

Lao People's Democratic Republic

Lao PDR

**The feasible study of Bio coke production
and distribution business**

(BOP business promotion survey)

Final report

(Summary)

(August, 2013)

Japan International Cooperation Agency (JICA)

Oji green resource Co., Ltd.

Naniwa Roki Co., Ltd.

Pricewaterhousecoopers Sustainability Co., Ltd.

Research objectives and backgrounds

1.1 Objectives

- Oji green resource Co., Ltd. has conducted the feasible study of Bio coke production and distribution business (BOP business promotion survey) with Naniwa Roki Co., Ltd. and Pricewaterhousecoopers Sustainability Co., Ltd. in Lao People's Democratic Republic (Lao PDR) during from August 22, 2012 to August 30, 2013.

1.2 Background

(1) What is Bio coke?

- Bio coke is developed by Dr. Tamio Ida Kinki University¹ (Member of this study team) and a new solid biomass fuel and Bio-coke is high density and strength compared to conventional solid biomass fuel, so it is expected to be used under high pressure, such as steel melting furnace. It has been considered to apply to alternative fuels for coal coke in steel melting furnaces and boiler fuel for agriculture.
- Bio coke is made from all of biomass, such as used tea leaves, wood waste, etc., and also is expected to reduce the greenhouse gas emission based on the idea of a carbon-neutral.
- At present, Bio coke is in production and distribution at Takatsuki Bio coke factory² in Japan.

(2) LPFLs plantation business in Lao PDR

- Oji Lao Plantation Forest (LPFL) is a company specializing in tree plantation for commercial business, with already planted area of 22,000 ha (up to date) in Bolikhamxay and Khammouane provinces.
- LPFL also set up Farmer Extension Plantations Scheme under the government concept of "2+3 system": 2 is Land+ Labor (villager), 3 is Finance + Technique + Market (LPFL). This is aiming for highly productive farmer plantations generating additional incomes to the local population. Until the end of 2010, 5,002 ha have been developed under this plantation scheme.

¹ Kinki University Bio coke project ; <http://www.kindai.ac.jp/bio-coke/>

² Takatsuki Bio coke business creation local consociation; <http://bio-cokes.info/pastLog.html>

