



ARCTICGREEN  
ENERGY CORPORATION

# Geothermal District Heating & Cooling in China

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# Arctic Green Energy's JV with China's Sinopec in China in Geothermal District Heating & Cooling



## Arctic Green Energy

- A **renewable energy knowledge** company owned by **Founder, management** and **Singapore's sovereign wealth fund, GIC**
- Focus is on the **global green energy transition** and how **cities are heated and cooled**
- Projects range from **Heating, Cooling & Power to Intelligent Energy Management Systems**
- Operations in **Asia and Europe**

## Sinopec Green Energy

- **Joint Venture** with leading Chinese SOE, **Sinopec**
- Established in 2006 and **profitable since 2009**
- **Market leader in China** both in terms of **market size and technical ability**
- **Exclusive rights** to some of the **most valuable geothermal concessions in China**
- A **national showcase in China for geothermal utilization and exploration**
- Being prepared for an **IPO**



**SINOPEC GREEN ENERGY**

#1	Market share & technical ability in China
60	Million m <sup>2</sup> in connected capacity
320	Million m <sup>2</sup> in additional signed projects
>60	Cities and/or counties with SGE exclusive concessions
>110	Patents registered
724	Wells drilled; average depth 2.2 km
719	Heat centrals in operation
3,5	Million tons of CO <sub>2</sub> saved in 2021
16	Million tons of CO <sub>2</sub> saved, cumulated
46,500	GWth thermal generated
108,000	Tons of SO <sub>x</sub> saved
33,000	Tons of NO <sub>x</sub> saved

# Sinopec Green Energy is Taking Down the Chimneys in China, transitioning Suffering Cities to Breathing Cities

Heating & Cooling Cities represents one of the world's most significant energy challenges

- Half of all energy created is for the generation of heat
- 70% of all energy is consumed by cities
- 85% of heating & cooling cities is generated by burning fossil fuels

## Suffering Cities



100%  
Fossil Fuels

## Breathing Cities



100%  
Renewables

Gradual Change to Renewables By Intelligent Management of Multiple Energy Sources

Coal

- Public Enemy Number 1
- Massive Environmental Damage
- Deteriorating Public Health
- Shortened Public Life Expectancy

Natural Gas

- Transition Energy
- CO<sub>2</sub> 56% < Coal
- Massive CH<sub>4</sub> (Methane) Emissions

Geothermal & Other Renewables

- Zero Emissions
- Renewable
- Baseload
- Price Competitive
- Clear Skies
- Environmental Cleanup
- Improved Public Health
- Extended Public Life Expectancy

# Status and potential of geothermal district heating and cooling in China

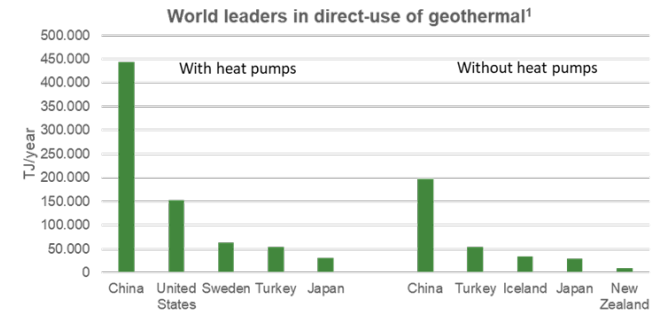


## Potential of Geothermal Heating & Cooling in China

The current size of the market, its growth rate coupled with rapid technical advances and China's massive low- mid temperature geothermal reservoirs make the future of geothermal district heating in China very bright

## Geothermal District Heating in China

- The Geothermal District Heating Industry in China today is about 150 million m<sup>2</sup>, not counting GSHP
- The total size of China's fast growing DH Systems is over 22 billion m<sup>2</sup>
- It is estimated the growth of the DH Systems is 3x the speed of urbanization



