"The Non-Firing Bricks production business investigation; for effective use of the untapped natural resources in India" – The report overview.

1. The project implementation of the basic elements.

1.1 The overview of the proposal project and the background of planning drafting.

In India, with the background of lively economic activity there is large demand in the brick industry and as a result, the coal which is burnt as fuel emits CO2, SO x, NO x, ash dust during the burning process. Also, the extraction of the clay, which is the raw material of the bricks, is causing a wasteland and requires mass consumption of the groundwater in a country where water resources are a problem.

India is the global leading country which is enthusiastically active in CDM and has the highest number of government approval compared with all other countries. (181approvals as of 15th Nov. 2005)

Under this circumstance, we have conducted the feasibility study to replace existing bricks with "Non-Firing Bricks", on basis of the plan to establish the joint venture with the local brick manufacturers and to secure both the workforce and the sales channels. Through this feasibility study, we have concluded the following benefits to be anticipated;

① Saving the consumption of coal (The energy saving).
② Preserve resources by using by-products, such as the fly ash, as 90% or more of raw materials (The resource saving).
③ Secure quality level by machine manufacturing
③ Save 30% or more of the water resources.
④ Reduce CO2 emission by approximately 30,000 tons per year (for the estimated annual production volume of about 58,000,000 bricks.)

Upon this conclusion, we have decided to investigate the profitability and feasibility of the CDM business which could result from the reduction of the C02 emission, resource preservation, the environmental protection, and the improved working conditions.

The background of the proceeding the concerned project is as follows;

(1) The status which surrounds brick industry

It is said that the brick production of India is increasing to the extent that it exceeds the economic growth. At this stage of the investigation, statistical material about the brick industry could not be found. However, the information that could be found stated that brick consumption is increasing 18% every year. This comes from an interview survey with the Mumbai Institute of Technology brick research team. From this information, and our actual investigation, it is predicted that the amount of coal consumed in brick production will rise by 25,920,000 tons per year. The current amount of coal consumed is 114,000,000 tons. Currently in brick factories, coal ash and all other waste amounts to 57,000,000 tons per year. Disposal is not done in the right way, as the waste is put into the hole made by the excavated clay. High demand of the bricks is seen from the fact that the delivery trucks are queuing for collecting the products at the factory.

(2) The energy situation in India

In India, between 1980 and 2001, the actual GDP increased at an average of 5.6% a year. In this period, the population increased by 2% a year. However, with the rapid economic development, industrialization, urbanization and motorization, came progress. The energy demand (the primary energy base) increased at 6.0% a year, which exceeded a previous substantial GDP growth rate. It also found that the power generation quantity grew at a rate of 8.1% a year and this coefficient of elasticity against GDP was at 1.5, which is the economic growth of high consumption type of electric power. It is rich domestic coal that catered for this rapidly growing electricity demand. The ratio caused coal heating power gross-generation to increase from 55% in 1980 to 78% in 2001, and the coal fired power generation quantity improved at annual rates of nearly 10%. This increasing coal consumption made the environmental problem, primarily the air pollution, worse. Also, car fuel consumption increased rapidly so first energy supply base increased at an annual rate of 5.9%, over a period of 20 years. It is expected that the high growth rate of the Indian economy will continue into the future. The development of the energy demand comes in relation to, and depends upon, the change of the GDP and population growth rates. But in 2001, commercial energy consumption per capita was still at quite a low level when compared with other Asian developing countries, at 0.316toe, as shown in the table. When thinking of the future economic development of this country, the energy requirement per capita is estimated to stretch to about twice the present level sooner or later, and the securing of this energy is absolutely necessary for the country to develop.

Table 1: The change of the energy consumption in the first commercial per person

(Unit: toe/the person)

Country	Energy consumption per person			The annual averagegrowth rate (%)(1995～2001)
	Year of 1995	2000	2001	
India	0.270	0.317	0.316	2.7
China	0.714	0.735	0.726	0.3
Thai	0.839	0.953	1.020	3.3
Malaysia	1.740	2.020	2.070	2.9
Philippines	0.368	0.429	0.414	2.0
Indonesia	0.410	0.478	0.499	3.3
Vietnam	0.122	0.183	0.207	9.2
Japan (Reference)	3.950	4.130	4.100	0.6

(Source: Energy Conservation Center "the Asian developing country energy saving" India)

40 or more % of India's home-use energy demand is dependent on biomass such as firewood, animal waste and cereal residual liquid etc. In the future, with the fast growing increase of the percentage of GDP and the population, it is thought that the demand for commercial energy will increase rapidly.