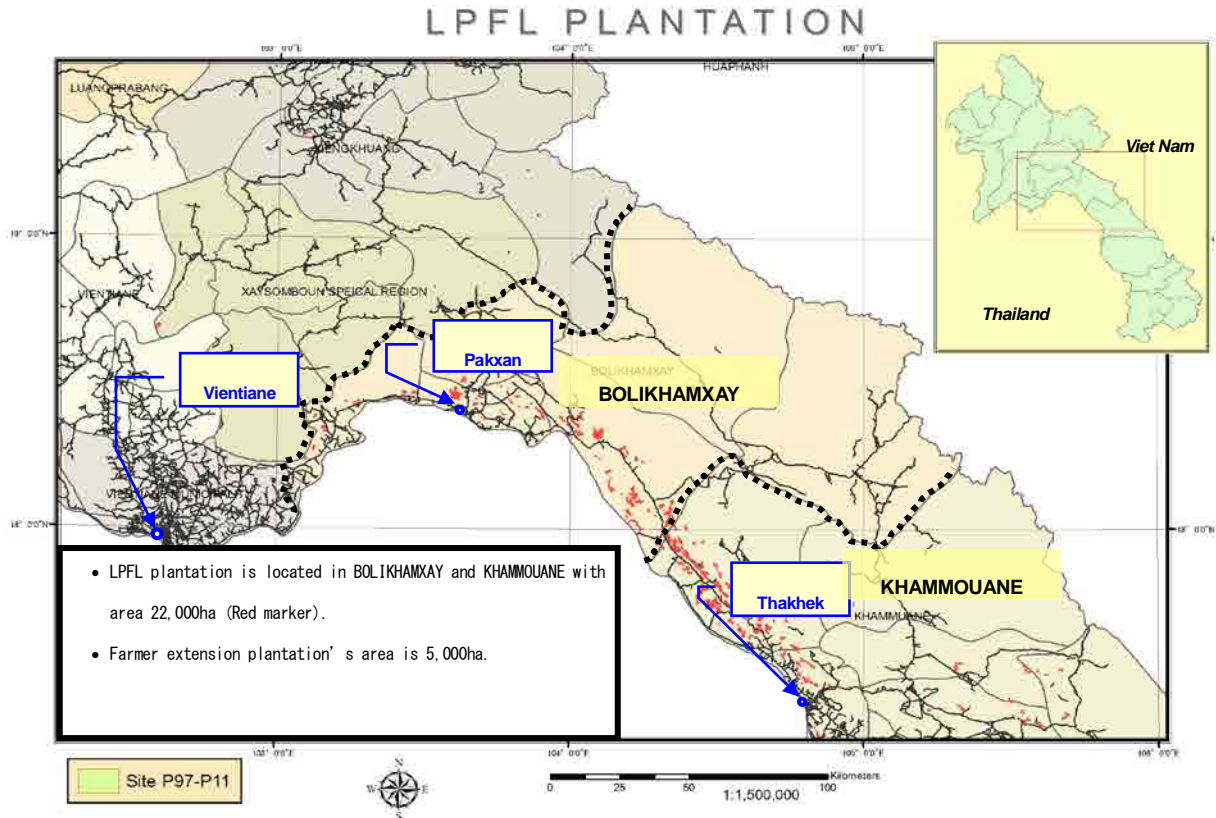


Figure 1 LPFL plantation site

I. Investment and business conditions

1.1 The Seventh five-year National Socio-Economic Development Plan (2011-2015)

- Lao PDR has grown its economy at a remarkable rate in recent years, with a sub-eight percent GDP growth rate over the past five years,

1.2 Renewable Energy Development Strategy in Lao PDR (2011)

- In 2011, Lao PDR disclosed the Renewable Energy Development Strategy in Lao PDR (2011),
- The Government will provide financial incentives and financing assistance to renewable energy projects and investors;
 - Import duty free on production machinery, equipment and raw materials;
 - Import duty free on chemical materials necessary for bio fuels production within 7 years;
 - Profit tax is divided in to 3 categories: 20%, 15% and 10%. Profit tax exemption is possible for a certain period depending on activities, investment areas and size investment.
- As mentioned above, Bio coke can reduce the CO2 emission as an alternative coal coke. In addition to the general investment promotion, it needs to have a discussion about possibility of financial incentive based on the Renewable Energy Development Strategy.

- Then Japan and Lao PDR signed the Joint Crediting Mechanism (JCM)³ on August 7 in 2013. And so it is expected to be in cooperation with the Renewable Energy Development Strategy and JCM.

1.3 Investment promotion Lao PDR (2011)

- Foreign direct investment has come to be widely recognized over the past decade as a major potential contributor to growth and development. It can bring capital, technology, management know-how and access to new markets.
- There are three types of investment in Lao PDR as follow: General business, Concession business, and Special economic zones and specific economic zones (SEZ).
- Details of promoted activities under the sectors are determined by the Government and classified into three different levels based on prioritized activities of the Government, the activities related to the poverty reduction, the improvement of living conditions of people, construction of infrastructure, human resource development, jobs creation, etc.
- We assume that Bio coke factory site is in Pakxan district Bolikhamxai province, or in Thakhek district Khammouane province, and so these sites are zoned for 2nd zone.
- In this business model, we assume in the form of a joint venture (JV) with local sawmill, and so it is classified as a general business.
- Profit tax ratio of general business is 24%, and profit tax exemption is divided in to 2, 4, and 6 years depends on promoted activities.

1.4 The conditions of target market (Competitive advantage of Bio coke and briquette charcoal)

1.4.1 Coal coke market

- The world coal coke market price is very influenced by Chinese amount of export. The major consuming nation of coal coke is Japan, Korea, and Taiwan.

Table 1 Coal coke imported experience (Yearly average: 2009 - 2012)

	Japan		Thailand		Korea		Taiwan	
	Import volume	CIF (US\$/ t)	Import volume	CIF (US\$/ t)	Import volume	CIF (US\$/ t)	Import volume	CIF (US\$/ t)
Chinese coal coke	315,796	510.70	31,701	570.52	273,052	428.87	86,082	456.85
Coal coke from other countries	114,024	303.45	85,412	406.41	141,740	347.23	564,165	216.66
Total	429,819	455.72	117,113	450.84	414,792	400.97	650,247	248.46

³ Aiming to promote investment and deployment of low carbon technologies, products, systems, services and infrastructure to achieve low carbon growth.

- Chinese coal coke price leads to higher import prices in each country.
 - There is not the industry to use coal coke such as casting company in Lao PDR.
- And so, we assume that the target market of Bio coke is for Japan and Thailand.

1.4.2 Coal market

- Cement Company is a major coal consumer in Lao PDR, its annual consumption is about 1 million ton, and its market price is about US\$113/ ton.
- Production cost of Bio coke is estimated US\$ 160 - 180/ ton, and so it is not expected to be price competitiveness to coal market.

1.4.3 Charcoal market

- Fuel wood and charcoal for cooking account for 60% - 70% of the total energy consumption in Lao PDR.
- Charcoal market price is extremely high pricing US\$ 292/ ton in Vientiane with double the price of Thakhek market price.



