

Project Information Document (PID)

Project Name:	China-Yantai IGCC Project
Region:	East Asia and Pacific Region
Sector	Power (100%)
Project ID:	P071439
Borrower(s)	Government of China
Implementing Agency	State Power Grid Company, Shandong Electric Power Group, Shandong International Investment and Trust, and Yantai Power Development Company. They will form a special purpose company to execute the project.
Environment Category:	A
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1. Country and Sector Background

Main Issues:

Coal accounts for about 70% of China's current primary energy supply and the country's coal consumption has exceeded 1.0 billion tons per annum in recent years. It is expected that coal will remain China's main option for meeting its enormous and growing energy supply needs for the foreseeable future, especially for power generation. The impact of such high growth rates in coal-fired power generation will cause unacceptable local, regional and global environmental problems.

Government Strategy:

China has therefore adopted a multi-pronged strategy to reduce pollution and GHG emissions from coal-fired power generation. The main components of this strategy are to: (a) rapidly close its many inefficient small coal-fired power generation units and replace them with much larger and more efficient units; (b) accelerate the application of flue gas de-sulfurization; and (c) pilot and demonstrate advanced coal-fired power generation technology, specifically Integrated Gasification Combined Cycle (IGCC) technology, which is the "clean coal" power generation technology that offers the best combination of pollution reduction, efficiency improvement and commercial viability prospects. China is also willing to take the initial steps towards a strategy for "zero power generation emissions".

Bank Strategy:

The Bank has actively supported China's environmental objective for many years by promoting technology transfer. The Bank's current Country Assistance Strategy (CAS 2003-2005, January 2003) stresses that one of the Bank's key objectives is to "facilitate China's environmentally sustainable development process, through investment lending in natural resource management, watershed rehabilitation and wastewater treatment, energy, global environment projects supported by the Global Environment Facility (GEF) and the

Montreal Protocol, and through related policy work.” And the CAS explicitly lists promoting clean coal technologies as one of the means to achieve China’s strategic objectives in energy sector that the Bank will support, in addition to changing the fuel mix and improving energy efficiency. Consistent with these objectives, the GEF is generously supporting several large energy efficiency and renewable energy projects in China. But accelerating development and deployment of clean coal technologies is another important area of focus to reduce greenhouse gas emissions and local pollution. Hence the Bank has long been providing technical assistance to the government in this specific area through policy advice on deployment of technologies, technical assessment and least cost environmental compliance studies, which have laid the ground work for this project.

Support to IGCC demonstration and replication is the next step in the Bank’s commitment for more than two decades to help China reduce the environmental impacts of coal based power generation. This assistance has comprised: (a) introduction of the first 300 and 600 MW units in the country; and (b) introduction of large super-critical units (2x900MW) and the “bubble concept” for optimal use of FGD. In the technology assessment, advanced clean coal technologies including Atmospheric Fluidized Bed Combustion (AFBC), Pressurized Fluidized Bed Combustion (PFBC) and the IGCC are identified to further improve environmental performance and energy efficiencies. Among others IGCC technology has been selected for this project, because the IGCC is not only a key next step in capturing environmental benefits from increased conversion efficiency, it also offers the possibility of reducing emissions of CO₂ from the gas stream that is significant as a first step towards the goal of “zero CO₂ emissions” from coal based power generation.

2. Objectives

The objectives of the project are to: (a) reduce China’s greenhouse gas emissions and local air pollutions from coal-fired power generation by accelerating the adoption of the integrated gasification and combined cycle (IGCC) technology; and (b) help the Chinese government to develop and to gradually implement a “zero CO₂ emissions from coal strategy” and plan for a pilot hydrogen production and CO₂ sequestration project, as a first, practical step to implementing such a project. The project would (a) provide Chinese government and utility industries with full access to cutting-edge knowledge of IGCC technology and international best practice in plant design and operation, which would both accelerate construction and improve plant performance, thus enhancing the technology’s replication potential and prospects; (b) strengthen the design and implementation of China’s IGCC replication strategy and action plan, and thus speed and deepen the dissemination of experience gained from constructing and operating the Yantai plant and; (c) by modifying the plant design to facilitate CO₂ sequestration, help China to immediately develop and subsequently begin implementing a long term strategy to gradually move towards a “power generation zero emissions” objective.

3. Rational for Bank’s Involvement

The GEF support for the proposed project is critical for the following reasons: (a) the financial and technical/operational risks of IGCC technology are high in any developed country and are more challenging even in a relatively advanced developing country such as China; (b) the success of the proposed pilot project is a critical step in China's gradual approach for adapting and developing IGCC technology on a large scale, and the GEF involvement would leverage cutting-edge technical knowledge and international best practice to ensure the success of the project; (c) China has the world's largest potential market for dissemination of the technology; (d) the potential for cost reduction is high because of the enormous size of the Chinese market and the country's successful experience in reducing manufacturing costs of large size coal-fired and hydro units after their introduction in China, which have benefited not only China but also international markets; (e) the GEF support to studies and analytical work on the "zero CO₂ emissions" option would increase awareness and initiate thinking World-wide about long term policies to achieve progress towards "zero CO₂ emissions" from coal-based power plants. The GEF support will, therefore, accelerate the dissemination in an orderly manner of the IGCC in power markets in China and other part of the world, and will ultimately achieve a very large reduction in greenhouse gas emissions World-wide.

