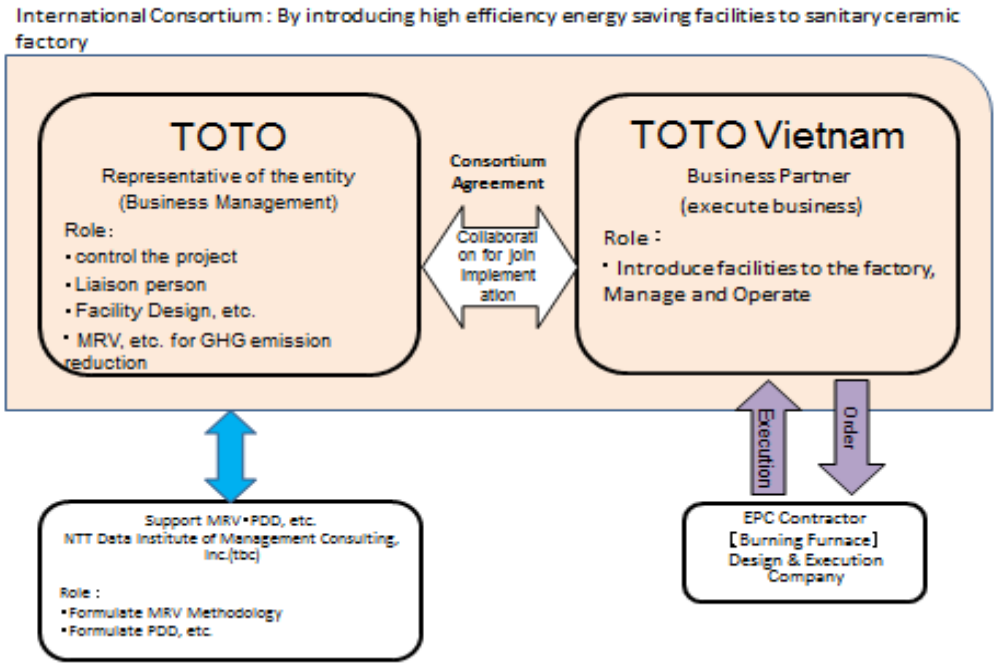


FIG 2-5 : Implementation Systems

2.3.2 Issues for facilitating JCM project formulation

Among our projects, there are some projects with high feasibility for commercialization and many of them are aiming to take the facilities subsidy from JCM scheme. We are utilizing the inter-city cooperation framework between the City of Kita-Kyushu and Hai-Phong City. If needed, it is possible for Hai-Phong City government to make an administrative guidance to the local companies. It is desirable to enhance public relations to provide the results of the commercialization so that more companies can show interest for JCM projects and that helps JCM projects become independent business. Moreover, the companies already commercialized as a model business (or to be so in the near future) are required to operate the facilities properly.

We will have to start discussing to formulate information platform by computerizing the advanced environmental technologies of The City of Kita-Kyushu and the needs of the local companies, which realizes the best matching for both sides.

2.3.3 Future Schedule

In the future, we will proceed the 2 JCM facilities subsidy projects further, and in addition, promote to expand the projects of the introduction of high efficiency electric furnace horizontally, and formulate the system like union, etc. for the promotion with the cooperation of The City of Kita-Kyushu.

Also we will keep seeking other JCM business opportunities in Hai-Phong City.

Chapter 3

Energy and Waste Sector

“Waste heat recovery power generation utilizing fuels and raw materials derived from industrial waste in a cement factory”

NTT Data Institute of Management Consulting, Inc.

Amita Corporation

3.1 Project Formation Feasibility Study Goals and Implementation System

3.1.1. Project overview (goals and target areas)

The goal of this project is to take an overall approach to reducing CO2 levels at the Hai Phong plant (hereafter referred to as “Factory A”) of a major cement producer in Vietnam by introducing waste heat recovery power generation equipment and turning industrial waste into raw materials and fuel for cement.

3.1.2. Application technologies and related legal system

(1) Application technologies

Applying the following two technologies will contribute to reducing CO2 levels in this project.

① Waste heat recovery power generation technology at the factory

The system recovers unused waste heat generated during the process of producing cement, and a high-efficiency turbine is driven by steam or a medium with a low boiling point to generate electricity.

② Turning industrial waste into raw materials and fuel for cement

Amita Corporation's blending technology, which is capable of using various types of industrial waste from over 4,000 kinds, recycles resources into the raw materials for cement and alternative fuel sources, as well as metallic raw materials and other terrestrial resources.

(2) Related legal system

This project is organized in the following way according to the relevant legal system.

The following legal system applies when turning industrial waste into raw materials and fuel for cement.

Hazardous waste management regulations (No.12/2011/TT-BTNMT)

When collecting, transporting, or disposing of waste materials stipulated on the list, a license must be obtained from DONRE when activities are confined to Hai Phong, and a license must be obtained from MONRE when activities extend to another jurisdiction. Licenses are divided into the following categories: Collection, Transportation, Storage, and Disposal. Those responsible for emitting hazardous waste must consign waste management to another party, concluding a contract with a vendor licensed to collect, transport, store, or dispose of such waste. A manifest must be filled out when transferring the shipment to the vendor.

3.1.3 Implementation system

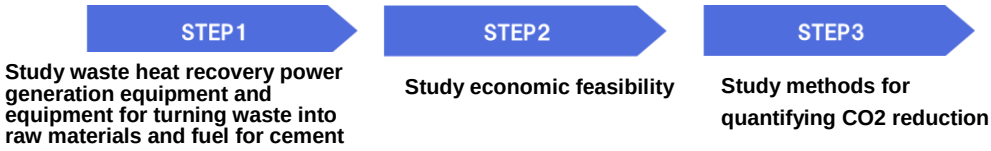
The implementation system for this project is as follows.

Figure 3-1: Implementation system

3.1.4 Survey method and schedule

(1) Survey method

The survey will be executed using the following three steps.



(2) Schedule

The survey schedule for this project is shown in the figure below.

Items	2015									2016		
	April	May	June	July	Aug	Sept	Octo	Nove	Dece	Janu	Febr	Mar
○Domestic meeting (In Kitakyushu)							☆1st (Mid-term report meeting)			☆2nd (Final report meeting)		
○Local workshop					☆Kickoff			☆Mid-term report		☆Final report		
○Local survey			☆		☆		☆	☆		☆		
1. Study waste heat recovery power generation equipment and equipment for turning waste into raw fuel for cement	Waste heat recovery power generation: Study equipment concept, Confirm locally → Basic design → Discussion and agreement											
	Turning waste into raw materials and fuel for cement: Confirm local conditions (acceptance criteria, emitted waste, biomass percentage, etc.) → Basic equipment concept, basic design → Discussion and agreement											
	Waste heat recovery power generation: Cost calculation based on basic design, Evaluation of payback, etc. → Discussion based on calculated cost, Study business model											
2. Study economic feasibility	Turning waste into raw materials and fuel for cement: Cost calculation based on basic design, Evaluation of payback, etc. → Discussion based on calculated cost, Study business model											
	Waste heat recovery power generation: Study scenarios → Study basic unit → Confer with expert organization											
3. Study methods for quantifying CO2 reduction levels	Turning waste into raw materials and fuel for cement: Study scenarios → Study basic unit → Confer with expert organization											
	Related information survey (fundamental information, emitting organizations, laws, risk, etc.)											
4. Related information survey										February 5 Final draft	March 4 Final report	

							October 30 Draft					
○Create report							☆				☆	☆

Figure 3-2: Survey schedule

3.2 Project Formation Feasibility Survey Results

3.2.1 Summary of local survey

(1) Waste heat recovery power generation

A local survey was carried out by an engineering firm in order to calculate the economic feasibility of waste heat recovery power generation equipment.

① On-site survey by an engineering firm

An on-survey was carried out with an engineering firm in order to determine the feasibility of implementing the technology.

	
Data survey in central control room	Comparing blueprints with actual sites

② Studying business models

The business model adopted for waste heat recovery power generation was for use at the company rather than selling electricity generated by waste heat recovery.