District Heating



Well established market, rapid growth

District Cooling



Future expansion market

## Geothermal District Cooling in China

- Still early days
- Eventually much larger market than District Heating
- Data Hosting Centers also present a significant cooling potential for direct use of geothermal

# Trends for geothermal district heating and cooling in China



## Constantly Growing Demand for Geothermal District Heating and Cooling Added

- Continued ever increasing growth for geothermal district heating
- Geothermal district cooling will eventually become a larger market

## Co-Generation/Hybrid Solutions

- Between branches of geothermal, hydrothermal, GSHP and power generation
- Between geothermal and other renewables

## Technical Advances

- More heat energy from less water volume at lower temperature
- Advances in drilling and effects of scale bringing down costs

## Future Developments

- Carbon Trading Credits
- Carbon Sequestration through geothermal reinjection

# Significant geothermal district heating projects in China

## Xiong'an New Area

New deputy capital of China, 100 km SW of Beijing, Construction well underway and will eventually cover 2,000 km<sup>2</sup>

- Sinopec Green Energy has finalized the energy transition for 95% of the original population of the area and is now working on surrounding communities
- Xiong'an will become a global showcase for state-of-the-art harnessing, utilization and management of geothermal resources.
- The pilot project "Rongdong residence resettlement" geothermal accounts for 20%-40% of thermal energy supply with total area of 2million sqm.



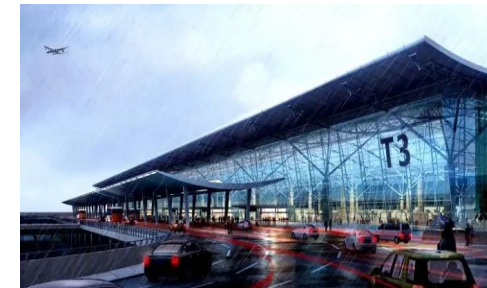
Ancient city of Xiong xian



Future city of Xiong'an

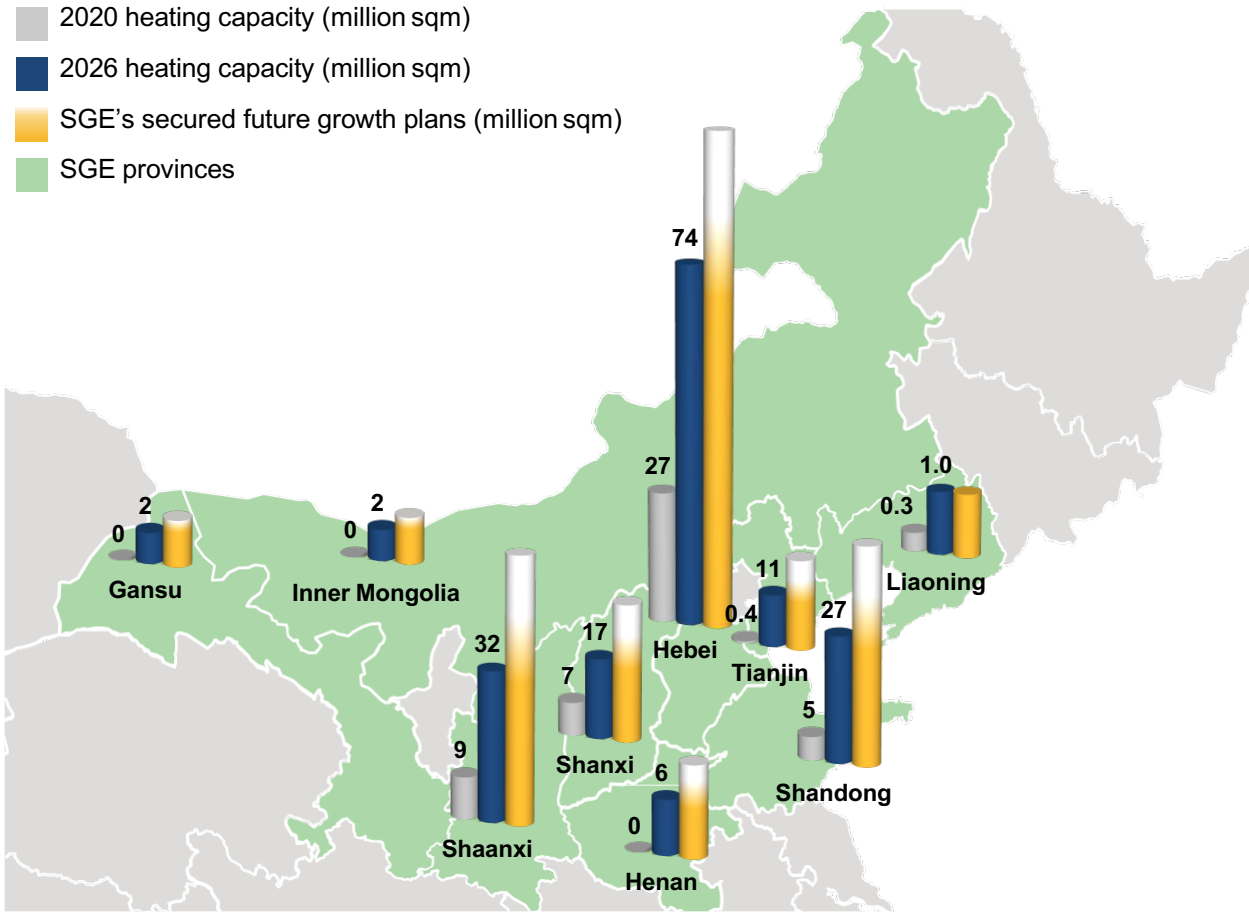
## Xi'an International Airport new Terminal, Shaanxi Province