Photo 1 Carbonizing methods from scrap piece wood and Native tree Mai-tiew

Table 2 Charcoal market price and monthly consumption

	Industrial using		General household (Vientiane)			Small restaurant (Thakhek)	Restaurant (Vientiane)
	Silicon company		5 households	households (combined usage)		3	2
Cooking heat source	Charcoal (scrap piece of wood)	Charcoal (Mai-tiew)	Charcoal (Mai-tiew)	Charcoal (Mai-tiew)	LP gas	Charcoal (Mai-tiew)	LP gas
Market prices (kip/kg)	1,500 ~ 1,600	1,900	2,333	2,333	11,333	1,033	6,571
(US\$/t)	188.9 ~ 201.5	239.3	292.5	292.5	1,427.5	130.1	827.7
Average amount used (kg/M)	-	-	35 (15 ~ 60)	12 (5 ~ 15)	12 (8 ~ 15)	284	255

2 kinds of raw wood for charcoal; Scrap piece of wood in saw mill and native tree species Mai-tiew
 Mai-tiew charcoal is fuel of choice for many consumers, because of good calorific power, cheap price and easily-available.

- Native tree Mai-tiew is very popular and much in demand as a raw wood of charcoal, because

of high calorific value and long burning. It has been increasing Amount of production and export for Japan and Korea yearly, and therefore there are growing concerns about resource depletion of Mai-tiew.

1.4.4 Possibility of briquette charcoal as an alternative for charcoal

- Briquette charcoal is very popular as an alternative charcoal in China, Thailand, and also Japan. Briquette charcoal is made from sawdust, and its production method is similar to Bio coke. Bio coke and briquette charcoal particularly can use the same equipments of crusher, shredder, and sieving machine (See figure 2).
- For this reason, we made a study about business model of Bio coke and briquette charcoal as bellow.

1.5 Selection and procurement system of raw materials

1.5.1 Possibility of food-processing residue and farmer's harvesting residue (Rice straw and rice husk)

- The Beer factory generates the processing waste from raw materials, but its amount is only about 150kg / day. And also the rum factory generates bagasse, but factory use to be burning to boiler.
 - Harvesting residue from farmers generates such as rice straw and rice husk in the farmer's field. Farmer generally leaves their residue after harvesting in field, and uses them as cattle feed or compost to field.
- **It is not expected the processing waste as a raw materials for Bio coke and briquette. And rice straw and rice husk are light and bulky, and so transportation cost is expensive.**

1.5.2 Possibility of saw mill waste (Scrap pieces of wood, bark, and saw dust)

- The saw mill has generated saw mill waste at any time of the year on large scale, such as scrap piece wood, saw dust and bark.
- Saw mill waste that be crushed to the size of 1mm - 2mm, is suitable for raw materials of bio coke and briquette charcoal.
- On the other hand, to build factory at the waste generation site, it has an advantage in raw material procurement and investment for basic infrastructures of land and electric equipment, consequently has reduce their investment cost.
- We investigated about waste generation and usage of saw mill waste to exiting saw mill in Pakxan district Bolikhamxai province and Thakhek district Khammouane province.
 - Local charcoal agent and/or farmer buy scrap piece wood as charcoal material on a

regular basis.

- Sawdust, no one to take, when some farmer want to take, is provided free. But its amount is very few. Consequently, saw mill cannot treat with much sawdust and landfill them in mill.
 - Most saw mill owner make a comment “Many saw mill have problem of sawmill waste, if it forms a raw material for sale market, we want to sell a saw dust and other waste”.
 - Big saw mill generates saw dust 5 ton – 10 ton /day in Pakxan area, it is possible to collect saw dust 50 ton – 70 ton/day from big and small saw mill within 10 km distance. Sawmill in Thakhek is biggest sawmill in this area, and generates sawdust 50 ton – 70 ton/day by itself.
- **For this reason, saw dust and bark is not much used as charcoal materials, they have much promise as raw material of Bio coke and briquette charcoal.**
- Raw wood of saw mill depends on the Government development plan for development of hydraulic power generation and/or road construction. In case of stopping or changing the development plan in future, it might be decrease an amount of raw wood.
- **And so we need to make a new raw procurement system to use a plantation-logging residue and biomass plantation in future.**



scrap piece wood for sale



No using bark and irregular wood



Donating saw dust to farmer



Biggest saw mill



Landfilled saw dust



Saw dust

Photo 2 Generation status of saw mill waste

1.5.3 Possibility of exiting plantation logging residue and new biomass plantation

(1) Exiting plantation logging residue

- LPFL has plans to log the planted tree annual 1,200 ha base in LPFL plantation site and annual 800 ha base in farmer extension plantation site after 2015. Logged tree that the top end is 10 cm over is for pulpwod or timber wood. Logging residue that the top end is 9 cm less is for

charcoal wood or raw materials for Bio coke. Logging residue has potential to generate annual from few hundred ton to one thousand ton by estimating from annual logging area.

