

Abstract - Final Report

Investigation of CDM (Clean Development Mechanism) Potential for Bio-coal Briquette Technology at the Huainan Coal Mine in Anhui Province, China

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1. Project Background

According to *China Statistical Yearbook 2006*, the Republic of China produced 2.6 billion tons of raw coal (a primary figure) in 2005 and had become the world's second largest coal mining country, after the USA. China, which is dependent on coal fuel as a principal energy source, also became the largest coal consuming country in 2005 due to the rapidly increasing energy demands of its industries.

China Statistical Yearbook 2006 reports that coal accounted for 70% of total primary energy consumption in 2006. This figure has increased continuously in lockstep with Chinese economic growth, starting in 2002 when the country's *Tenth Five-year Plan* was issued. The yearbook also reported a ratio of 76.4% raw coal production and 68.9% consumption toward total primary raw coal sources.

Due to rapid economic growth in China, many different raw energy sources are required to maintain domestic industrial production. However, at the same time, China faces environmental issues, including increasing SO₂ emissions and greenhouse gasses. Emissions amounted to 25,490 thousand tons of SO₂ and 11,800 thousand tons of soot in 2005. These figures exceeded the government's target volume for 2005 and would increase by 10 to 20% over the regulated value until the end of 2010. In China, 3 billion tons of CO₂ emission which was caused by fossil fuel combustion would be discharged according to the IEO official report and China became the second largest emitter of CO₂, after the USA.

The report also recorded 4.5 billion tons of CO₂ emission in 2004, representing 15% of the world's total CO₂ emissions. The Chinese government publication, *International Energy Outlook* projects, CO₂ emissions of 5.5 billion tons in 2010, 7.4 billion in 2020 and 8 billion in 2025, whence China would become the highest CO₂ emitting country.

China's *11th Five Year Plan*, which was based on the previous five-year plan, contains policies to address China's environmental problems, including: (i) developing technology to reuse waste resources; (ii) combating environmental deterioration; and (iii) reducing the disparity between rural and urban incomes.

The *11th Five Year Plan* aims at establishing an environmental friendly society, (a so-called "Healthy Society") in 2020, rather than promoting economy growth. The main issues addressed by the plan are: (i) maintaining continuous reliable economic growth (ii) increasing the efficiency of waste recycling; and (iii) reducing emissions of pollutants by 10%. The plan also establishes functional farmer's organization support of (ii) (iii), and related agricultural transport infrastructure. This plan also provides the following basic guidelines for the energy industry: (i) investigate energy saving technologies and improve industrial energy efficiency; (ii) develop advanced coal processing technologies and investigate the potential of efficiently utilizing all coal resources; and (iii) develop clean energy technologies.

In order to accomplish the above, the Chinese Government is investigating advanced energy recycling technologies, such as: (i) biomass electricity generation; (ii) biomass briquette fuel; (iii) wind power; (iii) bio- ethanol fuel; and (iv) bio-diesel fuel.

2. Project outline

2-1 Background of the project

China's Anhui Province is blessed with favorably located raw coal and has sufficient infrastructures to supply these materials widely throughout China. Huainan Mining Group Limited, one of the largest local coal mining organizations in China, is responsible for providing a large proportion of the raw coal supplies and electric power to the Yangtze River delta and China's eastern regions. Huainan Mining Group is also one of the principal organizations that have been tasked to carry out the Anhui Provincial Government's *East Point Development Strategy*. Production volume of coal at Huainan Group mines increased to 40,000 thousand tons in 2006 from 25,000 thousand tons in 2003. However, the *11th Five Year Plan* proposes to decrease the total volume of pollutants China emits and obliges Chinese organizations to study ways to substitute new energy resources for

coal in industrial production. As a result, Huainan Mining Group has decided to establish a new subsidiary to assess and develop environment friendly technologies, including: (i) ways of measuring the effectiveness of environmental technologies; and (ii) ways of measuring changes in the rate of environment deterioration. This project was established by as an official medium-term management strategy of Huainan Mining Group Limited, however they are aware that meaningful activity over the long term is required.

2-2 Operational sharing of the project

This project will be shared between China and Japan as follows.

