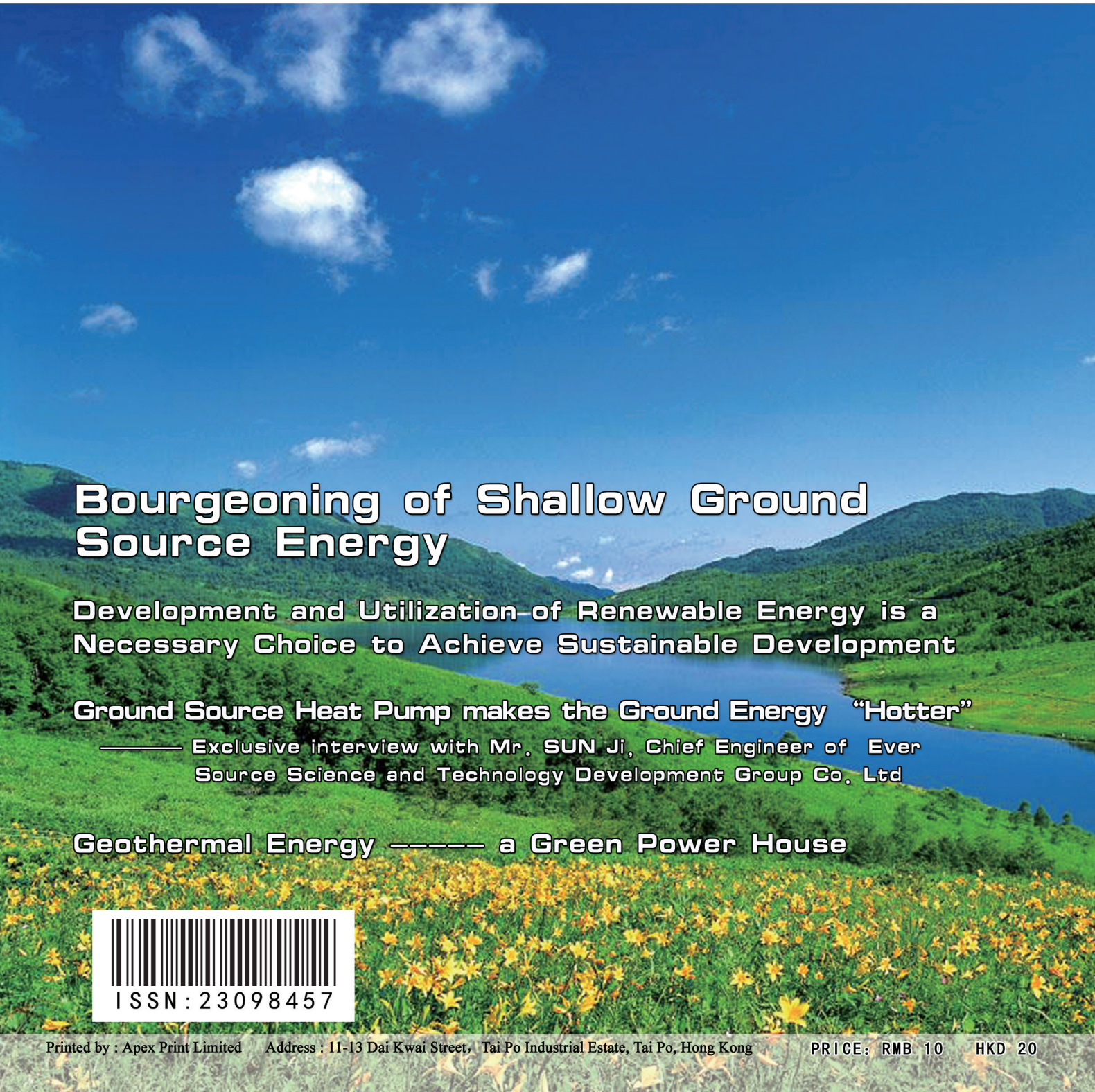
中國地能

CHINA GROUND SOURCE ENERGY

April 2014
1st Issue
BIMONTHLY



Bourgeoning of Shallow Ground Source Energy

Development and Utilization of Renewable Energy is a Necessary Choice to Achieve Sustainable Development

Ground Source Heat Pump makes the Ground Energy "Hotter"

——— Exclusive interview with Mr. SUN Ji, Chief Engineer of Ever Source Science and Technology Development Group Co. Ltd

Geothermal Energy ------ a Green Power House

ISSN : 23098457

Printed by : Apex Print Limited Address : 11-13 Dai Kwai Street, Tai Po Industrial Estate, Tai Po, Hong Kong PRICE: RMB 10 HKD 20

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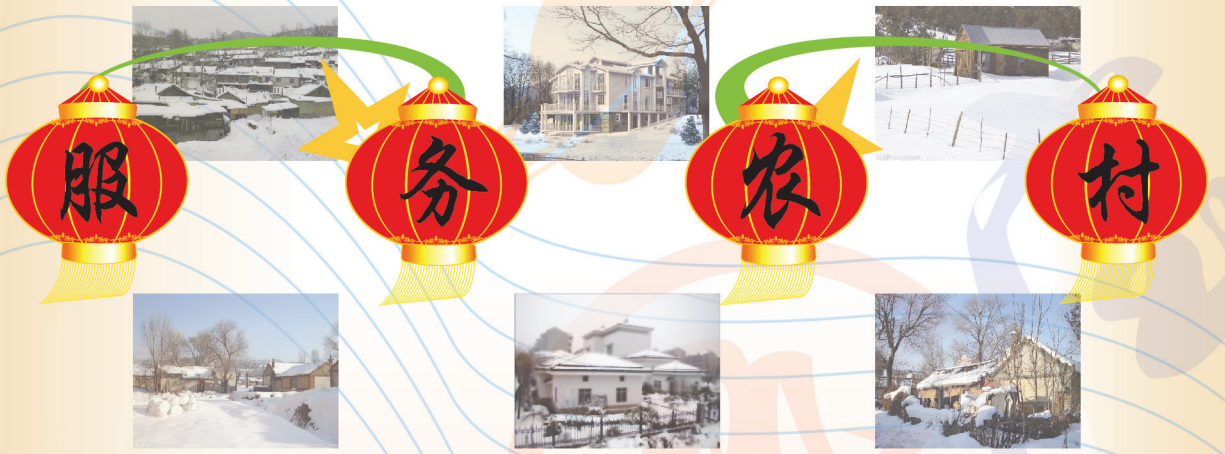

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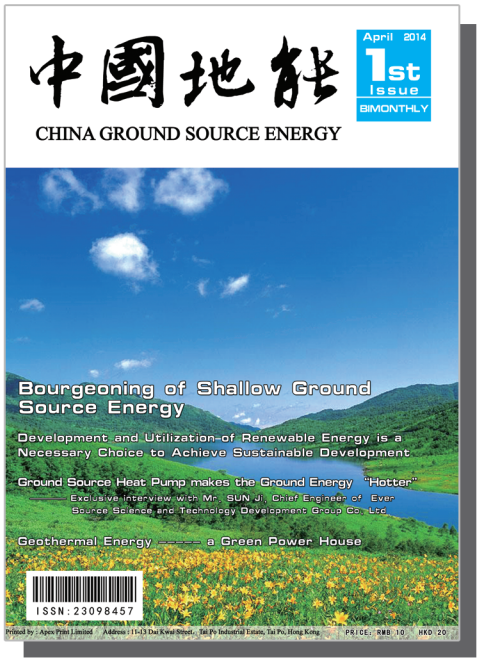
恒有源科技发展集团有限公司
Ever Source Science & Technology Development Group Co.,Ltd.



Soliciting Contributions

"China Ground Source Energy" is a scientific magazine published by the China Ground Source Energy Publishing House in Hongkong bimonthly in 16 mo with Issue No. 23098457 under joint sponsorship with the Special Committee on Shallow Ground Source (Thermal) Energy Development and Utilization under Beijing Association to Promote Energy Conservation and Environmental Protection. The magazine carries the mission to offer references and proposals for the government in making energy decisions, to serve as an effective forum for view exchanges among designers, users and general public, to disseminate successful expertise in shallow ground source energy utilization, to showcase good practices of completed projects, and to formulate a platform for technology promotion. Contributions from experts, scholars, scientists and engineers in energy conservation enterprises, research institutions, universities and colleges etc. are invited.

The magazine has many columns, mainly including Current Focus, Policy Advices, Development Forum, Exclusive Interview, Hotspot Info, Project Showcase, Knowledge Sharing etc..

Requirements on contributions:

1.Contributions better within 1000-3000 words shall have distinct viewpoints, reliable information sources, accurate data, standard forms and shall be of theoretical, scientific or practical value. The writer is self responsible for his views, and plagiarism and multiple submission of the draft are strictly prohibited. All submissions that fail to get a response in 30 days may call to check or be at own disposal.

2.Article layout shall include title, full names of writer(s) and employer(s), postal code, abstract, key words, body text, notes and bibliographic references;

3.Contributions shall be sent as separate attachments to emails. Please also make sure to sent writers' biographies, address, contact numbers etc in the email, so that editorial responses and sample issues can be delivered timely;

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中國地能
April 2014 1st Issue BIMONTHLY
CHINA GROUND SOURCE ENERGY

出版社/主办单位：中国地能出版社有限公司
China Ground Source Energy Press Limited
地址：香港皇后大道中99号中环中心37楼3709-10室
Address : Units 3709-10, 37/F, The Center, 99 Queen's Road Central, Central, Hong Kong
协办单位：北京节能环保促进会浅层地（热）能开发利用专业委员会
joint sponsor：Special Committee on Shallow Ground Source (Thermal) Energy Development and Utilization under Beijing Association to Promote Energy Conservation and Environmental
国际标准刊号/ISSN： 23098457
承印人：泰业印刷有限公司
Printed by : Apex Print Limited
地址：香港大埔大埔工业邨大贵街11-13号
Address : 11-13 Dai Kwai Street，Tai Po Industrial Estate, Tai Po, Hong Kong
发行部：龙云
Publishing Department : LONG Yun
广告部：赵彤
Advertising Department : ZHAO Tong
地址：北京市海淀区杏石口路102号
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Energies and Products

Inaugural Statement of *"China Ground Source Energy"*

■ "China Ground Source Energy" Editorial Committee

Energy is a motive power that drives national economy forward and an essential guarantee to people's living quality and physical health. It is a key element that has direct bearings on social stability and harmony and therefore, has been keeping every state and every head of state busy. Exploration and development of new energies could always improve average people's livelihood.

The shallow ground source energy and the deep geo-thermal energy produced by the earth (generally referred to as Ground Source Energy hereafter) is not only abundant, but also constant and renewable which can be directly used to substitute coals in providing combustion-free heating and cooling for buildings.

The world's history of energy development has been closely connected with industrial development. In the 18th century, it was coal and steam engine that brought about industrial revolution in UK. In the 19th century, with the discovery of oil and gas and the invention of internal combustion engines and turbines, automobiles, ships and aircrafts came into being which have greatly shortened the world's distance and promoted economic and trade exchanges among various countries. In the 21st century, the invention of compressor and heat pump made it a reality to utilize the low-grade (below 25°C) renewable shallow ground source energy to provide heating for buildings, which triggers a new industrial revolution in the heating sector. With boilers being replaced by heat pumps, coal replaced by ground source energy or geo-thermal energy, heating for buildings can be done without coals. This invention will also help China to radically cure environmental pollution by eradicating the root cause of haze. Therefore, it is imperative for China to further speed up its pace in promoting combustion-free heating with ground source energy. Supported by China's indigenous technology of integrated ground source heat pump system of heating and cooling, the new industry will experience even more rapid development in the 21st century.

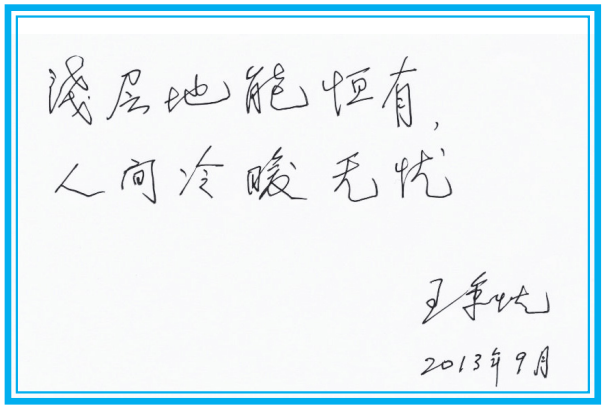
Being launched at this historical timing, ***"China Ground Source Energy"*** aims at popularizing knowledge and information, R&D results and new industrial trend in development and utilization of shallow ground thermal energy and deep geo-thermal energy.

The mission of ***"China Ground Source Energy"*** is to:

1. offer ideas and suggestions for the government in making energy decision, formulate a forum for designers and users in heating and cooling sectors to fully exchange views; and present scientific and technological knowledge and information for the general public to better understand the new industry of integrated ground source heat pump system of heating and cooling;

2. disseminate the expertise of providing heating and cooling with free ground source energy at cost of very small amount of electricity, and present projects using ground source energy to achieve integrated provision of heating and cooling for buildings in a combustion-free manner at a cost similar to traditional heating systems.

3. pursue harmony and coexistence between human beings and the nature and constitute a propagation platform for graded and scientific utilization of energies. ■



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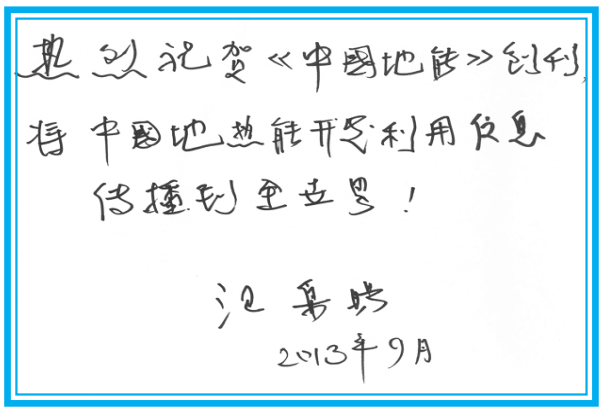

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Mr. WANG Jiyang

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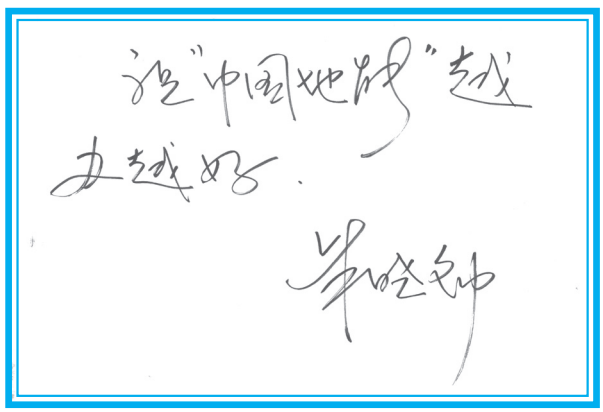

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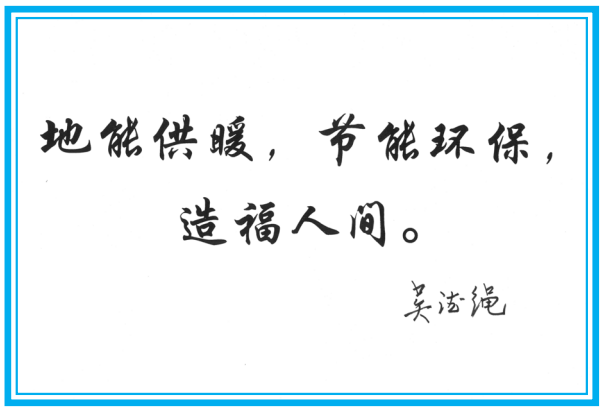

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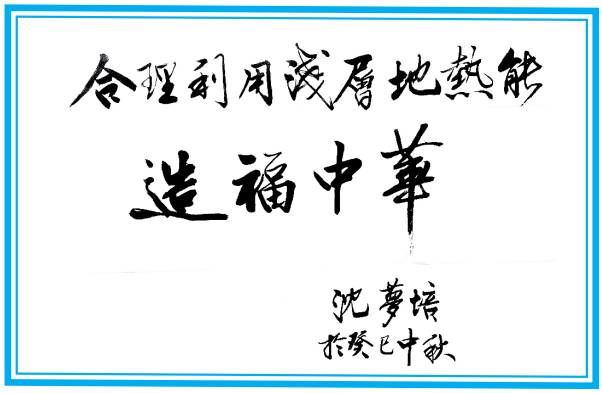