- To collect logging residue, LPFL has to employ 20 people/ ha, and LPFL estimate that the sale price of logging residue is about US\$ 20.9/ ton on road. This one is extremely high price, and factory cannot accept this price. And it is very difficult to secure manpower in this area. For this reason, this case is not feasible.
- **We think about feasible raw procurement scenario as bellows;**
 - **Farmer voluntary collects logging residue like collecting firewood, and carry them to factory by cultivator.**
 - **Or if farmers group and village can collect much logging residue, factory arranges a truck to buy them directly.**

(2) Acacia biomass plantation and Napier grass biomass plantation

- There are submerging lands that go down in water 1m – 3m depths in LPFL s concession area during the rainy season annually, this area is about 7,500 ha. Aiming to be effective use of their land, LPFL have been conducted the biomass trial of Acacia and Napier grass from October 2012.
- LPFL has estimated the biomass volume on logging from 4 months biomass volume data, and quoted the sale price on road. The sale price was quoted Acacia US\$ 8.0/ ton and Napier grass US\$ 11.0/ ton.
- **However, the above sales prices are acceptable price for factory, the above trial on going, the sale price vary greatly according to biomass volume on logging.**
- **It is apparent that Acacia and Napier grass has big potential to be raw material; we have plans to quote the sale price after the above trial period.**

1.5.4 Pre-production samples and analysis of bio coke

- Dr. Ida has made some precondition samples from several biomass and conducted an analysis of calorific value, CHN content, water content, and ash content.
- Biomass sample which used for analysis, we had collected them at local site from October to November 2012.

Table 3 The analysis of biomass from Lao PDR

No.	Samples	Gross Calorific Value [kJ/kg]	Gross Calorific Value [kcal/kg]	C [wt%]	H [wt%]	N [wt%]	Water Content [wt%]	Ash Content [wt%]
1	Stem of Mai tiew	18,350	4,390	46.59	6.39	0.11	9.34	0.58
2	Branches of Mai tiew	18,810	4,500	47.51	6.51	0.46	10.74	1.59
3	Branches of Eucalyptus	17,681	4,230	47.23	6.49	0.09	10.45	1.00
4	Branches of Acacia	18,099	4,330	46.66	6.55	0.46	9.75	2.27
5	Saw Dust	18,517	4,430	47.32	6.37	0.15	9.14	2.26
6	Napier grass	17,890	4,280	44.34	6.55	1.50	9.28	5.04

- Biomass sample; Stem of Mai-tie, Branches of Mai-tiew, Branches of Eucalyptus, Branches of

Acacia, Saw Dust, Napier grass.

- Gross calorific value and C content value; all biomass showed an average biomass value.
- N content value; Napier grass (herbaceous biomass) showed a slightly higher value, this value was not level that become some problem for burning.
- Also Ash content value: only Napier grass showed 5% level, this value was not level that become some problem, because of comparing with ash content of coal coke about 15%.

II. Business plan

2.1 Target selling price

(1) Target selling price of Bio coke

- According to an analysis of previous studies of Dr. Ida, Calorific value of Bio coke is lower than coal coke's value, and its range is about 4,302 kcal/kg - 5,497 kcal/kg.
- We assume that the standard calorific value of Bio coke is 4,500 kcal/kg and set the target sale price to the imported CIF price of Chinese coal coke by calorific equivalent price.

Table 4 Target sale price of Bio coke to Chinese coal coke for Japan and Thailand

Targeting market		for Japan	for Thailand	(for Korea)	(for Taiwan)
Bio coke	Standard calorific power (kcal/kg)	4,500.0	4,500.0	4,500.0	4,500.0
	Target sales prices (Calorific equivalent price) (US\$/t)	327.1	365.4	274.7	292.6
Chinese coal coke	Standard calorific power (kcal/kg)	7,026.0	7,026.0	7,026.0	7,026.0
	Import price (CIF) (US\$/t)	510.7	570.5	428.9	456.9

Source; Standard calorific power of coal coke; Published value (2005) of Ministry of Economy, Trade and Industry in Japan,

Target sales prices of Korea and Taiwan are for reference price.

(2) Target selling price of briquette charcoal

- Charcoal calorific value vary depends on the carbonization way, is about 6,500kcal - 7,500kcal/kg. We assume that Lao Charcoal calorific value is 7,086kcal/kg. In case of calorific equivalent price, the target sale price of charcoal briquette is US\$ 292.5/ ton. But in our monitoring test, there are some comments “briquette charcoal is good qualities, but lower price is better than charcoal (normally Mai-tiew)”.