(2) Turning waste cement into raw materials and fuel

A survey regarding turning waste cement into raw materials and fuel was carried out with two viewpoints in mind. The first was ensuring that a sufficient amount of waste materials is available for producing cement raw materials and fuel for use at Factory A, and the second was studying a partnership with Amita Corporation for collection and transportation of waste materials.

① Securing waste materials

The results of last year's survey on the first challenge of securing sufficient waste materials clearly show that there are not enough waste materials produced within Hai Phong. Specifically, the project requires collection of 2,000 tons of hazardous waste

monthly, and the city of Hai Phong only produces a monthly output of 689 tons of hazardous waste. Because of this, research went into including the Hanoi outskirts as well as Hai Phong in industrial waste collection.

	Hanoi	**Hai Phong**
Population	6,936,900	1,925,200
Working population	4,378,500	1,200,000
No. of businesses in industrial parks	363	205
No. of Japanese businesses	120	53
Industrial waste production	3,720 t/month	1,643 t/month
Hazardous waste production for cement raw materials and fuel	**1,560 t/month**	**689 t/month**

Figure 3-3: Comparison of waste production in Hanoi and Hai Phong

② Considering partner businesses

In order to study which businesses currently in northern Vietnam could serve as partners in this project for hazardous waste collection and transportation, and intermediate processing, talks were held with four companies in June (Companies A-D), four in October (Companies E-G), and three in January (H-J).

3.2.2. Feasibility of reducing greenhouse effect gas (specifically carbon dioxide, the source of energy) output

(1) Waste heat recovery power generation at the factory

By recovering previously discarded waste heat to generate electricity, it is possible to reduce the amount of electricity purchased from the system. This, in turn, reduces the amount of CO2 produced by the grid. If formalized, it will produce the following results.

CO2 reduction amount = waste heat recovery power generation system output (MWh) x Vietnamese grid output coefficient

Based on results of the local survey with the engineering firm and basic designs, it is estimated that 32,531,040 kWh can be produced yearly.

Because the output coefficient currently produced in Vietnam is 0.5408 tCO2/MWh, CO2 can be reduced by the following amount.

32,531MWh x 0.5408 tCO2/MWh = 17,592 tCO2/year

(2) Turning waste into raw materials and fuel for cement

By recycling waste that was previously incinerated, it is possible to reduce the CO2 produced by incineration. Based on local surveys, it is estimated that approximately 20% of waste is incinerated at the target collection points within Hai Phong.

3.2.3. MRV methodology and monitoring system

(1) MRV methodology for waste heat recovery power generation

The ID_AM001 “Power Generation by Waste Heat Recovery in Cement Industry” methodology already approved for use in Indonesia was used as a reference for studying the MRV methodology.

(2) MRV methodology for turning industrial waste into raw materials and fuel for cement

Four related CO2 reduction effects were quantified to study MRV methodologies for turning waste into raw materials and fuel for cement. ① Cement factory coal alternatives due to alternative fuels derived from industrial waste, ② simple incineration alternatives for industrial waste, ③ improved biomass ratio, ④

reduced transportation distance.

3.2.4. Estimated operating costs and cost effectiveness

(1) Estimated operating costs

① Waste heat recovery power generation

A detailed design survey was carried out at the end of October 2015 in order to estimate operating costs. Based on the results, estimates show an initial investment of 1.3 billion yen.

② Turning waste into raw materials and fuel for cement

The scale of a business for construction of a resource recycling plant would be an estimated 340 million yen for a SlurMix® production capacity of 5,000 tons/year, and CRM 24,000 tons/year.

When a JCM facilities subsidy rate of 30% is applied, the subsidy is 102 million yen.

(2) Cost effectiveness

① Waste heat recovery power generation

The following calculation applies if the service life of a waste heat recovery power plant is estimated at 15 years.

Cost effectiveness = total amount of CO2 reduced for 15 years ÷ subsidy for the initial investment (set at 50%)

Cost effectiveness = 263,891.8 t CO2 ÷ 650 million yen = approximately 2,500 yen/1t of CO2

② Turning waste into raw materials and fuel for cement

Estimates for cost effectiveness of reducing CO2 output (without JCM facilities subsidy) are 340 million yen ÷ 8,464 tons = 40,170 yen/ton.

3.2.5. Supplementary (co-benefits) effects

(1) Waste heat recovery power generation

Implementing waste heat recovery power generation reduces grid power output. Reducing the load of the grid should help reduce soot, SOx, NOx, and other air pollutants caused by coal-burning power plants used in generating power for the grid.

(2) Turning industrial waste into raw materials and fuel for cement

Promoting recycling of waste materials in this project should result in a variety of

co-benefits. Use of SlurMix® results in a reduced amount of fossil fuel usage. Because CRM fuel types have heat value, they can be used as alternative fuel sources and clay alternates for raw materials in cement, contributing to reduced usage of natural resources.

3.3 Studying JCM Commercialization

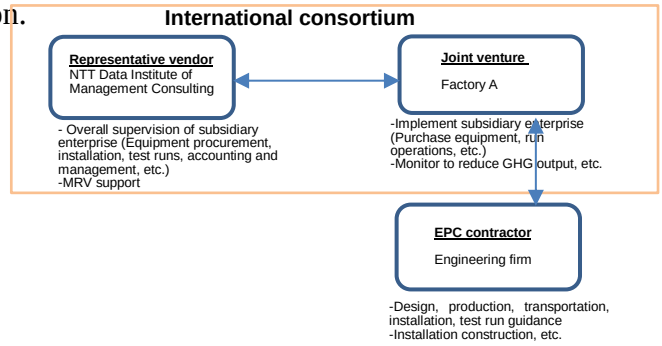
3.3.1. Commercialization plan (implementation system, investment support scheme, commercialization schedule, etc.)

(1) Implementation system

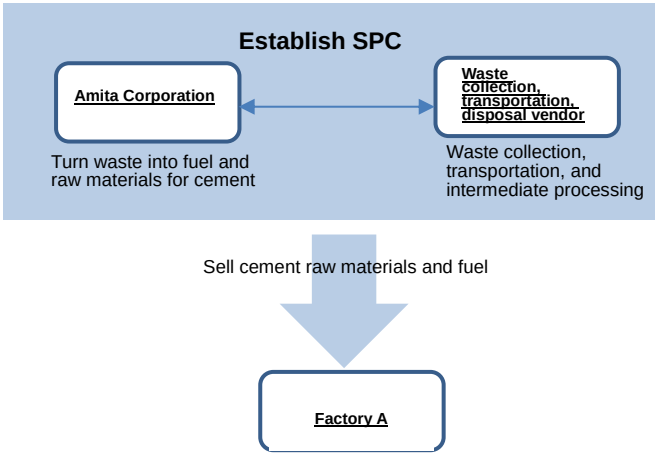
The following implementation system is being studied for JCM commercialization.

① Waste heat recovery power generation at the factory

The following scheme is possible as an implementation system for waste heat recovery power generation.



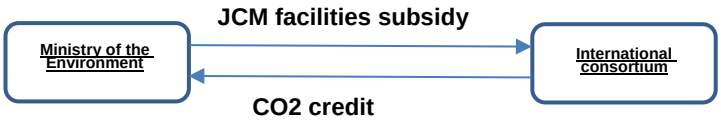
② Turning waste into raw materials and fuel for cement



(2) Investment support scheme

① Waste heat recovery power generation at the factory

A JCM facilities subsidy system is currently being studied.



② Turning waste into raw materials and fuel for cement

An investment support scheme will not be used.

(3) Commercialization schedule

Because an agreement has not been reached regarding progress on the waste heat recovery power generation project and project to turn waste into fuel and raw materials for cement, steps are being taken to proceed with the waste heat recovery power generation project, as it seems that this could be commercialized.

① Waste heat recovery power generation

Application for JCM facilities subsidy is planned for April 2016, and discussions and considerations are under way for continued detailed designs. Detailed equipment design was completed by the end of November 2015, resulting in a 2016 budget framework for Factory A with specific commercialization plans now under way.

