

Shanxi to be national hydrogen industry hub



Province developing complete supply chain for clean gas

By YUAN SHENGGAO

The North China province of Shanxi is expected to become a national hub for the hydrogen industry, according to local officials and industry insiders.

The development of hydrogen as a new source of energy is part of Shanxi's energy revolution strategy. A traditional base for coal mining, Shanxi has recently implemented an economic transformation move to reduce its reliance on coal and increase the ratio of new and renewable energy resources.

Local statistics show the generation capacity of electricity from new and renewable resources makes up more than 30 percent of Shanxi's power industry. These include a capacity of 20.47 million kilowatts in the wind power industry and a capacity of 13.37 million kW in the solar power industry.

The Shanxi government's choice of hydrogen as a breakthrough point for energy revolution stems from several reasons. Among others, the province has rich resources for cost-effective hydrogen

production, a full industrial chain from upstream manufacturing to downstream utilization, and a strong demand from the market.

The northern Shanxi city of Datong is one of the pioneers in the province developing a full chain for the hydrogen industry.

According to Liu Hongwen, deputy chief of the Datong bureau of industry and information technology, Datong is the first city in Shanxi to put a fleet of hydrogen-fuel-cell buses into operation. The fleet of 100 buses is supported by a number of hydrogen production plants and filling stations.

In Datong, hydrogen is mostly produced with the technique of water electrolysis.

"Water is the cleanest resource for making hydrogen but the production process requires a huge amount of electricity," Liu said. "The strong demand for electricity can be addressed with the large capacity of solar and wind power plants in Datong."

The wind and solar power sectors are affected by the weather and their unstable supply to power grids is a disadvantage when it comes to long-distance transmission. "However, such a problem can be solved when the electricity is used by local water electrolysis plants," Liu explained.

The official added that huge market demand can ensure the steady growth of the hydrogen industry.

In Datong, there are about 45,000 trucks used in the transportation of coal and ores.

"Most of those trucks travel on regular routes from mines to railway stations," Liu said. "It is feasible to turn those into HFC vehicles as the hydrogen filling stations can be easily accessible along the regular routes."

Datong became one of the first cities in China to release its development plan for the hydrogen industry in September 2020. According to the plan, businesses in hydrogen production and supply as well as hydrogen-consuming vehicle owners can enjoy subsidies from the government.

Replacing conventional trucks with hydrogen-fueled ones can be made possible thanks to the rapid development of the manufacturing industry of hydrogen fuel cells and HFC trucks in Shanxi.

Meijin Energy Group based in Qingxu county in Taiyuan is one of such manufacturers.

According to Yao Jincheng, vice-president of the company, Meijin's ambition is to grow into the largest base for heavy-duty HFC truck production in China.

The company has just debuted its first batch of HFC trucks. The 100 trucks are currently used in the transportation of supplies and finished products in Meijin's industrial park in Qingxu.

Yao said the biggest advantage of HFC trucks is the environmental benefit.

"An HFC truck can normally travel more than 100,000 kilometers a year and there is no carbon dioxide emissions at all," Yao said. "That is a sharp contrast to con-



Hydrogen-fuel-cell buses roll off the assembly line at a manufacturing plant in the Shanxi Transformation and Comprehensive Reform Demonstration Zone. GUO YANJIE / FOR CHINA DAILY

ventional diesel trucks that can discharge 120 metric tons of carbon dioxide during that period of time."

However, Yao is still concerned about the cost of using hydrogen as fuel.

Meijin is also a producer of hydrogen using coking gas as a raw material.

Coking gas-converted hydrogen is relatively cheaper than water-electrolyzed hydrogen, according to Yao.

Meijin is an operator of several coal mines and coking plants, which ensure its supply of coking gas for hydrogen production, Yao added.

"The hydrogen consumption of a 49-ton HFC truck is about 10 kilograms per 100 km, which can

translate into a cost of about 350 yuan (\$55) based on the current hydrogen price," Yao said. "This is about 50 yuan higher than the cost of a diesel-fueled truck."