Table 5 The target sale price of briquette charcoal in Vientiane

Targeting market for Vientiane			Briquette charcoal
Briquette charcoal	Standard calorific power	(kcal/kg)	7,086.0
charcoal	Target sales prices (adjusted)	(US\$/ton)	234.0
charcoal	Market price	(US\$/ton)	292.5
	Standard calorific power	(kcal/kg)	7,086.0

Reference; Wood pellet 3,800 - 4,500 kcal/ kg, wood chip 2,100kcal/kg

➤ **And so, we set the target sale price is US\$ 234/ ton which is US\$ 58.5/ ton less.**

2.2 Manufacturing conditions

- Investment terms: 20 years,
- Factory planned site: Existing saw mill in Pakxan district Bolikhamxai province, or in Thakhek district Khammouane province. This business model assumes in the form of a joint venture (JV) with local sawmill.
- Operating conditions: 3 sift/ 24 hrs, 25 days/ Month, 200 days/ Year,
- Products: Bio coke for Japan and Thailand, Briquette charcoal for Vientiane,
- Annual production volume: 3,000 ton for Bio coke and 60 ton for briquette charcoal,
- Annual raw procurement volume: 5,100 ton (estimated by saw dust on 40% moisture)

2.3 Raw procurement system and manufacturing process

- ① Small scale saw mill and/or farmers carry some saw mill waste, plantations logging waste, and small trees to factory, and sell them. We assume that the annual quantity purchase from them is 1,500 ton.
- ② Distant farmer cannot carry small trees to factory. For this reason, factory installs the small wood shredder in rice mill. Farmer carries them to rice mill, and crush down them by machine, and sell to rice mill. We assume that the annual quantity purchase is 600 ton from distant farmer. Factory collects a crushed material from rice mill regularly.
- ③ We assume that the annual external procurement quantity is total 2,100 ton. Usually, farmer's raw materials concentrate in dry season (from November to February). For this reason, factory has plans to adjust the amount of raw materials according to amount of farmer and small scale saw mill, and has plans to be stable procurement throughout the year.
- ④ Factory procures saw mill waste (Saw dust, bark, and etc.,) from JV partner. We assume that the annual internal procurement quantity is 3,000 ton.

- ⑤ Factory has plans to purchase raw materials on a wet weight base. We assume that the purchase price of raw materials is US\$ 6.19/ ton by reference to the local purchase price of Mai-tiew for charcoal wood. Usually, saw dust is provided free from saw mill to some farmers.
- ⑥ Uncrushed raw material 1st yard,
- ⑦ Fixed wood crusher (made in Thailand) for crushing small trees, scrap pieces wood, and bark,
- ⑧ Stock yard for 1st crushed raw materials (with roof),
- ⑨ Shredder for saw dust (made in Thailand),
- ⑩ Saw dust stock yard (with roof),
- ⑪ Sieving machine for saw dust (made in Thailand),
- ⑫ Saw dust dryer (made in Thailand),
- ⑬ Bio coke reactor (made in Japan),