(1) Japan:

1. Bio-coal briquette marketing
2. Consultation on the technology
3. Economic analysis on the Clean Development Mechanism (CDM) (preparing the feasibility study)

(2) China:

1. Provide a site to establish the plant
2. Build a stable supply of raw materials (coal/biomass)
3. Provide a facility investment plan and procure funds
(Japan will assist with estimates)

2-3 Project framework

(1) Purpose: The main objective of the project is to develop bio-coal briquettes for use by households and small industries to: (i) reduce CO₂ and SO₂ emissions from coal burning and meet environmental requirements; and (ii) effectively conserve local energy resources.

(2) Production capacity: 100,000 tons/year (in the early stages). Increase production capacity gradually in later stages, leading to a 1 million tons/year facility on completion.

(3) Technology: Use Japanese technology, such as: “Bio-coal Briquette Production technology

(4) Target markets and end-uses:

1. Markets: Anhui Province, Yangtze River delta and East China.
2. End-uses: The briquettes can be used as a household fuel as well as a fuel for light industries without the installation of expensive filters and scrubbers.

(5) Facility investment: 100,000 tons/year (50,000 tons/year x 2 lines)

Plant location: It is expected that a plant with the above production capacity will cost Japanese Yen 760,000,000, using mainly imported equipment and parts. The above figure excludes the cost of securing a plant site and constructing warehouses and is subject to final confirmation.

(6) Project financing: It is anticipated that the Chinese counterpart will supply 100% of the funding for the first stages. Some 30% of funding will be equity and 70% will be loans.

(7) Management form: Under consideration by the counterparts.

(8) Special conditions: (i) The counterparts plan to apply the CDM; and (ii) expect to start the project by October 2008.

2-4 Conditions of the project outline

2-4-1 Project location: (confirmed)

(1) Location: Anhui Province

(2) Location area: 15,000m². A similar size block of land is available adjoining the present location.

(3) Landowner: Huainan Mining Group Limited (counterparty)

(4) Infrastructure: (i) electricity – the counterparty can supply self-generated electricity (135,000kw x 2 units); (ii) water supply – it is confirmed that there is sufficient volume of underground water at the plant location and it is possible to drill for the water, if necessary, during the project; (iii)

transportation – present train tracks in the mining area can be used if necessary. Raw coal from the mining area would be transported by truck to the project location, a distance of around 2km.

(5) Environment problems at the project location: None.

2.4.2 Raw material supply system and prices: confirmed

(1) Raw material (coal-cleaning slurry or low-grade coal)

1. Raw material coal: Plan to source from Huainan Mining Group Limited (3.6 million tons/year: 2005 year basis).
2. Coal-cleaning slurry: Plan to source from the coal treatment/cleaning facility next to the diggings area (300,000ton/year: 2005 year basis).
3. Spare raw materials for emergency use: Huainan Dongchen Group Co., Ltd. (1.6 million tons/year: 2005 basis).

(2) Specification and prices

1. Raw material coal: moisture 0.3 – 0.5% 5,000 – 5,700Kcal
(Price 480 Chinese Yuan/ton: Ex-factory)
2. Coal Cleaning Slurry: Ash content 41.6% 3,300Kcal
(Price 248 Chinese Yuan/ton Ex-factory)

(3) Biomass supply system and prices: (confirmed)

1. Biomass: Rice straw should be used as biomass and collected from a 50 km radius from the site location.
2. Biomass volume available: According to a report by Huainan City and the Anhui Provincial Commission for Agriculture, around 1,200 tons of biomass (rice straw), of which 30% is combusted annually. Although Anhui Province is considering extending its biomass electric power generation (based on the *11th Five Year Plan*), the Huainan City area alone could potentially supply one million tons of biomass.
3. Biomass purchasing arrangement: A biomass electric power project is already operating in Anhui Province. In order to proceed, a professional local company has been contracted to correct and compress the biomass. The

biomass is transported to the existing regional electric power station. Because the biomass is processed before transportation, its price at 350 Yuan/ton is little higher than we first expected. However, we feel optimistic we can source the biomass at reduced prices as compression processing should not be necessary. Furthermore, the biomass stock yard has already been completed to serve the electricity generation project, and the bio-coal project could help ensure stability of biomass supply. The Anhui Provincial Commission for Agriculture is aggressively promoting this idea.