② Turning waste into raw materials and fuel for cement

In order to carry out the project to turn waste into fuel and raw materials for cement, it is necessary to receive waste from businesses producing the waste in Hai Duong Province, Bac Ninh Province, and Hanoi. Hai Duong Province disposes of over 30,000 tons of hazardous waste each year by incineration and in landfills. Because the amount in Hai Duong Province makes the project possible, partners will be selected in 2016 and establishment of SPC is being studied.

3.3.2. Challenges in commercialization

(1) Challenges in the waste heat recovery power generation project

No challenges in particular.

(2) Challenges in the project to turn industrial waste into raw materials and fuel for cement

The challenge in the project to turn waste into fuel and raw materials for cement is selection of local partner businesses. Vendors who offer hazardous waste collection, transportation, and intermediate disposal will continue to be approached.

It has become clear that bridging the gap between city and province jurisdictions is difficult regarding waste collection, making it necessary to check the interests across areas. Also, in 2015 a new environmental protection law was passed, and because revisions to laws and regulations concerning new waste material disposal are likely, business development must be in compliance with all regulations.

3.3.3. Schedule

The schedule going forward is as follows.

(1) Waste heat recovery power generation project

As of February 2016, an operating cost estimate was presented to local businesses and we are waiting on an answer regarding investments. If the project receives the go-ahead, application for JCM equipment subsidy is planned for April 2016, and discussions and considerations are under way for continued detailed designs.

(2) Turning industrial waste into raw materials and fuel for cement

Fiscal year 2016:

- Select partners
- Close investigation of F/S details
- Survey of waste producing businesses and sampling
- Negotiate conditions for supply of alternative fuels with cement companies
- Close investigation of investment costs for local equipment
- Form an agreement with relevant authorities and acquire permits and licenses
- Engineering and plant construction

Fiscal year 2017: Begin operation

Chapter 4

Cat Ba Island Section

“Energy saving, introduction of the renewable energy and an EV bus introduction project in remote islands”

NTT DATA INSTITUTE OF MANAGEMENT CONSULTING, Inc.

4.1 The Aim and implementation system of project formation feasibility study

4.1.1 Project Overview（The aim and Subject areas）

This feasibility study was implemented on the subject of “Energy saving, introduction of the renewable energy and an EV bus introduction project in remote islands”, taking over the result of the project formation feasibility study in FY 2014, under the inter-city collaboration between Hai Phong City and Kitakyushu City. The target island is Cat Ba Island, located in the 60 km Southeast of Hai Phong city. Cat Ba Island is the largest island in Halon Bay which is famous as the world heritage, with a population of 17000 inhabitants, rich in natural environment and ecosystem which attracts 1,400,000 visitors per year (in 2014). (Basic information and overview of Cat Ba Island has been compiled in FY 2014 project formation feasibility study report.)

Following matters including business environment in Cat Ba Island are confirmed within the last year’s survey.

① Main industry in Cat Ba Island is tourism and more tourists are desired. On the other hand, various precious ecosystem remains in the Cat Ba Island. Therefore, it is required to vitalize tourism with conserving the ecosystem.

② In 2017, the bridge between mainland Hai Phong City and Cat Hai Island will complete; increase of Cat Ba Island visitors from Cat Hai Island is anticipated. Furthermore, it is planned to prohibit visiting to Cat Ba Island on cars by ferry in or after 2017.

③ At present, tourists exclusively concentrate on summer season. The

occupancy rate of hotels and restaurants in the Island excessively different. Therefore, if energy saving investment to the diverse sightseeing facilities would implemented, it is not easy to recover the investment.

④ In order to promote the environmental conservation including the conservation of the ecosystem and CO2 emission reduction, it is necessary to introduce funding mechanism specified in the remote islands. Creating "Sightseeing fee (island entrance fee)" as a new financial resources for the environmental protection project especially in Cat Ba Island has been proposed to Hai Phong city; Hai Phong city has positively considering it.

In accordance with the situation above, the survey in this FY aims to realize the new financing mechanism as a remote island model (that is, to realize a new financial resource for Hai Phong city), also to create a JCM project in conjunction with the new financial mechanism. As an example of the model project, a photovoltaic powered zero-emission EV bus project is developed to start operation in 2017. Furthermore, a tourist boats' low carbonization applying electric motor is considered as one of the low carbon projects' utilizing the new financial mechanism.

4.1.2 Technology application and its related policies

1） Electric Vehicle（EV）

The proposed EV bus employs the technology of SoftEnergy Controls Inc. based in Kitakyushu city. SoftEnergy Controls Inc.'s EV bus system has following seven characteristics:

1) Utilization of lithium-ion battery applying technology owned by themselves,

2) Achieving the world lightest weight EV bus using aluminum alloy semi-monocoque body,

3) Achieving 0.8Wh/km power consumption, the world smallest level in the full size buses,

4) Introducing the latest real-time battery management system,

5) Mounting ceiling on board soft solar panels,

6) Peak cut effort of electricity with the charge utilizing electricity storage system, and

7) Charging from the photovoltaic power.

Moreover, as a low carbon technology for developing countries, it has already finished early demonstration stage with reality of bringing costs down proven by the track record more than 50 million km since 2010 in China, and is aiming at actual diffusion stage in various Asian developing countries. The bus mounts large capacity batteries on its light body, has not only long distance driving ability compering with competitors' products but also has realized the lowest vehicle price.

EV penetration in Vietnam is that very few electric vehicles have been running on public streets in restricted areas as tourism use mainly at the resort places. Vehicles are often open air type accommodating from 5 to 15people, used mainly as share-ride. Most of the vehicles are often made in China or Vietnam, mounting short lifespan batteries. The situation is similar in Cat Ba Island, too; another traffic service company introduced 10 EVs in last year. The Quoc Hung Co., Ltd. also introduced one EV experimentally.

The legal system operating EV bus as a public bus system has not been consolidated. However, the intention of Hai Phong traffic Department permitting EV buses' experimental operation limited in Cat Ba Island, a sightseeing area, has been confirmed.

The National Appropriate Mitigation Actions have set a target introducing of 30000 eco-cars by 2020 in its policy. Supposing 10% in the eco-car would be EV, the target of EV introduction would be 3000. From the present situation, full scale introduction is limited by its high cost.

２）Photovoltaic Power Generation

Introduction of CIGS thin film flexible solar system is designed for charging EV bus batteries for the Cat Ba EV bus project.

CIGS photovoltaic cell has the highest conversion efficiency in the thin film photovoltaic cells, generation under the environment crystal type cannot generates (weak sunshine time slots such as cloudy, early in the morning and evening) can be expected. This type of solar panel is robust over cloudy weather (as threshold level of solar radiation amount for generation is the half of crystal type solar panels), therefore suitable for the Northern Vietnam Climates, especially favorable in Cat Ba Island. Its generation efficiency against the obliquely entering light does not decrease relatively. Plastic part of solar panel is flexible and freely foldable so that accordion folded setting is possible. It does not need cradle support. Therefore this

type is quite suitable for the Islands, where site area is limited.

３）Zero-emission battery swap type EV bus cooperating with Photovoltaic Power Generation

Zero-emission EV bus system is considered, which utilizes photovoltaic power generation and battery swap system. The technology is supplied by SoftEnergy Controls Inc. Adopting battery swap system enables EV bus's longer driving distance without being limited by the charging time.