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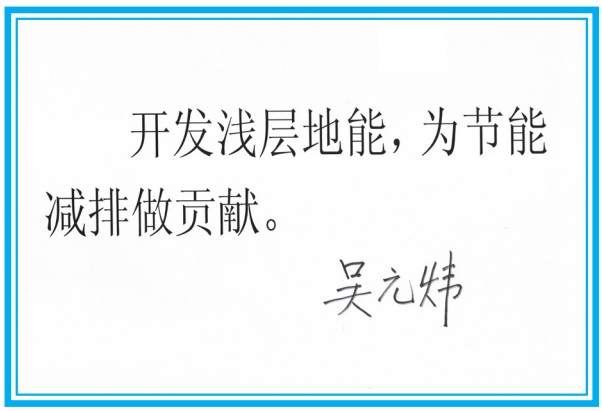

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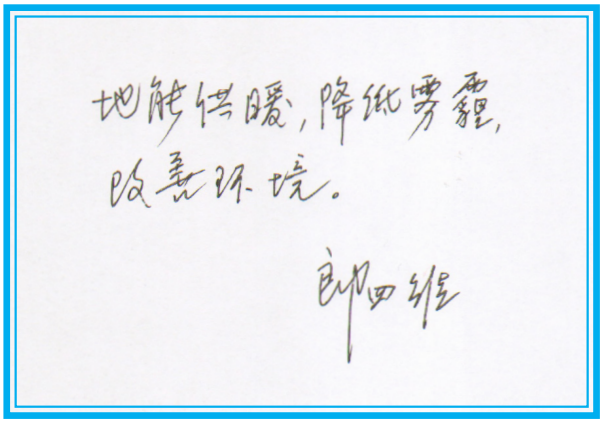

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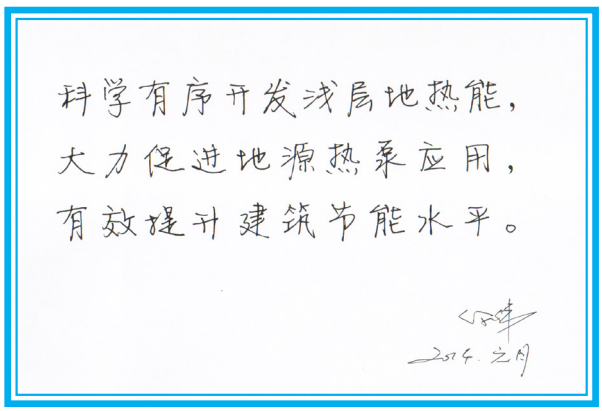

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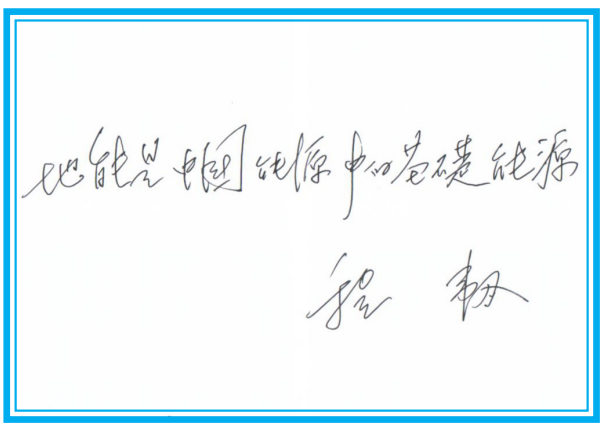

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Mr. CHENG Ren

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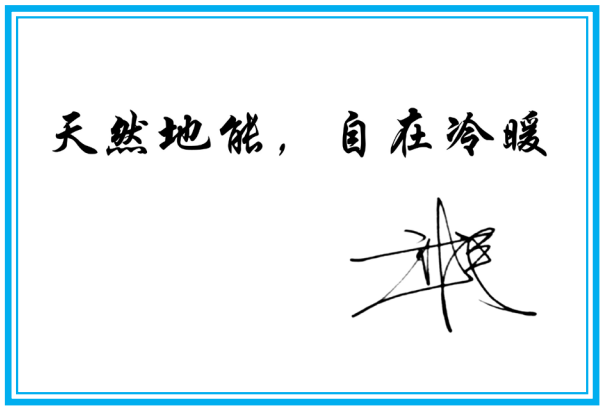

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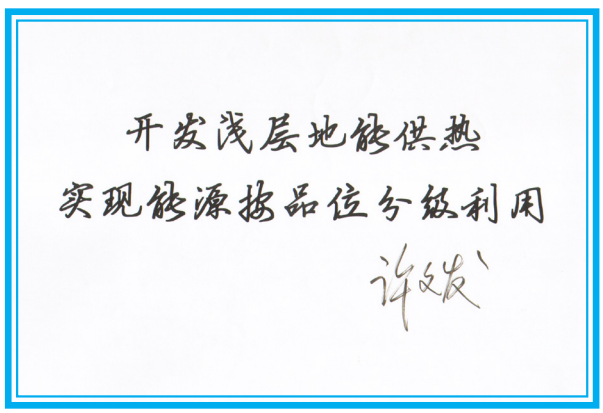

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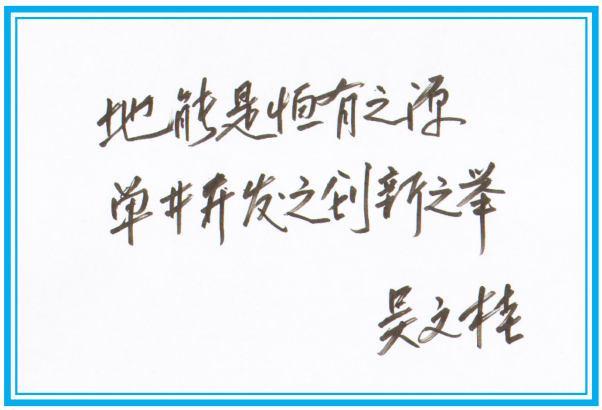

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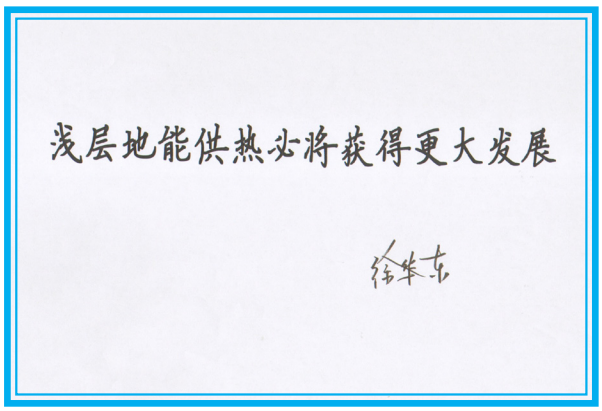

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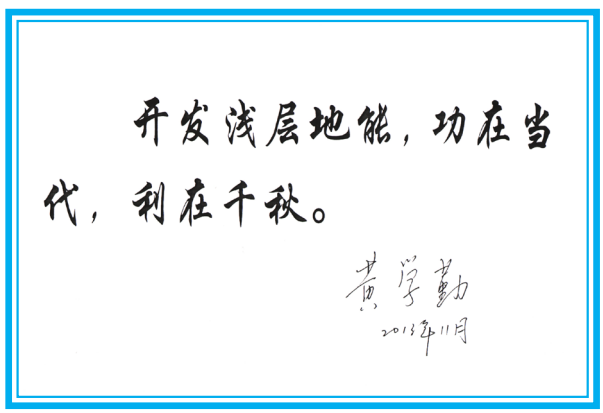

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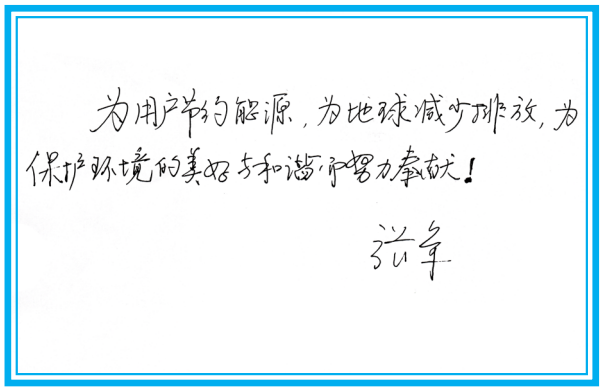

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Mr. ZHANG Jun

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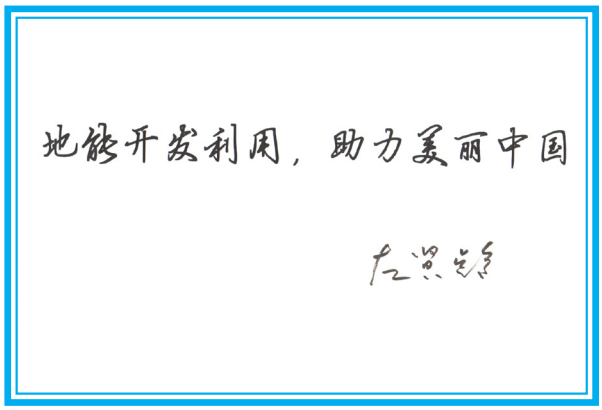


Inscription of Congratulations by Chief Engineer ZUO Xianling

Mr. ZUO Xianling

Research Fellow, Chief Engineer in Mechanics in China Aerospace Architectural Design and Research Institute.

Current Focus

Bourgeoning of Shallow Ground Source Energy

■ by ZHAO Yan

We shall put more emphasis on further development and utilization of shallow ground source energy. It is necessary to render more support, and improve policies and measures to forcefully strengthen exploration, planning, development and utilization of shallow ground source energy, taking it as an important means to explore and expand new areas of growth, so as to formulate a new era for ground source energy utilization.

——————XU Shaoshi

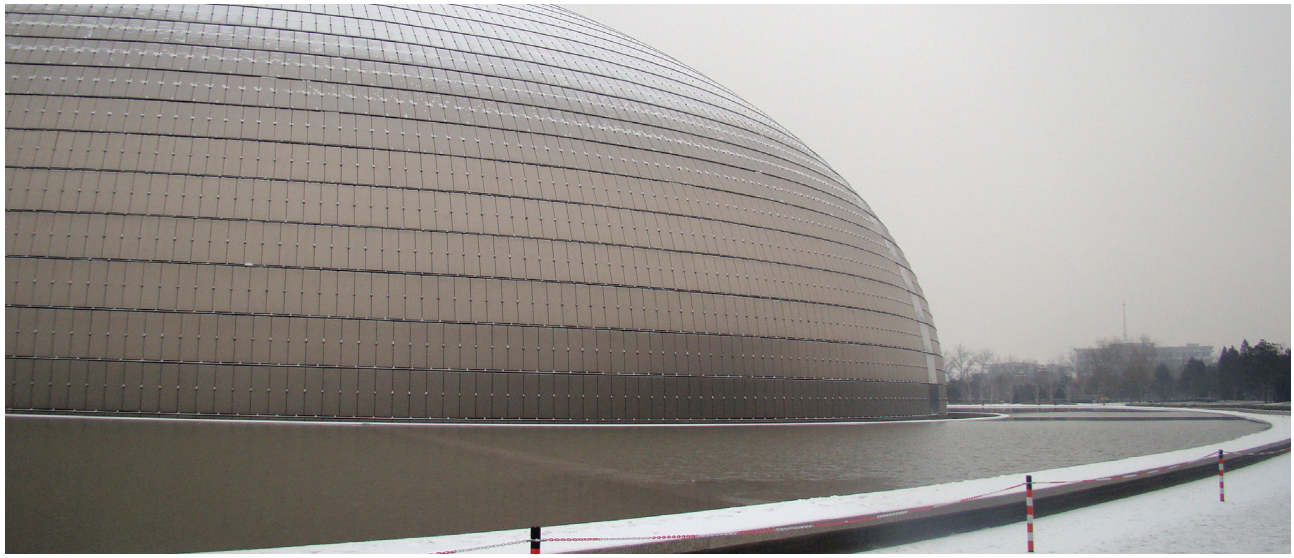
Minister of National Development and Reform Committee, PRC

With rapid economic growth, energy supply and consumption in China is becoming ever challenging. As a clean, cheap, abundant, renewable and environmentally friendly energy, the shallow ground source energy enjoys enormous prospect of development. It is of important significance for China to promote exploration and utilization of shallow ground source energy in building resource-saving and environment-friendly society, in safeguarding national energy security, in refining current energy structure and in realizing the country's strategic goal of energy saving and emission reduction.

By 2015, with the implementation of the 12th five-year plan of national economic development, the heating floorages by shallow ground source energy will aggregate to 350 million m^2. And according to the paper titled "Application Technology and Utilization of Shallow Ground Source Energy in China" published by the Ministry of Science and Technology, it is estimated that the total market value of shallow ground source energy development and utilization will be no less than RMB 70 billion Yuan, manifesting the enormous development potential and prosperous future of the industry.

The Ministry of Land and Resource (MLR) also encourages the development and utilization of shallow ground source energy. In 2006, it started the pilot work of shallow ground source energy exploitation and evaluation. In 2007, the Ministry held a national seminar in Beijing on hand-on experience-sharing of shallow ground source energy development and utilization. And in the same year, China Geological Prospecting Bureau established the Center of Research and Promotion of Shallow Ground Source Energy. In 2008, the Ministry released the Notice on Forcefully Promoting Development and Utilization of Shallow Ground Source Energy, which mapped out an overall plan on prospect evaluation, mapping and geological monitoring of shallow ground sour-ce energy resource. In 2009, the Ministry convened a national meeting in Tianjin on the administration of shallow grou-nd source energy and geothermal energy utilization, which endorsed the Norms of Prospect Evaluation of Ground Sour-ce Energy. In addition, the Center of Research and Promotion of Shallow Ground Source Energy under Chinese Geological Prospecting Bureau held four sessions of high-level workshops on geological prospect evaluation and development of ground source energy.

As Minister XU Shaoshi has pointed out, we shall put more emphasis on further development and utilization of shallow ground source energy. It is necessary to render more support, and improve policies and measures to forcefully strengthen exploration, planning, development and utilization of shallow ground source energy, taking it as an important means to explore and extend new areas of growth, so as to formulate a new era for shallow ground source energy utilization. In 2010, Shallow Ground Source Energy Resources in China was published as jointly compiled by Beijing Geological and Mineral Exploration and Development Bureau, and the Center of Research and Promotion of Shallow Ground Source Energy under Chinese Geological Prospecting Bureau. Vice Minister of MLR, Mr. WANG Min inscribed the book. The publication turned out to be of important guidance and reference value for prospect



Application Example of the HYY Single-Well Heat Exchange Circulation for Ground Source Energy Collection: the ever-flowing water in the 35,000 m^2 Landscape Pool outside the National Grand Theatre.

evaluation, development and utilization of shallow ground source energy in China.

Vigorous development of shallow ground source energy can greatly help China to ease the tension in fossil fuel supply. According the results from the study of geological prospects of Beijing in shallow ground source energy reserves, when the surface temperature in the flat area of Beijing drops by 1°C, the static shallow ground source energy within 3-150 meters underground is 1.94×10^{15}kj, equaling to 66.2 million tons standard coal equivalent (SCE). As such, in winter times, 4.48×10^{14}kj or 15.3 million tons SCE shallow ground source energy can be utilized to providing heating for a total floorage of 960 million m^2; and while in summer, 8.95×10^{14}kj can be used to cool a total floorage of 1.6 billion m^2. According to the master plan of Beijing Municipality, the total heating floorage will only reach to 1 billion m^2 by the year of 2020. Therefore, it is fair to say that with substantial development of shallow ground source energy, the energy consumption structure will be optimized and the tension in fossil fuels can be relieved.