4. Description

The proposed project consists of the construction, commissioning, operation, demonstration and replication of a green-field 300-400 MW IGCC plant at Yantai, Shandong Province, and the development of a long-term strategy to gradually achieve zero CO₂ emissions from coal-fired power generation in China. The overall IGCC plant train system would include an air separation plant for producing oxygen, an entrained coal gasifier, a gas clean-up system to remove sulfur gases, ammonia and ash, and a combined cycle power generation system. Other important auxiliary systems comprising the plant would include coal grinding equipment, a pressurized coal feed system, and associated heat exchangers to heat and cool gas streams. The State Power Grid Company, Shandong Electric Power Group, Shandong International Investment and Trust Co., and Yantai Power Development Company will form a Special Purpose Company to build, operate and manage the Yantai IGCC plant. The plant would be designed to use indigenous high sulfur, high calorific value and low ash coal.

5. Financing

The total project cost is estimated to be about US\$420 million, of which 20% will be financed by equity, 75% by a domestic loan and (China has requested) the balance by a US\$15-18 million GEF grant. The Chinese Government has decided bear the bulk of the US\$120 million cost difference between constructing a comparable PC plant (the least cost option) and the IGCC plant. It has requested GEF co-financing of just: (a) the incremental cost (\$9-10 million) of making the design changes and increasing the capacity of the oxygen plant, gas clean up system and other auxiliary system in order to (i) test various types of Chinese coal and thereby facilitate future replication of IGCC technology; and (ii) equip the plant for future hydrogen production and CO₂ sequestration; (b) capacity building (\$2-3 million) to provide state-of-the-art technical

assistance and training during the construction of the plant and to build-up the operational capacity of the implementing agency to ensure successful and high efficiency operation of the plant; (c) technology improvement to lower costs (\$3 million) which will focus on experience and knowledge dissemination and on actions that would lead to lower costs by tapping China's low cost domestic manufacturing potential; and (d) development of a zero emission CO₂ coal-fired power generation emission strategy (\$1-2 million).

6. Implementation

The proposed project will be implemented by a very experienced and capable group of large power companies, with strong support from Chinese government. The equity of the project will be shared by State Power Grid Company (42%), Shandong Electric Power Group (23%), Shandong International Investment and Trust (15%), and Yantai Power Development Company (20%). They will form a special purpose company to execute the project.

China's State Council and National Peoples' Congress have included the project in the list of the priority key projects to be initiated during the Tenth Five Year Plan (2001-05). Key projects included in this Plan are the priority projects recognized by the highest authority of the Chinese government. The Ministry of Finance (MoF) would be the recipient of the GEF grant, on behalf of the Chinese government. The current agency designated by the Chinese government as the lead executing agency is State Power Grid Corporation. The success of the proposed project would be determinant for the adoption and dissemination of the technology in China.

7. Sustainability

The Chinese Government and the implementing agency that will be directly responsible for the project are fully committed to the project's success and sustainability and have already collected a considerable volume of information and data on the construction, operation and maintenance of IGCC plants in the US and Europe. Senior Yantai power plant staff have also begun acquiring the requisite skills for operating and maintaining an IGCC power generation plant. A large part of the experience gained in operating IGCC projects in the US and Europe will be made available through the Bank/GEF support. The chance of ultimate success for the project is high and the global benefits from the dissemination of the technology in China and in other countries are also very high.

8. Lessons learned from past operations in the country/sector

Based on the history and experience of the six successful IGCC projects overseas, the risk that the proposed Yantai IGCC plant will not achieve its design performance targets and demonstration objective is low. However, implementation and operation of the technology in a less developed country and with coal types that have not been tested still carries appreciable technical risks. The plant availability factor may be lower during the first and second years than those achieved in overseas projects. Considerable initial plant adjustments and modifications may be necessary to adapt the technology to China.

9. Environment Aspects (including any public consultation)

IGCC technology is one of the most advanced clean coal technologies, and its environmental impacts are very low compared to conventional coal fired power plants even equipped with FGD, high performance precipitators and SCR systems.

Table 1 Typical performance characteristics of thermal power plants

	Past Practice (Pulverized coal plant)	Modern plant (Pulverized coal supercritical with FGD and SCR)	Modern plant (IGCC)	Future plant (IGCC with zero emissions technologies)	Natural Gas Combined Cycle
SO ₂ (mg/Mm ³)	1500-7500	150	10 or less	0	0
NO _x (mg/Nm ³)	500-1000	100	50 or less	50 or less	50 or less
Particulates (mg/Nm ³)	200-350	50	10 or less	0	0
Efficiency (% HHV)	25-35	37-44	45	43	55
CO ₂ (g/kWh)	900-1300	770-880	750	Near zero	350
Current Capital Costs (\$/kW)	500-700	900-1200	1200-1500	1500 <	600

Sources: "Technology Assessment of Clean Coal Technologies for China: Electric Power Production" for emissions; Costs from World Bank study: "Financing Clean Coal Technologies in China" draft report (HHV: High Heat Value)

The implementing agency led by the State Power Grid Company is very experienced in all aspects of power system construction and management, including environmental and social assessment and the design and implementation of appropriate environmental and social impact mitigation plans. These have already been developed and partially implemented in a participatory way during the initial project design phase. The Bank will ensure that the final plans and actions are fully consistent with environmental and social safeguard policies

Based on information provided by the implementing agency, the proposed unit will be built on an existing power plant site. No land acquisition or people relocation will be required. An Environmental Impact Assessment (EIA) has been carried out according to Chinese policies and approved by SEPA. The EIA will be reviewed and revised as needed to meet Bank standards and procedures. The consultation and disclosure processes carried out to date will be reviewed and complemented to meet Bank policies.

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Note: This is information on an evolving project. Certain components may not be necessarily included in the final project.