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Energy Conservation and GHG Emissions Reduction in Chinese TVEs – Phase II

Final Report for Brick Sector Replication Project for Energy Efficiency (3)

Reporting period: April 18 – December 10, 2005

Contract No. P. 2005/030

UNIDO Project Number: ED/CPR/99/G31

P. O. No. 16000799

Shenyang Hetai Building Material Technical Consulting Co. Ltd.

April 6, 2006

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Table of Contents

I. Foreword and Acknowledgement

1.1 Foreword

This document is the draft final report of the project referred to as Brick Sector Replication Project for Energy Efficiency (3). The report assesses and summarizes the progress made using the proposal dated November 28, 2004, which the Shenyang Hetai Building Material Technical Consulting Co. Ltd. (hereafter the Contractor), submitted to the UNIDO HQs in response to the Request for Proposal No. P. No. P. 2004/031-EG/CPR/99/G31 – Energy Conservation and GHG Emissions Reduction in Chinese TVEs – Phase II –Brick Sector Replication Project for Energy Efficiency (3) to provide consultations and engineering services to 16 brick making plants in Shenyang, Liaoning Province, China.

1.2 Acknowledgement

The contract is undertaken by the Contractor, with support from Liaoning Wall & Roof Material Reform Office and Shenyang Wall & Roof Material Reform Office. Here we offer our thanks to leaders of these offices and the project team members. At the same time we are very grateful to Ms. Latrech, the Contract Officer and Dr. Enver Khan, the project Manager from United Nations Industrial Development Organization (UNIDO), Ms. Wang Guiling, Deputy Director of the PMO, Mr. Zheng Ge, Project Assistant, Mr. Xu Litong, Senior Local Expert, Mr. Wang Xiwu, Senior Administrator of the PIC, Wanghai, Xiongwei, Song Dongfeng and other staff from Beijing Hongyuan company. It is with their support and supervision that the contract is successfully carried out and accomplished.

II. Project Overview

2.1 Project No.: UNIDO Contract No.05/030ml; P.O.No.16000799

2.2 Project Background

Funded by the Globe Environment Facilities (GEF), the project entitled "Energy Conservation and Greenhouse Gas Emissions reduction in Chinese TVEs" aims at reducing GHG emissions in China from TVEs in cement, brick, metal casting and coking sectors through promoting the energy efficiency. Project objectives include creating institutional mechanisms for barrier removal at the national, county, and enterprise level, building technical capacity for energy efficiency and product quality improvement in TVEs, and facilitating access to commercial financing for TVEs in the four sectors.

Nine pilot plants in the four sectors have been selected for technology demonstration, including Yongxing Shale Hollow Brick Plant in Sichuan Province and Xi'an Liucun Hollow Brick Plant in Shaanxi Province. Technology renovation has been undertaken or is being implemented at the pilot plants.

2.3 Project Objectives

This subcontract is intended to replicate the successful experiences and best practices of the pilot brick plants by implementing technology upgrade to improve energy efficiency and product quality at Tonggou No. 4 Brick Plant and other 15 non-pilot brick plants in Shenyang, Liaoning Province, China.

For project replication in the brick sector, UNIDO and the Project Management Office (PMO) of the Ministry of Agriculture have identified about 60 potential brick plants that are

willing and qualified to participate in project replication. The scope of this subcontract will cover the 16 of these plants.

2.4 Project Tasks

The tasks under this contract consist of two parts. Part one involves consulting services for the 16 replication plants, including carrying out a plant-level assessment, preparing a project proposal and feasibility study, and setting up a plant-wide management system. Part two involves engineering services to implement the 16 replication projects, including engineering design and construction, equipment purchase and installation, and personnel training.

It is stipulated in the contract that the contract period is 24 weeks formally starting from March 13, 2005 when a project briefing meeting was chaired jointly by Ms. Latrech, Contractor Officer of UNIDO, and the PMO in Beijing.

2.5 Basis of the report

The report is drafted based on the following documents:

1) The contract signed between United Nations Industrial Development Organization and Shenyang Hetai Building Material Technical Consulting Co. Ltd.

2) The proposal made by the Contractor

3) The inception report of the Contractor

4) Minutes of the briefing meeting dated March 11, 2005

5) Feasibility studies developed by the Contractor for the 16 participating plants

6) Letters from the 16 plants confirming the feasibility study

7) The Interim Report made by the Contractor

8) Installation and commissioning report by the Contractor

9) Basic information and data provided by the 16 plants

10) Practical status related to the technical renovation for energy efficiency in each of the plants

III. Progress and results achieved

In accordance with the contract all the contract tasks shall be accomplished within a period of 24 weeks. The contract was formally incepted on March 13, and has been implemented right in line with the proposed work plan.

In accordance with the stipulation of the contract reached between UNIDO and the Contractor on March 11, 2005, and the work plan confirmed at the project briefing meeting, the Project was formally incepted on March 13, 2005. The overall contract duration is 24 weeks, and the scope of work (tasks) involves two parts as mentioned above. The Contractor has accomplished the tasks through 6 activities which are as follows:

Project inception – Project briefing

Task One: Technical Consultation Services

Activity 1: On-site investigation and assessment

Activity 2: Develop feasibility study

Activity 3: Review feasibility study

Task Two: Engineering Services

Activity 4: Engineering design and equipment procurement (bidding)

Activity 5: Project supervision, technical training, equipment installation,

Activity 6: Establishing management system, draft final report

Project Completion

Successful Indicator: Smooth operation of the project; acceptance of the project; draft final report cleared

After 6 months work, all contract goals have been achieved, and services (including consulting and engineering services) have been delivered by the contractor and accepted by the 16 plants. Detail progress and results achieved please see Annex 1: Letter of Acceptance issued by the16 plants, Annex 2: Project Progress and Achievement, Annex 3: M & E Form - Brick Sector Replication Project (3), and Annex 4: Project Budget Allocation and Expenditure.

Below are quick overviews of the achievements of the project that can be readily compared with the work plan as presented at the briefing meeting. A timetable of the further work to be carried out is assessed.

3.1 Project inception (briefing):

Date: March 13, 2005

Place: Beijing

Members: Mao Lifang, Gao Zejiang, Wang Jiyu, Liu Beiqun

Output: Inception report

Details of the briefing covered the following issues:

- Understanding of the project objectives and tasks
- Strategy, methods and measures to implement the project
- Project team
- Finalize the work plan and project schedule
- Discuss issues concerned
- Detail requirements of the progress report

3.2 Task One: Technical Consultation Services

This task involves providing technical consultation services to the 16 plants; services include conducting a comprehensive technical assessment, proposing approaches and measures for energy efficiency, developing feasibility study, and devising production and energy management systems.

Activity 1: Conduct on-site investigation, assessment, and ensure that the proposed renovation measures/investment is agreed by the plant management

Date of completion: March 25, 2005 (2nd week from the project formal inception)

Venue: the 16 plants

Task members: all team members

Output: renovation measures/investment proposed, Letter of Commitment issued by each of the 16 plants.

● Given that graphical locations of the 16 plants are scattered in different regions, the Contractor overlapped the investigation and assessment simultaneously through its two groups to accomplish the tasks in time. Each group was in charge of 8 of the 16 TVEs. Detailed assignment are as below:

Group 1

Group leader: Wang Jiyu

Group Members: Liu Dongsheng, Wang Lihua, Zhang Yong, Zhou Xijie, Cai Bin

Plants covered:

1) Tonggou No.4 Brick Plant, Sujiatun District, Shenyang
2) Tonggou No.3 Brick Plant, Sujiatun District, Shenyang
3) Tonggou Hollow Brick Plant, Shenyang
4) Mabei Brick Plant, Yuhong District, Shenyang
5) Shenyang_Xihuan Hollow Brick Plan
6) Hollow Brick Plant, Waitoushan Town, Xihu District, Benxi City
7) Minsheng Brick Plant, Benxi
8) Mayi Brick Plant, Anshan

Group 2

Group Leader: Liu Beiqun

Group Members: Zhao Wei, Lv Zhanping, Xie Hongjie, Bi Yaxin, Zhang Fan

Plants covered:

9) Shenyang Wensheng Brick Plant
10) Qingshuitai Gaotang Hollow Brick Plant, Xinchengzi District,Shenyang
11) Shenyang Pingluo Building Material Plant
12) Dongbei Clay Brick Plant
13) Shenyang Gaokan Town No.6 Red Brick Plant
14) Tieling County Kangxing Red Brick Plant
15) Huangtukan Construction Materials Plant, Yuhong District,Shenyang
16) Dongsheshanzi No. 3 Red Brick Plant, Xinmin City

● The two groups started on-site investigation and assessment on March 13. Main issues covered include the following (details see Feasibility Study developed by the Contractor dated April 6 and 26 respectively)

1) Production process
2) Production technology and equipment
3) Raw materials
4) Energy and power consumption
5) Products, output and product marketing
6) Labors and technical staff
7) Ownership, fixed assets and financial status

- Based on the investigation, conduct the comprehensive analysis to the enterprise with the technicians, including how to improve the product quality and the social economy benefits, to reduce the energy consumption and the GHG emissions. Study the feasibility, set the desired goal (data in production increase, energy conservation and emissions reduction), and develop the technical renovation scheme suitable for the enterprise.
- The renovation measures and investment were proposed based on the investigation aiming at increasing production social and economical benefits and energy efficiency thereby reducing GHG emissions. All the measures and investment are practical and feasible.
- The preliminary renovation measures and investment were consulted with the plant management. The detailed lists of measures and investment for retrofitting the existing technology and equipments are presented to them and the benefits brought about by the renovation are introduced, therefore to help them have a clear idea about the purpose of this project.

