



ARCTICGREEN

**ZERO EMISSION CITIES**

Belgrade Serbia  
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- Arctic Green Energy
- Geothermal in Europe
- Hungary Role Story
- Serbia Opportunities
- Geothermal Milestones

- Arctic Green Energy was founded in 2010 and is a leading developer and operator of green energy projects, with a focus on geothermal district cooling and heating
- AGE's innovative capabilities and proven experience have been developed in Iceland, a global leader in the geothermal industry where geothermal provides 100% of country's space heating and ~35% of electricity generation
- AGE's largest portfolio company is Sinopec Green Energy a JV with China's Sinopec Group. Sinopec is a Chinese State Owned Oil and Gas Company and the 3<sup>rd</sup> largest company in the world by revenue
- AGE's group of companies are the world's largest geothermal district heating company with >700 employees, having built 508 heat centrals and drilled close to 600 wells across ~50 cities in Asia
- Leading technology and innovative capabilities – introduced large scale re-injection into China, introduced cascading use of geothermal brine, >50 patents registered

50 million m<sup>2</sup> geoDH capacity

A drop in the ocean

60 cities and counties

Including some of the most valuable geothermal potential cities in China

7,500,000 tons of CO<sub>2</sub> saved

Country of Sweden estimates its total carbon savings 1990 – 2013 amounted to 16 million tons

4.1 GW<sub>th</sub> generated

About same as all of EU GW<sub>th</sub> combined from geothermal

15 MW<sub>e</sub> generated

Generally 15 MW<sub>e</sub> can serve a city of 30,000 people

>50 patents registered

Including highly valuable re-injection patents

610 wells drilled

On the average the wells are 2,2 km deep. The deepest one is 3.8 km deep

508 heat centrals

Each heat central is a heat exchange station that serves a neighborhood

The management of Arctic Green Energy has been leading the development of:

- SGE China, 4 GWth, the largest geothermal heating operation worldwide
- Hellisheidi Power Plant, 305 MW and 400 MWth, the largest geothermal power plant worldwide
- Sorik Marapi, 240 MW, the second largest power project in Asia
- Tura, 3 MW and 7 MWth, the first geothermal power plant in Central East Europe



## District heating, China

50+ cities with Geothermal Heating Plants  
4100 MWth



## Hellisheiði, Iceland

Geothermal Power Plant, CHP  
303 MW and 400 MWth



## Sorik Marapi, Indonesia

Geothermal Power Plant  
240 MW



## Tura, Hungary

Geothermal Power Plant, CHP  
3 MW and 7 MWth

# Geothermal in Europe

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**How Cities are Heated & Cooled in the 21 Century  
will become a determining factor in the fight  
against Climate Change**

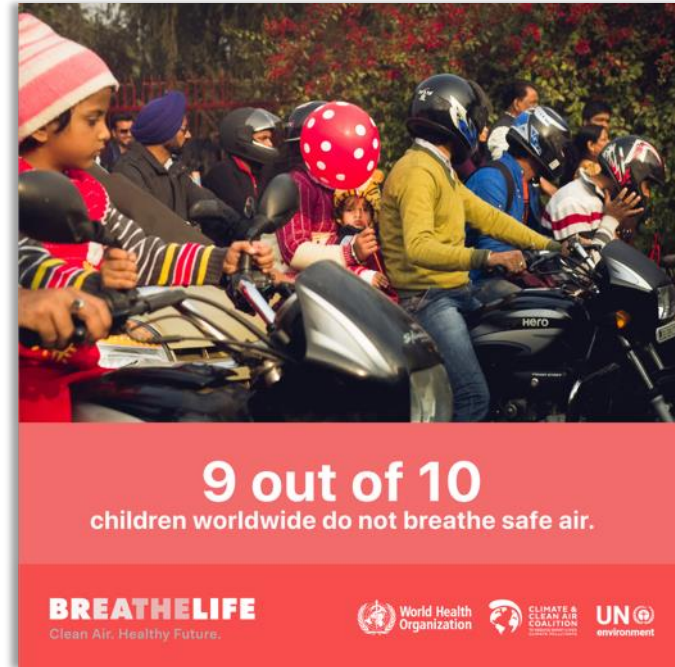
# World Health Organization on Air Pollution



Air pollution was responsible for **7 million** premature deaths in 2016, of these almost **600,000** were children under 5 years old.