(3) The coal situation in India

India is the 6th biggest energy market in the world, but there is little domestic energy production and of the world's energy production, India's share is only 2.3%. The primary energy supply is 480Mtoe. 41.2% of this energy supply is made up of combustible renewable energy and waste energy and 33% is made from coal which is the primary commercial energy source. In India, there are anthracite resources estimated at about 214B tons and the proved deposit of 84B tons and lignite resources of 28B tons.

Most of the produced coal is a general-coal. The low concentration of the poisonous minor trace elements such as sulfur (<0.6%) and chlorine (<0.1%) which is an advantage, however, the quality is bad for burning in spite of the characteristics of high ash content and moisture. The coal demand was 317M tons in 1999-2000. This increased to 513M tons in 2002-2003, and to 716M tons in 2006-2007. According to the Indian consultation group, it is estimated to increase to 815M tons in 2009-2010.

The liberalization of the coal industry has begun, and private investment has also become possible.

1) The influence of the quality.

Generally used sorted coal has the following characteristics;

・80% or more of the coal has 30%–50% ash content, with low iron and the poisonous minor elements at a level that can be ignored.
・Moisture is between 4%–7%. Moisture tends to become a higher value during the monsoon months.
・The sulfur content of 0.2%–0.7% is low.
・The gross–calorific–value is between 3000kcal/kg and 5000kcal/kg.
・The volatile–matter content is between 18% and 25%.

Because coal in India has a good chemical reactivity, it is favorable in spite of the high ash content and moisture. Other favorable characteristics are the low concentration of the poisonous minor elements, sulfur (<0.6%) and chlorine (<0.1%), and the high ashy fusion temperature (>1100℃) and the ratio (0.2 – 0.3) of base/the acid. The low sulfur content is useful with the blend. In spite of these advantages of anthracite in India, the quality is still low. The high ash content of the general–coal contributes to the technical difficulties and high costs of running the power plant. The need to throw away the surplus ash, slag formation on the boiler wall, boiler structure and economizer caused by burning, are all problems that need to be faced. If not properly dealt with, these problems cause a heat loss and sometimes the ruinous damage of all systems. Also, the power plant requires high running costs to deal with a lot of minute particle emissions, the precipitant and the waste disposal etc. The fault of the product quality of non–sorted coal is the existence of the adulterated–substances, such as stone grain, shale and metal, which are sometimes mixed in during the mining process. The coal producers do not make so much effort to improve such disadvantageous conditions. The coal consumers experience worsening the coal quality in the last few years. Due to the regular adulteration, the specifically low calorific potential and the increased ash content, the operating rate of the coal–fired power plant in India is only 65%.

2) The demand

The coal demand in 1999–2000 was 317M tons. The consumption has risen steadily in the last 20 years. Coal consumption in India is estimated to increase to 815M tons in 2000–2010, according to the consultation group. It increased to 513M tons in 2002–2003, and to 716M tons in 2006–2007. Even supposing that it increases at an annual rate as low as 6%–7% over the following 10 years, this would still equate to 690M tons in 2009–2010. The greatest coal consumers are; the electric power department (67%), the steel industry (13%), the coal producers themselves and the cement industry (4%). The other consumers are the fiber, fertilizer, brick industry. 15 M tons of binding coals were imported from Australia and 9M tons were imported from South Africa in 2005.

(4) The cement situation in India

1) From 1990 to 2004 production tripled.

2) In 1998 it exceeded the production of Japan and has remained the 2nd largest in the world, following China.

However, it has not increased as much as China's in recent years (from 1990 to 2004). Cement consumption per capita is not as high as China.

3) There are 110 modern factories now operating in India. 100kg per capita is produced, which is low compared with other areas. Eventually it is expected to increase to 500kg per capita, therefore the home market will be 500,000,000 tons.