Through the above-mentioned activities, the management of each plant expressed their commitments to provide co-financing to implement the project along with the progress. The lowest agreed co-financing proportion is 4:1. (A co-financing commitment have been issued and submitted to UNIDO and the PMO by the 16 plants)

Activity 2: Investigation and assessment, feasibility studies, draft framework of the management system

Date of completion: April 13, 2005 (5th week from project inception)

Venue: Shenyang, Liaoning Province

Task members: All the team members

Output: Feasibility study

- All information and technical data collected during investigations at the 16 plants were compiled and assessed; based on the investigation and consultation with the plant management, finalized technical renovation plans and investments, and developed feasibility study accordingly.

Chapters of the study are as the following:

Chapter 1 Preface

Chapter 2 Market Prediction

Chapter 3 Renovation Conditions

Chapter 4 Raw materials

Chapter 5 Renovation Plan

Chapter 6 Measures to meet relevant environmental standards and requirements

Chapter 7 Assessment of safety and industrial hygiene issues

Chapter 8 Building structural fire protection

Chapter 9 Measures for energy conservation and rational utilization of resources

Chapter 10 Organization, personnel and staffing requirements

Chapter 11 Project implementation schedule

Chapter 12 Cost estimate and economic and financial analysis

Chapter 13 Engineering economic analysis

Annex: General layout; process flow diagram

- Framework of the management system was also drafted according to practical conditions of each of the plants.

Activity 3: Review feasibility study, finalize renovation plan

Date of Completion: April 18, 2005 (6th week from the inception)

Venue: Shenyang

Task Members: Sang Yong, Li Qingfan, Ni Youjun, Representatives from Wall & Roof Material Reform Office and industrial associations at levels of Liaoning Provincial Government and Shenyang Municipal All team members Management staff of the plants

Output: Feasibility study for each of the 16 plants (See Feasibility Study Report submitted by the Contractor on April 30, 2005 for details)

- In order to optimize the limited funds for updating the production thereby increasing energy efficiency and reducing GHG emissions, an evaluation was specially conducted on the measures and investments proposed in the draft feasibility study. Based on comments and recommendations made at the evaluation meeting, the Contractor finalized the study accordingly. All goals/targets for energy efficiency can meet the requirement of the TOR and the Contract.

  At the evaluation meeting, experts focused on the production process update, restructure of products, reduction of energy and raw materials use, environmental protection, production safety, project budget and the availability of the project's economical analysis, etc.

- The finalized feasibility study has been accepted by the 16 plants by issuing a Letter of Confirmation respectively. All the co-financing requirement from the recipient plants to the complete technical renovation project budget is over 4:1(includes technical services and equipment procurement, details see Annex 5: Project Feasibility Study).

3.3 Task 2: Engineering Services

Provide engineering services for the renovation project of each of the 16 plants, including engineering design, construction, equipment procurement and installation, and technical training.

Activity 4: Conduct engineering design, assistant the plant management in construction

preparation and equipment procurement (bidding)

Date of Completion: May 20, 2005 (10th week from the inception)

Venue: Shenyang and the plants

Output: Engineering drawings, orders/contracts of equipment procurement

- Conduct engineering design in accordance with the feasibility study and the proposed project plan.

The design involves various engineering professions, e.g. production process, thermal engineering, mechanical engineering, civil engineering and electronic engineering and investment budget depending on practical conditions of each plant. In the design, all technical standards and codes adopted are the currently effective ones in China. The assessment and approval of the design were conducted strictly according to the standard procedures.

The Contractor facilitated the plants in procuring equipment after submitting the designing.

Interim Progress Report

Date of submission: 13th week (June 10, 2005)

Main contents: Reported briefly all activities conducted by the contractor to execute the contract tasks and the next step planning. In the report, it focused on activities related to engineering designing/drawings, equipment procurement and project co-financing by the plants as well. (Please refer to Interim Report submitted by the contractor on June 16, 2005 for a scanned copy of the orders/contracts)

Activity 5: Project supervision, co-financing placement, technical training, equipment installation, commissioning and trial operation

Date of completion: Week 20 (July 26,2005)

Venue: Shenyang, the 16 plants

Task members: All team members, officials local from local Wall Material Reform Office and local industrial associations, the management, equipment operators of the participating plants and technicians of equipment providers

Output: On-site supervision and technical training delivered thereafter ensuring the project construction conducted smoothly, equipment installed and commissioned by team members; co-financing placed timely by the plants.

Activities conducted within this period are as the following.

- On-site supervision: Experts/team members (of various technical professions) were assigned to deliver on-site technical supervision in line with the construction progress to solve technical problems encountered on-site.
- Technical training: Along with the construction progress, two technical training were delivered. The first training was post training focused on mainly equipment operators, and the second one was for the management of the plants.

➢ Training One:

Trainees: Equipment operators

Venue: The 16 plants

Time: During the on-site technical supervision

Trainers: Gao Zejiang, Wang Jiyu, Liu Beiqun, Liu Dongsheng, Zhao Wei, Lv

Zhanping and Wang Lihua

Topics of training:

1) How to deal with problems encountered during the production?
2) Routine maintenance of production machines
3) Firing system control of a Hoffman kiln
4) Crash program of a Hoffman kiln
5) Maintenances and repair of production equipment
6) Notices on improving product quality – new production technology and equipment for energy efficiency

- Training Two

Trainees: The management of the 16 plants

Venue: Shenyang, Liaoning, China

Time: week 20 (July 24-26, 2005)

Trainers: Gao Zejiang, Wang Jiyu, Liu Dongsheng, and Wang Lihua

Topics of training:

1) Current status of brick production in China and local and international development trends of new production technology
2) National industrial policy and incentive measures related to brick production
3) Technical process deployment in brick production
4) Production management
5) Prerequisites and measures for product quality improvement
6) Essentiality to improve employees' accomplishment
7) Establishment of a modern enterprise's management system

Equipment Installation and Commissioning Report

Submission Date: the 20th week (July 30, 2005)

Content:

The report includes all the activities before the drafting of the report and the detailed arrangement for the next step work, emphasizing on the installation and commissioning of the equipments and relevant data, also the use of the budget.

Some equipment needs to be installed and commissioned along with the construction progress. The equipment commissioning was conducted in an order of individual commissioning firstly, no-load trial running of the whole line secondly, and full-load trial running at last.

Details of equipment installation and commissioning please see Equipment Installation & Commissioning Report submitted by the contactor on September 8, 2005.

Activity 6: Assist the plant in establishing management system (or strengthen the existing system if one already exists), monitor co-financing from the plants, and draft final report

Date of completion: August 13, 2005 (Week 22)

Venue: Shenyang, participating plants

Participants: Mao Lifang, Gao Zejiang, Wang Jiyu, Liu Beiqun, Cai Bin and Zhang Fan

Output:

- Modern management system

Based on the framework of the production/energy management system developed during Activity 2, systems that suits practical situation and conditions of each plant have been developed so as to improve the current practices of production management, energy management, quality inspection, personnel training, and other areas that may require attention.