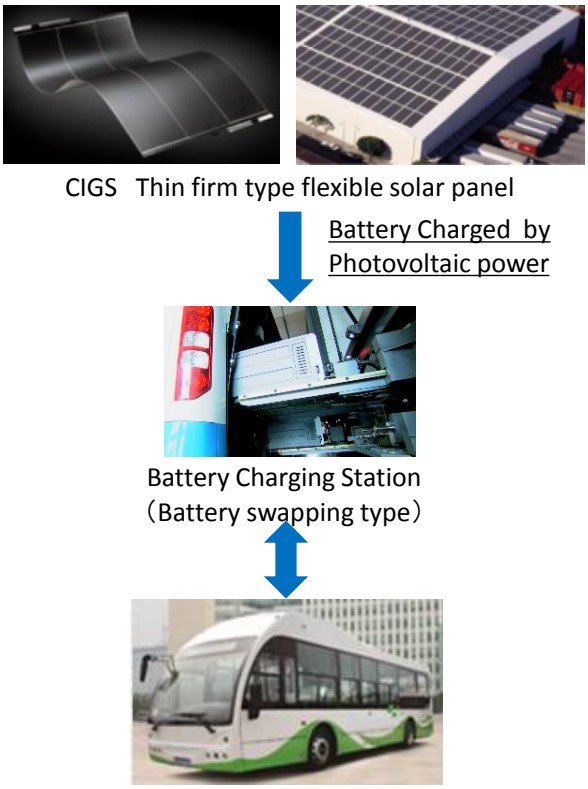


Fig. 4-1 Image of a photovoltaic battery swap zero-emission EV bus

4.1.3 Project organizational Structure and Schedule

Project organization structure of this project under the collaboration scheme of Hai Phong City and Kitakyushu city is shown in Fig. 4-2. The two cities are affiliated sister-city one another; under the city cooperation, the project was operated by NTT DATA Institute Of Management Consulting, Inc. as the primary body of the research and Nikken Sekkei Civil Engineering Ltd. for the overall coordination. SoftEnergy Controls Inc. （SECI） mainly conducted the technological study and cost estimation.

The bus company in Cat Ba Island has been identified as Quoc Hung Co., Ltd as the local partner company from the last year's survey.

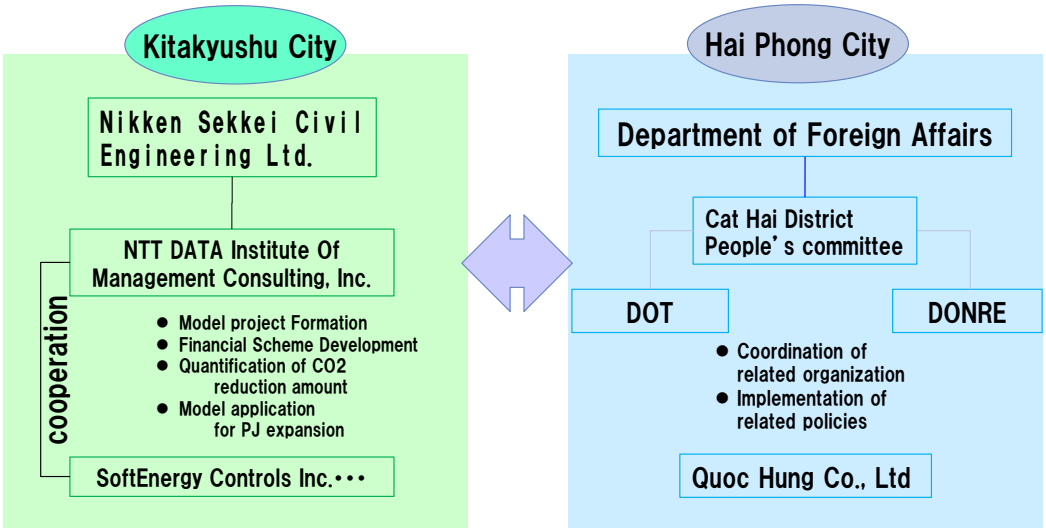


Fig. 4-2 Project Organization Structure

Survey Schedule is shown in Fig. 4-3.

Activities	2015								2016		
	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
● Conventions in Japan (Twice or so, at Kitakyushu)									☆ Final report		
● On site workshops (Twice or so)				☆ Kick off			☆ Interim report		☆ Final report		
● Field investigation		☆		☆	☆	☆	☆		☆	★	
1. Activities toward realization of the model project (Introduction of zero-emission EV bus)		Survey on fee and condition of use, etc.			Discussion toward the creation of entrance fee						
		Condition consideration of EV micro bus introduction			Specification of EV micro bus, etc.			Demonstration project on EV bus development(～Feb. 2017)			
2. Financial Scheme Development		Basic data collection			Cost profit Simulation			Consideration toward improving business characteristics			
3. Consideration of quantification method on CO2 emission reduction		Scenario discussion			Consideration of specific consumption, etc.			Hearing on specialized agencies			
4. Advance of Promotion toward facial expansion		Introduction of photovoltaic to environmental farm, zoo, botanical garden, replacing road lighting with LEDs, low carbonized sightseeing boats, information transmission for popularizing remote island models, etc.									
● Report writing						☆ 10/30 Draft				☆ 2/5 Final draft	☆ 3/18 Final report

Fig. 4-3 Survey Schedule

4.2 Result of the feasibility Study

4.2.1 Survey summary of the field investigation

The field investigation was conducted in June, July, August, September, October, November in 2015, January and February in 2016. Local Government shows strongly cooperative attitude with the project introducing EV Bus system in Cat Ba Island; an early implementation of a demonstration project is desired.

EV Bus Specification

There are two bus routes in Cat Ba Island; it is required to correspond with the following road conditions.

- Route 13（Cat Ba Town～Port Gia Luang）: Whole length 22km; the most steep incline is 8%; and includes total 1.8km sequence of slopes.
- Route 14（Cat Ba Town～Port Cai Vieng）: Whole length 25km; includes more slopes than Route 13, total 5km sequence of 6-7 % slopes. The most steep slope is 10%; however, it will be flattened to 6% with construction work by 2017.

Through discussion with Quoc Hung Co., Ltd. and Cat Hai District People's committee, it is identified that the EV bus for Cat Ba Island is required to meet such specifications and characteristics corresponding with following conditions and requirements.

－ There are many steep slopes in Cat Ba Island; the most steep slopes are 10% in two places; the bus need to correspond these slopes.
－ some roads have not paved and bumpy, therefore the height of the vehicle floor also comes to an issue.
－ It needs to correspond with devious and narrow roads.
－ Quoc Hung Co., Ltd. has a request for a bus accommodating up to 50 people.
－ It is near the sea. Anti corrosion measure is mandatory.
－ As a tourist bus, the luggage accommodation capacity is need to be considered.

Based on the above conditions and requirements, an EV microbus specification proposed from SECI is settled.

Situation of the consultation with Hai Phong Transportation Bureau

Hai Phong transportation bureau shows positively cooperative attitude with the EV bus system introduction of this project to promote environmentally conscious public transportation. The legal system for EV bus to run on the public street (out of the specified restricted area) has not been currently developed in Vietnam; however, we have shared the recognition that as it is sightseeing area and becomes restricted area because of the characteristics of Island bus route, it is possible to provide EV bus service under the present legal system in Cat Ba Island. Aiming to commercialization, first of all, a request has been complied that a pilot demonstration bus's experimentally run.

At the experimental demonstration run, the process will be following: beginning first by submitting detailed information of EV bus including specification and demonstration plan to the transportation bureau; will have been inspected not only by the transportation bureau but also by policy for security commitment and by department concerned for automobile safety inspection. Then, discussed at the Hai Phong city People's committee and receive a certificate for the demonstration run.

In future, legal system for EV bus to run on public street will have been expected to be developed. Hai Phong city has a policy to promote EV bus as a public transportation system in full scale.

4.2.2 Activity for realization of a new financing arrangement scheme

As a new medium to secure financial resource for environmental protection activity implementation in Cat Ba Island, a proposal of "environmental protection fee", a fee charged on the tourists who land Cat Ba Island by passenger boat in admission tax style, has been offered to Hai Phong city from the last FY. On the other hand, after the several discussions in this year's survey, it is agreed that the introduction of above financial mechanism is not going to be created a new scheme "Environmental conservation fee" but need to be proceeded in the scheme of "sightseeing fee"; because "sightseeing fee" is prescribed as one of the fees an local municipality may levy in ongoing "Ordinance on Charges and Fees decree (lately movement to enact is shown)", this fee item is suitable for implementing the environmental conservation of the sightseeing area.

Furthermore, a questionnaire survey on the tourists was conveyed in the September field investigation aiming to detect a fair fee level, demand possibility,

etc.

4.2.3 Greenhouse Gas (especially CO2 originated from energy source) Emission Reduction Possibility

In this feasibility study, as a zero-emission EV bus project, fossil fuel for diesel buses as the reference is replaced with photovoltaic electricity. 10 EV buses are set to be introduced in this JCM project.