4) The new plants have the latest facilities installed.

5) Slag cement;

The simple composition rate of ordinary cement is Clinker 95% + Gypsum 5%. In India's case, CO2 which emitted by the manufacturing process is 0.93t–CO2/t–cement.

The simple composition rate of slag cement is Slag 47% + Clinker 48% + Gypsum 5%. Slag is a by–product of the ironworks and the CO2 emission becomes negligible, at 0.93× (1–0.47) =0.49. If the electric power consumption of the grinder is taken into account, the CO2 emission of slag cement in India becomes a value, at an average of 0.49 t–CO2/t–slag cement.

(5) Summary

It is as follows when summarizing the above background;

1) In India, energy is lacking and because of future development, a further energy source must be secured. However, it cannot look forward to substantial improvement in funding, environmental problems etc.

2) As for the country's own resources, the effective use of rich coal is an important issue for India's development. There will be significant improvement in India's energy situation if the current bricks are replaced with "non-firing bricks", made from slag cement, using the comparatively advanced manufacturing technology.

1.2. The overview of the host country.

India currently has the 2nd largest population in the world (approx. 1,100,000,000), following China. Its importance is increasing internationally in the field of politics, economy etc., having been independent of the United Kingdom since 1947 and having problems domestically and internationally. The IT industry is developing economically once more, with a background of rich human resources since the 1990s, and the substantial GDP growth rate of 5.6% per year, on average, since the 1980s. The economic scale of the country has leapt to 12th in the world and 4th in Asia. Due to the motorisation mushroom, the rapid increase in power consumption etc in these processes, the C02 emissions of the country have become the 5th largest in the world, following Japan. (U.S; 24%, China; 13%, Russia; 6%, Japan; 5%, India; 4%) With such an economic development in recent years, India has become one of the regional powers, known as "BRICs". This is a term used to describe the style in which Brazil, Russia, India and China have all adjusted in similar ways to similar remarkable development.

In the present situation, GDP per capita is; Russia $4,093, Brazil $3,417, China $1,269 and India $608, which are not high. However, the BRICs are estimated to achieve big economic growth in the future, and as a result, the economic scale order will be; China, America, India, Japan, Brazil, Russia by 2050.

When looking at the relationship between India and Japan, Japan is the trading partner in India's exports (Ironstone, marine products etc are the main constituents). In the case of imports (general-instrumentation, electronic devices etc are main the constituents), Japan is India's 10th biggest partner, according to the country.

In recent years, IT technology has developed remarkably and the exportation of software Is growing (This isn't included in the trade value on the statistics). By slotting these technologies into the industrial goods, there is a possibility of increasing the value of export margin.

Like this, India is the country which has the best possibility of development in the future. Therefore, we should look to India (next to China) to deepen the relationship with Japan.

1.3 The policy status in terms of CDM/JI of the acceptance criteria and the DNA establishment status of the acceptance and policy in the host country.

(1) The Indian Government is very active in CDM business.

MOEF (Ministry of Environment and Forest) established DNA in December, 2003.

The Ministry of Finance, the Ministry of Foreign Affairs, the Department of Industry, and the Electric Power Ministry etc. are all members.

It has been given 181 recognition-of-governments since November 15th in 2005.

There are many projects in a various field, mainly biomass relation projects for sugarcane and chaff.

(2) According to Point Carbon Inc. in Norway, who is dealing with the worldwide information transmission about CDM, India is ranked as the 1st in the "ratings" (the evaluation bill) they

developed of CDM in the host country. India is followed by Chile, Brazil, China, and so on. This is the reasoning and background behind the evaluation of the country, and the following comments on India;

"India is the most attractive host country for the CDM project. India is the leader in the world for the number of recognition-of-government agenda items and the number of PDD. There are many players who have knowledge about this system in India. However, the investment environment is relatively poor, there are also many barriers at the business operation stage and there is a project which has problems in "addition-ability".

(3) Above mentioned India nominates the officials and people from the early stages and tackles CDM actively and the agenda items are given numerous recognition-of-governments. Therefore we predict the concerned agenda item may be given recognition-of-government also.