Rules and regulations of the system include

a) Regulations for workers and staff

b) Administrative provisions for energy conserving measures

c) Workshop administrative provisions

d) Equipment management rules

e) Product quality control regulations

f) Financial system

g) Personnel Administration and labor management

h) Operation manual

Project Completion: Smooth operation of the project, acceptance of the project, final report

Date of completion: By the end of 2005 (Week 28)

Venue: Shenyang, participating plants

Task members: Mao Lifang, Gao Zejiang, Wang Jiyu and Liu Beiqun

Output: Letter of Acceptance issued by the 16 plants

- **Project acceptance**

It will take about two weeks for the new production line from trial to smooth operation. The successful indicator of the project covers designed output and product quality after 72 hours (or two weeks) operation with a full load, and all results are in line with targets stipulated in the TOR. Project of each of the 16 plants is examined and accepted in accordance with the indicator. In addition, results of the project should also meet with currently effective Chinese codes and regulations related to environmental control and production safety.

Details of project results for energy efficiency and GHG emissions reduction see Annex 2: Project Progress and Achievement, and Annex 3: M & E Form - Brick Sector Replication Project (3).

- **Final report**

A draft final report, which would be considered final only after having been cleared by UNIDO and the PMO, summarizing all activities and results achieved along with all the outputs, will be submitted to UNIDO and the PMO.

IV Project Budget Allocation and Expenditure

It is stipulated in the contract that the total budget for this subcontract is US$192,000, or US$12,000 apiece for a total of 16 brick plants. The budget allocation should be such that the consulting services and engineering services comprise 30 percent of the total budget, while 70 percent is reserved for equipment purchase and construction for the beneficiary plants.

Engineering construction of all the 16 plants has been accomplished, all equipment introduced for the technical renovation project have been installed and commissioned by the Contractor. Up to now, all support for equipment procurement and engineering construction to the beneficiary plants by the project (account for 70% of the project budget) have been placed through the Contractor.

The total project investment at the 16 plants is US$1,368,370. Among which, US$192,000 is directly supported by the project, and US$1,176,370 is co-financed by the recipient plants. The average co-financing from the plants to the complete technical renovation project budget is 6.13:1 (includes technical services and equipment procurement). Details please see Annex 4: Project Budget Allocation and Expenditure.

V Economic Profit and Social Benefit Generated

- **Economic profit**

After the completion of the project, the total annual production capacity of the 16 pilot plants in Shenyang will reach to 621.5 million common bricks equivalent, 51.3 million more than that before the renovation. The gross investment of the project is US$1,368,370 , among which US$192,000 are from GEF project, and US$1,176,370 from co-financing by the plants. The average co-financing from the recipient plants to the complete technical renovation project budget is 6.13:1 (includes technical services and equipment procurement).

After the technical renovation, the plants achieved extraordinary economic benefits, with the consumption of coke and electricity being reduced, the product quality improved, the production management standardized, and the production cost lowered by 6%. The technical and economic analysis indicates that the average payback period is 0.71 year, with the shortest being 0.52 year and the longest 1.03 years.

- **Social Benefit**

-- Direct energy savings at the plants

The testing data gathered from the production process after technical renovation reveals that the average comprehensive energy (including coal and power) consumption per unit of product is 1.29 tce per 10 thousand bricks common equivalent, saving 14,792 tce and reducing 36,877 tons of GHG emissions annually.

-- Social impact

During the implementation of the contract, the Contractor cooperates closely with the local government, trade associations and the media concerned to promote the publicizing of energy conservation and GHG emissions reduction, thereby helping local plants understand fully the

co-existing relationship between natural resources and humankind, and the importance of energy efficiency. By implementing the project, experience in energy conservation and GHG emissions reduction have been accumulated, and the best practices have been disseminating within other plants subsequently. Social impacts of the project include the following.

1) The EE technology, production processes and equipment piloted by the project have been listed in "The 11th 5-year Economic Development Plan" by Liaoning Provincial Wall Materials Reform Office;

2) A special report entitled "The Implementation of Subcontract of Brick Sector Replication Projects for Energy Efficiency (3) in Shenyang" (GEF/UNIDO Project: Energy Conservation and GHG Emissions Reduction in Chinese TVEs – Phase II) was delivered at the annual meeting of Liaoning Provincial Wall Materials Association attracting great attention of the participants;

3) Series report of the project was circulated by magazines namely "Liaoning Construction Materials" and "Liaoning Wall Materials", and a special report entitled "The promotion of EE technology and production process of the GEF/UNIDO Project: Energy Conservation and GHG Emissions Reduction in Chinese TVEs – Phase II" is scheduled to be published on a national level, professional magazine – "World of Brick and Tile" in the coming year;

4) 6 non-replication plants have been leveraged by the project to renovate their production for energy efficiency. A total of US$59,000 investment has been made by the plants, and achieved good results.

All local parties concerned express that, in years to come, they will keep on conducting technical renovation for EE and GHG emissions reduction by further disseminating the pilot technology and best practices thereby improving the effective use of resources and protection of environment and making contribution to on global environmental protection and energy conservation.

VI Completion of the Project

The goal of the project has been successfully achieved.

The implementation of the project brings about significant economic profits and social benefits.

Economic profits: By updating production technology, the project helps local plants to save energy and reduce production cost directly, thus generating generous profits for enterprises;

Social benefits: It contributes to resources economization, environmental protection, and benefits to favorable living conditions for the descendants.

Annex 1 Letter of Acceptance issued by the plants

Tonggou No.4 Brick Plant, Sujiatun District, Shenyang

Letter of Acceptance

December 10, 2005

To whom it may concern

This is to confirm, on behalf of the plant, Tonggou No.4 Brick Plant, Sujiatun District, Shenyang, that the technical consulting and engineering services stipulated in the GEF/UNIDO contract (Contract NO.) for our technical renovation project for energy efficiency has been fully delivered by the contractor, Shenyang Hetai Building Material Technical Consulting Co. Ltd., and has been duly accepted by the plant. The project has been fully completed and operating smoothly thanks to the hardworking of the contractor.

Services delivered include the following:

1) Project Feasibility Study
2) Engineering design and equipment procurement
3) Project supervision, technical training, equipment installation and Commissioning
4) Establishing management system

For the plant (name of the plant):

Tonggou No.4 Brick Plant, Sujiatun District, Shenyang

Signature of the legal representative:

Hollow Brick Plant, Waitoushan Town, Xihu District, Benxi City

Letter of Acceptance

December 10, 2005

To whom it may concern

This is to confirm, on behalf of the plant, Hollow Brick Plant, Waitoushan Town, Xihu District, Benxi City, that the technical consulting and engineering services stipulated in the GEF/UNIDO contract (Contract NO.) for our technical renovation project for energy efficiency has been fully delivered by the contractor, Shenyang Hetai Building Material Technical Consulting Co. Ltd., and has been duly accepted by the plant. The project has been fully completed and operating smoothly thanks to the hardworking of the contractor.

Services delivered include the following:

1) Project Feasibility Study
2) Engineering design and equipment procurement
3) Project supervision, technical training, equipment installation and Commissioning
4) Establishing management system

For the plant (name of the plant):

Hollow Brick Plant, Waitoushan Town, Xihu District, Benxi City

Signature of the legal representative:

Shenyang Wensheng Brick Plant

Letter of Acceptance

December 10, 2005

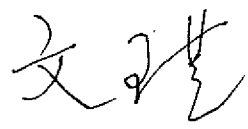
To whom it may concern

This is to confirm, on behalf of the plant, Shenyang Wensheng Brick Plant, that the technical consulting and engineering services stipulated in the GEF/UNIDO contract (Contract NO.) for our technical renovation project for energy efficiency has been fully delivered by the contractor, Shenyang Hetai Building Material Technical Consulting Co. Ltd., and has been duly accepted by the plant. The project has been fully completed and operating smoothly thanks to the hardworking of the contractor.

Services delivered include the following:

1) Project Feasibility Study
2) Engineering design and equipment procurement
3) Project supervision, technical training, equipment installation and Commissioning
4) Establishing management system

For the plant (name of the plant): Shenyang Wensheng Brick Plant

Signature of the legal representative: 

Qingshuitai Gaotang Hollow Brick Plant, Xinchengzi District, Shenyang

Letter of Acceptance

December 10, 2005

To whom it may concern

This is to confirm, on behalf of the plant, Qingshuitai Gaotang Hollow Brick Plant, Xinchengzi District, Shenyang, that the technical consulting and engineering services stipulated in the GEF/UNIDO contract (Contract NO.) for our technical renovation project for energy efficiency has been fully delivered by the contractor, Shenyang Hetai Building Material Technical Consulting Co. Ltd., and has been duly accepted by the plant. The project has been fully completed and operating smoothly thanks to the hardworking of the contractor.