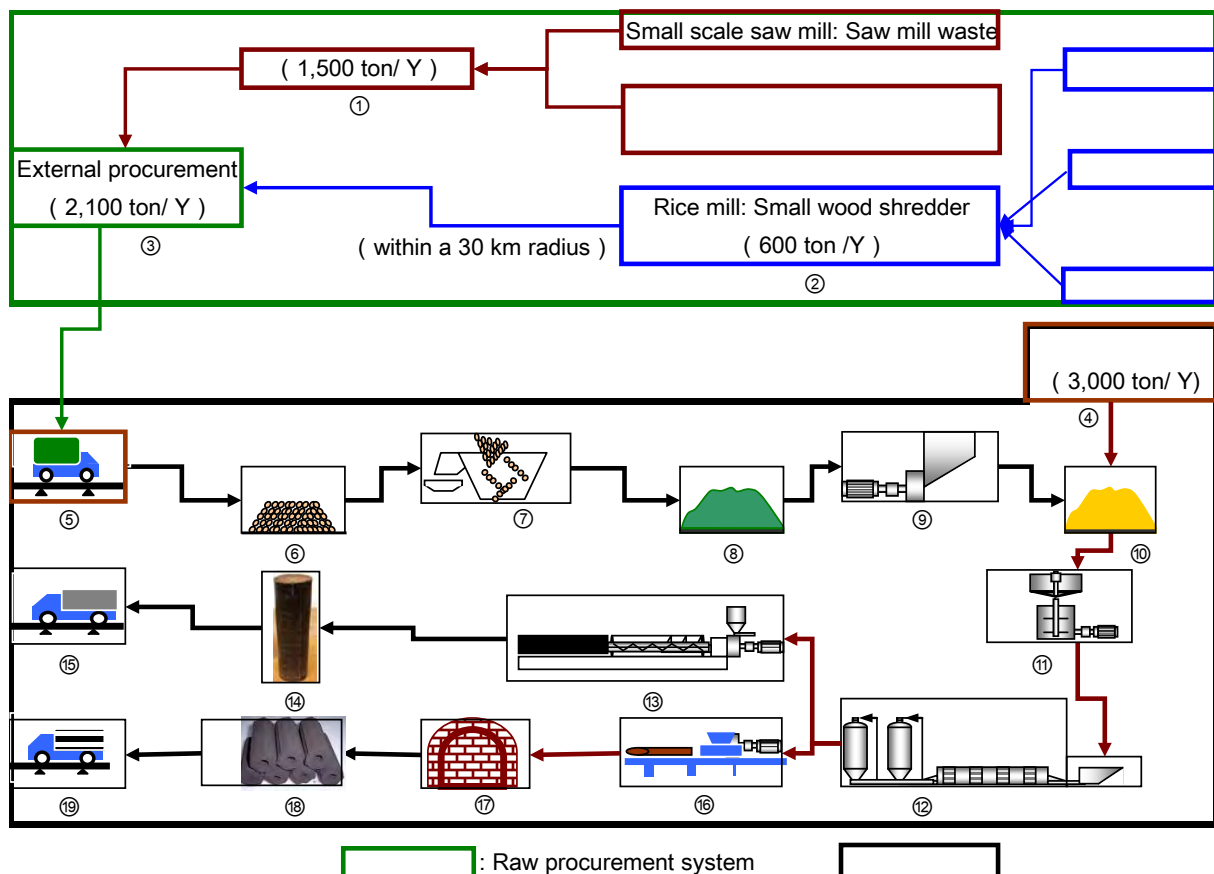


Figure 2 Raw procurement system and manufacturing process

- ⑭ Bio coke; Annual production volume is 3,000 ton (2,100 ton for Japan, 900 ton for Thailand). We assume that the target selling price for Japan is US\$ 327/ ton, one's for Thailand is

US\$ 365/ ton.

- ⑮ Bio coke's transportation route; Thakhek in Lao PDR – Bangkok in Thailand by truck, Bangkok – Yokohama in Japan by ship, Briquette extruder (made in Thailand); Annual production volume is 300 ton (for general households in Vientiane),
- ⑯ Charcoal kiln for briquette charcoal; Briquette decreases in weight by carbonization, and as a result, annual briquette charcoal volume was 60 ton (Yield ratio; 20 %),
- ⑰ Briquette charcoal for general household in Vientiane
- ⑱ Briquette charcoal's transportation route; Thakhek – Vientiane in Lao PDR by truck.

2.4 Products transportation cost

- We assume that there are 2 routes from Thakhek via Viet Num, or via Bangkok to export bio coke for Japan. In case of via Viet Num, its distance is about half of via Bangkok.
- As a hearing result to logistic companies in Lao PDR and Thailand, we had some comments “The road infrastructure for Thakhek - Vun Ang port is fragile, and/or bilateral customs procedure could not go along smoothly”
- For this reason, we assumed that transportation route to export bio coke for Japan was as follows;
 - **Transportation route of Bio coke: Thakhek - Bangkok - Yokohama for Japan, and Thakhek - Bangkok for Thailand,**
 - **Transportation cost of Bio coke: US\$ 97.2 / ton by 20 feet container (Thakhek – Bangkok), and US\$ 48.9/ ton by ship (Bangkok - Yokohama)**
 - **Transportation cost of Briquette charcoal: US\$ 20.2 / ton by truck (Thakhek - Vientiane)**

2.5 Planning of manpower and human resource development

- **Factory employs local people in principle.**
 - Operation: 24hrs/ day,
 - Employment: 44 people,
 - Manager class 1 people, Middle engineer 1 people, and worker 42 people (included 3 people for making briquette charcoal) ,
 - 18 people x 3 shift: Implementing wage differentials between day worker and night worker base.

2.6 Business model planning and evaluation

2.6.1 Financial conditions

(1) Capital: US\$ 600,000.

JV has plans to procure this capital from parent company respectively.

(2) Debt payable

JV has plans to procure this fund from local bank, or parent company respectively.

➤ **We assume that borrowing period is in 7 years.**

(3) Profit tax exemption

➤ **We assume that borrowing period is in 4 years.**

This value is an intermediate value between 2 year, 4 year, and 6 year in 2nd zone of general invest promotion.

(4) Debt with interest rate

Current interest rates (kip base) are at 6.5 % to 11.0% per annum from local bank in Lao PDR (surveyed by PwC). Debt with interest rate varies according to terms and conditions of loan,

➤ **And so we assume that debt with interest rate is at 6.5 % per annum.**

(5) Inflation rate

- Inflation rate was average 6.99 % per annum in the past decade for 2003 – 2012 (IMF - World Economic Outlook Databases 2013).

- Inflation rate is highly important factor and is difficult to predict. For this reason, we assume that 3 business models to evaluate for feasibility and profitability.