The development and utilization of shallow ground source energy has been underway for dozens of years in overseas countries. However, it started quite late in China with only about ten years' track record up to now. Currently, there are a great number of practices and application projects of shallow ground source energy in China and many research institutes and enterprises have carried out in-depth performance research and engineering pilot projects to improve the technology in shallow ground source energy exploitation and development. In spite of it, general public in China still lacks knowledge and understanding on ground source energy, especially the related technologies as well as its advantages of being cost-effective and reliable. Some architectural designing institutes are still reluctant to use such technologies due to lack of relevant acknowledgement and experiences. As a result, the further growth in shallow ground source energy development and utilization is severely restrained.

Being aware of the problems existing in the current process of shallow ground source energy exploration and application, the future efforts in this regards shall focus more on accelerating the prospect evaluation of shallow ground so-urce energy and clearly mapping out the reserves and potentials. We shall study the possible impact of shallow ground source energy utilization on geological environment, set up incentive policies to encourage shallow ground source energy exploration and utilization, and enhance the awareness of the public in this area.

Competent authorities of the government shall reinforce their efforts in advocating shallow ground energy utilization and publicize knowledge and promote dynamic interactions among different study disciplines. This is also where MLR and its subordinate authorities could play their irreplaceable and effective role. It is a good timing for us to advocate the technologies via the media, news report, scientific publicities to introduce some projects and good practices in this sector as demonstration samples in order to educate the public with the strong advantages and actual effectiveness of the energy in energy saving and emission reduction. Thus, it will help to increase people's awareness of the "green" side of these technologies and the shallow ground source energy. Besides, we shall also mobilize the local governments to actively promote the development and utilization of shallow ground sou-rce energy.

Moreover, to better improve the technology, all colleges, research institutes, professional associations and related agencies shall fully unleash their respective advantages to reinforce technical trainings and technical exchanges in areas of shallow ground source energy investigation and evaluation. With collective efforts, we will continue to attain technological breakthroughs and constantly perfect technologies in developing and utilizing shallow ground source energy.■

Policy Advices

Promoting Combustion-Free Ground Source Heating System, Accelerating Industrial Growth of Integrated Heating and Cooling System with Ground Source Energy and Mitigating Haze Pollution of Coal-Fired Heating

■ by WANG Guangqian

Wang GQ, born in April 1962 in the Nanyang Ctiy, Henan Province, obtained his bachelor degree from the Wuhan Institute of Hydraulic and Electric Engineering in 1982. And he got his master degree and PhD degree from the Tsinghua University in 1985 and 1989, respectively. He took post-doctoral work at the institute of mechanics, CAS from 1990 to 1992. Currently, he is a professor and general director of the State Key Laboratory of Hydroscience and Engineering at the Tsinghua University. He is also a general director of the Department of Engineering and Materials Science at the National Natural Science Foundation of China. Professor Wang is the vice editor of the Journal of Hydro- environment Research.

He was a winner of the National Outstanding Younger Fund Award in 1995 and the Yangtze River Scholar Award in 2000. He got financial supports from the Strategic Research Fund of National Natural Science Foundation in 2002. He is the chief scientist of the National Basic Research Program of China. Currently, Professor Wang is an academician of CAS. He is the member of the national committee of the 9th CPPCC, the standing committee of the 10th, 11th and the 12th CPPCC.

Professor Wang's main research achievements include: (1) developing a digital watershed model through integrating multiple hydrologic, hydrodynamic and sedimentation dynamic processes. Currently, software of the digital watershed model system has been developed for practical applications; (2) developing a kinetic model and obtaining corresponding theoretical solution for solid-liquid two-phase flows with low sediment concentrations; (3) developing of a kinetic model for solid-liquid two-phase flows with high sediment concentrations; (4) developing the granular flow model for debris flow; (5) Applications of the developed methodologies and models to many momentous projects, such as construction of the Three Gorges Project, operation of the Sanmenxia Reservoir in the Yellow River Basin, water resources regulation in the Yellow River Basin, have resulted in significant contributions. He has published more than 240 Papers and 5 monographs. Professor Wang has been awarded several national-level prizes for his achievements in science and engineering fields.

Wang GQ is the first Academician of CAS who was graduated from the Wuhan University since 1977.

An important cause of haze pollution is the low-altitude emission discharged by enormous fuel-combustions for heating. The emission containing harmful gas, dirt and vast heat when encountering typical weather condition transforms into haze.

Presently, the shallow ground source energy collection technology as an indigenous patent technology developed in China is capable of extracting massive amount of ground source energy to provide heating for buildings free from pollution and potential geological threats in any geological conditions and at very low cost. Therefore, a scientific structure of graded energy utilization is formulated.

The industrialization of such indigenous technology has triggered comprehensive upgrading of traditional heating industry (which features combustion, pollution and emission) into a new industry of integrated heating/cooling system with ground source energy (free of combustion, emission and pollution).

Assuming electricity price is 0.5 yuan/kWh and coal price is 500 yuan/ton, the running cost of the Ground Source Heating System in heating season is roughly the same as the traditional coal-burning heating in Beijing.

Industrialization of indigenous technologies is the foundation underlying all efforts to build up the country, and sound development of industries is the route to national rejuvenation. The industrialization of the indigenous technology in ground source energy collection and utilization can promote an all-round escalation of heating provision industry in China.

The collection technology of shallow ground source energy has been fairly mature with wide applicability and strong designability. Up to now, relevant rules and standards have been stipulated and published. Moreover, utilization of the ground source heating system does not increase the heating cost of building. The promotion of the ground source heating system by the government benefits the country and the people in general since it is combustion-free and cost-effective with instant returns. In addition, heating with the system liberates the government from making extra expenditures on air pollution control, landfill and frequent road maintenance for coal transport. In terms of marketing, there have been some brands enterprises and products including.

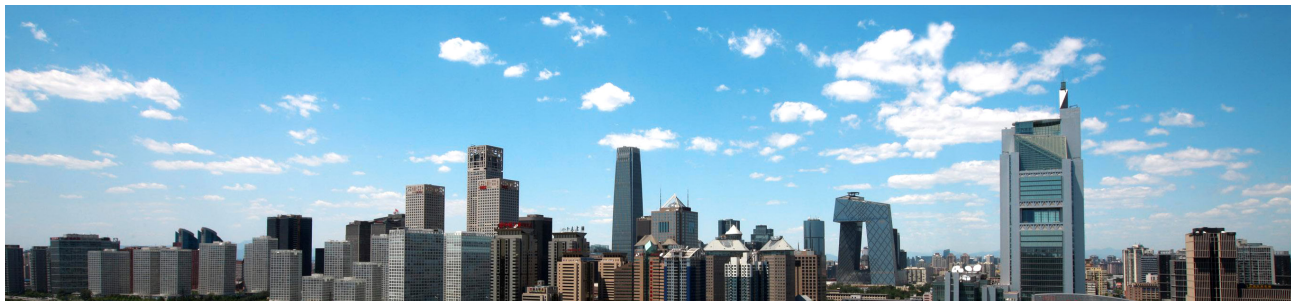
1. “Dispersed Ground Source Stations for Cooling/Heating” from 5 to 900MW productivity in towns and cities;
2. “Ground Source Heat Pump System” applicable to single building or building blocks;
3. “Ground Source Heating Devices” mainly used for household-based heating provision in rural areas;

Development in large scales can be more effective and efficient in achieving economic and environmental benefits. With 15 million m^2 floorage using ground source energy to provide non-combustion heating, the Industry of Integrated Heating and Cooling System with Ground Source Energy can realize annual output of 1 billion yuans, with 50 million yuan net profit and thousands of new jobs for less-educated labors (junior high school graduates). It can also replace coal burning by 562,500 tons of SCE and reduce CO_2 emission by 1.41 million tons.

To further promote the utilization of the technology, there are still conceptual and policy-related obstacles. For instance, the system is not entitled to the policy subsidies of heating as enjoyed by traditional heating industry. The approval process for heat exchange well drilling is the same as that for water wells. The market also lacks rational guidance and supervision and a systematic and complete industrial standards and access system are not yet in place. Therefore, this is truly an emerging industry that requires intensified support, administration and guidance from the state and the government. In light of the above, we would like to make the following proposals:

1. The development of the new industry shall be a systematic engineering that requires direct administration and guidance by decision makers with renewed mindset. The government remains the first responder to energy saving and environmental protection and such responsibility is unshirkable. Therefore, it is proposed that the government shall strictly ban any increase of building areas heated by coal burning and set up a straightforward and clear-cut policy to gradually replace coal burning with non-combustion heating by ground source energy.
2. Heating with shallow ground source energy shall be entitled to relevant preferential policies for clean energy utilization and environmentimprovement.
3. The approval process on drilling of heat exchange wells for ground source collection shall be consolidated and reformed. The Water Affairs Bureau could be the department solely responsible to conduct open and transparent approvals. It is not applicable to equalize its approval process to that of water wells.
4. Industrial associations shall be given their due role to play to standardize the development in ground source energy utilization sector so as to facilitate the government’s supervision and monitoring process.

The emerging industry of integrated heating/cooling system with ground source energy is a very representative practice of the recent development efforts in promoting ecological civilization construction and upgrading traditional industries. It is also the most economical and effective way to speed up haze control with support of industrial development. Forceful promotion of the combustion-free heating system is an important means to cure haze pollution. ■



Development Forum

Integrated Heating and Cooling with Shallow Ground Source Energy in Small Cities is an Emerging Industry in China

■ by YAN Yiping

The Third Plenary Session of the 18th Chinese Communist Party Congress has decided to further improve the sound development mechanism of urbanization, stick to the route of promoting new-type of urbanization with Chinese characteristics, place people at the core in pushing forward urbanization, and realize coordinated development among cities and towns of different sizes.

Facing with global financial crisis and economic recession, China is in active pursue of historical transformation in its economic development pattern. Expansion of domestic demand has become a long-term strategic solution for China to achieve economic and social growth. Stronger growth in cities and town can effectively drive up investment and consumption needs. Therefore, it has become a pressing and important topic of the times to forge ahead construction and development in big, medium and small cities, as it will result in more labor flow into cities and beef up urban investment and consumptions.

Population in urban areas is more concentrated than in rural areas. Most of those rural immigrants in cities will no longer engage in agriculture. Therefore, the new dwellers will consume more commercial energies especially for the purpose of heating in winters rather than biomass energies as they used in rural areas. The traditional way of heating in China was mainly coal-fired. With rich reserves, wide distribution, high heat and easy transportation, coal has naturally become the dominant heating source for small towns. However, while generating heat, the burning of coal also releases great amount of noxious gas and particulate matters such as SO_2 and smoke dust, which can do harm to people's health, buildings and plants. This was not a prominent issue fifty years ago when China was small in term of population and per capita living floor area and low in people's purchasing power and urban coal consumption. Since the mid-20th century, coal consumption in North China during winters has increased by large margin, as results of rapid expansion in population and fast growth of people's purchasing power and per capita living floor area. According to statistics, the coal consumption in North China in 2012 was about 8 times more than that in mid 1970s. Besides smoke dusts, pollution from coal burning also include pollution caused by coal transportation and storage, as well as pollution generated by residues treatment, coal transport vehicle emissions and boiler fires etc.. The sharp rise in coal consumption has made the air quality of Northern China in winter be obviously inferior to that in other seasons, especially in the densely populated areas such as the plain areas in North China and East China. During windless winter days in many small cities and towns of North China, the cities is usually overshadowed with smoke dust since early morning. The air smells smoky and feels bad if you stay outside longer, not to speak of jogging and physical exercise. According a study paper jointly completed by researchers from China, US and Israel and published in the Proceedings of National Academy of Science of US, the pollution from heating has caused the average life expectancy of residents in northern China 5.5 years shorter than people living in southern China. And it has induced an economic loss of 100 trillion yuan in China's labor market. Some studies in China also find that in some severely polluted cities and towns, due to poorer health, medical expenditures on middle-aged and elderly people are much higher while more youngsters fail to meet the physical criteria for military service compared with other regions of the country. In addition to harmful impact

on personal health, building structures and plants, serious air pollution also contains China's opening-up process and reform and utilization of foreign capitals, stains the country's international image and casts negative effects on China's bidding efforts on hosting some grand international events, thus hinders to a certain level the social and economic development of the country as a whole. Before the 21st century, China relied mostly on coal burning for heating that directly resulted in severe air pollution in winters, which had been a major hinder that failed China's first bidding for Olympic Games. Since then, Beijing municipal government had made determined efforts to substantially improve air quality of the city through measures of ban on coal-burning boilers and incentives on using clean energies etc, which eventually helped the city win the bidding of 2008 Olympic Games.

Coal-fired boilers affect not only local air quality, but also surrounding areas, and thus formulate a regional pollution. For example, in early 21st century, though Beijing has banned the use of coal-burning boilers, the coal-fired boilers are still rampant in areas surrounding Beijing. Therefore, in 2013, coal pollution remained as a major issue for Beijing.

By 2013, there have been 20,000 plus small-sized towns in China, more than half of which require heating in winter, especially those in Northeast and Northern China. Coal-fired boilers were still the most popular means of heating for the small towns. As we know, the objectives of urbanization in China are to create better development and living conditions for people in small townships, and to ensure good health of dwellers while attracting more investment, labor and resources into the towns. To achieve these goals, it is compulsory for us achieve a favorable living environment and improved air quality in small towns.

To radically solve the problem of coal pollution, scientists and engineers in China have developed and imported many kinds of clean heating technologies, most of which use natural gas, electric power or shallow ground source energy as the source for heating. There are many problems in heating with natural gas due to its great shortage in reserves and high development and storage cost. More importantly, natural gas reserves of limited reserves in China concentrate in the West China, but most consumption happens in the east part. Long distance pipelines are needed for transportation of natural gas. Due to high construction cost, it will take another 10-20 years construction work for gas lines to reach most of the middle and small-sized cities and town in China. In a fairly long period of time, people living in medium and small towns can only use LNG for cooking purpose rather than heating in winter. With regards to heating by electric power, the energy consumption and financial cost are excessively high, therefore it is not able and appropriate to popularize it in towns.

Among all the technologies of clean heating, heating with shallow ground source energy is the only feasible way that has been widely used in the world. With mature and reliable technology, heating with shallow ground source energy can help to solve coal pollution issues in China. The heating technology of shallow ground source energy developed by Beijing Ever Source Science and Technology Co. Ltd. (often referred to as HYY Group) is especially suitable for application in medium and small town and cities. As for heating of large areas or commodity buildings block, the HYY Group has developed an energy-station modality to achieve heating for dozens of buildings at the same time with high efficiency. For single architectures, the heating system based on shallow ground source energy developed by the HYY Group can be installed in a tailor-made manner, with zero impact on surrounding environment, no occupation of public areas and no extra burden on power consumptions. In addition, different from big or medium cities, small cities tend to have more detached houses. Heating and cooling for such houses can be easily solved by using the "Ground Source Energy Heating Device" independently developed by the HYY Group. The device being highly user-friendly is also high in automation and much lower in cost compared with heating with coals and air conditioners. The device being both safe and convenient can easily go well with surrounding plantation and layouts. Overall cost of such system including initial investment and operation cost is roughly the same as the cost of traditional heating method. Therefore, it won't incur extra financial burden on users, but its effects on pollution control and improvement of life quality are far more obvious.

Utilization of shallow ground source energy can also reduce energy consumptions for cooling in summers. If the system can be widely used in southern China that suffers from sizzling summer and freezing winter, it can help not only to reduce energy consumption and lower pollution, but also to substantially lower peak loading of power in heating and cooling seasons, so as to ensure sufficient power supply in extreme climate conditions.