Services delivered include the following:

1) Project Feasibility Study
2) Engineering design and equipment procurement
3) Project supervision, technical training, equipment installation and Commissioning
4) Establishing management system

For the plant (name of the plant):

Qingshuitai Gaotang Hollow Brick Plant, Xinchengzi District, Shenyang

Signature of the legal representative:

Shenyang Pingluo Building Materials Plant

Letter of Acceptance

December 10, 2005

To whom it may concern

This is to confirm, on behalf of the plant, Shenyang Pingluo Building Materials Plant, that the technical consulting and engineering services stipulated in the GEF/UNIDO contract (Contract NO.) for our technical renovation project for energy efficiency has been fully delivered by the contractor, Shenyang Hetai Building Material Technical Consulting Co. Ltd., and has been duly accepted by the plant. The project has been fully completed and operating smoothly thanks to the hardworking of the contractor.

Services delivered include the following:

1) Project Feasibility Study
2) Engineering design and equipment procurement
3) Project supervision, technical training, equipment installation and Commissioning
4) Establishing management system

For the plant (name of the plant):

Shenyang Pingluo Building Materials Plant

Signature of the legal representative:

Shenyang Xihuan Hollow Brick Plant

Letter of Acceptance

December 10, 2005

To whom it may concern

This is to confirm, on behalf of the plant, Shenyang Xihuan Hollow Brick Plant, that the technical consulting and engineering services stipulated in the GEF/UNIDO contract (Contract NO.) for our technical renovation project for energy efficiency has been fully delivered by the contractor, Shenyang Hetai Building Material Technical Consulting Co. Ltd., and has been duly accepted by the plant. The project has been fully completed and operating smoothly thanks to the hardworking of the contractor.

Services delivered include the following:

1) Project Feasibility Study
2) Engineering design and equipment procurement
3) Project supervision, technical training, equipment installation and Commissioning
4) Establishing management system

For the plant (name of the plant):

Shenyang Xihuan Hollow Brick Plant

Signature of the legal representative:

Shenyang Dongbei Red Brick Plant

Letter of Acceptance

December 10, 2005

To whom it may concern

This is to confirm, on behalf of the plant, Shenyang Dongbei Red Brick Plant, that the technical consulting and engineering services stipulated in the GEF/UNIDO contract (Contract NO.) for our technical renovation project for energy efficiency has been fully delivered by the contractor, Shenyang Hetai Building Material Technical Consulting Co. Ltd., and has been duly accepted by the plant. The project has been fully completed and operating smoothly thanks to the hardworking of the contractor.

Services delivered include the following:

1) Project Feasibility Study
2) Engineering design and equipment procurement
3) Project supervision, technical training, equipment installation and Commissioning
4) Establishing management system

For the plant (name of the plant): Shenyang Dongbei Red Brick Plant

Signature of the legal representative:

Shenyang Gaokan Town No.6 Red Brick Plant

Letter of Acceptance

December 10, 2005

To whom it may concern

This is to confirm, on behalf of the plant, Shenyang_Gaokan Town No.6 Red Brick Plant, that the technical consulting and engineering services stipulated in the GEF/UNIDO contract (Contract NO.) for our technical renovation project for energy efficiency has been fully delivered by the contractor, Shenyang Hetai Building Material Technical Consulting Co. Ltd., and has been duly accepted by the plant. The project has been fully completed and operating smoothly thanks to the hardworking of the contractor.

Services delivered include the following:

1) Project Feasibility Study
2) Engineering design and equipment procurement
3) Project supervision, technical training, equipment installation and Commissioning
4) Establishing management system

For the plant (name of the plant):

Shenyang_Gaokan Town No.6 Red Brick Plant

Signature of the legal representative: 刘七常会

Tieling County Kangxing Red Brick Plant

Letter of Acceptance

December 10, 2005

To whom it may concern

This is to confirm, on behalf of the plant, Tieling County Kangxing Red Brick Plant, that the technical consulting and engineering services stipulated in the GEF/UNIDO contract (Contract NO.) for our technical renovation project for energy efficiency has been fully delivered by the contractor, Shenyang Hetai Building Material Technical Consulting Co. Ltd., and has been duly accepted by the plant. The project has been fully completed and operating smoothly thanks to the hardworking of the contractor.

Services delivered include the following:

1) Project Feasibility Study
2) Engineering design and equipment procurement
3) Project supervision, technical training, equipment installation and Commissioning
4) Establishing management system

For the plant (name of the plant):

Tieling County Kangxing Red Brick Plant

Signature of the legal representative:

Tonggou No.3 Brick Plant, Sujiatun District, Shenyang

Letter of Acceptance

December 10, 2005

To whom it may concern

This is to confirm, on behalf of the plant, Tonggou No.3 Brick Plant, Sujiatun District, Shenyang, that the technical consulting and engineering services stipulated in the GEF/UNIDO contract (Contract NO.) for our technical renovation project for energy efficiency has been fully delivered by the contractor, Shenyang Hetai Building Material Technical Consulting Co. Ltd., and has been duly accepted by the plant. The project has been fully completed and operating smoothly thanks to the hardworking of the contractor.

Services delivered include the following:

1) Project Feasibility Study
2) Engineering design and equipment procurement
3) Project supervision, technical training, equipment installation and Commissioning
4) Establishing management system

For the plant (name of the plant):

Tonggou No.3 Brick Plant; Sujiatun District, Shenyang

Signature of the legal representative:

Tonggou Hollow Brick Plant, Shenyang

Letter of Acceptance

December 10, 2005

To whom it may concern

This is to confirm, on behalf of the plant, Tonggou Hollow Brick Plant, Shenyang, that the technical consulting and engineering services stipulated in the GEF/UNIDO contract (Contract NO.) for our technical renovation project for energy efficiency has been fully delivered by the contractor, Shenyang Hetai Building Material Technical Consulting Co. Ltd., and has been duly accepted by the plant. The project has been fully completed and operating smoothly thanks to the hardworking of the contractor.

Services delivered include the following:

1) Project Feasibility Study
2) Engineering design and equipment procurement
3) Project supervision, technical training, equipment installation and Commissioning
4) Establishing management system

For the plant (name of the plant):

Tonggou Hollow Brick Plant, Shenyang

Signature of the legal representative:

Huangtukan Construction Materials Plant, Yuhong District, Shenyang

Letter of Acceptance

December 10, 2005

To whom it may concern

This is to confirm, on behalf of the plant, Huangtukan Construction Materials Plant, Yuhong District, Shenyang, that the technical consulting and engineering services stipulated in the GEF/UNIDO contract (Contract NO.) for our technical renovation project for energy efficiency has been fully delivered by the contractor, Shenyang Hetai Building Material Technical Consulting Co. Ltd., and has been duly accepted by the plant. The project has been fully completed and operating smoothly thanks to the hardworking of the contractor.

Services delivered include the following:

1) Project Feasibility Study
2) Engineering design and equipment procurement
3) Project supervision, technical training, equipment installation and Commissioning
4) Establishing management system

For the plant (name of the plant):

Huangtukan Construction Materials Plant, Yuhong District, Shenyang

Signature of the legal representative:

Dongsheshanzi No.3 Red Brick Plant, Xinmin City

Letter of Acceptance

December 10, 2005

To whom it may concern

This is to confirm, on behalf of the plant, Dongsheshanzi No.3 Red Brick Plant, Xinmin City, that the technical consulting and engineering services stipulated in the GEF/UNIDO contract (Contract NO.) for our technical renovation project for energy efficiency has been fully delivered by the contractor, Shenyang Hetai Building Material Technical Consulting Co. Ltd., and has been duly accepted by the plant. The project has been fully completed and operating smoothly thanks to the hardworking of the contractor.

Services delivered include the following:

1) Project Feasibility Study
2) Engineering design and equipment procurement
3) Project supervision, technical training, equipment installation and Commissioning
4) Establishing management system

For the plant (name of the plant):

Dongsheshanzi No.3 Red Brick Plant, Xinmin City

Signature of the legal representative: 李成义

Mabei Brick Plant, Yuhong District, Shenyang

Letter of Acceptance

December 10, 2005

To whom it may concern

This is to confirm, on behalf of the plant, Mabei Brick Plant, Yuhong District, Shenyang, that the technical consulting and engineering services stipulated in the GEF/UNIDO contract (Contract NO.) for our technical renovation project for energy efficiency has been fully delivered by the contractor, Shenyang Hetai Building Material Technical Consulting Co. Ltd., and has been duly accepted by the plant. The project has been fully completed and operating smoothly thanks to the hardworking of the contractor.

