

PROSPECTS OF GHP & EGS DEVELOPMENT IN CHINA

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ABSTRACT

“Law of Renewable Energy of PRC” had clearly explained that geothermal energy belongs to renewable energy. It is encouraged for development from the Chinese Government in order to reduce CO₂ emission effectively in the country.

The great function and effect for energy saving and reduction of CO₂ emission on GHP has more and more been recognized by government and popular users. GHP district heating reached 18% of total building area in Shenyang City has harvested 330 days of excellent atmosphere environment. It shows absolute good environmental benefit. In the Yangtze River Basin where without facilities of district heating before, GHP space heating has become new highlight for new buildings. GHP is continuing growth and popularization.

By effect from “The Future of Geothermal Energy” of MIT of US, a few developers have been interested to develop the EGS in China. The China-Australia cooperation in EGS preliminary study in China within past 2 years had finished. Several potential areas have been selected and will carry out further study. The application of the EGS national research project is in progress.

China Academy of Engineering has completed the research “China Mid-Long Term Strategy of Energy Development”. It includes renewable energy development strategy. It will reach to 17%-34% total energy demand to become “one of leading energy” in 2050. China Academy of Science has also formulated “The Road Map to 2050 on China Energy Science Development”. It includes large scale of renewable energy power generation. China will start research of EGS power generation. It is planned to reach 5%-10% of total power generation in 2050.

INTRODUCTION

Energy is basic demand for social economic growth and people’s living improvement. Increasing the

efficiency of energy use and reducing its negative effect to environment have been paid close attention worldwide. The research discovery on optimized energy and the expand of new frontier of energy have been carrying out. Geothermal as one of renewable energies is experiencing such baptism.

From statistics of World Geothermal Congress 2010, the installed capacity of geothermal power generation has reached 10,715 MW in the world. It increased 19.9% than 5 years ago. Its average annual growth rate is 3.99%. USA, Indonesia and Iceland increased 530MW, 400MW and 373MW respectively. These numbers are higher than that statistics in WGC2005. The increase of geothermal direct use is more highlight. Its installed capacity had reached 50,583 MWt in 2009. It increased 78.9% with annual rate of 12.33%. The number has also different meaning that GHP had very rapid growth but conventional geothermal district heating reduced its proportion although the number increased meanwhile. Therefore geothermal industry has created new frontier and new era in world’s energy development. The reason is due to that energy saving and emission reduction had been considered urgently. The superiority of GHP is fitting the demand.

Another new territory is EGS. It has been studying substantially for several decades in 8 countries. Under guiding from newest research of “The Future of Geothermal Energy” of MIT, USA, various countries have accelerated corresponding activities. China has carried out preliminary study and may be as the 9th country in EGS domain.

GEOTHERMAL HEAT PUMP (GHP)

Heat pump research and application had been started in China in 1960s. However there was no condition for practical application due to lack of electricity even for civil lighting at that time. Around the period entering the 21st century passing through technical exchange between China and the world and following the world’s trend, GHP started new experimental

application and import of technology. And then it gains continued fast growth.

Fast Rising of the GHP Trade

The earliest GHP projects were started in Beijing at the end of 20th Century. The sum of project reached 369 with total heating (partially cooling together) area of 7.38 million m² in Beijing in 2006. It was the first place in China at that time. Beijing has been keeping annual increase of 3 to 5 million m². But since 2007 Shenyang has become the first place in China (Fig.1). Shenyang completed total 18.10 million m² of GHP projects in 2007. Then it increased more than 15 million m² per year. The total GHP heating area reached 35.85 million m² and 54.62 million m² in the city in 2008 and 2009 respectively.

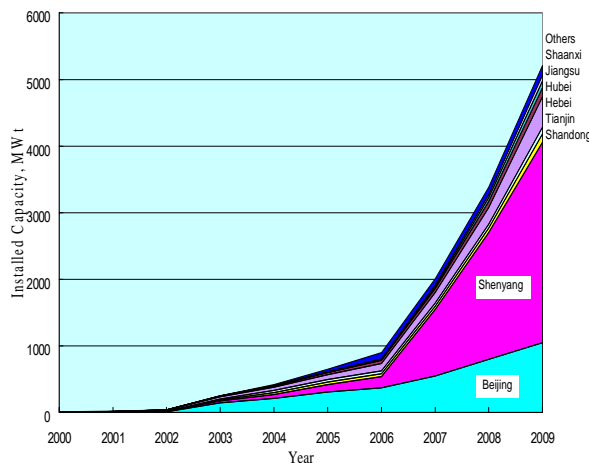


Fig.1 Growth of GHP in Different Regions in China

The increased GHP heating area is bigger and bigger in the country in recent years. It was 18.0 million m² in 2007, 24.0 million m² in 2008 and 38.7 million m² in 2009. In 2009 it had reached 100.7 million m² of building area with about 5,210 MWt of heat power. This number had made China become the second place of GHP utilization in the world. The annual increase rate has exceeded 60% in recent two years. It is rather fast than the world's average increase rate about 20% in recent 5 years. By incomplete statistics in 2010 the total utilization of GHP heating in China had reached 150 million m² of building area with about 6,000 MWt of heat power. GHP has substituted traditional coal boiler heating in a certain of proportion in some regions. It was 18% of total heating building area in Shenyang in 2008. Therefore the good atmosphere had reached 330 days in the city in the year. The previous heavy industrial city has created a new way for environmental protection and using clean energy.