Presently, there are more than 10,000 medium and small towns in China, with the population totaling 300million and floor space of buildings including private housings, offices, factories, schools, shops, dinning places and hospitals etc. accumulating to 15 billion m^2. With constant economic and social progress, more and more towns will have to adopt clean heating technologies. Since the ground source energy heating system relies on local resources and boasts mature technology, many cities in China have installed the system. In the 12th five-year plan, Chinese government has articulated a clear goal for promotion and development of shallow ground source energy heating. In 2013, four ministries and departments of the Central Government also jointly promulgated new incentives and relevant policies to encourage utilization of shallow ground source energy. Moreover, in order to eliminate pollution haze, local governments are also determined to adopt every means to reduce coal burning. In such a context, ground source heating technology unveils enormous potential and promising prospect of development. Shallow ground source energy can be used to provide both heating and cooling to replace air conditioners and boilers. The technology is mature and easy to comprehend and operate. Therefore, it is fair to believe that such an industry will become one of the emerging industries in medium and small cities in China that can better saturate heating needs and greatly promote economic and social development in various localities.■

To Achieve a Green Heating Network through Reform and Innovation

■ by WANG Jiyang

In the past two decades, various kinds of heat-pump technologies (including ground source heat pump, water source heat pump and heat pumps of other sources, such as surface water, sea water and drainage water etc..)used to provide heating, cooling and domestic hot water have been developed and applied all over the country. They are highly acknowledged by competent authorities and well received by end-users. With the application of such technology in Beijing Olympic Games in 2008 and the Shanghai World Expo in 2010, heat-pump technology has gradually claimed its fame. By the end of 2012, the total building area heated by heat-pump technology with high efficiency has reached to 210 million m^2. In January this year, four ministries in China including the National Energy Administration jointly released a ***"Guidance on Promoting Ground Source Energy Development and Utilization"***, which alluded that "by 2015, the total building area heated by ground source energy shall reach to 500million m^2. As such, the areas heated by heat-pump technology will surely increase substantially. This brings about both challenges and opportunities.

It is known by all that no city can survive without water and power grids. Similarly, every city needs heating supply network. It is very important to collect various "waste heat" and transfer it into useful energy through heat pump technology to provide heating supply that contributes to urban heating network. "Waste heat" in cities generally falls into three kinds including drained heat in subsoil drain, heat emitted by underground constructions such as subways and from construction process of underground structures such as new tunnels, and waste heat discharged during production processes in urban power plants or other factories such as refineries etc.. It shall be a significant contribution to the construction of urban heating supply network if the above-mentioned waste heat can be collected and utilized. To that purpose, heat pump technology is an optimal option.

Besides energy saving, heat pump technology can also help cities to reduce emissions as providing heating. As we all know, it is a major challenge for countries in the world to tackle climate change and environment pollution. In China, especially in the small and middle-sized cities in the northern China where heating is a must in winter time, the challenges in environmental protection are even more severe.

Currently, China is in its critical period of rapid development of urbanization. In the process of building new types of green cities, energy supply issue attains top priority. Not long ago, Premier LI Keqiang attended a seminar participated by academicians from China's Academy of Science and China's Academy of Engineering, to heed academic views on the energy supply issue. We should be soberly aware that to forge ahead green heating network in cities is an arduous task and a system engineering, which requires tangible efforts from administrative authorities and technological departments as well as forceful support and cooperation from propaganda departments and various media. Thanks to the concerted efforts of multiple departments, the magazine China Ground Source Energy debuts with its fist issue. This is crucial for the development of urban green heating network, and construction of green, scientific and cultural city in China. A tiny drop of water still can reflect sunlight. Likewise the magazine, though not a big book, can help people know more about the world's latest technology and updated concept in energy saving and environment protection as well as the most advanced patent technologies and outstanding practices in this area in China. Science and technology are productivity, so is information. We hope the magazine of China Ground Source Energy a prosperous future and wish it play its due role in the process of promoting material, spiritual and ecological civilization progress in China, and therefore contributing to the realization of China Dream for great national rejuvenation. ■

Promote Low-Carbon Urban Development through Utilization of Shallow Ground Source Energy

■ by WANG Bingchen

The Shallow Ground Source Energy Collection Technology through Single-well Heat Exchange Circulation System has been widely applied through out the country and surely achieved fairly good performance in terms of energy saving and emission reduction, featuring stable and reliable operations. Continuous efforts and support shall be exerted to ensure greater achievement.

——by Mr. Wang Binchen

Senior Counselor of the State Council, Master in engineering exploration, Adviser of the Science and Technology Committee and Director of Engineering and Technology Center of Construction and Environment under the Ministry of Housing and Urban and Rural Construction.

Urbanization in China is speeding up. This is a widely acknowledged fact as well as an inevitable route for China to develop.

Fast urbanization directly leads to increased demand for energy and resources. Therefore, energy efficiency of buildings shall be improved in real earnest. To lower energy consumption of building while maintaining a reasonably comfortable temperature for inhabitants, we shall utilize renewable energies to reform existing buildings and construct green and ecological architectures.

The strategic decision made by the Central Government to build an energy-efficient and environment-friendly society has created favorable opportunities for development and application of shallow ground source energy which is clean and renewable.

To improve energy efficiency of buildings, a viable route shall be to develop shallow ground source energy by using ground source heat pump technology, which can take use of the low-grade energy to provide heating and cooling for buildings by consuming a small amount of high-grade energy. This is highly energy conservative making shallow ground source energy a very effective solution to enhance energy efficiency in buildings.

In order to lower energy consumption of buildings, we shall strongly advocate for green constructions. And by green, we mean low carbon. This has been a mainstream development trend in the international architecture industry. Currently in China, 90% of the existing erections of 45 billion m^2 are costly in energy consumption, accounting for 42.3% of total carbon consumptions in the country. Low-carbon buildings have become a top priority task for China in its undertaking of energy conservation and emission reduction. With the accelerating urbanization process, housing construction will continue to expand with a yearly increase of 2 billion m^2. It is estimated that by the year of 2020, the total incremental of building areas in China will reach 20 billion m^2 and heating floorage will also grow by large margin. Therefore, energy consumption by buildings if not improved will further intensify the already dire energy supply and environment protection in China.

To improve energy efficiency in buildings and to construct low-carbon architectures and cities, ground source heat pump technology is a viable route. It helps to reduce consumption of the most conventional energy--- coal, and therefore achieves emission reduction. Its superiority is more salient when used for cooling. In cooling process, the system discharges heat to the underground and thus avoids heat pollution. Therefore, the ground source heat pump technology will contribute greatly to the development of low-carbon urbanization in China by promoting energy-efficient buildings and low-carbon economic development. ■

Development and Utilization of Renewable Energy is a Necessary Choice to Achieve Sustainable Development

■ by CHENG Ren

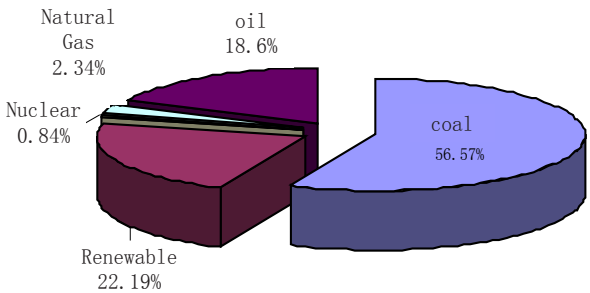
In the upcoming decades, fossil energy will remain dominant in the world's energy structure, taking up 60-70% of total energy consumption. However, there are environmental ceilings for consumption of fossil energies. A necessary route for China and the world is to enhance efficiency of mineral energies and increase utilization of clean fuel technology, new energy and renewables.

Out of 6.5 billion populations in the world, 1.4 billion or 20% are from developed countries, who consume 2/3 of the world's energy (66% of oil, 74.4% of gas and 93.8% of nuclear power etc….). Annual per capita energy consumption in developed countries is 4.5 tons of SCE in contrast to the mere 0.7 tons of SCE in developing nations which is 1/6 of the developed.

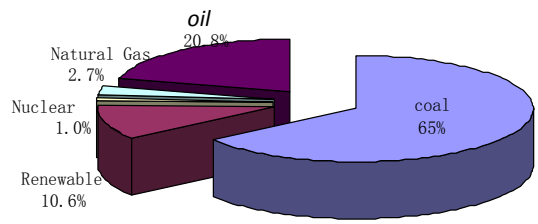
Annual primary energy consumption in the world has exceeded 12 billion tons of SCE, while China consumes 1.32 billion or 10%. Though the energy reserves in China is 12% of the world's total, per capita reserve is just half of the world's average level, ranking the 58th. The external dependency of primary energy in China is around 10%. Last year, China imported 150 million tons of oil products including 130 million tons of crude oil. Due to price hike, expense on oil import last year increased by 8 billion yuans and will increase for another 10 billion yuan this year. There are three centers for energy consumption in the world, namely North America (30%), Europe including Russia (30%) and Asian Pacific including big consuming countries like China and India (more than 30%). Therefore, it is a natural outcome for China to adjust its energy structure, set up "the Law on Renewable Energy" and give priority to development of renewable energies.

I.Current situation of renewable energy utilization in China

In China, renewable energies have become important components in the entire system of energy supply. In 2003, the total energy consumption in China were 19.9 tons of SCE, among which renewable energies including wind power, solar power, geo-thermal energy, tidal power, hydro power and biomass power take 440 million ton or 22%.

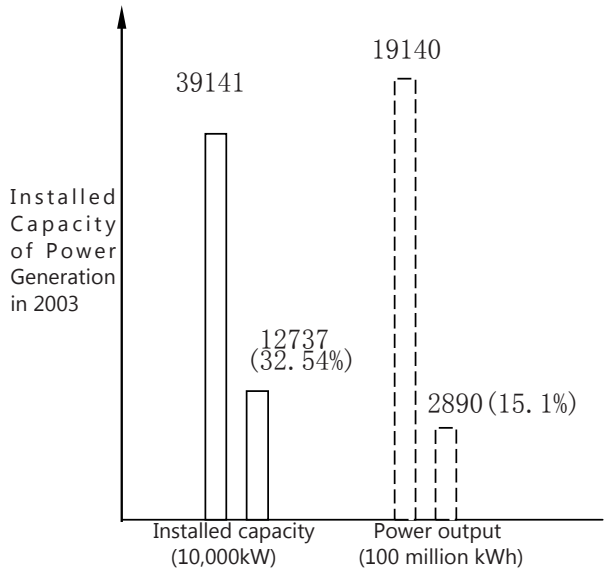


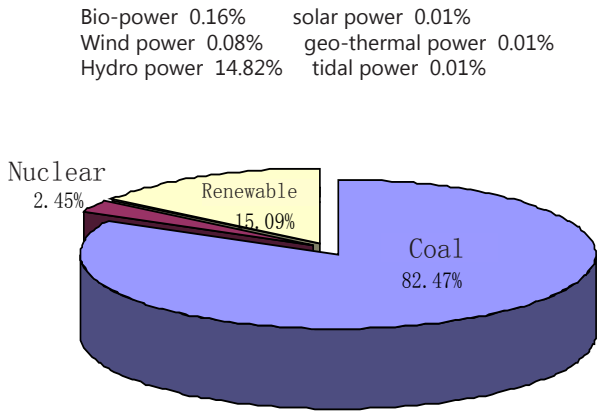
（inclusive of biomass energy）
Total Energy Consumption(2003): 19.9 tons SCE



（non-inclusive of biomass energy）
Total Energy Consumption(2003): 17.35 tons SCE

Presently in China, renewable energies are mainly used for power generation:





II.Development potentials of renewable energies in China

	Renewable Energies			Developable Reserves	Developed Reserves	Developed Ratio
1	Hydro Power	Large and medium hydro power station		379 million kW	108.26 million kW	28.56%
		Small stations <25,000kW		65 million kW	3.08million kW	47.66%
2	Wind Power	Onshore		253 million kW	764,000kW	0.076%
		Offshore		750millionkW	0	
3	Solar power -- Photovoltaic			520 million kW	55,000kW	0.01%
4	Geo-thermal (high degree thermal)			2.8 million kW	31,700kW	1.13%
5	Biomass power			500~600 million tons of SCE	6 million tons of SCE	(1~1.2)%
6	Tidal power			21.80 million kW	12,000kW	0.06%
7	Shallow Ground Source Energy (projected)		Total Reserves	Developable Reserves	Developed Reserves	Developed Ratio
		Underground Hydro Power	1.78 billion kW	178million kW	522,000 kW	0.29%
		Soil Power	6000 billion kW	6 billion kW	58,000 kW	0.001%

Note: Shallow Ground Source Energy (projected):
① assuming developable reserves of underground hydro power is 10% of the total reserve;
② assuming developable soil energy is 0.1% of the total reserve;
③ assuming the heated area by ground source energy reaches 10 million m^2 (90% by underground water power and 10% by soil power).

Effectiveness of shallow ground source energy in heating and cooling:

Shallow ground source energy features abundant reserves, rapid regeneration, constant temperature and easy collection.

1. a well (diameter: 0.7 meters, depth: around 100 meters) in locations with abundant underground water can produce equivalence power of 500-600 kW, able to provide heating and cooling for a floorage area of 7000-8000 m^2 in non-energy-saving buildings in Beijing.

2. a borehole (diameter: 0.5 meter, depth: within 100 meters) in locations with scarce underground water can produce equivalence power of 30-50 kW by using Daqing-tube heat exchangers, able to provide heating and cooling for a floorage area of 700-800 m^2 in non-energy-saving buildings in Beijing.

3. a borehole (diameter: 0.1 meter, depth: around 100 meter) in locations without underground water can produce equivalence power of 3-5 kW by using U-tube heat exchanger, able to provide heating and cooling for a floorage area of 70-80 m^2 in non-energy-saving buildings in Beijing.

In the upcoming decades, fossil energy will remain dominant in the world's energy structure, taking up 60–70% of total energy consumption. However, there are environmental ceilings for consumption of fossil energies. A necessary route for China and the world is to enhance efficiency of mineral energies and increase utilization of clean fuel technology, new energy and renewables.

Hydro-geological Conditions		Collection Technology	Well Depth (m)	Well Diameter (m)	Power of collectable heat (kW)	Power of Heat Collected per meter(W/m)	Heated Floorage in non-energy-saving buildings in Beijing (m^2)
Ground Source Energy	Abundant underground water	Shallow-ground production and injection well	800	0.7	500~600	5800	7000~8000
	Scarce underground water	Large annular tube heat exchanger	80	0.5	30~50	350	700~800
	None underground water	Small U-type heat exchanger	80	0.1	3~5	40	70~80
Geothermal Energy	Deep geo-thermal	Deep Geo-thermal Well	>2500	0.3	1750	580	20,000~30,000

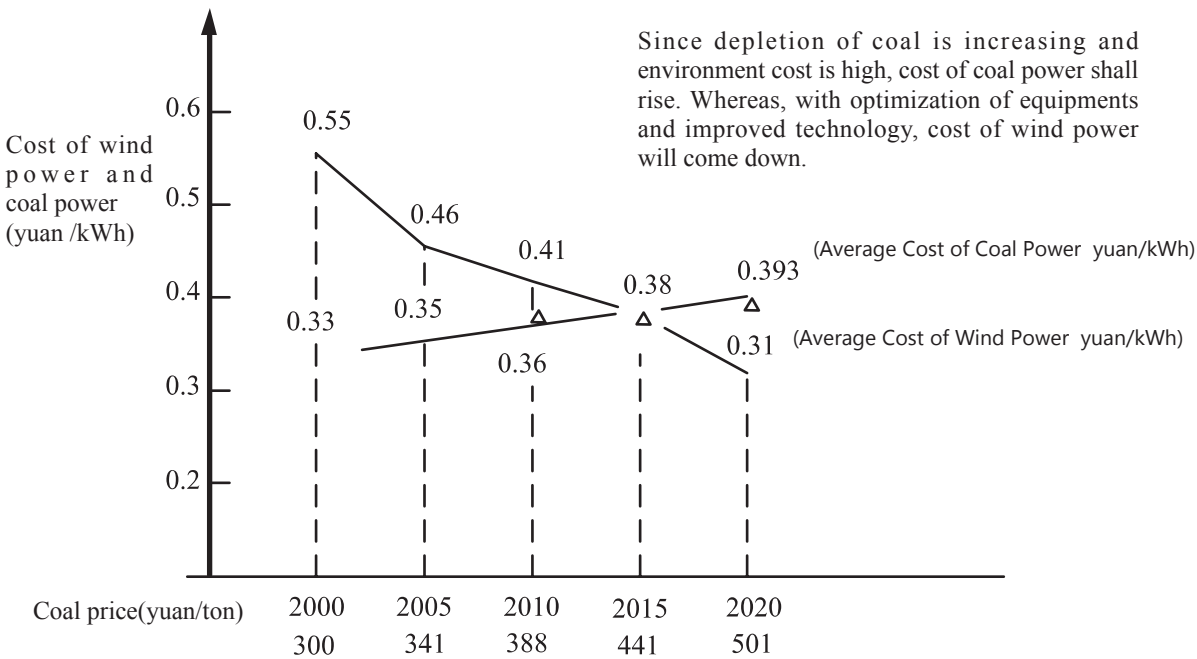
Effectiveness of Ground Source Energy Collection

III. Major Issues in Development of Renewable Energies in China

Currently, the on-grid price of wind power and solar power are by no means competitive to coal-fired power.