1.4 The point that the proposal project can contribute to the sustainable development in the host country and the point which can engage in technology transfers.

The non-firing caking technology is the technology which was already commercialized in Japan, and non-firing bricks are produced in 3 places; Kanto, Chubu and Kansai. Also, a clinker aggregate is produced in the Chugoku district.

All 3 sites recycle local waste. The facilities used can recycle various wastes, the application range is very wide and therefore this technology can be transferred anywhere.

Also, India is substantially lacking in energy. The project's proposal is to replace the existing bricks, which are baked with coal at present, with the non-firing brick, which uses slag cement with fewer CO_2 emissions. It attempts to effectively utilize the energy lost when burning coal. By using the waste of the coal ash etc as raw materials, it preserves natural resources and prolongs the life of the repository site. Moreover, by only introducing new facilities but not reducing the workforce, it states that it will contribute to a secure workforce and improve an inferior working environment, too. The social contribution is very high, as is the contribution to building a sustainable society.

1.5 The implementation system of the investigation

As for the main research, Kamei Seito Co., Ltd. have gathered a report but requested the following organizations in Japan and India to cooperate;

(1) Japan

1) Cooperating organization 1: Nagoya Institute of Technology ・The role: In addition to local raw materials, and evaluating the product, the burning test.
2) Cooperating organization 2: Marubeni Corp. ・The role : The contact business with the PDD, creating support and the place.
3) Cooperating organization 3: The Tokyo Electric Power Co., Inc. ・The role: The methodology and dissemination of information on CDM.

(2) India

1) Cooperating organization 1: Jypti Transformers & Electricals , Orissa state, Sambalpool City.
 ・The role: Responsible for the main organization to operate the CDM in India side. To assemble the information for the participating companies

2. The drafting of the project.

2.1 The specific contents of the project

In India, approximately 360,000,000,000 bricks are manufactured annually by the inefficient baking process. A great deal of low dignity coal is consumed as fuel and a lot of CO_2, SO_x, NO_x, and ash dust is emitted. Because of this inefficient process and the crudity of the materials, the quality of the product itself is unstable. This has been reported as being a big damage factor in the earthquake in the western part of India, which occurred in 2001. Mass consumption of the groundwater in a country where there is a problem with water resources, and creating wasteland by large excavations of the clay (for the raw materials of the bricks), has also become a big problem.

As the result of the local inspection, the coal which is used for the firing-bricks is more than 144,000,000 tons, emitted CO_2 is 186,000,000 tons, and also the domestic coal in India contains much ash (an average of 40%) so it proved that 57,000,000 tons or more of Surface Particulate Matter (SPM) was emitted per year. The process of producing the non-firing bricks which uses the coal ash which occurs in the coal-fired power plant, as the waste can be recycled as raw materials and the slag cement and the chemical reaction of the additives without burning. Therefore, this technology is predicted as a possible expectation for effective use of untapped resources and environmental protection, the consumption reduction of the fossil fuel (or, the conversion utilization: a short supply to the coal-fired power plant is estimated to rise up to 133 Mt in 2007 in India) and the improvement of the working environment. This technology is already commercialized in many parts of Japan.

The most of the domestic brick manufacturers in India do not even have the buildings or facilities, and as the organizations do not have the capacity to deal directly with international clients, we are planning the acquisition or the joint venture from the existing brick manufacture to replace the existing bricks to "Non-firing bricks" after securing the workforce and sales route with the local counterpart in India (Jypti Transformers The & Electricals).

On the basis of above plan, we proved the following items.

① It restrains the consumption of coal (The energy saving).
②The resource preservation, which uses by-products such as the fly ash in equal to or more than 90% of raw materials (The resource saving)
③The securing of steady production rates, due to the manufacturing machinery
④Equal to or more than 30% saving of the water resources
⑤The CO_2 reduction of approximately 30,000 tons per year can be looked forward to with1 line (about 58,000,000 annual amounts of manufacture)

It was decided to investigate the profitability and feasibility of CDM business to bring the credit acquisition.