➤ **Current business model,**

➤ **Modified business model A; is added 6.0 % per annum to the inflation rate over the next 20 years**

➤ **Modified business model B; is added 7.0 % per annum to the inflation rate over the next 20 years**

(6) Target sales price increasing rate

- Bio coke's target sales price moves in tandem with the imported CIF price of Chinese coal coke.

- The imported CIF price of Chinese coal coke fluctuated within the range of 3.0% - 4.0% in Japan.

➤ **We assume that target sales price increasing rate is 3.5% per annum.**

➤ **Charcoal briquette's target sales price moves in tandem with the inflation rate 6.0% or 7.0%.**

Table 6 Financial conditions

	Current business model	Modified business model A	Modified business model B	Remarks
Investment terms (Y)	20	20	20	Investment promotion law
Capital increase (US\$)	600,000	600,000	600,000	Minimum capital; US\$ 300,000 or more
Cash reserves (US\$/Y)	100,000	100,000	100,000	
Debt with interest rate (%)	6.5%	6.5%	6.5%	(Provisional value)
Profit tax (%)	24.0%	24.0%	24.0%	Current ratio in general business
Profit tax holiday (Zone 2) (年)	4	4	4	(Provisional value/ Intermediate value)
Minimum Tax (%)	0.25%	0.25%	0.25%	Current ratio
Inflation rate (%)	0.0%	6.0%	7.0%	(Provisional value/ kip base)
Target sales price increasing rate				
(Bio coke) (%)	0.0%	3.5%	3.5%	(Provisional value/ Intermediate value)
(Briquette charcoal) (%)	0.0%	6.0%	7.0%	Moving in tandem with the inflation rate

Increasing import price CIF of Chinese coal coke; 3.0% - 4.0% for 2009 - 2013

2.6.2 Current business model

(1) Project cost

- Investment cost was US\$ 1,856,139, and capital increase was US\$ 600,000 (Ratio; 32.0%).
- Debt payable was US\$ 1,256,139 (Ratio; 68.0%), and could refund in 6 years.

(2) Financial and profitability;

- Current net income was US\$ 3,068,116 (Ratio; 15.0%).
- Net present value (NPV) was US\$ 2,300,079, and internal rate of return (IRR) was 11.9%.

(3) Profit and loss planning

- Amount of sales was US\$ 20,510,053, and cost of sales was US\$ 16,245,909.
- **Current business model was feasible, but IRR was somewhat low.**
- If the road infrastructure (Thakhek - Vun Ang port) and the bilateral customs procedure are improved by public investment and support in the future, transportation cost go even lower, and then become an increasingly profitable business

2.6.3 Modified business model A; Impact of inflation rate and target sales price increasing rate to current business model

- Revised a Inflation rate 6.0% and the target sales price increasing rate 3.5%.
- However, cost of sales increased to 45% by an inflation rate. Amount of sales increased to 42% with elevation of target sales price increasing rate. And as a result, current net income became US\$ 4,093,025 (Ratio; 33%). IRR was improved from 11.9% to 14.7%
- **Modified business model A was feasible.**

2.6.4 Modified business model B; Impact of inflation rate and target sales price increasing rate to current business model

- Cost of sales exceeded the amount of sales, current net profit got into the red.

➤ **Modified business model A was not feasible.**

Table 7 Impact of inflation rate and target selling price rate to current business model (Modified business model A and B)

		Current business model	Modified business model A	Difference (%)	Modified business model B	Difference (%)
Precondition	Profit tax (%)	24.0%	24.0%	0.0%	24.0%	0.0%
	Profit tax holiday (Y)	4	4	0	4	0
	Debt with interest rate (%)	6.5%	6.5%	0.0%	6.5%	0.0%
	Inflation rate (%)	0.0%	6.0%	6.0%	7.0%	7.0%
	Target sales price increasing rate (%)	0.0%	3.5%	3.5%	3.5%	3.5%
Investment amount (US\$)	1,856,139	1,856,139	0	1,856,139	0	
Current net income (%)	15.0%	14.0%	-0.9%	7.3%	-7.7%	
Operating income margin (%)	20.8%	19.1%	-1.7%	10.6%	-10.2%	
Recurring profit margin (%)	19.4%	18.0%	-1.4%	9.7%	-9.7%	
NPV (5.0%) (US\$)	2,300,079	2,894,493	594,414	1,979,538	-320,541	
IRR (5.0%) (%)	11.9%	14.7%	2.9%	11.7%	-0.1%	
Amount of sales (US\$)	20,510,053	29,155,838	8,645,785 42%	29,214,945	8,704,892 42%	
Cost of sales (US\$)	16,245,909	23,595,627	7,349,718 45%	26,111,532	9,865,623 61%	
Business profit (US\$)	4,264,144	5,560,210	1,296,067 30%	3,103,413	-1,160,731 -27%	
Current profit (US\$)	3,980,609	5,294,805	1,314,195 33%	2,835,612	-1,144,998 -29%	
Pretax current income (US\$)	3,980,609	5,294,805	1,314,195 33%	2,835,612	-1,144,998 -29%	
Current net income (US\$)	3,068,116	4,093,025	1,024,909 33%	2,118,226	-949,890 -31%	

- As above, the inflation rate and the target sales price increasing rate have a decisive influence on feasibility and profitability of business model.
- Bio coke has potential to reduce carbon dioxide emissions from coal coke's burning.

