

## TITLE: LOW-CARBON UTILISATION OF BULK SOLID WASTE THROUGH TECHNOLOGY INNOVATION IN XUZHOU

### ISSUE AREAS

- ICT and SMART technology
- Sustainable mobility
- Land use and nature-based solutions
- Clean energy
- Sustainable solid waste management
- Building energy efficiency
- Innovative urban governance
- Low carbon consumption

### OVERVIEW

The Project of Low-Carbon Utilisation of Bulk Solid Waste in Xuzhou was initiated and designed as a demonstration project of green, low-carbon and sustainable utilisation of bulk solid waste, jointly by Jiangsu Zhenfeng Environmental Protection Group and Chinese Academy of Sciences. Through this project, the innovative synergistic disposal system for bulk solid waste (coal gangue, sludge, contaminated soil) had been researched and established, and several technologies such as waste heat power generation and ultra-low air pollutant emissions had been showcased to address the challenge of bulk solid waste treatment and utilisation in low-carbon approaches. The project holds a processing volume of 1.16 million tons of coal gangue, 520,000 tons of contaminated soil, 420,000 tons of industrial sludge, and 3.9 million tons of river bottom sludge; and will generate 80 million kWh of power from waste heat.

### THE CHALLENGE - WHY HAS THE CITY TAKEN ACTION

**Heavy pollution caused by accumulated bulk solid waste:** Xuzhou has been one of China's main coal production bases for more than 130 years. In the process of coal mining, a large amount of coal gangue has been generated, for instance 2.3 million tons in 2019. Heavy pollutions in atmosphere, water and soil will be caused and public health be harmed if solid waste is not properly collected, treated and disposed of.

**Necessity for resource conservation and utilisation by low-carbon technologies:** Bulk solid waste is of great value in terms of being utilised as raw materials for industrial manufacturing or as fuel resources for power generation. The traditional approach to treat solid waste (coal gangue, sludge, contaminated soil) separately is energy-intensive and highly polluting, such as producing sintered bricks from coal gangue, sludge dehydration, drying or incineration, and thermal desorption of contaminated soil. It is essential to develop a synergistic treatment and utilisation system for bulk solid waste (coal gangue, sludge, contaminated soil) through technology innovation.

### GOALS AND OBJECTIVES

- To demonstrate an innovative synergistic treatment and utilisation system for bulk solid waste (coal gangue, sludge, contaminated soil) as a solution to the challenge of bulk solid waste treatment
- To reduce energy consumption and greenhouse gas emissions caused by traditional solid waste utilisation technology
- To enhance resource conservation and recycling through circular economy

### HOW DID STI PROVIDE A LOW CARBON AND CLIMATE RESILIENT SOLUTION?

(STI as a means of implementation)

- Improved decision making
- Offering a low-cost solution
- Inclusive decision making

- Improved governance  Behavioural change

(STI as a direct technical solution)

- Cleaner/more eco-friendly infrastructure  Cleaner/more eco-friendly equipment
- Faster/better/larger data availability/processing

- How was it innovative? (What enabling policies were employed? What were the local/national governments policy targets, goals and strategies? Were new S&T approaches developed or existing S&T approaches enhanced? Was the cities geography/culture capitalised upon?)

**Enabling policies:** “National Law on the Prevention and Control of Environmental Pollution by Solid Waste”, “Regulations on Comprehensive Utilization of Coal Gangue” by Chinese Central Government; "Thirteenth Five-Year" Circular Economy Development Plan and “Implementation Plan for Piloting ‘Zero-Waste City’ in Xuzhou” by Xuzhou Municipal Government, which all stressed the task to improve the capacity of industrial solid waste processing and enhance the level of solid waste utilising as resources.

**New S&T approaches developed:** The new synergistic treatment and utilisation for bulk solid waste (coal gangue, sludge, contaminated soil) is developed, in which the coal gangue, sludge and contaminated soil is co-processed and further utilised as raw material to manufacture sintered bricks. The whole calcination process only relies on the energy from autoignition of coal gangue, instead of supplied energy from coal firing, therefore saved a lot of energy. Meanwhile, advanced facilities for emission reduction have been installed, such as dust removal, desulfurization, denitrification, VOCs treatment, flue gas treatment, as well as online monitoring, to ensure that the emission meets air quality standards.

- What science and technologies were used? (What does it do? How does it work? How does it address the challenge?)

**Environmental risk control technology for centralized hazardous waste disposal facilities:** This technology was developed to guide the operation of hazardous waste disposal facilities, consequently reducing the systemic environmental risks of the operation of these facilities.

**Solidification and stabilization technology for contaminated soil:** This technology was developed to pre-treat heavy metal pollutants in the contaminated soil so that the soil can meet the standards of being used as a raw material to manufacture sintered bricks to prevent secondary pollution.

**Low-temperature plasma coupling technology for industrial waste gas treatment:** The technology was developed to remove unconventional air pollutants (mercury and dioxins) from industrial waste gas effectively and economically. It solves the problem that the activated carbon adsorption material not only has a small adsorption capacity but also is difficult to regenerate and harmful to dispose of as hazardous waste.