When the buses are actually run for route bus, it is supposed that the bus shuttles 5 times either route 13 or route 14; that is, running distance per day is assumed 250 km. As the result of on-site hearing, fuel mileage of light fuel oil is 4 km/l. Emission amount of the project is zero as charged by photovoltaic power, which is renewable.

Applying the emission factor of light fuel oil 2.58[kg CO2/L], CO2 Emission Reduction is calculated as followings.

【Fossil Fuel Replacing Effect with photovoltaic】
(250[km/day]/4[km/L])×365[day/year]×2.58[kgCO2/L]×10
＝588,563 [kg CO2/year]
≒589[tCO2/year]

【Switching Effect from 12 seater vans to EV bus by banning the 12 seater vans】

The 12 seater vans will be banned since 2017. There are about 20 vans in Cat Ba Island; user is 500 people/van/year, running distance is 45,000km/van/year, fuel mileage (gasoline) is 8km/L. Applying the emission factor of gasoline 2.32[kg CO2/L], Emission Reduction is calculated as
(45000[km/year]/8[km/L])×2.32[kg CO2/L]×20 ＝ 261[tCO2/year]

【Switching Effect from diesel buses to EV bus by banning the diesel buses with the opening of Tan vu bridge】

Demand of the competitor's three diesel buses is assumed to be absorbed by this EV bus system.
(250[km/day]/4[km/L])×365[day/year]×2.58[kgCO2/L]×3 ＝ 177[tCO2/year]

The total CO2 emission reduction effect is calculated at 1,072 tCO2/year.

4.2.4 Estimated Project Cost and Cost Efficiency

Estimated project cost (initial cost) of this project is listed below. Initial cost is planned to be covered 50% by Quoc Hung Co., Ltd. with its own account, 15% by Joint Credit Mechanism subsidiary for facilities, 35% by subsidiary from entrance fee of Cat Ba Island.

Table 4-1 Project Cost of Zero-Emission EV Bus System Introduction

Project Cost	467,500,000 yen
Facilities cost	● 10 EV buses 317,500,000 yen （31,750,000 yen×10buses） ● Photovoltaic power（500 kW） 150,000,000 yen
Breakdown of cost coverage	Quoc Hung Co., Ltd. with its own account ： 233,750,000 yen（50％） Subsidiary from Cat Ba Island entrance fee ：163,625,000 yen（35％） JCM subsidiary for facilities： 70,125,000 yen（15％）

Cost effectiveness of CO2 emission reduction by JCM subsidiary for facilities is estimated to be calculated below;
70,125,000 yen÷1027t＝68,000 yen/tCO2

Estimation by SECI shows that running cost of EV bus system reduced as small as almost one third of diesel buses'. Currently, Quoc Hung Co., Ltd. pays about 12,000,000 yen per year with light fuel oil for 10 diesel bus; as this cost would come out even, Quoc Hung Co., Ltd. would have possibility to gain the coverage of initial cost for EV bus system introduction.

4.2.5 Co-Benefit Effects

Co-benefit of EV bus system introduction is reduction of atmospheric pollution caused by diesel exhaust. Introduction of photovoltaic power leads to reduction of the blackout frequency. It also serves as energy saving therefore decrease grid connected power consumption, indirectly contributed to the improvement of atmospheric pollution caused by power plants.

4.3 Development of JCM project

4.3.1 business plan（organizational structure, financial assistance scheme, commercialization schedule, etc.）

Following organization structure could be taken for JCM project commercialization. The organization structure will be discussed in the future.

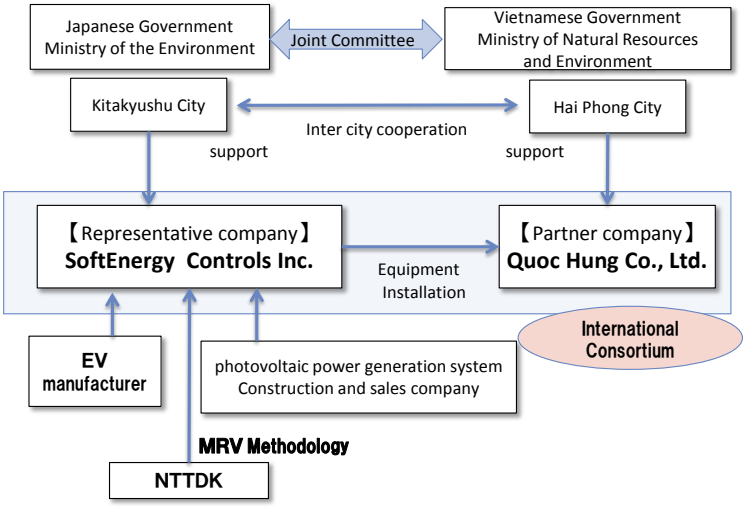


Fig. 4-4 Tentative Organization Structure for JCM Subsidiary for Facilities

As shown above, financial assistance scheme is on the assumption that the rest of 50% coverage of Quoc Hung Co., Ltd. with its own account is covered 25% by Cat Ba Island entrance fee and 25% by JCM subsidiary for facilities.

Commercialization schedule is shown below. Demonstration project (Low carbon technology innovation creating projects for developing country) will be implemented in this fiscal year to the next FY; that is, an EV bus would be introduced and run to demonstrate technical feasibility. Then it is planned to be introduced 10 EV buses by the JCM project till opening of Tan vu bridge, in the middle of 2017.

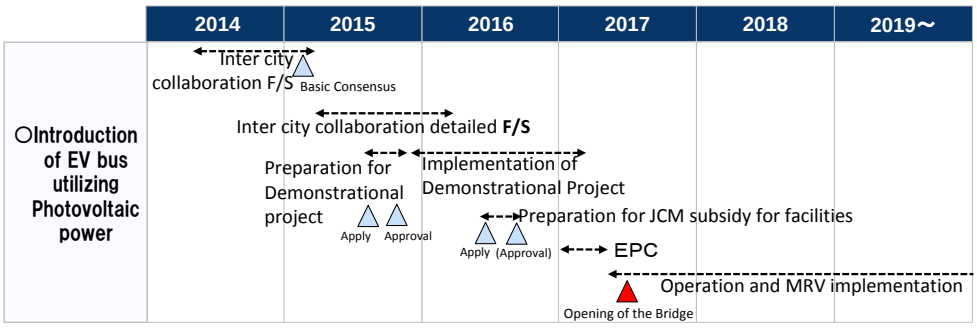


Fig. 4-5　Schedule for commercialization

4.3.2　Issues for commercialization

Before the JCM project commercialization, driving performance and security need to be fully verified in the demonstration experiment from the aspect of the public transportation. First of all, success of the demonstration experiment is required.

Cost effectiveness is an issue at the commercialization in JCM project. From the viewpoint of possibility on cost cutting, Quoc Hung Co., Ltd. Is securing a budget for purchase as they had planned replace of a diesel bus in 2017; therefore it is confirmed that Quoc Hung Co., Ltd. may cover 50% of initial cost for the introduction of an EV bus which is quite more expensive than a diesel bus. On the other hand, institutionalization is positively proceeded for the creation of entrance fee of Cat Ba Island, fully utilizing the strong relationship between Kitakyushu City and Hai Phong City. Cost reduction of EV bus itself will also be considered. Its price target is 20,000,000yen per bus including batteries as the dissemination price.

4.3.3　Future Schedule

Aiming at formulating as a JCM project, the demonstration project of "Photovoltaic powered EV bus suitable for Cat Ba Island" is implemented from November 2015 in this fiscal year, applying an MOE's scheme, Low carbon technology innovation creating projects for developing countries. Not only technical demonstration and verification but also cost reduction will be a focus for improvement of profitability. Realization of the JCM project within FY 2016 is aimed.