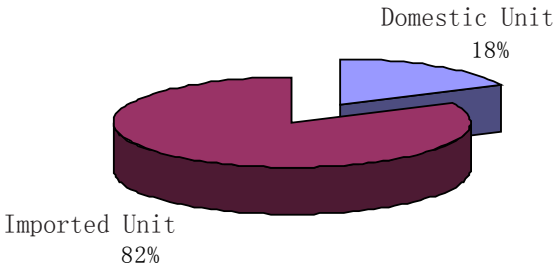
Wind power: >0.5 yuan/kWh
Solar Power: 2-3 yuan/kWh
Coal power: 0.315yuan/kWh

		Average investment (yuan/kW)	Average on-grid tariff(after tax) (yuan/kWh)
1	Coal power (>600,000 kW, imported and domestic power units)	4700	309
2	Gas power (>350,000kW, imported and domestic power units)	3150	415
3	Nuclear power (>1 million kW, imported and domestic power units)	12066	369
4	Wind power 50,000-200,000kW	9420	640



Since depletion of coal is increasing and environment cost is high, cost of coal power shall rise. Whereas, with optimization of equipments and improved technology, cost of wind power will come down.

Major obstacles for China to develop renewable energies exclusive of small-scale hydro power include insufficient capital input, comparative low level of scientific research, small scale of industry, and low localization degree of technology and equipments. Taking wind power as an example:



IV. Measures Chinese government has taken to encourage development of renewable energies.

In 1994, during the 9th five-year plan, Chinese government published "China's Agenda of the 21st Century" (i.e. White Paper on Population, Environment and Development), where it committed to implement related decisions of the UN on world's environment protection.

In 2002, during the 15th five-year plan, at the 2nd World's Summit on Sustainable Development, former Prime Minister Zhu Rongji on behalf of Chinese government announced that China endorsed "the Kyoto Protocol"and committed to undertake its due responsibility. Energy, especially renewable was one of the important agenda of the meeting.

In 2006, during the 11th Five-Year Plan China has formally launched the "Law of Renewable Energies". This manifested the determination of Chinese government to prioritize the development of renewable energies in energy sector. It asks and requires governments at different levels and relevant energy enterprises to support and promote renewable energies utilization, to establish medium-to-long term objectives and supporting measures by defining five priority areas and implementing six major supporting measures.

Policies incentives for renewable energies development include mandatory policies (such as Wind Power Tariff Administrative Rules, Electric Power Law, Energy Saving Law and Renewable Energy Law), economic incentives (such as tax reduction and exemption, price preference, interest-subsidized loan), R&D Policies (such as financing, investment and demonstration) and market incentives (special funds, franchising, policy propaganda).

The five major areas in renewable energy sector are: wind power, solar thermo power, solar heating and ground source heat pump heating (cooling), gas cooled reactor power station, and hydrogen energy.

The six major supporting measures are to set up medium-to-long development plan, conduct resource exploitation and utilization; establish Development Guidance Catalogue, market access requirement and administration of Licensing, formulate pricing and cost allocation mechanism, implement industrial development plan, policies and supporting measures, and erect quota management system.

V. Problems demanding prompt solution in implementing the Renewable Energy Law

i. Set up clear targets and stipulate medium-to-long term development plan.

Different renewable energies have different market conditions and application, therefore plans and targets shall be comprehensive.

- Wind energy: being quite regional and inconstant, it is generally used to generate power with installation of several units;

- Solar energy: being regional, seasonal and periodical, it is normally used for solar thermo power generation and solar heating purposes;

- Geo-thermal energy: being limited by hydro-geological conditions, the energy has strong locality and constrictions, it is applicable to provide heating and domestic hot water, and some can be used for power generation.

- Bio-mass energy: with wide coverage and huge amounts, the energy is suitable for development in the rural areas.

- Hydro-energy: with different hydro conditions, the energy can be used for power plant of different capacities. Tidal energy can be used for power generation.

- Ground source energy (underground water, soil and surface water): it is a comparatively stable low energy being different from traditional geo-thermal energy. With mature collection technology, the energy being abundant and highly renewable has become an important fast-growing segment in the renewable energy sector. The energy can be applied to provide heating and cooling for buildings, as a good substitute for mineral energies.

ii. Set up policies and supporting measures to promote development of renewable energies, including mandatory policies, economic incentives, R&D policies and market incentives.

iii. Encourage the "industrial alliances in renewable sector" and expedite the construction of "industrial base of renewable energies.

iv. Assess reserves of ground source energy, verify its renewal cycle, identify the amount and conditions for ground source energy exploitation and utilization, and establish supportive policies and measures to promote ground source energy development.

v. Adjust and coordinate current energy prices. ■

To Better Understand Ground Source Energy: Saving 30% More Energy than Coal Burning

■ by WANG Wei

At an interview on March 13, 2013 by the Economic Herald, Mr. Chang Jiuchun, Deputy Director General of Shandong Geothermal Specialized Committee and Vice President of Shangdong Land and Minerals Engineering Group Co. Ltd. pointed at one ground source heat pump in the demonstration park for ground source energy utilization in Zhangqiu city and said to the reporter, "Such a system using ground source energy to provide heating in winter can save 30-40% of energy compared to tradition coal burning. Therefore, it enjoys enormous prospect of development. Merely last year, our company implemented 9 ground source energy utilization projects".

The confidence of Mr. Chang Jiuchun on ground source energy development was further consolidated by the government's newly promulgated policies and measures on supporting ground source energy utilization. Recently, the State Energy Administration, Ministry of Finance, Ministry of Land and Resources and Ministry of Housing and Urban-Rural Development have jointly issued the Guidance on Promoting Development and Utilization of Ground (Thermal) Energy (hereinafter referred to as "Guidance") which opens up more policy rooms for development and utilization of ground source energy.

Not long ago, the National Research and Technology Promotion Centre for Geothermal Development and Utilization was formulated. The Centre mainly conducts strategic planning of ground source energy development, key technology research, professional training and international exchanges. It has been widely acknowledged that commercialization of ground source energy utilization technology is now entering into a rapid growth period.

Mr Xu Junxiang,vice Chairman of the Specialized Committee on Ground Thermal in China Energy Council said in the interview that "utilization of ground source and thermal energies for heating will transform energy structure of the country, greatly reduce air pollution caused by coal burning heating and substantially improve urban ecological environment. In order to utilize the ground thermal resources in a rational way, we must change from extensive development modality into intensive to accomplish scientific planning and management and better solve the issue of thermal equilibrium".

■ Shallow ground source energy development is becoming popular

At an interview with Mr. Meng Bo, project manager of Shandong Ground Source Heat Pump Project in Shangdong Land and Mineral Engineering Group said: "heat exchanging pipes are buried at about 100 meters below the ground surface where the temperature is constant at 15°C. Taking use of the temperature difference between ground surface and the constant zone underneath, the ground source heat pump system can provide heating in winter and cooling in summer."

According to Mr. Meng's introduction, traditional integrated urban heating system relies mainly on coal burning to generate heat. Whereas, the ground source system extracts heat from the underground through heat exchange pipes to preheat the radiator pipes and then raise heat temperature through heat pumps.

"In winters, it works like to warm water of 15°C instead of below 0°C up to 45°C. The energy saving is obvious and significant. Similarly, in summers, it is like to cool water of 15°C instead 30°C down to 7°C. Energy sufficiency is self evident" said Mr. Meng in his explanation of the advantages of ground source energy utilization compared to coal burned heating and cooling by air conditioners.

According to preliminary estimation, the ground thermal energy reserves within 3000 meters depth underground in Shandong is around 31.863×10^{19} Joule or 15 billion tons of SCE, which can be used to provide heating, domestic hot water, planting, breeding and irrigation. As introduced by Mr. Xu Junxiang, if all the ground source energy potentials in Shandong can be fully developed in scale, it can generate dozens of billion yuans economic returns.

As a matter of fact, many countries and regions in the world have utilized ground source and thermal energy to achieve great improvement in ecological environment in their process of promoting energy conservation. Taking Iceland as an example, air quality in the country has been radically improved by replacing coal and fuels with clean ground thermal energy. Carbon dioxide emission as results from greenhouse effects decreased by 98.9% from 1960 to 2000, thanks to clean air brought about by ground energy development. Iceland is now listed as one of the three most livable cities in the world.

In recent years, ground thermal energy development became popular in many cities of Shandong Province. Since geothermal energy exploitation and development is a highly risky and costly industry, many companies have landed their interest on development and utilization of shallow ground thermal energy, namely the ground source energy.

"Although the energy-saving effect of shallow ground thermal energy is not as good as the geothermal energy, it has very superior advantages including wide applicability and less input. Moreover, as it is a closure system, the ground source system is free from any contamination to underground water system and is not subject to special geological distributions, as geothermal energy is." According to Mr. Chang Jiuchun, many real estate developers have approached to them to seek cooperation to install the system in their projects. Heating and cooling by ground source systems have become selling points for many estate projects.

■ Withdrawal and deposit of energy shall be balanced

"The difficult challenge in the development and utilization of ground thermal energy lies in the balancing between withdrawal and deposit of energy. The amount withdrawn in winters and that injected back in summers shall maintain balanced." said Mr. Xu Junxiang. He pointed out that this is an issue faced by many companies in ground thermal energy development sector.

"Ground source energy is like a bank that based on needs of development and utilization, it needs to balance withdrawal and deposit so as to operate effectively", Mr. Chang said.

Outside of the machine room of ground source system in Shandong Land and Mineral Engineering Gouop, the reporters also saw several Solar photovoltaic panels. Mr. Meng explained: "the solar system was added on to the ground source system. It changes solar power into ground themal energy and make the energy conservation effect even more ideal. So in line with the needs, we store heat in summers and extract heat in winters. At the same time, we can collect extra energy via solar photovoltaic panel and then put it back to the underground through heat exchangers."

Actually, after an entire heating season, the underground temperature may normally decrease by 2-3°C. If rejection is not done in time, the ground thermal energy will become overdrawn.

Pointing at a screen in the machine room, Mr. Meng told us that "if the ground temperature is lower than 3°C, the system will stop automatically." To avoid any abnormity in ground temperature, the project of Shandong Land and Mineral Engineering Group is equipped with an underground sensor, through which we may know the accurate ground temperature."

"Look, the screen shows the ground temperature is currently 14.9°C", said Mr. Meng Bo. Although it is approaching to the end of heating season, thanks to the solar panel, the ground temperature makes little change.

Mr. Chang Jiuchun clarified that currently the ground thermal energy enjoys enormous market. However, there are certain enterprises who value more about profits, care little on project design and engineering, ignore heat balance, and thus lead to ground energy loss and waste.

■ Strengthening dynamic supervision

The "Guidance" has sketched out the blueprint of ground source thermal energy development. It clarifies that by 2015, ground energy reserves and distribution layout shall be checked out to build up national database and service network for ground resources; total heating area by ground source energy in the country shall exceed 500 million m^2, installed capacity of geothermal power will reach to 100 megawatt, and annually utilization of ground thermal resources will amount to 20 million tons of SCE, to formulate a fairly complete industrial system composing of resource assessment, technology development and utilization, manufacturing of key equipments and industrial services.

To that end, Mr. Chang Jiuchun suggested that more emphasis shall be given to the rational utilization of ground thermal energy. In some localities, due to excessive exploitation of deep underground thermal energy and untimely rejection of ground water, the land surface subsided. Moreover, the ground water if not rejected back into underground will cause harm to agricultural lands since it contain high acid and alkali content.

To Mr. Xu Junxiang, exploitation and development of geothermal energy is an industry of high risk and high input. Geothermal energy has slow renewability and limited reserves. Its exploitation can gradually change table level, reserve amount, quality and temperature of ground water. In a bid to prevent it from geological disasters and excessive exploitation that causes surface subsidence and depletion of thermal water resources, ground thermal exploitation and development shall be monitored in real-time. ■

[serial 1]

Use Heat Pump Technology to Extract Shallow Ground Source Energy and Achieve Heating in Winter and Cooling in Summer

■ by SHEN Mengpei

Evolution of world civilization is also a history of energy development and utilization. The 19th century's industrial revolution in UK was also called "Steam Engine Revolution", which discovered coal burning as a power which liberated people from heavy labor and increased productivity enormously. Trains and ships driven by steam engine have greatly expanded human being's ability to conquer the world. Steam engine has become a symbol of human civilization of that time. In 20th century, a new energy--- oil has been discovered, together with the invention of internal combustion engine, which have made automobiles and airplanes popularized and accelerated development of modern industry. However, due to excessive exploitation, starting from 1970s, oil crisis emerged. At the same time, enormous amount of emissions and pollutions have endangered human being living environment.

According to the energy survey by the World Energy Commission (WEC) in 2004, oil reserves on the earth can be exploited for 40 years, natural gas for 60 years, and coal for 200 years. According to statistics in 1995 of the International Panel on Climate Change (IPCC), compared to the mid of 18th century of industrial revolution, nitride oxide content in air has increased by 15%, methane by 100%, carbon dioxide by 30% reaching to 360ppm and will increase to 425ppm by 2015 and 500ppm by the end of 21st century which is nearly two folds higher than the level of 280 ppm before industrial revolution. By then, under the greenhouse effect, the earth temperature will increase by 1-3.5°C. Climate change has highlighted environment protection as a strategic issue in sustainable development of human beings.

Before nuclear power was discovered, coal and oil products including natural gas took above 99% of energy consumption of human beings. People used coal to generate power and heating and oil to drive transport vehicles. New energy development and utilization has not been put on agenda until the 21st century when the enormous living crisis has forced all countries to actively explore new energies so as to improve ecological environment.

In 1954, the United States invented the heat pump system to make use of underground heat energy. After half a century evolution, heat pump has been very popular in western developed countries and maintained 20-30% of annual increase in number of users. Both the ranch of former President Bush in Texas and Buckingham Palace of British Queen have applied ground source heat pump technology.

Heat pump system can be utilized to provide heating and cooling with ground source or water source which is a new type of green energy and should be actively promoted in China. Ground source or water source heat pump technology are mainly embodied in four types of products: underground thermal water heat pump, water source heat pump, ground (soil) source heat pump and sewage water heat pump (including river and sea water). In 1999-2000, I was engaged in the research and promotion work of water source heat pumps in Fengtai District of Beijing together with Beijing Geology and Mineral Administration. Since 2000, water source heat pumps have been applied in Beijing. Up to now, there are thousands of buildings and companies using water source heat pumps to get heating and cooling.

In early 2005, Senior counselor of the State Council, Mr. Wang Bingchen flagged the proposal of rational utilization of ground thermal energy and prioritize the work of the Group on Urban Construction and Water Resource on development and utilization of ground thermal energy. Counselor Wu Xuemin and I both supported his proposal. China has been using fossil energy such as coal and oil as fuels and is now encountered with severe energy and environment problems. First of all, oil reserve in China is in great shortage and huge amount of oil is imported every year. Secondly, even though coal reserve is rich in China, coal burning causes serious environment pollution and CO_2 emission and imposes great threat on people's health. Chinese government has come to realize the danger and promulgated the ***Law on Renewable Energy*** to advocate forceful development and utilization of renewable energies and green energies to replace conventional fossil fuels so as to promote energy conservation and emission reduction. However, when the country made the plan, it only prioritized the development of solar power, wind power and biomass power and put little emphasis on ground thermal energy.

