

# Technological Innovation



In 2005, the technological innovation of the Company, aimed at improving its production efficiency and effectiveness, raising the competitiveness of its core business and promoting the Company's sustainable development established a platform for technological innovation, initiating key technological breakthroughs for industry development particularly through technological cooperation in various sectors and levels and continuously nurturing its own innovation abilities thereby further improving the competitiveness of the Company's core business.

## (I) Investment in Technology

The Company increased its investment in technology in 2005 to reach approximately RMB930 million, representing a year-on-year increase of 17.1%. Key technological innovation projects accounted for more than 70% of this amount. In consideration of a combination of the time aspects of the Company's near to mid-long term needs, production and construction as well as key technologies and general technical skills, technological innovation projects the Company invested in were initiated at three levels, namely national level projects, the Company's key projects as well as subsidiaries' and branches' technological innovation projects.

## (II) Technology Team

Currently, the Company has established a preliminary three-tier technology innovation organisation system made up of a decision-making system comprised of members of its technology committee and expert advisory committee, a management system comprised of the technology management department personnel and experts as well as a research and development system comprised of the coal and power technology center and the technology departments of the subsidiaries and branches of the Company. In order to enhance the efficiency and level of management, the Company has established a technology management department, The Technology & Information Department, staffed with practically experienced doctorate and masters degree holders. The Shendong Coal Technology Centre, Guohua Power Technology Research Center and Transportation Technology Research Center (under construction) established in conjunction with our industry developmental needs are charged with implementing the Company's innovation. The technology management departments of subsidiaries (branches) and the participating units of technological innovation projects are becoming the entities for introduction, absorption and development of technologies. Our technological innovation team has been expanded to 235 members, of which more than 50% are top level senior engineers, more than 60% are R&D personnel and more than 80% are young and middle aged personnel. At the same time, the Company has established long-term strategic cooperation relationships with Shanghai Municipality, China Aerospace Technology Group, China Coal Research Institute and China University of Mining and Technology. These relationships have provided strong technological assistance to the Company for the implementation of its technological innovation projects.

1. Control room of power plant
2. Maintenance service center of Shendong Mines
3. Control room of Shendong Mines

### **(III) Benefits from Technology**

#### **1. Economic Benefits**

In 2005, the implementation of key technological innovations created sound economic benefits. The implementation of our project in localising our hydraulic shield technology has saved us approximately RMB1.5 billion in equipment expenditure. The wide application of the results of our research on the technology of high-strength mining of long working faces and extensive mining heights is expected to save more than RMB350 million annually in aggregate. Our technology in high-efficiency, safe combustion boilers in the Company's power plants has generally allowed our power plants designed to fire Shenhua Coal to utilise only Shenhua Coal. The promotion of such technology will facilitate the further expansion of the market share of Shenhua Coal and enhance the level of production safety. With the implementation of the comprehensive dust treatment technology research at the Zhunge'er coal selection factory, this major long-standing potential problem faced by safely management has basically been resolved.

#### **2. Social and Environmental Benefits**

Our sustainable exploitation of resources and protection of the environment in the Company's mines will increase coal resource recovery rate in our mines by 5-10 percentage points. The achievement of our technology in high-strength mining of long working faces and extensive mining height may increase the coal resource recovery rate by 3.8% directly. The application of the Zhunge'er coal residual stone-fired power generation technology has enhanced the mining resource overall usage efficiency. The industrial application of water-saving power generation technologies, such as sea water desalination, direct air cooling technology and sea water cooling tower technology, have expanded the channels for water resources development, and provide technological support for the establishment of large water-saving, mine-mouth power stations for regions where are rich in coal but lacking in water. Meanwhile, it will significantly increase the overall environmental sustainability of mining areas and provide technological support to the establishment of sustainable developing mines which are resource-saving and environmentally friendly in nature.

#### **3. Development of Talent**

The implementation of the Company's technological innovation projects has facilitated the development of technological personnel. Currently, more than 200 technological personnel of the Company have participated directly in the implementation of our technological innovation projects. This has not only promoted the building of a new independent innovation system with an integrated model of production, learning and research focused on the Company, but also driven the development and nurturing of technological talent in the Company.

### **(IV) Innovation**

In 2005, the Company implemented its technological innovation projects in full. 37 technological innovation projects commenced last year developed smoothly with significant breakthroughs and preliminary achievements. 17 newly initiated technological innovation projects have further increased the depth and width of technological innovation. In 2005, the Company was very successful in its attempt in protecting intellectual property rights, and was granted 47 patents (including 3 invention patents) and submitted 50 patent applications (including 10 invention patents).