2.7 Financing plan

- There are 3 categorized way of raising funds; the borrowing via controlling company of bank, the borrowing from the Japanese official lending system via controlling company, the borrowing of JV from local ban.
- We have plans to seek a range way of raising funds after decision in business.

2.8 Schedule after decision in business

- We need to be more study and discussion with concerned person for decision in business. Oji has plans to make a continual study about Japanese coal coke's user and local JV partner by March 2014.
- Case of decision in business, Oji has plans to approach and discuss with Lao government, and apply the business proposal in 2014. Oji assumes to start in business on April 2015.

2.9 Possibility of utilization of Joint crediting mechanism (JCM) of Bio coke

- **Biomass of Raw material is carbon neutral. And there are CO2 emission from consumptions of fuel and electric power on collecting raw materials, manufacturing,**

and transporting products in this business model.

- CO2 emission with coal coke burning is reduced by alternating to Bio coke in Japan and Thailand.
- Bio coke and this business model fall basically in policy with the Seventh five-year National Socio-Economic Development Plan, Japanese government country assistant policy, and also JCM.

III. Possibility of cooperation with JICA activities

3.1 Financial cooperation

- Oji assumes to utilize the JICA the foreign investment and loan program,
- It is expected to have applicability of maximum investment promotion such as profit tax and exemption from Lao government, and also JCM.

IV. Development impacts

4.1 Setting the development indicators to development subjects

Table 8 Development issue and development index (Target value) through this business activity

	Development issue	Development index (Target value)
1. Market and distribution	(Bio coke) 1) Dependence on Chinese coal coke, Japan: 315,796 ton/ year Thailand; 31,701 ton/ year 2) Influence on Chinese coal coke's import CIF price; Japan:US\$510.7/ton, Thailand; US\$ 570.5/ton (Briquette charcoal) Charcoal market price in Vientiane: US\$ 293/ton Not popular an alternative good, and/or price is extremely high (LP gas).	(Bio coke) 1) Offering to market; Japan: 2,100 ton/ year Thailand: 900 ton/ year 2) Target sale price; For Japan: US\$ 327/ ton For Thailand: US\$ 365/ton 3) CO2 emission reduction by alternating bio coke (Briquette charcoal) 4) Offering to market: Vientiane: 60 ton/ year 5) Target sale price: For Vientiane : US\$ 234/ ton 6) Fuel reduction rate per household: 20%/year.

2. Logistic and transportation	-	(Briquette charcoal) Sales base in Vientiane: Direct sale at sale base; Or commissioned sale to BOP group,
3. Manufacturing	- Absence, or less access to local market to sell raw materials, - Unknown how to set the sale price, - Limiting an approach ways to local market - Sales price is lower, - Difficult to predict, - Absence, or less access to get cash. - Absence, or less access to job opportunity - Not treat with much sawmill waste, - Land filling saw dust - Varying in quality of charcoal - Low efficiency of local kiln	(Bio coke) Annual production: 3,000 ton/ year Briquette charcoal: 60 ton/ year Employment: 44 people Average annual salary: US\$1,723/year. Salary ratio to annual income of employee: %/ year Annual trained employee to OJT: people /year Factory payment to the work condition improvement and OJT
4. Raw material production / collection	(Sawmill) Too much sawmill waste, Not treat with sawdust, Absence sawmill market, (Farmer) Absence market to sell raw materials and logging residue, Resource depletion of Mai-tiew,	Raw procurement amount; 5,100 ton/year Sawmill waste ratio of total raw materials: %/ year. External raw procurement:2,100 ton /year Household of raw material sale: 210household year. Farmer's raw material sales of total income: %/ year/ household. Mai-tiew plantation area : 210 ha/ year

4.2 Development impacts action scenario

- This business model has potentials to expand production scale depends on biomass amount and /or collectable amount, and also expand to another area in Lao PDR. And more, this business model has potentials to expand into Asia area.
- This business model has potentials to reduce the CO2 emission in Asia , from utilizing biomass waste of carbon neutral, manufacturing Bio coke, and exporting Bio coke to consumer country of coal coke
- It is expected to become the pioneering business model as BOP business in Lao PDR among another country that aim to achieve the sustainable and ecological economic development.