**BREATHELIFE**  
Clean Air. Healthy Future.

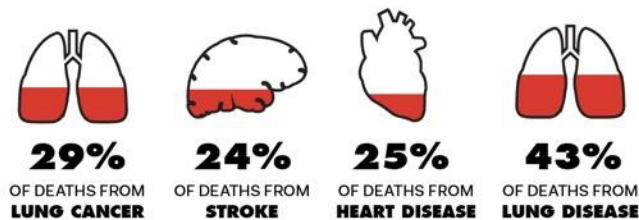
World Health Organization  
CLIMATE & CLEAN AIR COALITION  
UN environment



**9 out of 10** children worldwide do not breathe safe air.

**BREATHELIFE**  
Clean Air. Healthy Future.

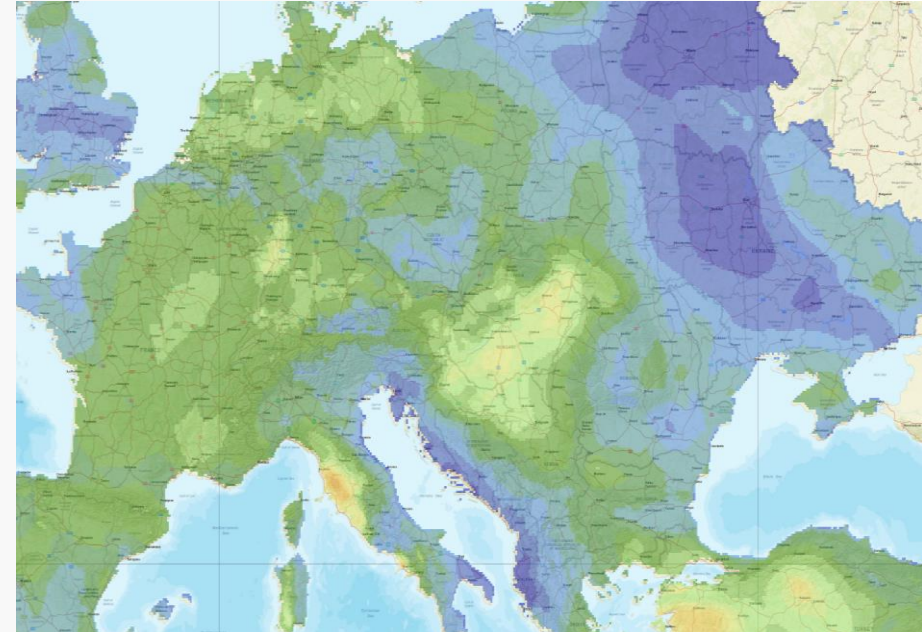
World Health Organization  
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UN environment





# Europe Opportunity

- The population of European countries is close to 500 million
- It has been estimated that 25% of households can be heated pollution free with sustainable geothermal energy.
- Geothermal district heating can be retrofitted into existing systems simply by replacing the energy source. Cost is competitive
- Europe represents a significant opportunity for Arctic Green