On creation of Cat Ba Island Sightseeing fee (Island entrance fee), continuously promote the activity of Hai Phong city for institutionalization with positive approach and supporting activities by Kitakyushu city. With respect to expansion of the EV bus project, it is supposed to base on the sightseeing fee. In future, low carbonization of diesel sightseeing boats utilizing the similar technology with zero-emission EV bus is a target not only for Cat Ba Bay but also for a larger market such as Ha Long Bay of Cat Ba Island.

Chapter 5

Collaboration of Kitakyushu City - Haiphong City

“Support Project for Green Growth Promotion Plan”

Nikken Sekkei Civil Engineering Ltd.

5.1 Survey Outline

5.1.1 Purpose and Organization of the Project

The purpose of this project is low-carbon promotion in Haiphong city, through the consideration of the new JCM project and support measures for horizontal development of the JCM project, in order to achieve the Haiphong city green growth promotion plan prepared in 2014.

・The follow-up project consists of the following activities.

1) Develop a CO_2 emissions reduction model
2) Create a framework for horizontal development of the project
3) Discover new activities for CO_2 emissions reduction
4) Hold workshops in Haiphong city

5.1.2 Schedule

1) Work period: April 20, 2015 - March 18, 2016
2) Hold workshops in Haiphong city (three times)
   ・1st workshop: August 4, 2015
   ・2nd workshop: November 17, 2015
   ・3rd workshop: January 12, 2016
3) On-site survey in Haiphong city (4 times)
   ・1st survey: August 3-7, 2015
   ・2nd survey: September 28-October 2, 2015
   ・3rd survey: November 18-20, 2015
   ・4th survey: January 13, 14, 2016
4) Conference of related parties in Japan (Kitakyushu city)
   ・December 16, 2015

5.2 Develop a CO_2emissions reduction model

・In this consideration, details regarding CO_2 emissions reduction activities, effect of its introduction (amount of CO_2emissions reduction, amount of energy reduction), and cost for introduction, etc. which can be introduced to Haiphong city, are organized and summarized in the report (project model sheet).

・Activities to prepare the project model sheet are as follows.

1) Switch from foundry / coal furnace or Chinese electric furnace to high efficiency electric furnace
2) Exhaust heat recovery power generation in cement factories
3) Introduction of EV buses
4) Plastic processing industry / Renovation from hydraulic injection molding equipment to electrical injection molding equipment
5) General factories / Upgrading from mercury vapor lamps to LED lighting
6) General factories / Introduction of inverter equipped compressors

5.3 Create a framework for horizontal development of the project

・For the horizontal development of the project, 1) - 3) have been considered as part of a framework (ideas) which can be carried out in Haiphong, and proposed to the city.

・Furthermore, organizations in charge of each idea should be governmental agencies, companies, and citizens. In this operation, methods to implement each idea were provided and information provision was carried out.

<u>Proposal 1. Information development based on the project model</u>

・Distribute the model sheet that was prepared in the previous chapter, or publish the results on the website (Organization in charge: Commerce and Industrial Bureau, Energy Saving Center, HATEX*)

* Haiphong Technology & Equipment Transfer and Exchange

・When a company has implemented energy-saving approaches, the company shall file a report with the Commerce and Industry Bureau and Energy Saving Center, etc. (which shares this information with the government and companies, in order to connect it to the horizontal development to other companies)

<u>Proposal 2. Self-assessment by the company using simple and easy to understand indicators</u>

・Identifying companies which are late in implementing energy-saving measures by collecting

and comparing energy consumption basic units calculated by the company (energy consumption / production volume) by each business type, and encourage such late companies to put forth more effort.

・In this operation, energy consumption (electricity, heavy oil, light gas oil, gasoline, converted total energy (tonne of oil equivalent)) and production volume of main energy consumer companies in the city between 2012-2014, as regulated under the Energy Saving Law, are collected and the following a-c are calculated as representative values.

a. Increase/decrease in energy amounts compared with previous assessments

b. Basic unit (energy consumption / production)

c. Basic unit average by category, numerical value of the highest energy efficiency

Proposal 3. Promotion of education activities for CO_2 reduction

・Promote CO2 reduction at the citizen level, by distributing brochures with an energy-saving / eco menu that can be carried out at home.

・In this operation, provide an energy-saving / eco menu with suggestions on operating methods for representative household electrical appliances, such as air-conditioning, lights, refrigerators, and cars, in consideration of the contents of the brochure currently being prepared by Haiphong city Commerce and Industry Bureau.

5.4 Discover new activities for CO_2 emissions reduction

5.4.1 On-site Survey

(1) Survey method

◆ Hearings at local companies

・An on-site survey was carried out by holding hearings that targeted large-scale companies which were introduced by Haiphong City and the Commerce and Industry Bureau (shipbuilding, metal processing, plastic processing, etc.) and local Japanese companies(21 companies), with the consideration of Ministry of Environment and JCM equipment aid project. The survey was carried out 4 times- August 3-7, September 28-October 2, November 18-10, 2015, and January 13, 14, 2016.

◆Explanation at the Japan Chamber of Commerce and Industry

・Moreover, for the JCM equipment aid project, the resources were sent to the member companies of the branch, and called for application to this project, as well as explaining at the branch meeting (held in September 30, 2015, 56 persons from 48 Japanese companies participated) of Commerce and Industry Bureau, Viet Nam and Japan, Haiphong branch.

(2) Survey results

◆Japanese companies

・Regarding Japanese companies, due to recent equipment renewal or new factory construction (new equipment has already been ordered), no company meets the timing for equipment renewal.

・However, continued announcements are important for the steady continued achievement in Haiphong since some companies are planning to expand factories in near future.

◆Vietnamese companies

・All Viet Nam capital companies expressed interests in the JCM equipment aid project.

・ Regarding the need for equipment that promotes energy saving, injection molding equipment, CNC machining tools, electric furnaces, compressors, welding equipment, and lighting (switching to LED), etc. can be mentioned.

・Among these, when considering the possibility of applying for JCM equipment aid, a detailed consideration in this chapter for injection molding equipment and compressors was determined important (refer to Table 5.4.1.1).

・When considering which company should be selected for equipment introduction, consideration as to whether the company is in the financial position to properly maintain the introduced equipment and will continue business.

・In consideration of the above matters, 1) introduction of compressors with built-in inverters to S company and 2) Possible introduction of electric injection molding equipment to G Company are considered in the following paragraphs.

Table 5.4.1.1. Possible application of the JCM equipment aid for equipment which meet energy saving needs

Equipment	Possible application of the JCM equipment aid	
Injection molding equipment	・The largest plastic processing companies in the north, including S company as well as plastic processing companies within the city using hydraulic power (Taiwan, China, Korean, Italian). ・By switching from hydraulic power to Japanese electric type, an energy savings of approx. 60% can be achieved. ・Regarding equipment renewal, registration as emission reduction methodology (032) of the domestic credit system in Japan is being carried out. Moreover, this is the target activity of the Ecolease Promotion Project for Homes and Businesses (Ministry of Environment / Japan Association of Energy Service Companies) in 2012.	○
CNC machining tools	・Equipment used in companies which carry out metal processing for car part manufacturing, etc. in the city, are made in Taiwan, China, Korean, as well as used equipment from Japan. ・Equipment made in Japan is reputed to manufacture high precision parts, with fewer defects and high durability. At the on-site hearing, request for high-performance, energy-saving machining tools from Japan was often heard. ・However, if Japanese machining tools are introduced, increased precision of parts manufacturing and production efficiency may also lead to increased energy consumption. As a result, quantification of CO2 emissions reduction is difficult.	×
Electrical furnaces	・Electrical furnaces are considered in Chapter 2 Energy Field “Energy Saving Project of Factory and Buildings,” and are not considered in this chapter.	―
Compressors	・Compressors are production machines used in the general manufacturing factories in Haiphong city, but many are not equipped with an inverter. ・CO_2 emissions reduction can be promoted by updating to energy-saving, built-in inverter compressors.	○
Welding equipment	・Welding equipment made in Viet Nam and China are used in shipbuilding and metal processing companies. ・A conference of Viet Nam capital companies was held, but machines from Japanese are expensive and a compromise in prices could not be reached.	×
Lighting (switching to LED)	・Upgrading from mercury vapor lamps and fluorescent lights to LED lighting is needed not only by Viet Nam capital companies, but also by Japanese companies. ・However, JCM equipment aid is provided to commercial facilities, etc. in Viet Nam, and adapting application of the JCM equipment aid for only changing to LED lighting is difficult and lacks novelty, according to an assessment by the Ministry of Environment.	×

5.4.2 Consideration of the possibility of equipment introduction

In this section, the possibility of introduction of compressors with a built-in inverter to S company and 2) introduction of electric injection molding equipment to G company were considered based of the survey results from the previous section.