Services delivered include the following:

1) Project Feasibility Study
2) Engineering design and equipment procurement
3) Project supervision, technical training, equipment installation and Commissioning
4) Establishing management system

For the plant (name of the plant):

Mabei Brick Plant, Yuhong District, Shenyang

Signature of the legal representative:

Minsheng Brick Plant, Benxi City

Letter of Acceptance

December 10, 2005

To whom it may concern

This is to confirm, on behalf of the plant, Minsheng Brick Plant, Benxi City, that the technical consulting and engineering services stipulated in the GEF/UNIDO contract (Contract NO.) for our technical renovation project for energy efficiency has been fully delivered by the contractor, Shenyang Hetai Building Material Technical Consulting Co. Ltd., and has been duly accepted by the plant. The project has been fully completed and operating smoothly thanks to the hardworking of the contractor.

Services delivered include the following:

1) Project Feasibility Study
2) Engineering design and equipment procurement
3) Project supervision, technical training, equipment installation and Commissioning
4) Establishing management system

For the plant (name of the plant): Minsheng Brick Plant, Benxi City

Signature of the legal representative:

Mayi Brick Plant, Anshan

Letter of Acceptance

December 10, 2005

To whom it may concern

This is to confirm, on behalf of the plant, Mayi Brick Plant, Anshan, that the technical consulting and engineering services stipulated in the GEF/UNIDO contract (Contract NO.) for our technical renovation project for energy efficiency has been fully delivered by the contractor, Shenyang Hetai Building Material Technical Consulting Co. Ltd., and has been duly accepted by the plant. The project has been fully completed and operating smoothly thanks to the hardworking of the contractor.

Services delivered include the following:

1) Project Feasibility Study
2) Engineering design and equipment procurement
3) Project supervision, technical training, equipment installation and Commissioning
4) Establishing management system

For the plant (name of the plant): Mayi Brick Plant, Anshan

Signature of the legal representative: 李勇

Annex2:

Project Progress and Achievement

No.	Task/Activity		Participants	Output	Time (Week)
1	Project Inception: Briefing		Mao Lifang, Gao Zejiang, Wang Jiyu, Liu Beiqun	Briefing report	Date of completion: March 11, 2005
2	Task 1 Consulting Services	Activity1: On-site investigation, plant assessment and ensure that the proposed renovation measures/investment is agreed by the plant management	Mao Lifang, Gao Zejiang **Group 1**: Wang Jiyu, Zhang Yong, Cai Bin, Wang Lihua, Liu Dongsheng, Zhou Xijie **Group 2**: Liu Beiqun, Lv Zhanping , XieHongjie,Zhao Wei, Zhang Fan, Bi Yaxin	Technical renovation plan, Letter of Confirmation (co-financing)	Completed on March 25th, 2005
		Activity 2: Investigation and assessment, feasibility studies, draft project proposals and framework of the management system	Mao Lifang, Gao Zejiang **Group 1**: Wang Jiyu, Zhang Yong, Cai Bin, Wang Lihua, Liu Dongsheng, Zhou Xijie, **Group 2**: Liu Beiqun, Lv Zhanping ,XieHongjie,Zhao Wei, Zhang Fan, Bi Yaxin	Draft feasibility study	Completed on April 13, 2005
		Activity 3: Review feasibility study, finalize renovation plan	**Evaluation experts**: Li Qingfan, Sang Yong, Ni Youjun Mao Lifang, Gao Zejiang **Group 1**: Wang Jiyu, Zhang Yong, Cai Bin Wang Lihua, Liu Dongsheng, Zhou Xijie **Group 2**: Liu Beiqun, Lv Zhanping , XieHongjie,Zhao Wei, Zhang Fan, Bi Yaxin	Evaluation comments	Completed on April 18, 2005
3	Task 2: Engineering Services	Activity 4: Conduct engineering design, assist the plant management in preparing project construction and equipment procurement bidding	Mao Lifang, Gao Zejiang **Group 1**: Wang Jiyu, Liu Dongsheng, Wang Lihua, Zhang Yong, Zhou Xijie **Group 2**: Liu Beiqun, Lv Zhanping , XieHongjie,Zhao Wei, Zhang Fan, Bi Yaxin	Engineering drawings, Progress report	Completed on May 20, 2005 Date of completion (Progress report): May 30, 2005
		Activity 5: Supervise project construction; place co-financing; deliver technical training; conduct equipment installation, commissioning and trial operation	Mao Lifang, Gao Zejiang **Group 1**: Wang Jiyu, Liu Dongsheng, Wang Lihua, Zhang Yong, Zhou Xijie **Group 2**: Liu Beiqun, Lv Zhanping , XieHongjie,Zhao Wei, Zhang Fan, Bi Yaxin	Completion of engineering works, Installation and commissioning report	Completed on July 10, 2005; (Installation report Completed on July 30, 2005)
		Activity 6: Assist the plant in establishing a management system (or strengthen the existing system if one already exists), monitor co-financing placement, and draft final report	Mao Lifang, GaoZejiang **Group 1:** Wang Jiyu, Cai Bin **Group 2:** Liu Beiqun, Zhang Fan	Modern Management system, Draft final report	Completed on September 10, 2005
4	**Project completion:** Smooth operation of the project, acceptance of the project, draft final report		Mao Lifang, Gao Zejiang **Group 1**: Wang Jiyu **Group 2**: Liu Beiqun	Project completion and hand-over; final report	Completed on September 24, 2005