3. Counterpart details

We were officially introduced to the counterpart to the project – Huainan Dongchen Group Co.,Ltd. – by Huainan Mining Group Limited at our first meeting. Huainan Dongchen Group is responsible for industrial activities, including mining and other business related to this project. The company is also responsible for: (i) monitoring any negative environmental impacts from mining activities; (ii) overseeing mine safety and investigating mineral resources; and (iii) solving problems derived from mine closures and restoration of mined-out areas. Several discussions have already been held with the counterpart during our three visits to China.

1. Name: Huainan Dongchen Group Co.,Ltd.
2. Executive: President of CEO Mr. Gan Fei
Vice President Mr. Wng Li Hui
3. Address: Huainan, Anhui, China
4. Related subsidiaries: 19
5. Number of mines: 8 (16 billion tonnes/ year)
6. Number of employees: 25,000
7. Capital: 340,000 thousand Chinese Yuan
8. Property: 1.2 million Chinese Yuan
9. Turnover: 1.4 million Chinese Yuan (1.6 million Yuan in 2005)
10. Annual tax payment: more than 100,000 thousand Chinese Yuan

4. Effect of introducing Bio-coal Briquettes

4-1: Expected direct impact

Soot and dust are reduced drastically to 1/10th to 1/15th of the original coal, because biomass increases volatile matter in the briquette and thus increases ignitability and combustibility of the coal. Moreover, bio-coal briquette includes 20% to 30% biomass, decreasing coal consumption equal to the quantity of the biomass content. Slaked lime absorbs SO_2 , reducing its emission by 50% to 70%, and turns ashes into an anhydrous gypsum in the form of fine sand which could possibly be used as a soil improvement agent. Due to high pressures, the briquettes are solid enough to keep their shape during handling and transportation, as well as burning.

4-2: Expected environmental benefits

In the process of combustion, biomass burns before coal in a lower temperature zone. This creates numerous pinholes on the surface of the burning briquette, increasing the surface area of the briquette in contact with oxygen and increasing the combustibility of the remaining coal. Consequently, coal consumption decreases by more than 25% in an industrial boiler and more than 30% in household uses. Assuming 100,000 tons of bio-coal briquette production annually and 20% biomass content in briquettes, the estimated quantity of Greenhouse Gases (CO_2) sequestered in "tons of carbon equivalent" would be 56,500 tons of CO_2 /year, calculated according to the IPCC Guidelines for National Greenhouse Gas Inventories.

4-3: Expected indirect impact:

The introduction of the new briquettes will create new jobs, while maintaining coal mining. Without the project, high-sulfur coal reserves will become worthless and mine closures will result in high unemployment. Similar coal is mined and used in neighboring provinces, where similar problems to those facing Anhui province currently exist. If successfully implemented, the briquette technology can be replicated elsewhere in the region.

5. Economic analysis

5-1: Economic efficiency

Bio-coal briquettes are less price competitive than raw coal at commercial volumes because they cost more to manufacture. In order to overcome this economic barrier and achieve stable market prices for bio-coal briquette, we believe that approving CDM (clean development mechanism) and gaining income from CER (Certified Emission Reduction) would be necessary for the business to succeed. Furthermore, accomplishment of the CDM project will strengthen the international standing of the Kyoto Protocol and provide mutual assistance benefits for Japan and China.

5-2: Economic analysis

The internal rate of return (IRR) for 21 years from the beginning of bio briquette production equates to 6.6% without CER credit. Consequently, it would difficult for the bio-coal business to be commercially feasible over the long term unless its economic efficiency could be enhanced through CER. If CER enhancement is available, adding our estimated Greenhouse Gases (CO₂) sequestered "tons of carbon equivalents" of 56,500 tons CO₂/year, would improve the IRR to 26.71%. The details of the calculation are included below.

6. Conclusion

The conditions favor the success of the project. Firstly, our project partner, Huainan Mining Group Limited, is in an ideal position to manage the project. It has adopted the project as an official medium-term management strategy and one of the company's main operating organizations has decided to establish a new subsidiary to assess and develop bio-briquette technology. Secondly, Anhui Province, where the project is based, has ready supplies of raw coal and agricultural waste materials plus the infrastructure required to supply these materials to the project site. Finally, we are confident that this project meets the official government policy guidelines on addressing environmental problems given in China's *11th Five-year Plan*. Bio-coal briquette technology offers effective solutions for the environment deterioration and energy saving issues facing China today.