Along with the rapid increase of GHP application in order to meet the great demand of rather expanded market, GHP production enterprises grew fast, too. Shandong Fureda Company commenced earliest

production of heat pump (using imported compressor) in China. In recent 10 years, such manufacturer has grown over 200. They distribute in Shandong, Beijing, Shenzhen, Dalian, Hangzhou, Suzhou and Guangzhou etc. places. National made product is water-water system big unit mainly. Most of units are screw-type compressor plus tube-type heat exchanger, but also eddy-type compressor plus plate heat exchanger. Big unit has power 2,000-3,000 kWt, but there is also small unit for home use which is less than 10 kWt. Besides the main unit manufacturers there are more 100 plants to produce related auxiliary attachments and PE tubes etc. In addition, some famous foreign companies have progressively established their production bases or joint venture enterprises in China

Furthermore, the design and construction companies have also expanded rapidly. Many new companies have founded in recent years. The total ranks of the trade have over 100,000 people.

As mark of trade activity various exhibitions and symposiums concerned with GHP held many times per year in different places in China. The participants for the National Second High-rank Forum of GHP Trade held in 2010 had reached 400 peoples. It had created the new record of the trade conference. Besides, various training courses were held by GHP councils of China Renewable Energy Society and China Resources Comprehensive Use Society, and Geothermal Council of China Energy Society for over 20 times per year. The junior and intermediate technician were trained there. The demand exceeds supply for professional BS and postgraduate of master degree and PhD. All these cases reflect a thriving situation of GHP trade.

Policy Support and Market Ratification

The great growth of the GHP trade relies on the support of policy and fund from National Government, and on market ratification from users.

The support from National Government is mainly in favorable policies. "Law of Renewable Energy", "Law of Energy Saving" and concerned enforcement regulations had formulated such care. The Mid-Long Term Programming of Energy Development in China has made clear target also. In the other hand public beneficial support is implemented. Ministry of Land and Resources and Tianjin People's Government have carried out a joint project of assessment of shallow geothermal energy. The result, which showed suitable, basic suitable and unsuitable divisions, was served to local GHP projects in order to avoid risk. A demonstration project of engineering application with environment monitoring is continuing there. Such projects have been arranged in many provinces, cities and autonomous regions. The purpose is to guide all parts of the country to carry out more GHP projects healthily to reach the target for energy saving and CO₂ emission reduction.

The ratification of user market has also important function. At the beginning GHP was applied in government office, schools, hospitals etc public buildings mainly. These all belong to national investment. At present such case has been changed. There was no district heating facilities in Nanjing before. But now developers constructed dwelling house communities have applied GHP heating system. Even it increased investment cost but it has gained user's welcome. The comfortable heating has become attraction. The function and efficiency of GHP have also gained user's ratification.

Solving Problem to Healthily Growth

Along with the rapid growth of GHP market and the fast expansion of GHP trade, it is inevitable that something wrong occurred. Initial design institutes and construction teams had not ability to bear so huge tasks. Big lack of market made new companies to involve the works. They are less experience and insufficient intelligence. So they may remain hidden trouble of engineering. Some improper matching between surface and subsurface parts of GHP system were occurred due to insufficient professional technician. Weak thermal response test and modeling prediction were also problems. The site thermal response test had been improved since 2009 according to revised national standard of Technical Code for GHP System. But modeling calculation is still lacking usually.

Several significant events happened in 2010. Expert group inspected the past rapid growth of GHP in Shenyang. Beijing Ever Source Science and Technology Development Co. Ltd. invited appraisal for their past projects with over 7 year's monitoring. They showed ground temperature recovering process by monitoring and summarized idea of Quality First in whole life period. It showed important contribution and an active example. Shenyang and Beijing as two biggest GHP application cities have adjusted properly their development plan, and have chosen more reliable new scheme.

ENHANCES GEOTHERMAL SYSTEM (EGS)

EGS research has made progress from previous data and references study by individual researchers transferred into preliminary site study in some selected regions.