Annex3: M & E Form - Brick Sector Replication Project (3) - Shenyang

No.	TVEs	Business Profile	Technical Process and Major Energy-use Equipments	E E Baseline								Proposed Technical Renovation	Project Investment				Project Status	Anticipated Results									Remarks [1]
				Energy Type	Energy consumption (physical quantity)	Conversion Factor	Energy use (tce)	Energy Use/Unit Product		Output Before Renovation	Total energy use (tce)	CO2 Coefficient	CO2 Emissions (t/a.)		Total(RMB Y 10,000)	GEF (US$)	Others(RMB Y 10,000)			Start-end date	Financial Evaluation			Production after renovation	Energy Use/Unit Product		Energy Savings (tce/a.)	CO2 emission Reduction (t/a.)	
1	Tonggou No.4 Brick Plant, Sujiatun District, Shenyang	A collectively owned enterprise, established in 1989, with fixed assets of $120,000. Output before the renovation: 26.50 M bricks common equivalent/a.; Total employees: 140	clay and coal cinders mixed in a cased raw-meal feeder (mixer) and 2 dual-spindle mixers, then fed into a double-stage vacuum extruder; extruded columns cut into green bricks; air dried green bricks fired in a Hoffman kiln.	Internal combustive coal (t)	3,858.40	1.000	3,858.40	Coal:	1.46 tce/10,000 bce [2]	2,650 10,000 bce/a./	4,020.41	2.493	10,022.88	1. renew the coal cinder grinding system 2. enlarge the Hoffman kiln by building 8 extra chambers; 3. retrofit the kiln; 4. introduce power capacitance enhancing devices (PCED) on motors 5.introduce a new energy efficient air blower	57	12,000	commercial loan		accomplished	March - August, 2005	Payback period	2.42	year	3,400 x 10000 bce/a.	Coal:	1.23 tce/10,000 bce	806.26	2,010.01	
				External combustive coal (t)			0.00	Power:	0.06 tce/10,000 bce							entrustment loan				IRR	83.63	%		Power:	0.05 tce/10,000 bce			
				Power/MWh	423.00	0.383	162.01									funds due	47			NPV	354.39	x 10000 RMB						
				Sum total			4,020.41	C energy consumption[3]	1.52 tce/10,000 bce							public subsidy				Cost of energy saving[4]	55.82	RMB/tce		C energy consumption	1.28 tce/10,000 bce			
2	Hollow Brick Plant, Waitoushan Town, Xihu District, Benxi City	A private owned enterprise, established in 1994, with fixed assets of $458,000. Output before the renovation: 35 M bricks common equivalent/a.; Total employees: 140	clay and coal cinders mixed in a cased raw-meal feeder (mixer) and 3 dual-spindle mixers; then fed into a double-stage vacuum extruder; extruded columns cut into green bricks; air dried green bricks fired in a Hoffman kiln.	Internal combustive coal (t)	4,987.50	1.000	4,987.50	Coal:	1.43 tce/10,000 bce	3,500 10,000 bce/a./	5,201.51	2.493	12,967.37	1. renew the coal cinder grinding system 2. retrofit the Hoffman kiln; 3. Introduce reactive power capacitance compensation devices on the transformer 4. introduce a new energy efficient air blower	51	11,900	commercial loan		accomplished	March - August, 2005	Payback period	3.32	year	3,500 x 10000 bce/a.	Coal:	1.26 tce/10,000 bce	623.51	1,554.42	
				External combustive coal (t)			0.00	Power:	0.06 tce/10,000 bce							entrustment loan				IRR	43.10	%		Power:	0.05 tce/10,000 bce			
				Power/MWh	558.78	0.383	214.01									funds due	41			NPV	100.22	x 10000 RMB						
				Sum total			5,201.51	C energy consumption	1.49 tce/10,000 bce							public subsidy				Cost of energy saving	47.61	RMB/tce		C energy consumption	1.31 tce/10,000 bce			
3	Shenyang Wensheng Brick Plant	A private owned enterprise, established in 1989, with fixed assets of $545,000. Output before the renovation: 55 M bricks common equivalent/a.; Total employees: 160	clay and coal cinders mixed in a cased raw-meal feeder (mixer) and 4 dual-spindle mixers, then fed into a double-stage vacuum extruder; extruded columns cut into green bricks; air dried green bricks fired in a Hoffman kiln.	Internal combustive coal (t)	7,870.50	1.000	7,870.50	Coal:	1.43 tce/10,000 bce	5,500 10,000 bce/a./	8,169.78	2.493	20,367.25	1. renew the coal cinder grinding system 2. retrofit the Hoffman kiln; 3. Introduce reactive power capacitance compensation devices on the transformer 4. Introduce power capacitance enhancing devices (PCED) on motors	85	12,800	commercial loan		accomplished	March - August, 2005	Payback period	4.51	year	5,500 x 10000 bce/a.	Coal:	1.25 tce/10,000 bce	1,074.78	2,679.42	
				External combustive coal (t)			0.00	Power:	0.05 tce/10,000 bce							entrustment loan				IRR	27.85	%		Power:	0.04 tce/10,000 bce			
				Power/MWh	781.40	0.383	299.28									funds due	75			NPV	91.70	x 10000 RMB						
				Sum total			8,169.78	C energy consumption	1.49 tce/10,000 bce							public subsidy				Cost of energy saving	27.15	RMB/tce		C energy consumption	1.29 tce/10,000 bce			
4	Qingshuitai Gaotang Hollow Brick Plant, Xinchengzi District, Shenyang	A private owned enterprise, established in 1978, with fixed assets of $364,000. Output before the renovation: 27.7 M bricks common equivalent/a.; Total employees: 110	clay and coal cinders mixed in a cased raw-meal feeder (mixer) and 5 dual-spindle mixers, then fed into a double-stage vacuum extruder; extruded columns cut into green bricks; air dried green bricks fired in a Hoffman kiln.	Internal combustive coal (t)	4,088.50	1.000	4,088.50	Coal:	1.48 tce/10,000 bce	2,770 10,000 bce/a./	4,233.60	2.493	10,554.37	1. renew the coal cinder grinding system 2. enlarge the Hoffman kiln by building 8 extra chambers; 3. retrofit the Hoffman kiln; 4. introduce power capacitance enhancing devices (PCED) on motors	57	12,100	commercial loan		accomplished	March - August, 2005	Payback period	2.33	year	3,500 x 10000 bce/a.	Coal:	1.27 tce/10,000 bce	781.82	1,949.07	
				External combustive coal (t)			0.00	Power:	0.05 tce/10,000 bce							entrustment loan				IRR	87.51	%		Power:	0.04 tce/10,000 bce			
				Power/MWh	378.86	0.383	145.10									funds due	47			NPV	378.12	x 10000 RMB						
				Sum total			4,233.60	C energy consumption	1.53 tce/10,000 bce							public subsidy				Cost of energy saving	70.67	RMB/tce		C energy consumption	1.31 tce/10,000 bce			
5	Shenyang Pingluo Building Material Plant	A private owned enterprise, established in 1988, with fixed assets of $254,000. Output before the renovation: 28 M bricks common equivalent/a.; Total employees: 130	clay and coal cinders mixed in a cased raw-meal feeder (mixer) and 6 dual-spindle mixers; then fed into a double-stage vacuum extruder; extruded columns cut into green bricks; air dried green bricks fired in a Hoffman kiln.	Internal combustive coal (t)	4,373.60	1.000	4,373.60	Coal:	1.56 tce/10,000 bce	2,800 10,000 bce/a./	4,519.39	2.493	11,266.84	1.Build a new 44 -- chamber Hoffman kiln; 2.introduce power capacitance enhancing devices (PCED) on motors	109	12,800	commercial loan		accomplished	March - August, 2005	Payback period	2.40	year	3,800 x 10000 bce/a.	Coal:	1.14 tce/10,000 bce	1,668.84	4,160.41	
				External combustive coal (t)			0.00	Power:	0.05 tce/10,000 bce							entrustment loan				IRR	81.60	%		Power:	0.03 tce/10,000 bce			
				Power/MWh	380.65	0.383	145.79									funds due	98			NPV	616.64	x 10000 RMB						
				Sum total			4,519.39	C energy consumption	1.61 tce/10,000 bce							public subsidy				Cost of energy saving	54.55	RMB/tce		C energy consumption	1.17 tce/10,000 bce			
6	Shenyang Xihuan Hollow Brick Plan	A private owned enterprise, established in 1991, with fixed assets of $315,000. Output before the renovation: 35 M bricks common equivalent/a.; Total employees: 160	clay and coal cinders mixed in a cased raw-meal feeder (mixer) and 7 dual-spindle mixers, then fed into a double-stage vacuum extruder; extruded columns cut into green bricks; air dried green bricks fired in a Hoffman kiln.	Internal combustive coal (t)	4,858.00	1.000	4,858.00	Coal:	1.39 tce/10,000 bce	3,500 10,000 bce/a./	5,058.51	2.493	12,610.86	1. renew the coal cinder grinding system 2. retrofit the Hoffman kiln; 3. Introduce reactive power capacitance compensation devices on the transformer 4. introduce a new energy efficient air blower1.	54	12,300	commercial loan		accomplished	March - August, 2005	Payback period	7.02	year	3,500 x 10000 bce/a.	Coal:	1.22 tce/10,000 bce	663.21	1,653.38	
				External combustive coal (t)			0.00	Power:	0.06 tce/10,000 bce							entrustment loan				IRR	11.54	%		Power:	0.04 tce/10,000 bce			
				Power/MWh	523.52	0.383	200.51									funds due	44			NPV	4.38	x 10000 RMB						
				Sum total			5,058.51	C energy consumption	1.45 tce/10,000 bce							public subsidy				Cost of energy saving	27.05	RMB/tce		C energy consumption[5]	1.26 tce/10,000 bce			