During November 15-28th, 2005, the Counselors' Office of the State Council sent three senior counselors to visit Egypt, Israel and Turkey, including Mr. Wang Bingchen, Mr. Wu Xuemin and me. In Turkey, the purpose of the visit was to understand its development and utilization technology in ground thermal energy sector as well as its government incentives and guiding policies. We were very enlightened. Turkish government has adopted a series of incentives including VAT exemption on companies with turnovers from ground thermal energy development being lower than investment, half-priced electricity if it was used for utilization of ground thermal energy and free use of land etc.. The incentives have effectively promoted the growth of ground thermal sector. After the visit, we reported what we learnt in Turkey to the competent authority in China and suggested that we should learn from the experience of Turkey to render preferential policies to encourage development of ground thermal energy and enhance the importance of ground thermal energy in national energy development plan.

During 2005-2006, I took part in several research projects on ground source energy development and utilization organized by the Counselors' Office of the State Council. The projects have given me many opportunities of field and site visits to the buildings and companies in Beijing, Tianjin and Hebei Province that were installed with water source or ground source heat pumps. We came to the conclusion that the shallow ground thermal energy (or the so called ground source energy) is a truly green energy being free of pollution and emission and highly effective in energy saving and environment protection, and its cost is similar to or even lower than conventional energies. As a new technology for sustainable development and a new generation environment system of cooling and heating, the technology enjoys enormous industrial and market development opportunities. It is acknowledged that distribution of traditional geothermal energy is very restrictive to four necessary special geological conditions including heat source, heat storage, heat conducting channel and cover layer. Whereas, shallow ground thermal energy is widely distributed in underground water and rock mass that store solar heat. Taking use of ground source heat pump

The engineering cite of one HYY Ground Source Heat Pump Project in the United States

technology, such energy is easy to extract and utilize with high performance and low energy consumption. Based on practices both in China and abroad, we believe that the ground source heat pump technology shall be actively used to forcefully develop shallow ground thermal energy as a solution to clean heating and cooling for buildings. With the government support, the technology enjoys enormous prospect of development.

■ What is shallow ground thermal energy?

Shallow ground thermal energy (ground source energy) is a renewable energy or an indirect solar energy. 30% of energy radiated by the sun to the earth is reflected back by clouds and ground surface, 19% is absorbed by clouds and 51% by land and oceans to formulate a constant temperature zone at around several hundreds meters under the ground surface, where shallow ground thermal energy is stored.

Cave that our ancient ancestor lived in was an original example of human beings in its early utilization of shallow ground thermal energy to achieve cooling in summer and heating in winter. After years of practice, people became aware that temperature change under ground surface is much slower. Normally the annual temperature difference at 15 meters deep underground is less than 0.3°C and can be less than 0.1°C if going deeper. In the crustal surface of the earth, usually within 400 meters, there forms a constant zone where temperatures of water, soil and rocks remain constant at under 25°C throughout the year regardless of its geographic location. For example, at the 15 meters depth, the temperature in Mudanjiang is approximately 10°C, Beijing approximately 13°C, Taian approximately 15°C and Changsha approximately 17°C. Geological survey shows that underneath the constant zone, there is a gradual increase of temperature with 3-4°C rise for every 100 meters depth, and that shallow ground thermal energy locates above constant zone or within 100 meters depth from the ground surface where solar effect is more substantial.

In 1964, a technology that uses shallow ground thermal energy to provide heating was developed abroad. Its rationale was to drill two boreholes with one pumping water out into heat pumps to exchange heat and the other injecting water after heat exchange back into underground. Heat pumps can upgrade the energy with constant heat exchanges to provide heating and cooling for architectures. Such a system is often referred to as underground water source heat pump system or multiple-well system.

Assuming that water temperature is 15°C in production well and 10°C in injection well and the flow rate from production well to injection well is 100 tons per hour, it is known from thermodynamics that heat output achieved by heat pumps from underground water is 580kw. In the process, power consumption by heat pumps and water pumps is about 180kw, which eventually transforms into heat as part of heat output. Therefore, the total heat output of the system shall be 580+180=760kw, with merely 180kw power consumption. The power energy efficiency is around 4.2. In contrast, when we use electric boilers for heating, we must consume 760kw power to achieve 760kw heat. Though the energy efficiency of electric boiler is 100%, it is still not comparable to the heat pump technology which saves three quarters electricity to produce same amount of heat.

Another merit of heat pump system using shallow ground thermal energy is that **such system makes no combustion of any fuel and therefore produces no emission problems.** Due to its powerful effects in energy

conservation and environment protection, the new heating system when it came out has aroused much of a stir in the world and high expectations on it to solve the tension in energy and environment. However, many practices showed that such system might incur a series of problems of underground water system, such as changes of water flow, water contamination and serious impact on geological and structural situation. In addition, water flow also washes away sand and earth and may cause collapse of water production well and clogs in injection well, thus shorten life cycle of the system. It imposes threat on underground water system, and therefore on the security of human being. As such, since 1970s, such system has been strictly restricted.

However, studies have never stopped to experiment other ways of shallow ground thermal energy utilization. In Europe, a system in this regards called buried pipeline system soon became popular. There were two types, namely vertical buried pipeline system and horizontal system. The latter is to horizontally bury pipelines of certain length at 2-10 meters depth underground. It uses water or anti-frozen liquid as media flowing in the pipeline to exchange heat from the underground via pipe walls. After fluid media enters heat pumps, the process is exactly the same as underground water source system. That is to say, the only difference between buried pipeline system and underground water source system lies in the way to collect shallow energy. Since the pipeline is an entirely close loop, the system is highly secure to ground water. However, the system also has strong defect of occupying too much outdoor space to attain sufficient heat exchange. And because of it, it is difficult for it to get wide application. In the vertical system, the media circulates in a U-shaped pipe which is buried vertically under the ground. Compared to the horizontal system, the vertical system consumes less land space, but very high cost. However, balanced flow distribution among multiple U-shaped pipelines in parallel connection has been an insurmountable technical obstacle for the vertical system. Besides vertical and horizontal, there is also vertical spiral type which is invented to expand heat exchange surface. However, the spiral type also failed to achieve scale application due its highly complicate techniques, excessively high cost and difficulties in engineering.

The multiple-well system is banned in many regions due to its harmful impact on underground water system. Large scale application of horizontal pipeline system is difficult to achieve due to its high demand of land space and low heat output. Whereas, the vertical system is restricted from wide spread due to its unsolvable technical problem of balancing flow distributions in shallow energy collection.

The single-well system developed by the HYY Company has successfully managed to collect shallow ground thermal energy with no water loss, no water contamination and no potential danger to geological situations. Its working rational is as follow:

Collection and extraction of shallow ground thermal energy is often achieved through close contact between water/media flows and ground water and soil. Geologically speaking, there are two types of geo-structures, namely aqueous and non-aqueous. Correspondingly, there are two heat extraction means.

1. Heat extraction in aqueous structures

A clap board is used to separate a water well into upper well for injection and lower well for water production. Pump at the lower part of the well transports water to devices that take away heat from it. Afterwards, the cooled water enters into the upper well. Under effects of water pressure difference between the upper and the lower well, the cooled water makes grand systematic circulation outside the well body and takes in heat from underground soil during the circulation to accomplish effective heat exchange process.

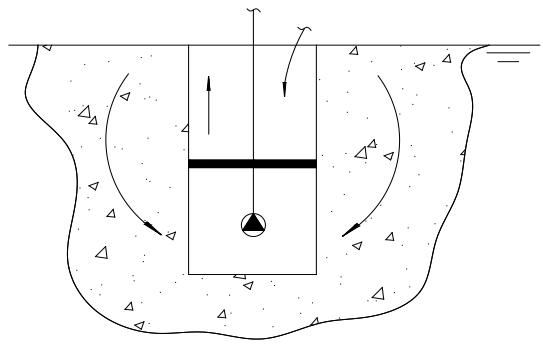


chart 1

2. Heat collection in non-aqueous structures

In non-aqueous structures, heat can only be exchanged with water/media flowing along well walls. Therefore, the size of surface in contact between water and well wall is crucially important. Meanwhile, heat loss shall be strictly prevented during the process. The essence of heat collection in non-aqueous structure is to maximally expand heat exchange areas and manage to realize no heat loss. ■

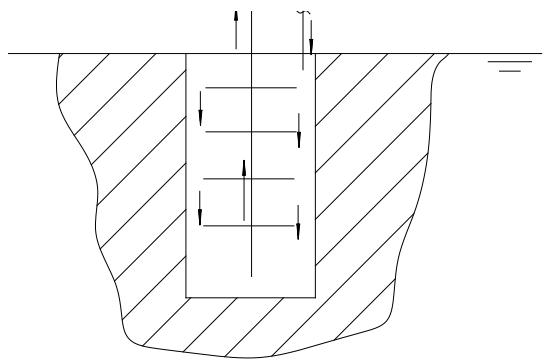


chart 2

(To Be Continued)

Exclusive Interview

Ground Source Heat Pump makes the Ground Energy "Hotter"

———————— Exclusive interview with Mr. SUN Ji, Chief Engineer of Ever Source Science and Technology Development Group Co. Ltd

■ by WANG Li GAO Peng

Editor's note: HYY Ground Source Heat Pump environment system is an indigenous technological system self-developed by China to utilize ground source energy in the end of last century. The core technology is the single-well heat exchange circulation for ground source energy collection, which uses underground water as media to extract heat from underground rock soil mass. It has the combined advantages of water source heat pump and traditional ground source heat pump, being highly efficient, secure, compact and zero impact on underground water system and geological structure. With strong designability and wide applicability, the system has become a favorable option for ground source energy development and utilization in the world.

With increasingly wide application of underground heat resources, technical improvement in related areas is attracting more attentions than before. Currently, there are three kinds of systems for utilizing ground source energy to provide heating for buildings, namely: water source heat pump, ground source heat pump, and HYY ground source heat pump.

Water source heat pump system takes ground water as heat source and makes use of water production well to constantly exchange heat with underground water. The system was popular at the early-stage development and utilization of shallow ground energy. It is easy to operate and relatively reliable and efficient especially in places where underground water is sufficient enough. However, it may compose a threat to the balance and safety of underground water since the system has to pump water out from underground.

Ground source heat pump system is also called as buried-tube heat pump system. It uses underground soil as the heat source and constantly exchange heat with underground rocks and soils through buried tubes. It imposes no threat against underground water mass and geological structure. However, the system requires big area of land space and performs low efficiency. It is hard for the heat collection tubes in parallel connection to reach hydraulic balance. Due to the factor of thermal expansion, it is generally true that heat exchange efficiency of buried tube system attenuates year on year.

Compared with ground source heat pump, the HYY ground source heat pump shakes off the disadvantages of low heat exchange efficiency and negative impact on geological conditions. As such, the HYY ground source heat pump acquires wide applicability and better responses from end users.

HYY Ground Source Heat Pump system is a new type of shallow ground source energy development technology indigenously developed by China. The core technology is the single well heat exchange circulation system for ground source energy collection, which has attained inventive patent rights from many countries and regions, including China, United States and European Union. As proved by an expert group led by Mr. Wang Bingchen, former counselor of China's State Council, Master of China's Engineering and Exploitation, it is a technology of international advanced level. In the 2003 annual meeting of the International Geothermal Association held in Mexico, a study paper titled "Utilization of Shallow Ground Source Energy" written by Professor Ladislaus Rybach, Deputy Director of the International Energy Association (ICEA) and Mr. XU Shengheng, President of the Ever Source Science and Technology Development Group Co. Ltd.(HYY) has won the Award of Best Paper (2003). In 2008, the study project titled "Using Shallow Ground Source Energy as Substitute Energy for Heating through Scientific Development" won the First Prize of Scientific and Technology Progress issued by All-China Federation of Industry and Commerce. In January 2013, the State Development and Reform Committee (NDRC) stated that "the single-well heat exchange circulation system for ground source energy collection is a world's advanced technology. We shall seize the opportunity to expand governments' support to the technology and speed up the pace in its utilization and application."

The Ever Source Science and Technology Development Group Co. Ltd. (often referred to as HYY) is a company engaged in R&D, design, production and all-round technology services in the development and utilization of the shallow ground source energy. The single-well heat exchange circulation system for ground source energy collection is HYY's indigenous innovation technology with international patent rights. In order to better understand its ground source heat pump system and its technology, we completed a special interview with HYY's Chief Engineer, Mr. SUN Ji.

Mr. Sun said in the interview, "after years of water quality monitoring, it has been proved that the single well heat collection technology (namely the single-well heat exchange circulation system for ground source energy collection) is a heat collection device with completely closed circulation of water media. There is no water loss and consumption in its operation and no impact on local ground water situation and geological structure".

Since 2001, HYY has raised fund by itself to conduct ground

water quality monitoring on projects using its single-well heat exchange technology . It also organized three special seminars to review the results on water resources protection in 2001, 2003 and 2005 respectively. The results from the long-term monitor and supervision done by Beijing Water Environment Supervision Center have also shown that all indicators except temperature in water quality monitoring of single-well systems make no big changes indicating that the system imposes no impact on ground water quality.

"Engineering Technical Standards on Single-well Heat Exchange Circulation System for Ground Source Energy Collection" (Beijing Local Standards DB11/T935-2012) has been stipulated and implemented. HYY is one of the key participants of composing the standards. To implement the standard, HYY Company voluntarily gave up its patent rights on water well sealing device with Patent No. ZL200610002239.8 and got it registered in the Technology Supervision Bureau. Single-well Heat Exchange Circulation System Technology for Ground Energy Collection is a kind of application technology. The patent technology is a result out of countless experiments with enormous input of capital, labor and kinds by HYY in these twenty years. As assessed and reviewed many times by national academicians, state counselors and senior experts in China, the technology is identified as being internationally advanced, safe to underground water quality and geological structure, as well as suitable for massive promotion and application.

Mr. Sun also said: "We hope that more enterprises could utilize the above patent technology. Economically speaking, we sacrificed some of our profits. But now we are proud to claim this is one contribution we made to reduce PM2.5 pollution in Beijing. And deregistration of the patent can help to bring about rapid development of China's ground source energy industry".

Development of ground source heat pump industry has always been nagged by the question of imbalanced heating and cooling demands. Supposing that a ground source heat pump system is used only for single purpose, cooling or heating, the question is whether or not its application may cause temperature increase or drop in certain locality. Mr. Sun gave us his analysis that theoretically speaking, if the working load of a single-purpose cooling/ heating system is excessively high, and its run time is extraordinarily long, such consequence might incur. However, viewing from the more than 10 million m^2 projects that HYY has completed throughout China as well as in Mongolia and US, such problem never happens. One reason might be that the almighty nature has made such temperature changes too small to be noticed. The other reason is that the single-well heat exchange circulation system can accumulate heat. In most circumstances, heat discharged into the underground in summer is extracted and utilized during winter times, thus makes the temperature difference even more negligible and interference on nature more trivial. The survey we conducted told us that the temperature actually resumes very quickly in the underground mass surrounding the single-well heat exchange circulation system.

When asked by reporter as to what the next innovation or technical breakthrough might be for the ground source energy collection technology, Mr. Sun answered: "we have been making breakthroughs and innovations. Ever since the successful inventions of the single-well heat exchange circulation system for ground source energy collection in 2000, we have never stopped our exploration and optimization. Currently, with steady industrialization and commercialization of the technology, we have accomplished very standardized and modularized engineering technology and products system that can fit diverse geological conditions, different architectures, and various construction craft. To accommodate different hydro-geological conditions, we invented energy collection wells with and without energy storage granules. In view of different formation lithology, we have developed different technique designs and a complete series of well products with borehole diameters ranging from 108mm to 1200mm and of various models of power output of heating from 15kw to 500kw. Besides, we also produce heat pump units and air terminals. Thus, we can offer a complete set of technology system of heating, cooling and domestic hot water for buildings of any function in various geological conditions. Based on the core technology of single-well system, the Company has developed and successfully commercialized a series of mature commodity products including Ground Source Heat Pump Environment System, Dispersed Stations of Ground Source System for Cooling and Heating, and Ground Source Heat Pump System without Machine rooms. Ground Source Heat Pump Environment System, in combination with conventional heat pump technology and different air terminal units can collect ground source energy to produce heating, cooling and domestic hot water for single buildings. Dispersed Station of Ground Source System for Cooling and Heating is an integrated heating solution to substitute urban heating infrastructure to provide heating and cooling as well as domestic hot water for building. Based on the needs of building blocks, it can set up a centralized utility supply network with dispersed stations that integrates various innovative technologies to achieve comprehensive utilization of renewable energies including ground energy as the major source, and other clean energies such as natural gas, fuel and geo-thermal energy. Ground Source Heat Pump System without Machine rooms is a new type of air heating system, of which the core element is the split ground source heat pumps. The system achieves independent air heating and cooling by rooms which can realize not only household-based heat metering, but also separate heating and cooling for rural households.