5.4.2.1 Compressor with built-in inverter

- Load on compressors without a built-in inverter is adjusted by switching operations between load and no load. During no load operation, electricity is consumed even if the work amount is zero.
- On the other hand, in compressors with a built-in inverter, motor revolution is adjusted by the inverter, so electricity consumption will be proportional to load. When work is zero, the amount of electricity (actual work amount) consumed will also be zero.
- Hence, under the same load conditions, a compressor with a built-in inverter will consume less electricity than a compressor without one.
- A compressor is one of the most inexpensive and commonly used power sources among production equipment, and consumes approx. 20% of electricity at general manufacturing factories in Japan.
- As in Japan, compressors in Haiphong city are used in various fields such as shipbuilding, metal processing, and plastic processing. However, there are many cases of compressors without a built-in inverter, so the ripple effect from the JCM equipment aid project is expected to be very high.
- Moreover, compressors are basic equipment with high electricity consumption but can be replaced with compressors with a built-in inverter at a low price and high cost-benefit performance for CO_2 emissions reduction.

(1) Effect of equipment introduction (estimated)

- S company uses compressors (without an inverter, lubricating, screw type, 75kW) for welding, cleaning of cut building materials.
- Consequently, when the existing compressors are replaced with those with a built-in inverter (lubricating, screw type, 75kW), as shown in Table 5.4.2.1, annual electricity consumption will be 132,000kWh, for an reduction in annual CO_2 emissions of 71.4t- CO_2.
- Since service years of a compressor are 10 years, a reduction of 714t-CO_2 over 10 years (corresponding to equipment used in the manufacture of metal products according to the new and used asset classification chart on the useful service life of machinery and equipment (other equipment).

Table 5.4.2.1　Effect of equipment introduction (per one compressor with built-in inverter

Items	Proposal	Present	Remarks
Name of manufacturer	KOBELCO	KOBELCO	
Model	75kW Built-in inverter	75kW standard machine without a built-in inverter	
Air volume	14.9 m3/min	13.5 m3/min	
Maximum power output	76 kW	77.5 kW	
Operation load rate	62%	68 kW	
Operation power	46.9 kW	70.1 kW	
Total efficiency	90%	86%	
Input power	52.1 kW	81.5 kW	
Input original unit	0.09446 kW/m3	0.14765 kW/m3	
Energy saving percentage	64%	100%	
Consumed electricity (annual)	234,631 kWh	366,773 kWh	
Reduced electricity consumption (Annual)	approx. 132,000 kWh		=366,773 -234,631
CO2 emissions reduction (Annual)	Approx.71.4 t-CO2		=Reduced electricity consumption ×Grid electricity emissions coefficient (0.5408t-CO2/MWh)
CO2 emissions reduction (service years: 10 years)	Approx. 714 t-CO2		

<Calculation conditions>

Item	Unit	Set value	Remarks
Discharge pressure	MPa	0.6/0.7	Inverter machine: 0.6MPa Standard machine: 0.7MPa
Used air volume	m^3/min	9.2.	
Annual operation hours	hour	4,500.	15 hours/day×300day

(2) Cost-benefit performance (estimated)

・The initial cost is about 4,720,000 yen including transport / installation costs. If JCM equipment aid can be received for 50%, the amount of aid will be about 2,360,000 yen.

・Hence, the amount of aid per 1 t of CO_2 emissions reduction over the service years (10 years) will be as shown below.

Amount of aid per 1t of CO_2 emissions reduction＝Amount of aid／CO_2 emissions reduction (service years: 10 years)

＝2,360,000 yen／714

＝3,300 yen

(3) Monitoring method: Consideration of summarized quantification of CO_2 emissions reduction

Monitoring method and summarized quantification of CO_2 emissions reduction were carried out for the development of an MRV methodology as shown below.

◆Setting reference points

・The compressor set as reference point is a standard model without an inverter, lubricating, screw type, 75kW. Furthermore, the same manufacture and rated air volume is selected for the new equipment.

◆Monitoring after introduction of the new equipment

・The electric power used by the new equipment (compressor with built-in inverter) is measured by a measurement device (pulse transmitter), and the amount of consumed electricity is calculated. Furthermore, the amount of discharged air is measured and the average load rate of the new equipment is calculated.

・Regarding electricity consumption (estimated value) of the compressor without an inverter which is used as reference, it is estimated according to the average load rate of the new equipment, and the partial load performance chart of reference.

・The reduction effect of electricity consumption can be calculated by determining the difference between electricity consumption (actual measured value) and the reference value (estimated value).

・The CO_2 emissions reduction is calculated by multiplying the consumption reduction amount with the grid electricity emissions coefficient.

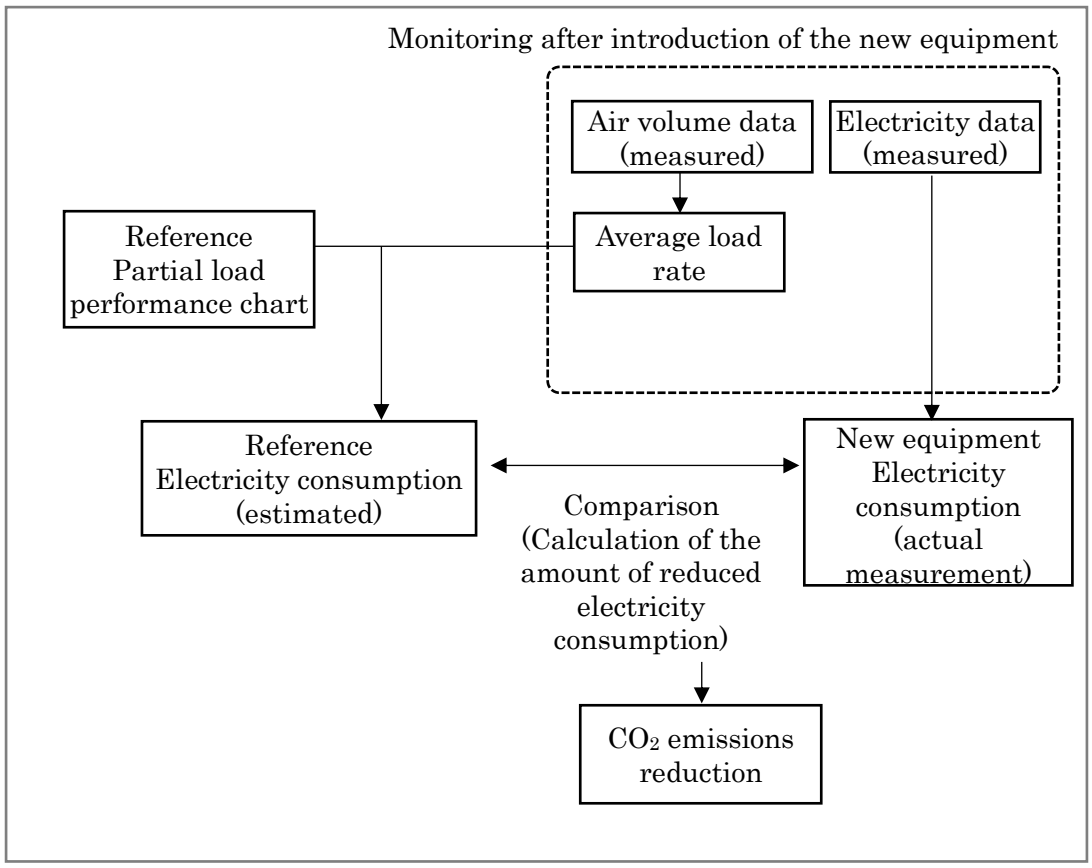


Fig. 5.4.2.1 Monitoring- Calculation flow of the amount of

(4) Project Implementation system

・The project implementation system is shown below.