Considering there are subsidies for HFC vehicles and hydrogen prices are expected to be further lowered with production scale expansion, HFC trucks can be more attractive to vehicle owners in the future, Yao said.

While coking gas-converted hydrogen shows a relative cost advantage over water-electrolyzed hydrogen, experts said reducing CO2 emissions in the production process is a pressing challenge needing to be addressed.

Shi Yulin, an expert in hydrogen research in Shanxi, said recycling CO2 in the coking process for the

production of chemicals and other industrial materials can be a solution to the problem.

"For instance, recycled CO2 can be used as refrigerant and an energy storage agent," Shi said. "Emissions reduction is always the result of efficient use of resources."

The hydrogen industry is showing a huge potential for growth throughout the world.

According to a report released by international organization the Hydrogen Council, the hydrogen industry will reach a market scale of \$2.5 trillion by 2050. Hydrogen has the potential to lead to a reduction of 6 billion tons of CO2 emissions and create more than 30 million jobs by that time.

Guo Yanjie contributed to this story.

Fortress on Great Wall named after princess

By YUAN SHENGGAO

In China, the association between the Great Wall and women has always been one tinged with a pathos of tragedy, as the ancient defensive works were sometimes the battlegrounds that could lead to the death of their loved ones.

As seen in the legend of Meng Jiangnyu, a woman who saw the collapse of a section of the Great Wall through her tears and curses.

But there is another story of a woman who devoted much of her energy to protecting the Great Wall and safeguarding the nation, making the section of wall she was stationed a household name among Chinese people.

The woman is Princess Pingyang, the third daughter of Li Yuan, the founding emperor of the Tang Dynasty (618-907), and the section of the Great Wall named after her is called Niangziguan Pass, or Female General's Pass.

The pass is an important Great Wall fortress located in the Taihang Mountains in the northeast of Pingding county in Shanxi province.

Niangziguan Pass, controlling an important passage between

Shanxi and its neighboring Hebei province, was a strategic stronghold in times of conflict and thus is a silent witness to many wars throughout history.

Built against rising cliffs on one side and facing a deep chasm on the other, Niangziguan Pass holds such a strategic position that is said to be impassable even to an army of 10,000. It is among the nine most famous fortresses along the Great Wall.

But for a certain period of time, this strategically important fortress was managed by the female general Pingyang, who did an even better job than her male colleagues, according to the history books in Pingding county.

The existing fortress and the Great Wall were built in 1542 during the Ming Dynasty (1368-1644) by the famed general Qi Jiguang, with two gate towers and a 500-meter wall that remain intact.

To memorialize Princess Pingyang, a statue of the female general was built at the southern gate of the fortress. Behind the statue was a watch tower called "the Tower of Veteran Generals".

To the southwest of the fortress is a village also called Niangzi-



Niangziguan Pass in the county of Pingding is an important fortress on the Great Wall. WU TAO / FOR CHINA DAILY

guan. Villagers there said they are mostly the offspring of the soldiers stationed in the fortress centuries ago.

The village was built along a stream called Taohe. Most of the houses there were built with stone, with many having a history of more than 100 years.

The streets, paved with cobblestones, can lead tourists to the Great Wall and the pass, as well as the meandering stream. Such a layout has made the best use of the mountains, the Great Wall and the stream, giving tourists an experience combining the features of a

typical riverside town in the south of China and a frontier settlement in the north.

A small reservoir has been built on the Taohe Stream, forming a pond of about 8,000 square meters. With reflections of the mountains, the Great Wall and the fortress, the western bank of the pond is an ideal site for tourists to take pictures.

Niangziguan Pass was included on the list for the protection of Shanxi's cultural heritage sites in 1986.

Wang Pei contributed to this story.

Environmental protection taxes drive companies toward greener future

By YUAN SHENGGAO

Shanxi's taxation authorities are using taxes as a tool to guide environmentally friendly and high-quality development in the North China province.