- China's first International Airport Terminal to be heated by geothermal
- One of the largest airports in the world with associated buildings covering one million m<sup>2</sup> of floorspace



Xi'an International Airport

# Growth in Geothermal district heating across northern China



Source: Company information



Greenhouse farming in Shandong province



Inside Heat Centra ls in Shaanxi province



Cloud based intelligent control system

# Geothermal in China's decarbonization agenda and Gov't policies



China has declared that CO<sub>2</sub> emissions will peak by 2030 and China will be Carbon Neutral by 2060

- Clean heating will play a critical role in China's carbon 30/60 carbon neutrality plan
- Geothermal is the most economic and sustainable solution in clean heating and this has been proven on a massive scale
- While geothermal is still a small part of the overall picture it is expected to multiply in size in a short time

The Chinese government is speeding up legislation and policies in relation to geothermal.

Since early 2021, Chinese government issued series notice and guidance in promoting use of geothermal. Geothermal was widely discussed at National Congress earlier this year:

- **Chinese government's "Agenda to 14th 5-year plan and 2035 long term vision"** indicates that non-fossil energy consumption will account for 20% of total energy consumption".
- **Chinese National Energy Authority** has issued **"Guidance on promoting geothermal"**
- **National Administration of Public Affairs** issued notice to promote use of geothermal to government office buildings.
- **Chinese State Council** published **"Guidance in establishing green low-carbon circular economy system"**, geothermal is included as an important part of the green energy transition
- Authorities are shutting down geothermal wells that do not meet environmental standards, such as reinjection



## 1. - Lack of Knowledge of Geothermal

Still relatively low knowledge level amongst municipal and national energy planners

- We are constantly educating decision and policy makers
- We have established a UNSECO University Level Geothermal Training Program in China for capacity training

## 2. - Regulatory & Tax Challenges

- China's regulatory framework as still not fully embraced the renewable nature of geothermal energy with production and reinjection wells and there is still tendency to treat geothermal as a mining industry with a finite resource.

## 3. - Myths and Competitor Undermining

- Undermining of the geothermal industry by stakeholders of fossil fuel-based heating solutions
- Myths like harnessing of low temperature geothermal with re-injection will damage ground water or cause earthquakes are common misinformation spread by competitors.