## KEY AREAS OF CONSTRAINT/SUPPORT

- o INFRASTRUCTURE REQUIREMENT

Two new production lines to manufacture sintered bricks from bulk solid waste (coal gangue, sludge, contaminated soil) are to be set up, equipped with a set of waste heat power generation system, as the waste heat power generation can be operated around the clock while one of the brick production lines is in maintenance.

o POLICIES AND REGULATIONS

“National Law on the Prevention and Control of Environmental Pollution by Solid Waste”, “Regulations on Comprehensive Utilization of Coal Gangue” by Chinese Central Government; “Thirteenth Five-Year” Circular Economy Development Plan and “Implementation Plan for Piloting ‘Zero-Waste City’ in Xuzhou” by Xuzhou Municipal Government, which all stressed the task to improve the capacity of industrial solid waste processing and enhance the level of solid waste utilising as resources.

o THE SCALE OF THE PROGRAMME/PROJECT

For Xuzhou city, Geographic area: 11765 km<sup>2</sup>; Inhabitants: 9.0839million; GDP: 732 billion Chinese Yuan (2020 data)<sup>1</sup>

o TECHNOLOGY CAPACITY

The technology is provided by Chinese Academy of Sciences. Major technological breakthroughs include:

Dust-free Pretreatment: all crushing, grinding and mixing are implemented in a fully enclosed semi-underground warehouse, with supporting waste gas collection and treatment facilities;

Unmanned brick-making: fully automatic brick-making, brick-unloading, and packaging production lines are adopted to reduce personnel safety accident rates and improve occupational hygiene;

Full collection of uncontrolled exhaust gas: all production workshops are fully enclosed, the drying process is modified with micro-negative pressure, and uncontrolled exhaust gas is collected;

Intelligent temperature control and waste heat power generation: using the intelligent temperature control system to realize the controllable sintering temperature of the tunnel kiln, and supporting waste heat power generation;

Large-scale co-processing: 2 million tons of approved solid waste, including 420,000 tons of sludge and 520,000 tons of contaminated soil;

High standards for waste gas treatment: dust removal, desulfurization, denitrification, VOCs treatment, dioxin control, flue gas de-whitening, 60-meter high-altitude emission.

All these technologies taken together ensure the highest energy efficiency and lowest waste gas emission for the production process.

o FINANCE

The total investment is 300 million Chinese yuan for two production lines to manufacture sintered bricks from bulk solid waste (coal gangue, sludge, contaminated soil), equipped with a set of waste heat power generation system.

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<sup>1</sup> Xuzhou City Statistical Yearbook 2021

Main Funds are self-raised by the enterprises. Part of the funds will be supported by loans from China Development Bank recommended by the Ministry of Ecology and Environment and the National Development and Reform Commission.

o HUMAN RESOURCE CAPACITY

It is needed for the workforce throughout the production line being trained for intelligent manufacturing, hi-tech operation, inspection and management to ensure the safety and efficiency of the production.

o POLITICAL COMMITMENT

Full support from Xuzhou government: Since this project is a solid waste recycling and reusing project that has helped the city dispose of sludge and contaminated soil, Xuzhou Zhenfeng New Wall Material Co., Ltd. has been included in the “List of Companies Exempted for Xuzhou City’s 2020-2021 Autumn and Winter off-peak Production and Emergency Control for Heavy Pollution Weather. In the period when large-scale air pollution may occur, many companies must reduce or suspend production, but the Xuzhou solid waste project mentioned is exempted from this.

o KEY BENEFICIARIES

The local government and the public/local communities will benefit from the project as it contributes to achieving the energy conservation and emission reduction targets and the improvement of air quality and the living environment. Moreover, the success of this project demonstrated the viability of using these advanced technologies to address the challenge of treat and utilise bulk solid wastes, which can be replicated in similar cities in China and abroad.

## IMPACTS

o CARBON REDUCTIONS

The estimated carbon emission reduction for this demonstration project will be 1.75 million tons per year, including (1) 1.23 million tons from replacing clay with coal gangue to make sintered bricks, porous bricks, and produce new wall materials; (2) 308 thousand tons from utilising the calorific value of coal gangue and power generating from waste heat; (3) 246 thousand tons from technology innovation and energy efficiency improvement of the industrial process for solid waste utilisation.

o CO-BENEFITS

- o National and international recognition and application: proof of successful application of R&D to improve energy efficiency and green solid waste processing can be emulated in China and abroad in places that face similar challenges.
- o Non-renewable resources saved: 2 million tons of clay and shale is saved every year by replacing them with coal gangue to make sintered bricks, porous bricks, and producing new wall materials.
- o 80 million kWh of power generated per year from waste heat and 1 million tons of water saved per year.

- o Jobs have been created and the local economy boosted by the development of circular economy.

## TIMELINE

February 2019 – October 2021 (phase one)

October 2021- December 2022 (phase two)

## FACTORS FOR SUCCESS

This project has demonstrated that with the right political and financial support, this can be a successful model to be replicated in other places for processing. The combination of technologies proved successful to treat and utilise bulk solid waste as a resource for building materials in an approach being energy efficient and waste minimized and controlled.

## LESSONS LEARNED

- Opportunities, Challenges and Scaling Up

The utilization of bulk solid waste has been traditionally known as highly energy intensive, water intensive and polluting. It is urgent to promote technology innovations for low-carbon utilization of bulk solid waste across the field, which will produce enormous carbon reduction benefits.

It is important to test innovative technologies through demonstration projects to build up confidence for enterprises to retrofit industrial kilns by adopting power generation from waste heat and combined heat and power generation.

The investment in related technological retrofit is relatively large, in which green finance can play an important role.

- Sustainability

This project is financially sustainable by itself, developed and operated by Jiangsu Zhenfeng Environmental Protection Group.

- Transferability

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- Efficiency / effectiveness

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- Institutional constraints / supports

It is essential to provide extensive education and training for professional and technical personnel regarding to solid waste treatment and utilisation, intelligent manufacturing and management.

FURTHER INFORMATION / CONTACT

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