Impact of "The Future of Geothermal Energy"

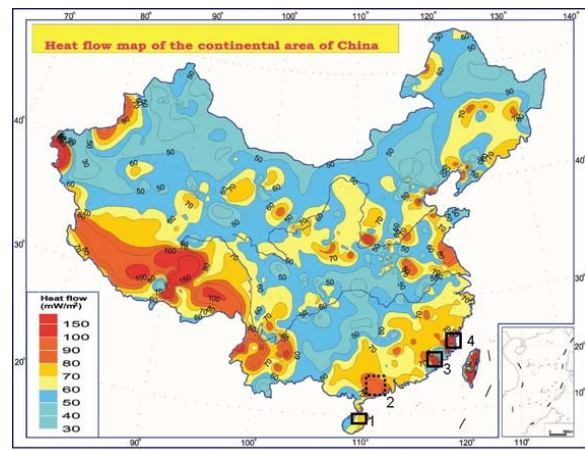
Massachusetts Institute of Technology completed the research report "The Future of Geothermal Energy --- Impact of Enhanced Geothermal System [EGS] on the United States in the 21st Century" in 2006. US Department of Energy organized the consequent report "An Evaluation of Enhanced Geothermal System Technology" in 2008. It summarized the

great potential of EGS. It will provide 100 GWe of base-load electric-generating capacity by 2050 in US. The total EGS resource base is more than 13 million exajoules (EJ). The extractable portion exceeds 200,000 EJ or about 2,000 times the annual consumption of primary energy in the United States in 2005. Such attractive huge energy potential has caused attention of US DOE. The US President Obama has granted further research fund.

Such impact has induced a new upsurge on EGS study worldwide. Of course the wave has affected in China.

Preliminary Study of the Resources Potential

Preliminary EGS study has been started in China. In 2007 Geothermal Council of China Energy Society (GCES) and Petratherm Ltd (Australia) signed a cooperation agreement to jointly undertake the project "Research on the potential of Enhanced Geothermal Systems (EGS) in China". In 2008 experts of both sides had carried out investigation in some potential areas. Further testing analysis and model studies combined with geological and geophysical data are also researched (Fig.2). In 2009 Chinese experts investigated Australian EGS projects, including 4,000 m well drilling and micro-audio monitoring in Petratherm, and EGS double wells circulation test and pilot plant of 1 MW electric generation by Geodynamics. Such successful experience and undergone setback give us valuable reference. Australian said their EGS potential is 26,000 time of primary energy use in 2008 in the country.



*Fig.2 Heat Flow Map of China with Selected EGS Potential Regions
(1-NE Hainan, 2-Yangjiang, 3-Zhangzhou, 4-Fuzhou)*

In April 2010 High-Technology Research and Development Bureau of Chinese Academy of Science hosted the EGS Symposium for the first time in China. Experts and scholars carried out

professional discussion and discussed feasibility of EGS development in China.

Requirement and Possibility of Further Research

On the other hand, in 2009 the relevant institutions of research and exploration submitted a project application to the China Geological Survey and the Ministry of Land and Resources in order to undertake suitable tasks, match the cooperation and have an in-depth study in 2010. It is hoped that an evaluation report on EGS, such as "The Future of Geothermal Energy" in USA, can be submitted in a few years to provide the country reference for energy policy and energy planning.

Concerned institutes and exploration teams have jointly submitted a project application, which named deepening research of EGS in China, to the China Geological Survey and the Ministry of Land and Resources. Chinese EGS workers hope to get national fund to carry out further research. We strive for submitting Chinese "The Future of Geothermal Energy" within a few years. And experimental geophysical survey and deep drilling should be stated in selected potential regions. The project has been passed expert's review. It is possible to be commenced in 2011 the starting year of the 12th Five-year Programme.

Some Chinese developers have also interested in EGS development. China Geothermal Power Generation Co. Ltd. and its branches have founded in 2010. Individual companies have selected working site to prepare test drilling.

PROSPECTS OF THE DEVELOPMENT

"The Programming on Mid-Long Term Renewable Energy Development in China" had been drawn up by National Development and Reforming Committee (NDRC) in 2007. It programmed that geothermal energy use would reach 4 million tons of standard coal equivalent in 2010 and 12 million tons of standard coal equivalent in 2020. This first target has been achieved actually. China used conventional geothermal energy plus GHP had reached 4.61 million tons of standard coal equivalent in 2009.

The project "Research on mid- and long-term energy development strategy in China" has been completed by the Chinese Academy of Engineering, in which more than 50 academicians of CAE participated. The report appointed out that the development of renewable energy in China is aimed at large-scale alternative to fossil fuels, reducing carbon emissions and reducing dependence on foreign energy. Strategic objectives are that for non-hydro renewable energy strategic positioning is: to be supplemental energy (around 2010), to provide 60 million tons of standard coal equivalent, accounting for around 2% of the total energy demand; to be an alternative energy sources (around 2020), to provide 180 million to 330 million tons of standard coal equivalent, accounting for 5-

10% of the total energy demand; to be one of the mainstream sources of energy (around 2030), to provide 400 million to 800 million tons of standard coal equivalent, accounting for around 10-19% of the total energy demand; and to be one of the leading forms of energy (around 2050), to provide 880 million to 1,710 million tons of standard coal equivalent, accounting for around 17-34% of the total energy demand. For geothermal energy, geothermal power generation and direct heat use are included in this strategy (mainly for building heating).

Chinese Academy of Science has also completed the "Road Map on China Energy Science Development to 2050". Large scale renewable energy power generation has been programmed. It includes conventional geothermal power generation and EGS power generation.

All in all, based on imposing target of energy saving and emission reduction, renewable energies development including geothermal energy has been attached importance in China. It will form favorable condition of accelerating growth.

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