At present, China is promoting the Plan of "Green Ecological City" to accelerate the development of green single buildings. The single-well heat exchange circulation system for ground source energy collection has been widely spread and applied both in China and around the world. The technology, with its high designability, versatile applicability and adaptability to different regions and buildings, has applied to more than 7 million m^2 in Beijing and more than 10 million m^2 nation-wide. Typical application include some key Olympic venues such as the landscape ponds of the National Stadium and the National Aquatic Center, Beijing landmark architectures such as 35,000m^2 landscape pond of the National Theatre, office buildings such as those of All-China Federation of Industry and Commerce and the National School of Administration, cultural facilities such as the Haidian Foreign Language Experimental School, high-end hotels such as the Beijing Nirvana Resort Hotel, Airport Crown Plaza Hotel, residential houses such as Qingqin Villas, Four-season Villas, and industrial facilities such as the Changping Water Treatment Plant. HYY has won the "Energy Star" heating project award jointly granted by the Energy Department and the Environment Protection Agency of US in Hersheys School of Nebraska of US. Moreover, the first application project of HYY in Mongolia was also very successful which proves with facts that the HYY ground source heat pump system can be used to heat areas of extreme cold and close to permafrost and well demonstrates the wide applicability and solid reliability of the technology. ■

Hotspot Info

Photo of the Launching Ceremony of the Specialized Committee of on Development and Utilization of Ground Source (Thermal) Energy under Beijing Association of Promoting Energy Conservation and Environment Protection

Launching Ceremony in Beijing of the Specialized Committee on Development and Utilization of Shallow Ground Source (Thermal) Energy under Beijing Association to Promote Energy Conservation and Environmental Protection

■ by TAN Ming

On March 16, 2013, the launching ceremony of the Specialized Committee on Development and Utilization of Shallow Ground Source (Thermal) Energy under Beijing Association to Promote Energy Conservation and Environmental Protection was held in Beijing. The ceremony was moderated by Mr. Wang Bingchen, Senior Counselor of the State Council. Present the meeting were Mr. Shi Dinghuan, former Secretary General of Ministry of Science and Technology, Counselor of the State Council and Director of China Renewable Energy Society, Mr. Shen Mengpei, Senior Counselor of the State Council, Mr. Wang Jiyang, Academician of China Science Academy, Chairman Chai Xiaozhong, Vice Chairman Ni Wenju and Vice Chairman Chen Huaiwei of Beijing Association to Promote Energy Conservation and Environmental Protection, and other nearly 70 participants.

In the meeting, Mr. Chen Huaiwei read out the administrative permit issued by Beijing Bureau of Civil Affairs on establishing "the Specialized Committee on Development and Utilization of Shallow Ground Source (Thermal) Energy" by Beijing Association to Promote Energy Conservation and Environmental Protection. Vice Chairman Ni Wenju announced the members of the Specialized Committee. President of Ever Source (HYY) Science and Technology Development Group, Mr. Xu Shengheng is the Director of the Committee, while deputy directors are Mr. Zhang Jun, Chairman of Beijing Huayu Energy Technology Development Co. Ltd., Mr. Huang Xueqin, Chairman of the Huaqing Group and Professor Wu Qiang from China University of Mining and Technology(Beijing). Representatives from the advisory body of the Committee, Mr. Shen Mengpei made a speech of how the Committee was firstly initiated and established. In the ceremony, Mr. Chai Xiaozhong, Mr. Xu Shengheng and other deputy directors officially inaugurated the Committee.

After the inauguration, Mr. Xu Shengheng reported the working plan and priority tasks of the Committee in 2013. Mr. Shi Dinghuan, on behalf of the senior advisers of the Committee also warmly congratulated the launching of the Committee in his speech. At the end of the ceremony, Mr. Chai Xiaozhong delivered an important speech.

In the 18th Congress of China's Communist Party, ecological construction has been highlighted as one of the top priorities. Exploitation and utilization of shallow ground source (thermal) energy goes along with market development trend. The establishment of this Committee meets the need to implement ecological civilization construction and also echoes Beijing's endeavor in promoting energy conservation and environmental protection. The Specialized Committee will give full play to its industrial advantages under the leadership of Beijing Association to Promote Energy Conservation and Environmental Protection and with supports from leaders, experts, scholars and colleagues. It will actively engage in various activities, unify the efforts of energy conservation and environmental protection enterprises and promote development of ground source energy system in Beijing, so as to contribute more to the undertakings of energy saving and environmental protection in Beijing. ■

Field Visit to HYY Project in Beijing Haidian Foreign Language Experimental School by Members from the Committee of Population, Resource and Environmental Protection in NPPCC

■ by HE Hong

On November 28, 2013, a delegation of more than 40 members from the Committee of Population, Resource and Environmental Protection in NPPCC headed by Chairman Jia Zhibang visited one of the projects constructed by the Ever Source Science and Technology Development Group Co. Ltd. (often referred to as HYY) in Beijing Haidian Foreign Language Experimental School. Mr. Wang Xiaokang, Member of the Committee and Chairman of China Energy Conservation and Environmental Protection Group, Mr. Zheng Qiyu, Chairman of China Ground Energy Resource Industry Group and Mr. XU Shengheng, President of Ever Source Science and Technology Development Group & China Ground Source Energy Industry Group have accompanied the delegation for the visit.

Chairman WANG Xiaokang from China Energy Conservation and Environmental Protection Group is introducing the project performance to visiting leaders.

Chairman Wang Xiaokang warmly welcomed the delegation to visit HYY project, elaborated the energy conservation reality in China, and introduced the mainstream priority businesses of China Energy Conservation and Environmental Protection Group.

President Xu Shengheng presented technological advantages and development prospect of ground source energy as substitute energy for heating, application and performance in energy saving and emission reduction of the single-well system in the project, as well as the pros and cons of the three type collection technology of ground source energy in the world. The single-well heat exchange circulation technology for shallow ground source energy collection is one of the three types and also a self-developed technology of the Company. It exceeds the other two since it is highly efficient, environment friendly and space saving which are typical negative impacts caused by the buried tubes system, and it can also avoid water loss, pollution and potential geological disasters which might be unavoidable for the water production well system.

Mr. Xu also pointed out that the emerging industry of integrated heating and cooling system with ground source energy is an all-round industrial escalation of traditional heating and cooling industries. Such escalation incurs three aspects. Firstly, it is an escalation of energy utilization that realizes graded scientific utilization of energies; secondly, it is an escalation of energy utilization technique that develops the best utilization technique for the use of the cleanest energy --- electricity;

Chairman JIA Zhibang from the Committee of Population, Resource and Environment Protection in NPPCC is visiting the HYY Project in Haidian Foreign Language Experimental School.

thirdly, it is an escalation of environmental protection level of the applied region that causes zero pollution and zero emission.

After the presentation, the delegation also visited the School Reception Office at the East Gate of the School where the "Household-based Ground Source Heating Device" (i.e., Split Forms of Ground Source Heat Pump Environment System) is utilized and the Multi-function Building of the School where the ground source heat pump environment system is applied, as well as the seasonal heated swimming pool and the shallow ground source energy collection wells.

During the visit, all members of the Committee showed great interest in the technology, asked in great details about the application theories and effects of the ground source heat pump environment system and made many concrete proposals and valuable comments to the future development of the HYY Group. ■

Workshop on the Emerging Industry of Integrated Heating and Cooling System with Ground Source Energy

■ by SUN Ying

Participants in the Workshop on the Emerging Industry of Integrated Ground Source System of Heating and Cooling witness the Signing of the Strategic Framework Agreement on Constructing Dispersed Ground Source Energy Stations of 900MW for Cooling and Heating in Xiaojiaowan International Business Centre in Jinzhou District of Dalian.

On the morning of December 16th, 2013, the Workshop on the Emerging Industry of integrated heating/cooling system with ground source energywas held in the Energy Conservation Building in Beijing. Present at the meeting were Mr. Ding Henggao, Academician of Chinese Academy of Engineering; Mr. Wang Guangqian, Academician of China's Academy of Science and Principle of the Qinghai University; Mr. Wang Binchen, Senior State Counselor of the State Council; Mr. Wu Desheng, former Head of Beijing Construction Designing Institute; Mr. Wang Fushan, Senior Engineer of the Institute of Geodesy and Geophysics of China's Academy of Science;Mr. Lu Wenbin, Deputy Director General of the Environment Investment Department of NDRC; Mr. Zeng Xiaoan, Deputy Director General of the Economic Construction Department of Ministry of Finance; Mr. Han Aixin, Deputy Director General of the Energy Conservation Department of Ministry of Housing and Urban-Rural Development; Mr. Liu Yan, Deputy Mayor of Dalian Municipality; Mr. Chu Tianyun, Deputy Director of the Jinzhou New Zone Administration Commission of Dalian; Mr. Wang Xiaokang, Chairman of China Energy Conservation and Environmental Protection Group (CECEPG); Mr. Zheng Qiyu, Vice President of CECEPG; Mr. Xu Shengheng, President of China Ground Source Energy Industry Group Co. Ltd. and dozens of other experts and leaders. Mr. Zheng Qiyu chaired the workshop.

The Emerging Industry of Integrated Heating and Cooling System with Ground Source Energy uses the clean, pollution-free and renewable low-grade shallow ground source energy to substitute conventional fossil energies to provide heat for buildings. The industry emerges at the time of juncture when traditional heating modalities of high energy consumption and pollution and conventional air cooling industry are forced to make industrial escalations. The ground source energy system has realized graded use of energies and provided an integrated solution of heating and cooling for buildings.

After profound discussion and reviews, participating experts and professionals came to the consensus that the system is reliable, environment-friendly and energy-conservative that shall be greatly promoted and "Engineering Technical Standards on Single-well Heat Exchange Circulation System for Ground Source Energy Collection" as the very first standard issued by China in this sector has rendered theoretical foundation for the HYY single-well circulation system and dismantled various suspects and concerns. It is scientific for HYY to combing shallow ground source energy collection technology with heat pumps technology to produce heating and cooling for buildings. As an indigenous technology industry, the system enjoys enormous prospect and shall be promoted throughout the country.

Participants also witnessed the signing of the Strategic Framework Agreement on Constructing Dispersed Ground Source Energy Stations of 900MW for Cooling and Heating in Xiaoyaowan International Business Centre in Jinzhou District of Dalian. The project was the first solid project to be implemented after the signing of the strategic cooperative agreement between Dalian Municipal Government and China Energy Conservation and Environmental Protection Group. The successful implementation of the project will be important for Dalian to achieve transformation and escalation of urban construction and industries and realize low-carbon, energy conservation and environment friendly growth.

Vice Mayor Liu Yan of Dalian congratulated the signing of the Agreement. He committed that Dalian government will earnestly implement the Agreement, render forceful support to the project and enable it to play an active role in the urbanization process of Dalian.

Chairman Wang Xiaokang also expressed his cordial appreciation to the Dalian government for its support to the project which helps to advance the utilization of ground source energy from a stage of demonstration to a level of pure commercialization. It was hoped that interested parties could render forceful support to the project to jointly turn it into a demonstrative sample of successful commercialization. ■

Chairman WANG Xiaokang from China Energy Conservation and Environmental Protection Group is introducing the project to the visiting delegation from Finland.

Field Visit to HYY Project in Beijing Haidian Foreign Language Experimental School by Delegation from the Finland Parliamentary Committee for the Future

■ by DAI Qi

On December 12th, 2013, Ms. Lipponen, Chairman of Finland Parliamentary Committee for the Future led a Finland business delegation of around 40 members and visited the HYY project in Beijing Haidian Foreign Language Experimental School. Mr. JIA Zhibang, Chairman of the Population, Resource and Environment Committee (PREC) of National Political Consultative Conference, Mr. WANG Xiaokang, member of PREC and Chairman of China Energy Conservation and Environmental Protection Group, and Mr. XU Shengheng, President of Ever Source Science and Technology Development Group Ltd. (HYY) & China Ground Source Energy Industry Group Co. Ltd. accompanied the delegation throughout the tour.

Chairman Wang Xiaokang warmly welcomed the delegation to visit the project site and introduced the application details, general performance and operational situation of the project.

In the Q&A session, President Xu Shengheng responded to all questions and concerns of the delegates about initial investment, single-well depth, architecture types, impact of outside temperature on system operation etc..

The delegation also visited the natatorium of the School where the pool water is heated by HYY ground source heat pump environment system, the shallow ground source energy collection well and the Fencing Hall. The visit has aroused great interests among members of the delegation and many have expressed their desire to explore further opportunities for cooperation. ■

Delegates from Finland raising questions with great interests

Project Showcase

Case Study of HYY Ground Source Heat Pump Environment System with Single-Well Heat Exchange Circulation

■ Beijing Ever Source Property Management Co. Ltd.

■ **Project name:** Beijing Haidian Foreign Language Experimental School

■ **Location:** No. 20, Xingshikou Road, Haidian District, Beijing

■ **Project type:** School including Teachers' building, classroom building, natatorium, stadium, dormitories, canteens and landscape pools etc..

■ **Owner's Data:** The school is an internationally oriented school equipped with state-of-art facilities set up in July 1999 to meet the needs of further expansion of Zhongguancun Scientific and Technological Park. At its initial stage, the school covered an areas of 10,000 m^2 and a total floor space of 2,000 m^2 with four teaching classes and more than 140 students. In 2001, the school moved to its current location and renamed as it is now with a area coverage of 150,000 m^2 and floorage of 62,000 m^2. After another decade's development, the school further expanded its space to more than 230,000 m^2 and a total floorage of 90,000m^2. The school now enrolls students from 3-18 years of ages with 136 classes, more than 4400 students and 940 faculties. Up to now, the school has won many different titles including "Beijing Outstanding Private School", "Beijing Top-ten Private Primary and High School", "Most Influential Brand Educational Institute in Beijing", and "China's Advance Primary and High School in Moral Education" and many awards such as "Green School of Beijing Haidian District", "Green and Beautiful Garden School in Capital Beijing", "Beijing Demo School of Good Manners" and "Beijing School of Health Promotion".

■ Floor area: the project is to provide heating and cooling for a total floorage of 92,632 m^2 completed by two phases. The first phase started in 2001 covered nine buildings with a floorage of 62,283 m^2 which was put into operation in September 2001. And the second phase covered seven buildings with an extra floorage of 23,265 m^2 which went into function in September 2008 and September 2009 respectively. In addition, the Badminton and Table Tennis Center in the northern part of the School built in 2011 with an area of 2,266 m^2 was also installed with the system which started operation in December 2011. In August 2012, the school built up a nursery school of 4818 m^2 equipped with the system.

■ **General profile of the project:** The project was put into service in 2001. The school is a boarding school with more than 940 faculties and 4,402 students from preschool to senior high school, among which 176 in preschool, 205 in nursery school, 2,284 in primary school, 1,112 in junior high and 625 in senior high. Machine rooms were designed and built in light of the needs and function of different buildings. The whole project is equipped with 14 independently-operating machine rooms of ground source heat pump environment system.

■ **Operation quality of the system:** The school possesses more than 400 classrooms of various kinds including traditional classrooms, multimedia classroom, piano rooms and multifunction rooms, all equipped with the most advanced educational tools and devices. Students' dorms are designed according to international standards. Each apartment has bunk beds for six, with independent toilet and 24 hour domestic hot water. Room temperature is adjustable between 18-26°C to meet the need of heating and cooling in winter and summer. Taking into account of special requirements of schools, the system is set to automatically start operation when environment temperature goes above 26°C or below 18°C for five consecutive days and stop when environment temperature is between 18-26°C. Uninterrupted domestic hot water is kept at 40-45°C.