2.2 The assumption project scale

(1) The number of participating companies: 18 companies
(2) Production: 56,000,000 units / year
(3) The cost of equipment: About 300,000,000 yen
(6) The CO_2 reduction: 30,000 tons per year
(7) The credit acquisition: 34,500,000 yen per year (CO_2 As 1-ton US$10, IUS$=115 yen)

2.3 PDD (as attached)

2.4 The GHG reduction and the leakage by the project implementation

1) The C02 reduction: Approx 30,000 tons per year. After 10 years, it becomes about 300,000 tons.
2) The leakage: There is not new CO_2 occurrence in the concerned project.

2.5 The monitoring plan

In the this project, it implements the following monitoring

- Electricity consumption at the project plant in the year *y*
- Slug cement consumptions in the year *y*
- The amount of a transported slug cement to the plant by a vehicle mode *v* in the year *y*
- The amount of fly ash transported to the project plant by a vehicle mode *v* in the year *y*
- The amount of sponge iron transported to the project plant by 9t trucks in the year *y*
- Transportation distance of slug cement by 9t trucks from Bargarh Cements Works of the Associated Cement Companies Limited to the project plant (1way)
- Transportation distance of fly ash by 9t trucks from Hindalco Coal Power Plant to the project plant (1 way)
- Transportation distance of sponge iron by 9t trucks from Shyam DRI Power Limited to the project plant (1 way)
- Vehicle Miles Traveled of brick transportation for a vehicle mode *v* in the year *y*

2.6 The environmental-impact/the other indirect influences

The concerned project has no existing elements that aggravate environment. SO x, NO x, and ash dust reaching fine particles decreases in the atmosphere, and the environment is improved by this project. Also, because the amount of consumption of the groundwater, too, is substantially reduced and the waste and the drainage also don't go out of the manufacturing process, the general environmental improvement effect is big. It also improves the global warming phenomenon, and it is useful for the improvement of the inferior working environment and GHG is reduced as a result.

2.7 The comments of the interested parties

The following comments have been obtained from local residents, the District and Central Government. People who participated were Corporate Executives etc.

(1) Corporate Executive

It hopes that this CDM project is realized and as a result, that GHG is reduced. It expects that PDD will be approved in the early stages, that financing from the bank is gained by the collateral in CER, and that we can participate.

