

Beijing Municipal Administrative Center Taps Johnson Controls for Sustainable District Heating and Cooling Solution

Eco-project Sets the Standards for Smart, Clean Urban Living Using Renewable Energy-powered Heat Pumps

“By using geothermal energy in its administrative office area, the Beijing Municipal Administrative Center is able to cut the use of natural gas by 12 million cubic meters each year, which is equivalent to a reduction of 15,000 tons of standard coal, or replacement of 40,000 tons of CO₂ emissions, similar to planting an additional 100,000 trees (to absorb the same amount of CO₂) in the surrounding area.”

Donghui XIE, Vice President, Beijing Geothermal Research Institute & Deputy General Manager, Beijing Huaqing Geothermal Development Group

Overview

Located in the Tongzhou district, the Beijing Municipal Administrative Center is a dynamic eco-city with modern amenities and lush greenery. Johnson Controls worked with the Beijing Municipal Administrative Center to build an efficient, intelligent and reliable large-scale district heating and cooling system that uses geothermal energy, as opposed to traditional biomass fuels. Johnson Controls supplied four units of ground-source heat pumps situated in one of the energy stations in the administrative office area.

The solution has several energy-saving features with positive environmental, economic and social impact. With a total installed capacity of 39 megawatts, the heat pumps operate in cooling mode to provide central cooling for Beijing Municipal Administrative Center in summer, and provide central heating during

winter – an approach that allows for more efficient functionality. The heat pumps act as a comprehensive energy supply system providing both cooling and heating all year round while concurrently reducing the overall energy consumption of the buildings. The energy storage water tanks stores thermal energy at night for utilization during the day, which further reduces the energy consumption of the air conditioning system.

Background

The green, modern Tongzhou District in the eastern Beijing area is home to the new municipal administrative center of the capital. Situated within a 40-minute drive from downtown Beijing, the 155 square-kilometer sub-center is developed to meet the expansion needs of the capital and to relocate resources in a more balanced way. A thriving eco-city with government offices, businesses, residential homes, healthcare facilities, recreational outlets and green spaces, the

sub-center is poised as a standard-bearer for a sustainable, world-class megalopolis. The eco-city is also expected to drive the co-ordinated development of the greater Beijing-Tianjin-Hebei region.

Designed to comply with the country's sustainability standards, the Beijing Municipal Administrative Center, is designed to harness renewable energy to power its six energy stations. Under the national guidelines, new urban projects will be built with an emphasis on low energy consumption, pollution and carbon emissions. These include the development of near-zero carbon emission projects that use clean energy sources and energy-saving green building technologies.

Heat pump systems leveraging renewable energy are an economically viable solution to greening a city. Using geothermal energy heat pumps, centralized energy stations can provide clean heating and consume significantly less energy, as compared to using traditional biomass fuels. Ground-source heat pumps are also highly efficient and more cost-effective than gas furnaces and boilers.

Project requirements

The energy stations of the Beijing Municipal Administrative Center supply central heating and cooling to some 3.8 million square meters of administrative office space. The energy stations are built to satisfy several stringent requirements: They have to operate 100% on clean energy and maximize the use of renewable energy source. In addition, these energy stations have to be cost effective and be a source of reliable energy supply.

Following a detailed analysis, it was determined that an approach using multiple energy sources will supply Beijing Municipal Administrative Center's energy needs.

Shallow level geothermal energy forms the primary source while the secondary source is drawn from deep level geothermal energy. Both geothermal energy sources will be supplemented by other forms of clean energy.

Contributing 60% of the district system's designed heating load, the geothermal heat pumps are also able to supply 90% of the system's annual heating needs. The shortfall of the heating requirements during peak periods is supplemented by gas heating.

Integrated with a smart management platform of the energy station, coupled with six regional energy stations to back up each other, the solution is a showcase of a highly efficient, safe, reliable and green energy system.

Building a clean, efficient, reliable and cost-efficient district heating and cooling energy station

Beijing Municipal Administrative Center Energy Station No. 2, serving a total building area of about 960,000 square meters, houses four units of YORK® CYK two-stage centrifugal high-temperature heat pumps. The heating capacity of each heat pump reaches 9,750 kilowatts and its cooling capacity is 9,150 kilowatts. In summer, the heat pumps provide chilled water at 5.5°C to the air conditioning system during the day to cool the interior spaces and supplies chilled water at 4°C at night to conserve energy. In winter months, the heat pumps provide heated water at 52°C for central heating and produce heated water at 55°C at night to store heat.

The total heating capacity of the four heat pumps installed in the energy station reaches 39 megawatts, of which 30 megawatts are from the geothermal resources. During a single heating season (4 months) in Beijing, the total heat supply of the heat pump system is equivalent to the heat supply of 12 million cubic meters of natural gas or 15,000 tons of standard coal, which would replace 40,000 tons of CO₂ emissions each year.

The Energy Station No. 2 is also equipped with regulating mechanisms. During summer months, the heat pumps can release excess heat through a cooling tower to maintain the reliability and stability of the cooling system. Under extreme cold conditions in winter, gas-

fired boilers will supplement the heating should the heat pumps produce insufficient heat to meet the overall heating demands.

Thanks to the combination of high efficiency centrifugal heat pumps and advanced energy storage technology, the energy station uses less energy to meet heating and cooling needs, as compared to using biomass fuels. The energy station is cost-efficient and meets the requisite clean heating goals.

The Beijing Municipal Administrative Center project is one of China's largest energy station projects providing heating and cooling via geothermal resources. The total length of its underground geothermal pipelines totals 44 kilometers, or the equivalent in length to Beijing's Third Ring Road. The successful operation of Energy Station No. 2 sets a new benchmark for similar energy station projects of centralized large-scale utilization of geothermal energy in the country.