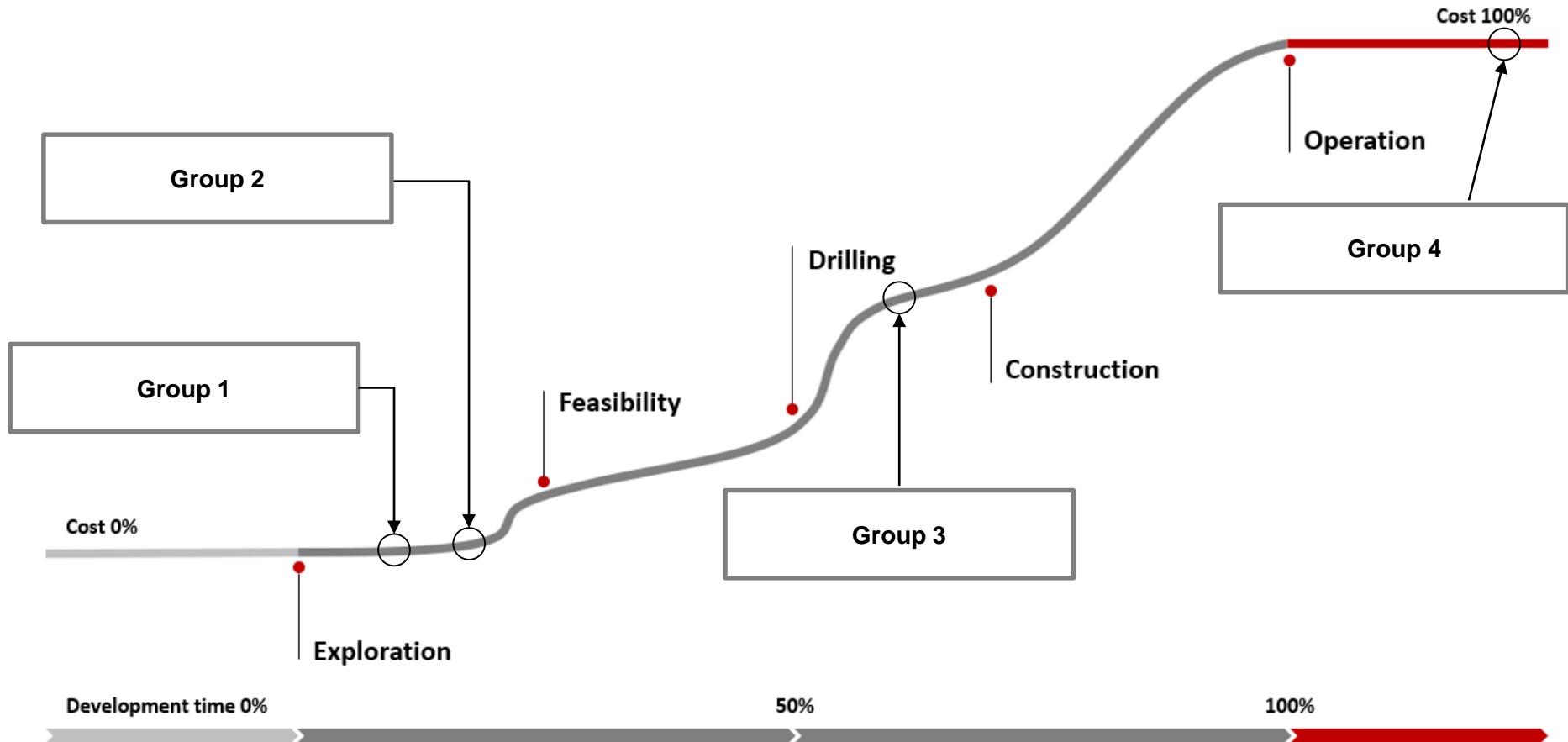


# Europe Geothermal Opportunities



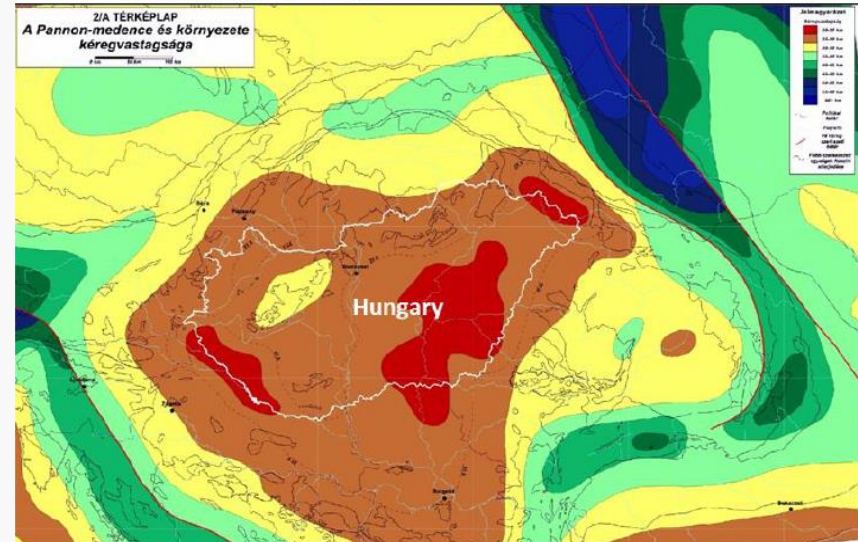
- Geothermal potential in Europe is relatively under-utilized which creates a wide range of opportunities, especially in low to medium temperature areas
- This potential is recognized by many European countries and national governments, including Germany, Hungary and Poland, which have set renewable targets to replace coal, oil and gas heating with geothermal energy
- Energy prices remain high in Europe both for heat and power. Incentives schemes are designed to encourage renewable energy development
- Increased focus on sustainability and reduced emissions have made capital readily available as financial institutions have designated capital for renewable energy development and energy infrastructure
- Geothermal data are available through seismic measurements and old oil- and gas-well data which reduces development risk

# Projects at different levels of development



# Hungary

- Hungary has the highest geothermal potential in Central Europe with temperatures ranging from 80°C to 140°C in only 1500m drilling depths.
- Cost of drilling is low due to plain sandstone layers and generally low construction costs.
- Feed In Tariffs for heat and power provided with geothermal are high and supported by the government



# Tura Geothermal Plant, Hungary, showcase for CHP Plant

- The Tura geothermal heat and power plant is located near Budapest the capital of Hungary
- The project was acquired with existing geothermal wells in the first half of 2016, design and licensing commenced in July 2016, installation in December 2016 and commissioning in September 2017
- The Tura plant is selling electricity to the grid and has a power capacity of 3 MW and thermal capacity of 7 MW<sub>th</sub>
- The total project cost was EUR 10,8 million, including early development and drilling, or around EUR 4,0 million per MW
- The majority of project cost, 70%, was financed by a non recourse project financing facility by Erste Bank Hungary