(2) The nearby resident

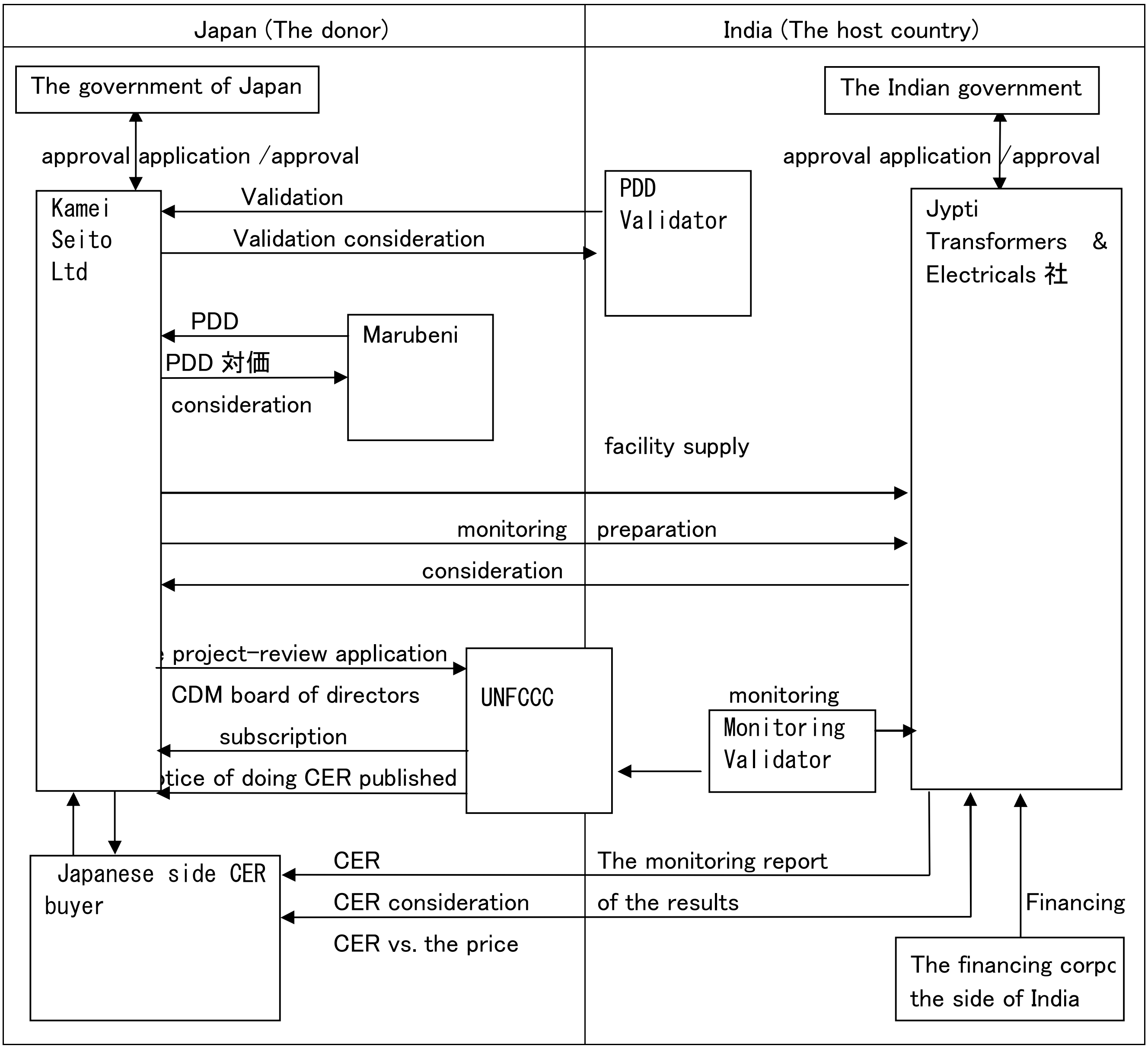
We look forward to environmental protection, employment expansion, and improved working nvironment in the area from this project. Also, we look forward to an improved quality of bricks that are more stable in earthquakes etc. so people do not die.

(3) The quality of living in general improves and lasting development can be looked forward to. It is good that, with this project, environmental protection will be moving ahead, due to the recycling of the coal ash, which has become a social problem in the whole of India. We also appreciate the bricks' quality becoming more stable.

3. Commercialization

3.1 The implementation system of the project (Domestic, in the host country and others)

The present situation of implementation systems for this project is shown below. Specific investors have not been decided.



3.2 The fund plan for the project implementation

The specific investment and the financing plans are, as yet, undecided, but to expect 12.5% of investment each from Japan and India, and the remaining 75% to be funded by a loan. On the Japanese side JBIC, trading companies, the bank etc. have been thought of, but there is a relation to the CER price future direction, too, and the present situation is undecided.
It plans to review once the general stages of the plan are fixed.

3.3 The cost effectiveness

To confirm the cost effectiveness, it implemented a financial analysis (the IRR computation) in a statement attached at the end. To confirm the effect of CDM, the CER price calculated in step 4, was calculated as US$ O/t-C02, US$ 5/t-C02, US$ 10/t-C02, and US$ 15/t-C02.

IRR calculation result

Credit price (US$/t-CO2)	Before Tax IRR(%)	After tax IRR (%)
O	23.56	10.27
5	29.82	17.50
10	35.83	24.11
15	41.66	30.35

As a result, the CER price exceeds 20-25% which generally becomes the standard of the investment outlet therefore, CDM commercializing is possible.
The investment collection year is show in Table 4.

The investment collection year

Credit price(US$/t-C02)	Investment collection
O	3.7
5	3.1
10	2.7
15	2.3

Investment collection year = Construction cost / (annual sales per year - Cost per year)
The investment collection year exceeds standards from the general judgment level (about 3.5 years).

3.4 The probability and the challenge of the specific commercialization.
In the present situation, commercialization hasn't been embodied, however the analysis will carry on reviewing and developing valid conditions after the end of investigation.

4. The validation/ determination
Validation has not been implemented in this research, however, our company plans to implement a validation separately hereafter.