7	Dongbei Clay Brick Plant	A private owned enterprise, established in 1993, with fixed assets of $969,000. Output before the renovation: 35.2 M bricks common equivalent/a.; Total employees: 220	clay and coal cinders mixed in a cased raw-meal feeder (mixer) and 8 dual-spindle mixers; then fed into a double-stage vacuum extruder; extruded columns cut into green bricks; air dried green bricks fired in a Hoffman kiln.	Internal combustive coal (t)	4,611.20	1.000	4,611.20	Coal:	1.31 tce/10,000 bce	3,520	10,000 bce/a./	4,813.42	2.493	11,999.87	build a 16-chamber green brick dryer	179	12,600	commercial loan		accomplished	March - August, 2005	Payback period	4.44	year		Coal:	1.31 tce/10,000 bce							
				External combustive coal (t)			0.00	Power:	0.06 tce/10,000 bce									entrustment loan				IRR	29.79	%		Power:	0.08 tce/10,000 bce					
				Power/MWh	528.00	0.383	202.22									funds due	169			NPV	252.47	x 10000 RMB	4,350 x 10000 bce/a.			1,299.74	3,240.25					
				Sum total			4,813.42	C energy consumption	1.37 tce/10,000 bce							public subsidy				Cost of energy saving	126.20	RMB/tce		C energy consumption	1.39 tce/10,000 bce							
8	Shenyang Huokan Town No.6 Red Brick Plant	A private owned enterprise, established in 1985, with fixed assets of $460,000. Output before the renovation: 43.5 M bricks common equivalent/a.; Total employees: 140	clay and coal cinders mixed in a cased raw-meal feeder (mixer) and 9 dual-spindle mixers; then fed into a double-stage vacuum extruder; extruded columns cut into green bricks; air dried green bricks fired in a Hoffman kiln.	Internal combustive coal (t)	6,699.00	1.000	6,699.00	Coal:	1.54 tce/10,000 bce	4,350	10,000 bce/a./	7,148.11	2.493	17,820.23	1.retrofit the 24-chamber green brick dryer; 2. retrofit the Hoffman kiln; 3. introduce FPN frequency controllers onto air blowers	65	12,000	commercial loan		accomplished	March - August, 2005	Payback period	3.92	year		Coal:	1.32 tce/10,000 bce							
				External combustive coal (t)			0.00	Power:	0.10 tce/10,000 bce									entrustment loan				IRR	34.20	%		Power:	0.07 tce/10,000 bce					
				Power/MWh	1,172.60	0.383	449.11									funds due	55			NPV	106.69	x 10000 RMB	4,350 x 10000 bce/a.			1,084.21	2,702.93					
				Sum total			7,148.11	C energy consumption	1.64 tce/10,000 bce							public subsidy				Cost of energy saving	55.65	RMB/tce		C energy consumption	1.39 tce/10,000 bce							
9	Tieling County Kangxing Red Brick Plant	A private owned enterprise, established in 1988, with fixed assets of $242,000. Output before the renovation: 30 M bricks common equivalent/a.; Total employees: 120	clay and coal cinders mixed in a cased raw-meal feeder (mixer) and 10 dual-spindle mixers; then fed into a double-stage vacuum extruder; extruded columns cut into green bricks; air dried green bricks fired in a Hoffman kiln	Internal combustive coal (t)	4,389.00	1.000	4,389.00	Coal:	1.46 tce/10,000 bce	3,000	10,000 bce/a./	4,590.34	2.493	11,443.73	1.retrofit the 24-chamber green brick dryer; 2. retrofit the Hoffman kiln; 3.introduce power capacitance enhancing devices (PCED) on motors	50	11,700	commercial loan		accomplished	March - August, 2005	Payback period	4.76	year		Coal:	1.26 tce/10,000 bce							
				External combustive coal (t)			0.00	Power:	0.07 tce/10,000 bce									entrustment loan				IRR	25.77	%		Power:	0.04 tce/10,000 bce					
				Power/MWh	525.70	0.383	201.34									funds due	40			NPV	46.70	x 10000 RMB	3,000 x 10000 bce/a.			687.34	1,713.55					
				Sum total			4,590.34	C energy consumption	1.53 tce/10,000 bce							public subsidy				Cost of energy saving	53.36	RMB/tce		C energy consumption	1.30 tce/10,000 bce							
10	Tonggou No.3 Brick Plant, Sujiatun District, Shenyang	A collectively owned enterprise, established in 1992, with fixed assets of $145,000. Output before the renovation: 32 M bricks common equivalent/a.; Total employees: 100	clay and coal cinders mixed in a cased raw-meal feeder (mixer) and 11 dual-spindle mixers; then fed into a double-stage vacuum extruder; extruded columns cut into green bricks; air dried green bricks fired in a Hoffman kiln.	Internal combustive coal (t)	4,259.20	1.000	4,259.20	Coal:	1.33 tce/10,000 bce	3,200	10,000 bce/a./	4,422.62	2.493	11,025.60	1. enlarge the Hoffman kiln by building 12 extra chambers; 2. retrofit the kiln; 3. introduce reactive power capacitance compensation devices on the transformer 4.introduce reactive power capacitance compensation devices on the transformer 5.introduce power capacitance enhancing	48	11,200	commercial loan		accomplished	March - August, 2005	Payback period	2.94	year		Coal:	1.16 tce/10,000 bce							
				External combustive coal (t)			0.00	Power:	0.05 tce/10,000 bce									entrustment loan				IRR	68.03	%		Power:	0.04 tce/10,000 bce					
				Power/MWh	426.69	0.383	163.42									funds due	38			NPV	248.43	x 10000 RMB	4,250 x 10000 bce/a.			788.67	1,966.15					
				Sum total			4,422.62	C energy consumption	1.38 tce/10,000 bce							public subsidy				Cost of energy saving	55.93	RMB/tce		C energy consumption	1.20 tce/10,000 bce							
11	Tonggou Hollow Brick Plant, Shenyang	A collectively owned enterprise, established in 1993, with fixed assets of $485,000. Output before the renovation: 70 M bricks common equivalent/a.; Total employees: 400	clay and coal cinders mixed in a cased raw-meal feeder (mixer) and 12 dual-spindle mixers; then fed into a double-stage vacuum extruder; extruded columns cut into green bricks; air dried green bricks fired in a Hoffman kiln.	Internal combustive coal (t)	9,380.00	1.000	9,380.00	Coal:	1.34 tce/10,000 bce	7,000	10,000 bce/a./	9,692.95	2.493	24,164.52	1.retrofit the kiln; 2.introduce power capacitance enhancing devices (PCED) on motors	54	12,300	commercial loan		accomplished	March - August, 2005	Payback period	3.41	year		Coal:	1.18 tce/10,000 bce							
				External combustive coal (t)			0.00	Power:	0.04 tce/10,000 bce									entrustment loan				IRR	41.18	%		Power:	0.04 tce/10,000 bce					
				Power/MWh	817.10	0.383	312.95									funds due	44			NPV	106.31	x 10000 RMB	7,000 x 10000 bce/a.			1,181.65	2,945.85					
				Sum total			9,692.95	C energy consumption	1.38 tce/10,000 bce							public subsidy				Cost of energy saving	35.00	RMB/tce		C energy consumption	1.22 tce/10,000 bce							
12	Huangtukan Construction Materials Plant, Yuhong District, Shenyang	A private owned enterprise, established in 1994, with fixed assets of $968,500. Output before the renovation: 32.3 M bricks common equivalent/a.; Total employees: 220	clay and coal cinders mixed in a cased raw-meal feeder (mixer) and 13 dual-spindle mixers; then fed into a double-stage vacuum extruder; extruded columns cut into green bricks; air dried green bricks fired in a Hoffman kiln.	Internal combustive coal (t)	4,360.50	1.000	4,360.50	Coal:	1.35 tce/10,000 bce	3,230	10,000 bce/a./	4,551.23	2.493	11,346.23	build a 12-chamber green brick dryer	120	12,600	commercial loan		accomplished	March - August, 2016	Payback period	2.10	year		Coal:	1.35 tce/10,000 bce							
				External combustive coal (t)			0.00	Power:	0.06 tce/10,000 bce									entrustment loan				IRR	69.97	%		Power:	0.12 tce/10,000 bce					
				Power/MWh	498.00	0.383	190.73									funds due	109			NPV	539.77	x 10000 RMB	4,000 x 10000 bce/a.			1,051.56	2,621.54					
				Sum total			4,551.23	C energy consumption[21]	1.41 tce/10,000 bce							public subsidy				Cost of energy saving	57.12	RMB/tce		C energy consumption	1.47 tce/10,000 bce							