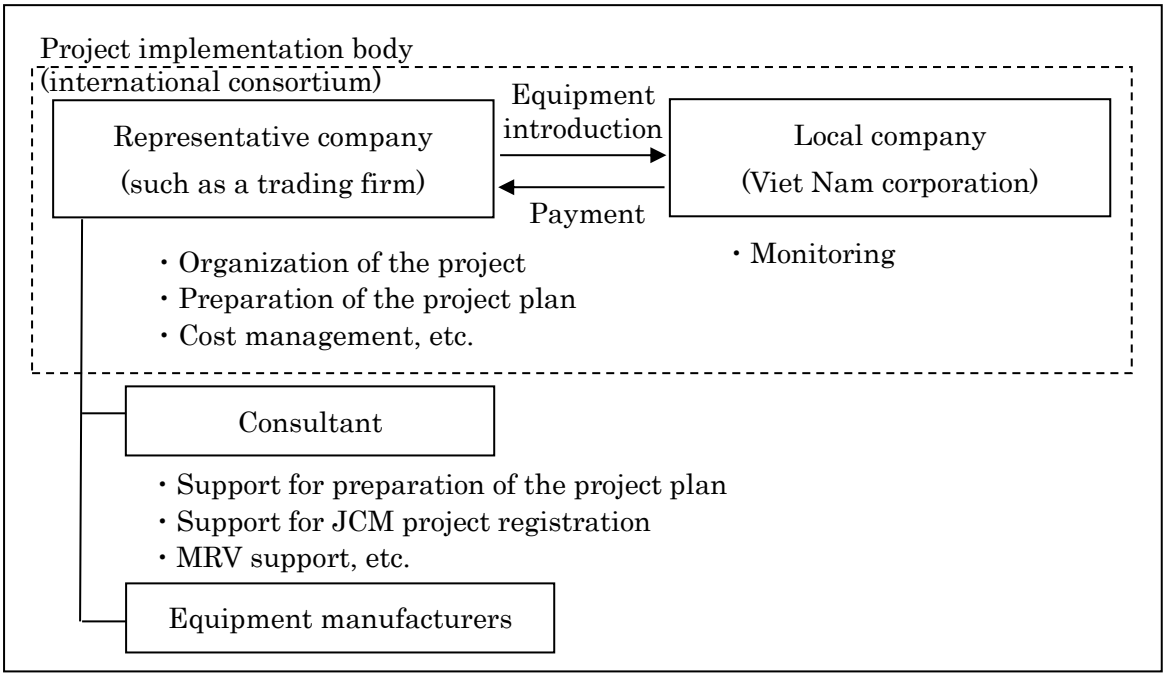


Fig. 5.4.2.2 Project implementation system

(5) Future tasks

・In the JCM equipment aid project, reliable operation of the introduced equipment during the service years, and reduction of CO_2 emissions are important.

・A detailed consideration of the monitoring methods and summarized quantification of CO_2 emissions reduction must be carried out for the development of MRV methodology.

・Compressors made in Japan have fewer defects, but require regular inspections in order to maintain high energy-saving performance during the service years.

5.4.2.2 Consideration of possibility of introduction of electrical injection molding equipment

・According to the results of the on-site survey of the several companies, including the largest plastic processing company in North Viet Nam, plastic processing companies in the city generally use hydraulic injection molding equipment.

・Hydraulic type equipment can control variation in load by controlling the amount of pumped oil. By increasing / decreasing the amount of oil in the middle of the tube, the generated oil pressure becomes heat and dissipates. For example, power energy is lost as speed changes, this

is the largest source of energy loss.[* 1.]

・On the other hand, most energy loss from electric type equipment is mechanical, and there are fewer sources of loss, so switching from hydraulic to electric type machinery can promote energy-saving. [* 1.]

*1: Special issue Latest Trends in Hydraulic Technology in the Environment Age. Case2- Shinsuke Takahashi, Nissei Plastic Industrial Co., Ltd.

(1) Effect of equipment introduction

・When comparing hydraulic and electric type equipment in the case of 350t locking force, an energy savings of 60% can be achieved, which is a reduction of 72,000kWh electric consumption and 39t-CO_2 of CO_2 emissions.

・The service years of injection molding equipment (in plastic product manufacturing) are 8 years, so a reduction of CO_2 emissions over the entire service years would be 312t-CO_2.

Table 5.4.2.2 Effect of equipment introduction (updating from hydraulic to electrical type equipment)

Item	Hydraulic type	Electrical type	Remarks
Locking force	350t	350t	
Electricity consumption	20kW	8kW	60% energy saving by electrical type
Annual electricity consumption	240,000 kWh	96,000 kWh	250 days × 24 hours operation
Reduced electricity consumption (Annual)	72,000 kWh		Approx. 600,000 yen cost reduction per year (Approx. 8 yen/kWh)
CO_2 emissions reduction (Annual)	39t-CO_2		=Reduced electricity consumption ×Grid electricity emissions coefficient (0.5408t-CO_2/MWh)
CO_2 emissions reduction (service years: 8 years)	312 t-CO_2		

(2) Cost-benefit performance

・Initial cost for electrical injection molding equipment is approx. 25,500,000 yen including transport, installation costs (hearing results from Japanese companies).

◆ With 50% coverage by JCM equipment aid

・Amount of aid for 50% of the initial costs will be about 12,750,000 yen. The amount of aid per

1 t of CO_2 emissions reduction over the service years (8 years) will be as shown below.

Amount of aid per 1t of CO_2 emissions reduction＝Amount of aid／CO_2 emissions reduction (service years: 8 years)

＝ 12,750,000 yen／312

＝40,900 yen

・The energy saving rate by switching from hydraulic type to electrical type machinery is very high (about 60%), but since injection molding equipment has a lower electricity consumption for its product price to begin with, cost-benefit performance is small.

◆ With 15% coverage by JCM equipment aid

・Amount of aid for 15% of initial costs will be 3,825,000 yen, and the amount of aid for 1t of CO_2 emissions reduction will be as shown below and the cost-benefit performance will be high.

Amount of aid per 1t of CO_2 emissions reduction＝Amount of aid ／CO_2 emissions reduction (service years: 8 years)

＝3,825,000 yen／312

＝12,300 yen

・In this case, a local company can purchase the electrical injection molding equipment for about 21,675,000 yen (＝25,500,000 yen × 85%). However, since hydraulic injection molding equipment made in China, Taiwan, etc., can be introduced into the region, profitability will be lower as shown below.

Collection year of initial costs＝(mechanical type (15% aid)－hydraulic type)／Amount of reduction of electricity cost in case of mechanical type

＝(21,675,000 yen－8,000,000 yen)／600,000 yen

= 22.8 year

・Hence, since agreement from the local company is difficult to obtain, the monitoring method, quantification of CO_2 emissions reduction, project implementation system, and future tasks are not considered here.

5.5 Hold workshops in Haiphong city

・Workshops were held three times in the region in order to report the details of this operation and progress and to discuss operation tasks with related personnel in Haiphong city.

・Dates the workshops were held and details of the discussion are as shown in Table 5.5.1.

Table 5.5.1　Date / place of workshop and description of the discussion

	Date / place of workshop	Description of the Discussion
・1st workshop	Tuesday, Aug. 4, 2015 14:00-18:00 Place: Haiphong City Conference Center	Inception conference ・Update from the previous year ・Explanation of this year's implementation policy and schedule of activities, and request for cooperation
2nd Workshop	Tuesday, Nov. 17, 2015 13:50-18:00 Place: Haiphong City Conference Center	Midterm report ・Update of this year's progress ・Discussion on the introduction of a tourism handling fee (fee to enter the area, environmental conservation fee)
3rd Workshop	Tuesday, Jan. 12, 2016 14:00-17:30 PM Place: Haiphong City Conference Center	Final report ・Results report of this year's activities the year and response policies from now. ・Discussion on the introduction of a tourism handling fee (fee to enter the area, environmental conservation fee)