## *Technological Innovation*

The Company's major technology projects, which are being implemented or have already completed include:

### **1. Hydraulic Shield Localisation Technology**

This was a breakthrough in the Company's strategy of localising key equipment for coal mining. Implementation has been sped up through measures including the introduction of strategic cooperation, technological innovation and change in exploitation methods. Among them, 5.5 metres ("m") hydraulic shields have been in use for almost three months in the Halagou mine. The shields will also be used in Shigetai mine in the near future. The 4.5m hydraulic shield model machine passed its pressure test conducted in accordance with European standards and mass production has been completed. The production of a 3.5m model hydraulic shield, which is suitable for the mining conditions of coal seams in the Shendong Mines, has been completed and will undergo a pressure test in the near future. The research and manufacturing of high-strength hydraulic ultra-high shield with mining heights over 6m has commenced. Currently, the local mining machinery manufacturing companies which worked with the Company have mastered the core technology for the design and manufacturing of hydraulic shields and the research and product systems of hydraulic shield with mining heights of 3.5m, 4.5m, 5.0m, 5.5m and over 6m have been preliminarily established.

### **2. Sustainable Exploration of Resources and Protection of the Environment in the Shendong Mines**

In response to the lack of resources and geological disasters and impact on ecological environment (including underground coal fires, underground water environment and surface ecology) as a result of the rapid development of mines, we have increased our focus on the research and experimentation of such technologies as mining techniques which increase the rate of resource recovery, water conservation and utilisation mining methods, and technology for the coordination and protection of the environment in the mines. Technology including those to enhance coal recovery rates, protection of water resources and ecological environment as well as technology for preventing underground coal fires will be implemented and adopted by our system of sustainably exploiting our resources and protecting the environment to assist the Company in maximising the use of resources and minimising effects on the environment.

### **3. High Efficiency Safe Combustion of Boilers**

The combustion technology of Shenhua Coal is a key technology in further expanding the scope of application of Shenhua Coal as well as its market share. In respect of the characteristics of Shenhua Coal and problems arising from operation of power plants, we initiated research on the fundamental specific characteristics of combustion of Shenhua Coal and research on anti-coagulation technology of Shenhua Coal in 600MW power plants. In 2005, the project succeeded in enabling us to create power plants designed to combust only Shenhua Coal.

#### **4. Water Saving Power Generation Technology**

In 2005, the Company undertook technological projects such as research on low-temperature multi-level sea water desalination, research on technology for direct air-cooling system operation in extreme low-temperature areas and research on sea water cooling tower technology. The technology for low-temperature multi-level sea water desalination has increased our water resources and will be used to produce water for use at Huanghua Power Plant in the near future. The implementation of the technology for direct air-cooling system operation in extreme low-temperature areas has started to produce an impact on the environment, our operations and our research on key techniques in water treatment systems. We are focusing on key techniques in our research on sea water cooling tower technology. It is expected that new environmentally friendly technology will be applied in our new power plants.

#### **5. Safety Production Technology**

In respect of the issue of the inherent safety level of the Company's coal production, we commenced a project to conduct research on inherent safety management systems in conjunction with the State Administration of Coal Safety. The project focused on the research of government regulatory systems and standards as well as theory, standards and implementation guidelines on inherent coal mine safety issues, with the aim of forming an inherent safety management system applicable to the PRC. Meanwhile, a series of projects on mine safety technology focusing on mine gas, coal fire and dust have been commenced.

#### **6. Research on High Productivity Mining of Long Working Faces and Extensive Mining Heights**

This project deals with the law of movement of rock rooves in mining areas and the apparent characteristics of roof pressure under geological conditions of shallow overburden and thin bedrock in the Shendong Mines. Technologies such as control over adjacent rocks in mining areas suitable for geological conditions of coal seams, selection of a comprehensive set of equipment on the working face, deployment of coal posts along laneways, support and control over adjacent rocks have been developed, which have created the technology for high-productivity mining of long working faces, and extensive mining heights. In the Shendong Mines, 3 working faces have successfully implemented such technology, of which Yujialiang mine has a working face of 360m, Shangwan mine and Halagou mine have working faces of 300m, marking an increase in the resource recovery rate by 3.8%. Currently, the technology has been implemented in 7 working faces.