■ **Project performance:** The school project was a demonstration project launched in 2001. Up to now, it has operated more than 12 years. Ever since 2002, we have kept monitoring the operation. In the past 11 years, the total consumption of electricity by heating in winters accumulated to 30.97 million kWh. Compared to heating by electric boilers, it has saved accumulatively 92.91 million kWh power, and 30659 tons coals that would have been burned for power generation of. Compared with direct coal burning heating, it has saved 10,220 tons of coal and reduced smoky emission of 131.11 million standard m^3, CO_2 emission by 28784 tons and SO_2 emission by 230 tons.

Power Consumption（1000kWH）	Equivalent coal burning（tons）	Reduced smoky emission (10,000 Nm^3)	CO_2emission reduction（tons）	SO_2Emission Reduction（tons）	Emission Reduction NOX（tons）	Reduction of Polluting Particles=（tons）
3097	10220	13111	28784	230	174	438

Total power consumption for cooling in summers is 11.27 million kWh, 2.26 million kWh less than traditional centralized air conditioning systems. As the system needs no cooling tower and therefore no water loss from evaporation, water consumption is saved by 9197 tons.

In 2012, total power consumption for heating in winters accumulated to 3.69 million kWh, 11 million kWh less than traditional electric boilers, saving 3680 tons coal. Compared to heating boilers, it saved 1226 tons of coal, lowered smoke emission by 15.73 million m^3, and reduced CO2 emission by 3454 tons and SO2 emission by 28 tons. Due to further enhancement of heating efficiency, with no calculation of other green energy being utilized, the system itself can save 13 million kWh electricity every year and save 4350 tons of coal for power generation compared to electrical boilers and 1450 tons of coal if compared to direct heating by boilers.

In 2012, the total power consumption in summer is 1.24 million kWh, saving 248,000 kWh electricity and 1104 tons of water compared to traditional centralized air conditioning systems.

Years of practice has proved the project operation to be stable. Average power consumption is 37.92 kWh/m^3 in winter and 14.74 kWh/m^2 in summer, with a total annual power consumption of 52.66 kWh/m^2. Based on residential electricity price of 0.4886 yuan/kWh, the total operation cost of a year is 25.72 yuan/m^2.

Building	Building area	System Functions	Power Consumption in Winter（kWh/ M^2）	Power Consumption in summer（kWh/ M^2）	Yearly power consumption (kWh/ M^2)	Domestic hot water supply in winter（tons）	Operation cost（yuan/ M^2）
Comprehensive Teaching Building	8047	Heating & Cooling	24.32	10.63	34.95	-	17.08
Building of art	6009	Heating & Cooling	23.07	9.45	32.52	-	15.89
Primary School Teaching Building	8897	Heating & Cooling	21.71	10.36	32.07	-	15.67
High School Building	5248	Heating & Cooling	21.91	8.98	30.89	-	15.09
North Canteen	4455	Heating & Cooling	24.54	10.64	35.19	-	17.19
Natatorium	5603	H & C & Domestic hot water	55.01	13.41	68.42	11675.84	33.43
Girls Dorm	6296	H & C & Domestic hot water	40.85	16.26	57.11	5690.01	27.90
Boys Dorm	6296	H & C & Domestic hot water	40.07	17.07	57.13	5281.644	27.91
Primary School Dorm	12000	H & C & Domestic hot water	49.46	17.27	66.73	19463.33	32.60
Dorm of Southern Area	4698	H & C & Domestic hot water	59.34	15.87	75.21	11486.61	36.75
Teaching Building and Dorm in South Area	15529	H & C & Domestic hot water	49.47	15.08	64.54	25194.63	31.54
Canteen of South Area	3040	Heating & Cooling	22.64	18.93	41.56	-	20.31
Center of Badminton table Tennis and Swordplay	2364	Heating & Cooling	51.00	38.20	89.20	-	43.58
Nursery	4818	H & C & Domestic hot water	47.50	4.20	51.70	7026.25	25.26

Note:

1. The Ground Source Heat Pump Systems in dormitory buildings, natatorium and nursery school provide domestic hot water for more than 5400 students and school faculties. With 8-meter-high ceiling, heating and cooling needs of the Badminton and Table Tennis Center and the Fencing Center which are in an inflatable canopy architecture doubles the normal needs of buildings with the same floorage.
2. In winters, power consumption of domestic hot water is 12kWh/ton, with outlet water temperature of 50-55℃ .
3. In summer, the system uses its residual heat to provide domestic hot water. No extra power consumption is needed. ■

Knowledge Sharing

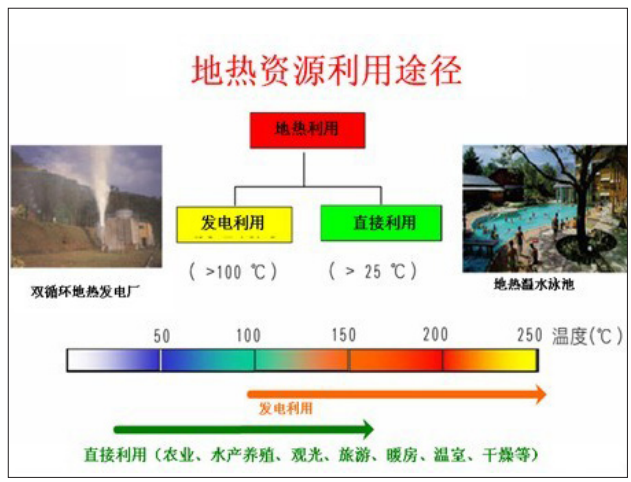
Geothermal Energy —— a Green Power House

■ by the editor 's office

The world's development trend of energy tells us that the optimal energy of human beings shall be clean, efficient and able to bring about high energy efficiency, economic return and environmental benefit. Meanwhile, the contradiction between demand and supply of energy in the world has kept people looking for various renewable energies. With continuous exploration of mankind, geothermal energy is discovered and utilized.

Geothermal energy is a natural thermal energy extracted from the earth crust. The energy takes the form of heat that comes from the lava inside the earth. The temperature of earth interior can go as high as 7000°C and at the depth of 80 to 100 miles, the temperature comes down to 650 to 1200°C . Via the flow of underground water, lava moves to the earth curst that is 1-5 km deep under the surface and thus heat is transferred to places close to the ground. High-temperature lava heats its surrounding underground water. The hot water due to its movement eventually emerges from the ground surface. The easiest and most cost-effective way to utilize geothermal energy is to directly draw the hot water and extract heat from it. Geothermal energy is renewable, widespreading, abundant in reserves and low in cost (as compared to the unit development cost of fossil fuel or nuclear). Based on temperature differences of geothermal fluids, it can be utilized for mainly two purposes including power generation and direct application. To be more specific,

1. fluid at 200-400°C is used to generate electric power;
2. fluid at 150-200°C is used for binary generation,



cooling, industrial dry and industrial heat treatment;

3. fluid at 100-150°C is used for binary generation, heating, cooling, industrial dry, dehydration treatment, salt production and canned food;
4. fluid at 50-100°C is used for heating, greenhouse heating, domestic hot water, industrial dry;
5. fluid at 20-50°C is used for spa, aquiculture, breeding husbandry, soil warming and dehydration treatment.

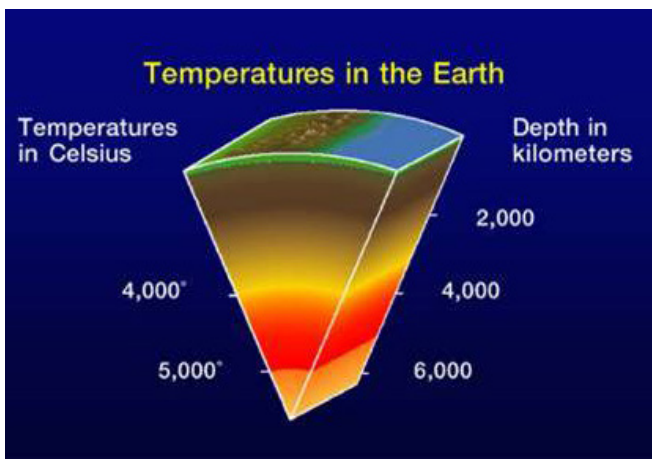
Nowadays, many countries have started to develop and utilize geothermal energy in a graded manner to enhance utilization efficiency. Development models of this kind include cogeneration system of power and heating,

Editor's note: The world's development trend of energy tells us that the optimal energy of human beings shall be clean, efficient and able to bring about high energy efficiency, economic return and environmental benefit. Meanwhile, the contradiction between demand and supply of energy in the world has kept people looking for various renewable energies. With continuous exploration of mankind, geothermal energy is discovered and utilized.

tri-generation system of power, heating and cooling, and heating before breeding.

Besides traditional geothermal energy, another highly efficient, clean and renewable energy with abundant reserves has now entered into our lives. That is shallow ground geothermal energy, or ground source energy.

The shallow ground geothermal energy refers to the heat resulted from comprehensive action of sunshines and earth core that is carried by rocks, gravels and underground waters in the constant temperature zone around 400 meters deep under the ground surface. Besides being enormously huge in reserves and rapid in its renewability, the new energy is inexhaustible, wide spreading and highly constant at all seasons. This is truly a huge green power house for mankind. The shallow geothermal energy as a natural reserve has been utilized by human being ever since ancient times. The caves that our ancestors lived were beneficiaries of shallow geothermal energy as being cool in summer and warm in winter.



With evolution of human beings, especially after industrialization, different technologies have been developed to exploit and utilize shallow ground geothermal energy. Compared to its utilization by our ancestors, modern utilization is supported by scientific means and tools of system integration as results from inter-discipline studies. Such system integration includes concentrated heat pump units system, shallow geothermal energy station, dispersed joint energy station etc..

Shallow ground thermal energy as a sustainable and renewable energy of wide spread and constant production can be an optimal energy to substitute conventional heating resource and therefore its development and utilization is of significant and practical meaning to China's endeavor in constructing an energy-saving and environmental-friendly society.■

Water Source Heat Pump, Ground Source Heat Pump and Ground Source Heat Pump Environment System

■ by SUN Ji

There are mainly three types of systems applying heat pump technology to extract and utilize underground energies from water, rocks and soil, namely Water Source Heat Pump System, Ground Source Heat Pump System and Ground Source Heat Pump Environment System.

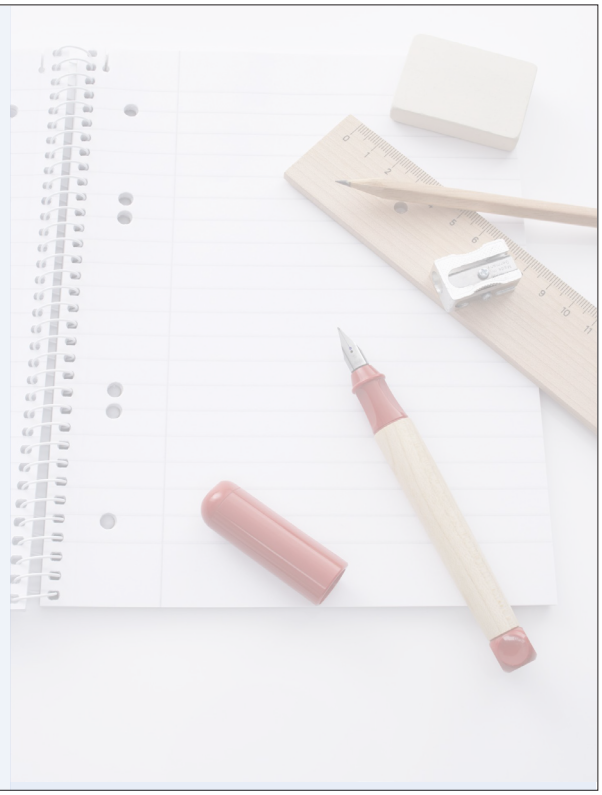
Water source heat pump system takes ground water as heat source and makes use of water production well to constantly exchange heat with underground water. The system was popular at the early-stage development and utilization of shallow ground source energy. It is easy to operate and relatively reliable and efficient especially in places where underground water is sufficient enough. However, it may compose a threat to the balance and safety of underground water since the system has to pump water out from underground.

Ground source heat pump system is also called as buried-tube heat pump system. It uses underground soil as the heat source and constantly exchange heat with underground rocks and soils through buried-tubes or pipelines. It imposes no threat against underground water mass and geological structure. However, the system requires big area of land space and performs low efficiency. It is hard for the heat collection tubes in parallel connection to reach hydraulic balance. Due to the factor of thermal expansion and contraction, it is generally true that heat exchange efficiency of buried tube system attenuates year on year.

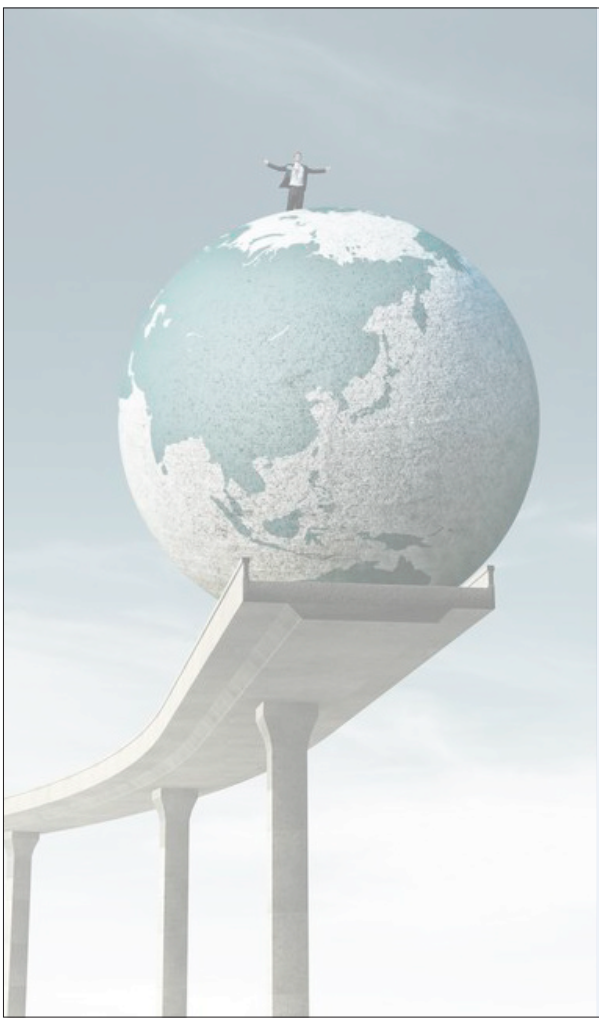
Ground source heat pump environment system is a new type of shallow ground source energy development technology indigenously developed by China at the end of last century. It uses the single-well heat exchange circulation for ground source energy collection as its core technique to extract ground source energy from underground rock and soil mass. It is not only highly efficient and secure, but also space-saving and of no impact on underground water system and geological structure. With high designability and wide applicability, the system is currently an optimal solution to develop and utilize ground source energies.■

Regional Underground Temperature Analysis Based on Empirical Data

■ by LAO Ma



Geologists have discovered after years of research that in a depth of dozens of meters to hundreds of meters under the ground lays a constant zone where temperature does not vary with time and seasons. Temperature of the constant zone often approximates the average annual surface temperature of the region. For instance, in Beijing the temperature of its underground constant zone is around 15°C. When HYY ground source heat pump environment system runs, it exchanges heat with the constant zone to extract heat in winter and discharge heat in summer to provide heating and cooling to buildings.■



Energies and Products

■ by the editor 's office

Discovery of energies is always accompanied by invention of new technology products. The two have jointly promoted human civilization and social development.

New invention of technology products has been constantly pushing forward the utilization level of energies. Continuous expansion of knowledge and constantly increasing requirements of human beings have also helped to forge ahead new inventions of products for better energy utilization and more profound understanding on energies by the mankind.

For instance: the discovery of coal only became significant when steam engine was invented. And it is the invention of internal combustion engine that made oil a highly strategic resource. Similarly, the ground source energy was made a substitute energy for heating with the invention of stable and mature products of heat pumps which is a technique integration with compressor being its core technique. Heat pumps can help to move and upgrade ground source energy to utilization areas to provide heating, cooling and domestic hot water for buildings. Therefore, it is time to replace conventional heating industry that burns mineral resources, makes emissions and generates pollutions with a new industry that can serve the need of both heating and cooling for building in an integrated way free of combustions, pollutions and emissions.■