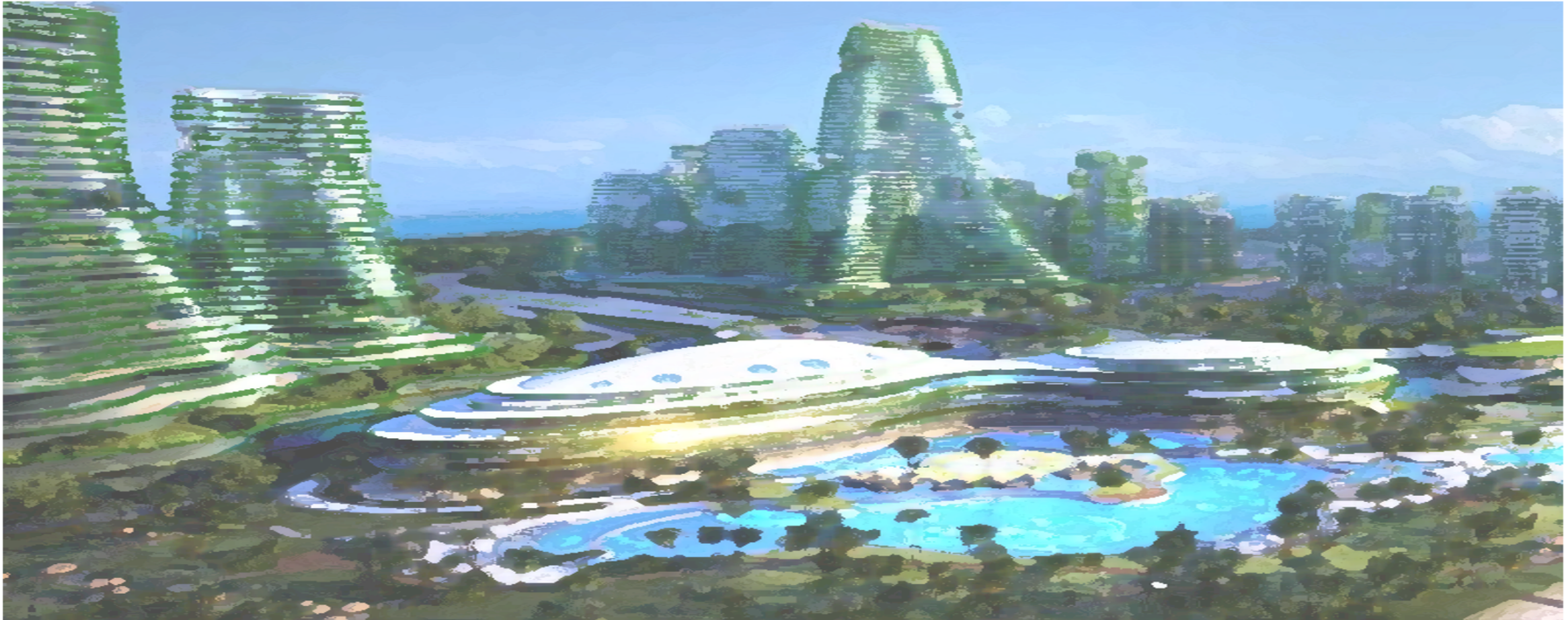
## How to Respond?

- Science and factful approach are taken quite seriously in China so we constantly try to educate the public and the policy makers that there is a renewable, baseload and more profitable alternative to the fossil fuels when it comes to heating and cooling cities

# The Healthy, Living, Breathing Cities

## The Cities of Tomorrow

- Will have **dual energy systems with multiple renewable energy inputs**, highly synchronised, **one carries electricity,  $MW_e$**  and the other carries **water,  $MW_{th}$**  (heating & cooling).
- **Any future renewable energy system will need a baseload backbone**; geothermal is the only baseload renewable energy source that is baseload.
- How cities are **heated and cooled** will lead the march to global **decarbonisation, carbon neutrality** and ultimately **carbon positivity**.





# Thank You

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