Statistics from the Shanxi Taxation Administration show that the province collected 1.13 billion yuan (\$177.8 million) in environmental protection tax during the first 10 months of this year, decreasing 7.87 percent from the same period in 2020. The water resource tax collected reached 4.44 billion yuan during the same period, growing 16.94 percent year-on-year.

Officials at the administration said environmental protection tax and resources tax are the major means that the taxation authorities use to guide environmentally friendly and resource-conserving growth.

The two tax items are correlated with each other, according to the officials. Rising costs resulting from the resources tax can drive enterprises to improve their efficiency and economy in using resources, and therefore reduce discharges and emissions.

Shanxi began to levy environmental protection tax in January 2018 and resources tax in September 2020.

"The growth rate of levied water resources tax began to drop one year after it was announced," a provincial taxation administration said. "We are expecting a decrease in this tax collection in the near future, as the drop in environmental protection tax signals a downward trend."

The drop is also a result of

enterprises' willingness to reduce discharges and emissions as the amounts serve as a basis for the amount of tax collected, officials said.

In addition, enterprises that perform well in environmental protection and resources conservation can enjoy tax reductions or even exemption. This is another reason for the drop in environmental protection tax collected this year.

Dongxin Machinery, based in the city of Houma, for instance, is one of the beneficiaries of the tax system.

"In the past, our company was the subject of frequent measures including halts of operations and fines as a result of our inability to meet environmental requirements," said Yang Shengjie, an executive of the company. "So it was very difficult for us to make profits."

He said the company began to see changes in 2018 after it invested more than 40 million yuan to upgrade its facilities for cleaner and higher-efficiency production.

"We have seen a steady decrease in paid environmental tax over the past three years and we were finally removed from the list of heavy-polluting enterprises," Yang said.

The executive said its business revenue reached a record high of 160 million yuan in the first three quarters of this year. Its profit surpassed 10 million yuan, increasing more than 100 percent from the same period last year, according to Yang.

Ren Zhixia contributed to this story.



Staff members serve a business representative at a taxation office in the Shanxi Transformation and Comprehensive Reform Demonstration Zone. REN ZHIXIA / FOR CHINA DAILY

Mining operations receive innovative upgrades

By YUAN SHENGGAO

Open-pit mining might be the safest and simplest way of coal mining. However, there are still challenges for operators to overcome.

Industry insiders say one of the challenges is to refill the pit after the coal resource is depleted to repair the damage to the environment.

But the depletion of resources doesn't mean all the coal in the mines is extracted. For the stability of the coal mine, a certain amount of coal should be kept to form terrace slopes to prevent the collapse of pit walls.

But the latest results of a pit-slope coal mining research program conducted by Zhongmei Kegong Energy Technology Development, a Shanxi-based subsidiary of China Coal Technology Engineering Group, are expected to offer a solution to this problem.

The company implemented the research program at the Pingshuo Antaibao Coal Mine in the Shanxi



Workers use advanced mining equipment to extract coal from an open pit at the Pingshuo Antaibao Coal Mine. ZHANG YI / FOR CHINA DAILY

city of Shuozhou, one of the largest among the 400-plus open-pit coal mines in China.

The company's executives said the technological solutions it offers include geomechanics-based tests and appraisals,

unmanned tunnel boring and reinforced coal column supporting.

The solution also features intelligent and fully automated coal stripping, which can substantially improve operational safety while increasing efficiency.

To prevent the pollution of air from coal dust and coal-bed methane, automated gas recovery and air-cleaning techniques are also part of the company's solutions.

The company's research report shows that, the pit-slope coal extraction volume at the various mining sites in Pingshuo Antaibao can reach 800,000 metric tons a year.

Company executives said these new solutions are made in response to the requirement of Shanxi's energy revolution strategy, which features increasing the ratio of new energy resources, improving efficiency and reducing the environmental footprint of the conventional coal-mining industry through technological innovations.

Statistics from the Shanxi Energy Administration show that a total of 157 million tons of outdated coal-mining capacity was phased out during the past five years, while more than 68 percent of the remaining capacity has been upgraded to advanced levels.

Zhang Yi contributed to this story.