13	Dongshesha nzi No. 3 Red Brick Plant, Xinmin City	A private owned enterprise, established in 1984, with fixed assets of $150,000. Output before the renovation: 25 M bricks common equivalent/a ; Total employees: 132	clay and coal cinders mixed in a cased raw-meal feeder (mixer) and 14 dual-spindle mixers; then fed into a double-stage vacuum extruder; extruded columns cut into green bricks; air dried green bricks fired in a Hoffman kiln.	Internal combustive coal (t)	3,880.00	1.000	3,880.00	Coal:	1.55	tce/10,000 bce	2,500	10,000 bce/a./	4,037.10	2.493	10,064.49	1. renew the double-stage vacuum extruder; 2. renew the coal cinder grinding system 3. retrofit the Hoffman kiln; 4. introduce power capacitance enhancing devices (PCED) on motors 5. introduce FPN frequency controllers onto air blowers	54	11,400	commercial loan		accomplished	March - August, 2005	Payback period	2.54	year		Coal:	1.24	tce/10,000 bce	842.60	2,100.60	
				External combustive coal (t)			0.00	Power:	0.06	tce/10,000 bce								entrustment loan					IRR	53.88	%		Power:	0.04	tce/10,000 bce			
				Power/MWh	410.18	0.383	157.10											funds due	44				NPV	192.52	x 10000 RMB	2,500 x 10000 bce/a.						
				Sum total			4,037.10	C energy consumption	1.61	tce/10,000 bce								public subsidy					Cost of energy saving	62.32	RMB/tce		C energy consumption	1.28	tce/10,000 bce			
14	Mabei Brick Plant, Yuhong District, Shenyang	A private owned enterprise, established in 1987, with fixed assets of $109,000. Output before the renovation: 39 M bricks common equivalent/a.; Total employees: 140	clay and coal cinders mixed in a cased raw-meal feeder (mixer) and 15 dual-spindle mixers; then fed into a double-stage vacuum extruder; extruded columns cut into green bricks; air dried green bricks fired in a Hoffman kiln.	Internal combustive coal (t)	5,475.60	1.000	5,475.60	Coal:	1.40	tce/10,000 bce	3,900	10,000 bce/a./	5,678.82	2.493	14,157.30	1. renew the coal cinder grinding system 2. retrofit the Hoffman kiln; 3. introduce reactive power capacitance compensation devices on the transformer 4. introduce power capacitance enhancing devices (PCED) on motors; 5. introduce a new energy efficient air	50	11,400	commercial loan		accomplished	March - August, 2005	Payback period	3.60	year		Coal:	1.23	tce/10,000 bce	763.65	1,903.78	
				External combustive coal (t)			0.00	Power:	0.03	tce/10,000 bce								entrustment loan					IRR	38.23	%		Power:	0.03	tce/10,000 bce			
				Power/MWh	530.60	0.383	203.22											funds due	41				NPV	88.59	x 10000 RMB	3,900 x 10000 bce/a.						
				Sum total			5,678.82	C energy consumption	1.46	tce/10,000 bce								public subsidy					Cost of energy saving	59.13	RMB/tce		C energy consumption	1.26	tce/10,000 bce			
15	Minsheng Brick Plant, Benxi	A private owned enterprise, established in 1981, with fixed assets of $292,000. Output before the renovation: 36 M bricks common equivalent/a., Total employees: 158	clay and coal cinders mixed in a cased raw-meal feeder (mixer) and 16 dual-spindle mixers; then fed into a double-stage vacuum extruder; extruded columns cut into green bricks; air dried green bricks fired in a Hoffman kiln.	Internal combustive coal (t)	4,903.20	1.000	4,903.20	Coal:	1.36	tce/10,000 bce	3,600	10,000 bce/a./	5,135.41	2.493	12,802.58	1. renew the coal cinder grinding system 2. retrofit the Hoffman kiln; 3. introduce power capacitance enhancing devices (PCED) on motors	47	11,200	commercial loan		accomplished	March - August, 2005	Payback period	4.29	year		Coal:	1.19	tce/10,000 bce	672.49	1,676.52	
				External combustive coal (t)			0.00	Power:	0.06	tce/10,000 bce								entrustment loan					IRR	29.81	%		Power:	0.05	tce/10,000 bce			
				Power/MWh	606.30	0.383	232.21											funds due	38				NPV	56.59	x 10000 RMB	3,600 x 10000 bce/a.						
				Sum total			5,135.41	C energy consumption	1.43	tce/10,000 bce								public subsidy					Cost of energy saving	51.76	RMB/tce		C energy consumption	1.24	tce/10,000 bce			
16	Muyi Brick Plant, Anshan	A collectively owned enterprise, established in 1980, with fixed assets of $72,700. Output before the renovation: 20 M bricks common equivalent/a ; Total employees: 86	clay and coal cinders mixed in a cased raw-meal feeder (mixer) and 17 dual-spindle mixers; then fed into a double-stage vacuum extruder; extruded columns cut into green bricks; air dried green bricks fired in a Hoffman kiln.	Internal combustive coal (t)	3,192.00	1.000	3,192.00	Coal:	1.60	tce/10,000 bce	2,000	10,000 bce/a./	3,320.92	2.493	8,279.05	1.renew the double-stage vacuum extruder; 2.retrofit the Hoffman kiln; 3. introduce power capacitance enhancing devices (PCED) on motors 4. introduce FPN frequency controllers onto air blowers	52	11,700	commercial loan		accomplished	March - August, 2005	Payback period	7.19	year		Coal:	1.22	tce/10,000 bce	802.02	1,999.44	
				External combustive coal (t)			0.00	Power:	0.06	tce/10,000 bce								entrustment loan					IRR	13.99	%		Power:	0.04	tce/10,000 bce			
				Power/MWh	336.60	0.383	128.92											funds due	42				NPV	11.29	x 10000 RMB	2,000 x 10000 bce/a.						
				Sum total			3,320.92	C energy consumption	1.66	tce/10,000 bce								public subsidy					Cost of energy saving	69.63	RMB/tce		C energy consumption	1.26	tce/10,000 bce			
Total																	1130	192000		971.70					62150.00 x 10000 bce/a.		C energy consumption (average)	1.29	tce/10,000 bce	14792.34	36877.31	

Note:

1. Remarks: Comparing with the last version of the M&E Form annexed to the draft final report, technical figures in this Form have been updated or revised by verifying with not only feasibility study, progress report, installation report, on-site testing results, the annual EE report (2004) and the first-half-year report (2005) but also the year-end EE report (2005) of each of the plants, which we have just received.
2. bce: brick common equivalent
3. c energy consumption: comprehensive energy consumption
4. Formula for calculating cost of energy savings :

$$CE=\frac{Invest\frac{i}{(1+i)^n-1}+Cost}{EP}$$

Legend:

CE—cost of energy savings, Y/tce;

Invest— Initial cost (Y)

i—Discount rate;

n— Project lifecycle (a.)

c_2-c_1=incremental cost per product. c_2 - cost per product after the renovation; c_1- cost per product before the renovation. (Y/10,000 bce)

P2 - annual output after the renovation, (x 10,000 bce)

EP— annual energy savings (tce/a.)

5. Calculation of energy savings at TVE No. 7 and No. 12. "Artificial drying technology" technology has been applied to replace the "natural drying" technology at the two TVEs. After the renovation, waste heat exhausted from kilns is introduced into the artificial drying chamber as heating energy. This is of a type of waste heat (energy) recycling. Exact energy savings at the two TVEs are calculated by subtracting the power consumption of the newly added blowers from the total heat energy recycled.

Annex 4: Project Budget Allocation and Expenditure

Unit: US$1,000

No.	Plant	Project Budget (US$)	Co-financing (US$)	Project Support			Remarks
				Total (US$)	Among which		
					70% (equipment procurement)	30% (technical services)	
1	Tonggou No.4 Brick Plant, Sujiatun District, Shenyang	69.01	57.01	12.0	8.4	3.6	All project construction has been completed in the 16 plants.
2	Hollow Brick Plant, Waitoushan Town, Xihu District, Benxi City	61.2	49.3	11.9	8.3	3.6	
3	Shenyang Wensheng Brick Plant	103.42	90.62	12.8	9	3.8	
4	Qingshuitai Gaotang Hollow Brick Plant, Xinchengzi District,Shenyang	68.66	56.56	12.1	8.5	3.6	
5	Shenyang Pingluo Building Material Plant	131.47	118.67	12.8	9	3.8	
6	Shenyang Xihuan Hollow Brick Plan	65.08	52.78	12.3	8.6	3.7	
7	Dongbei Clay Brick Plant	217.3	204.7	12.6	8.8	3.8	
8	Shenyang Gaokan Town No.6 Red Brick Plant	78.8	66.8	12.0	8.4	3.6	
9	Tieling County Kangxing Red Brick Plant	60.17	48.47	11.7	8.2	3.5	
10	Tonggou No.3 Brick Plant, Sujiatun District, Shenyang	57.8	46.6	11.2	7.8	3.4	
11	Tonggou Hollow Brick Plant, Shenyang	65.46	53.16	12.3	8.6	3.7	
12	Huangtukan Construction Materials Plant, Yuhong District,Shenyang	144.65	132.05	12.6	8.8	3.8	
13	Dongsheshanzi No. 3 Red Brick Plant, Xinmin City	64.91	53.51	11.4	8	3.4	
14	Mabei Brick Plant, Yuhong District, Shenyang	60.84	49.44	11.4	8	3.4	
15	Minsheng Brick Plant, Benxi	57	45.8	11.2	7.8	3.4	
16	Mayi Brick Plant, Anshan	62.6	50.9	11.7	8.2	3.5	
	Total	136.837	117.637	19.20	13.44	5.76	