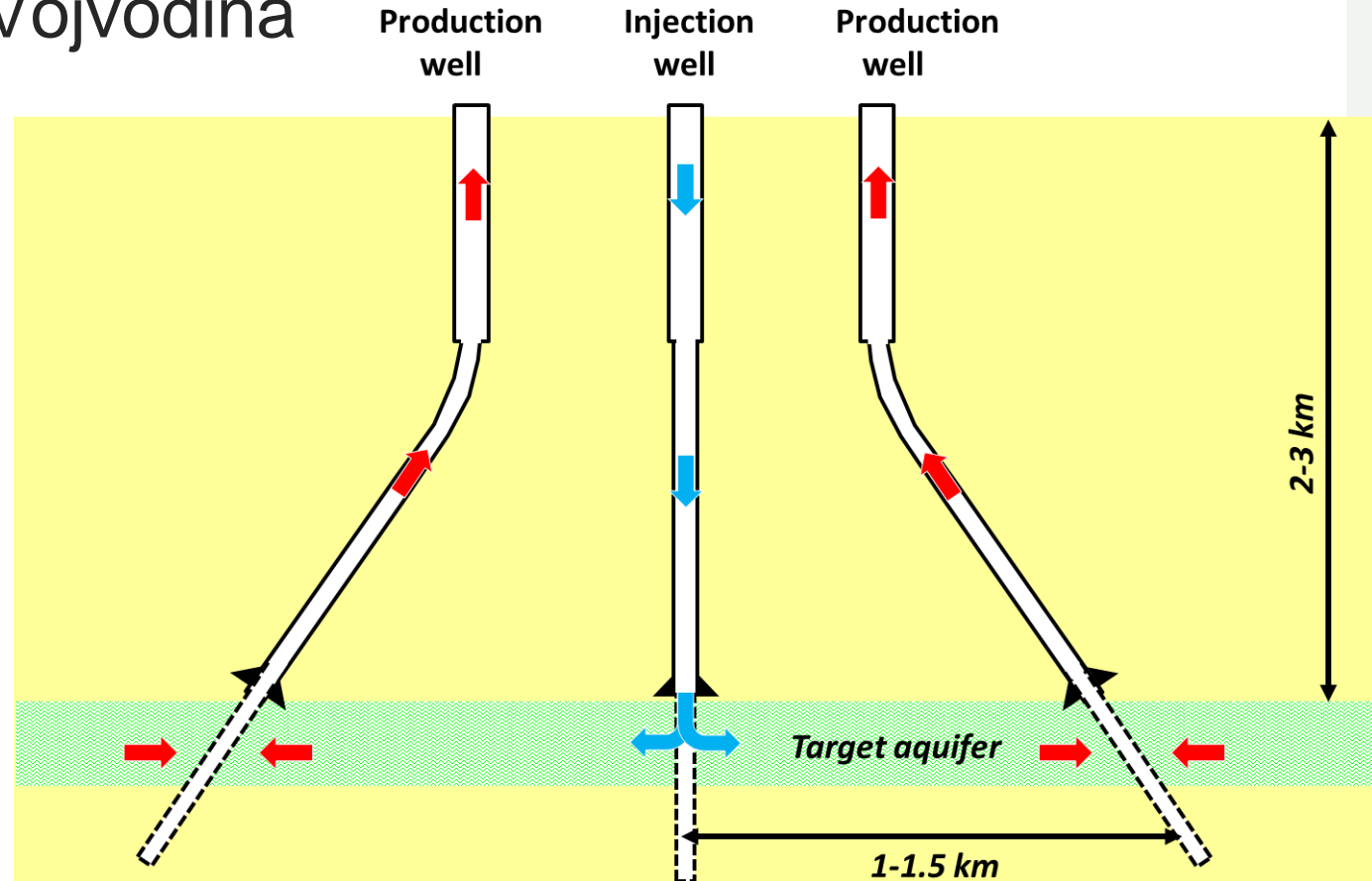
# Serbia

- Pannonian sedimentary basin in Vojvodina, around and north of Novi Sad
- The Vranjska Banja existing field, characterized with vertical faults and a volcanic related geothermal activity



# Well triplet in Vojvodina

- All wells on same pad
- At best extract up to 200 kg/s of 150 °C
- A target aquifer still to be indentified



## Serbia Challenges

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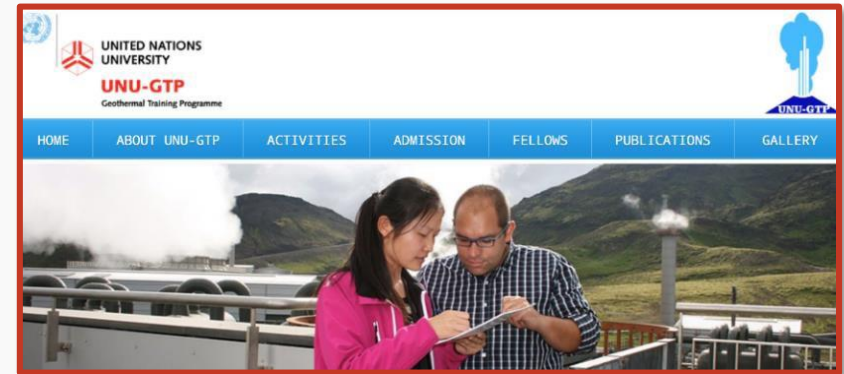
- For Power Production, then Feed In Tariffs are available for some projects.
- For District Heating, the prices are relatively high. Currently the heating is provided with coal-, oil- and gas heating plants partly connected to a distribution network.
- Infrastructure projects needs to be coordinated with the authorities.
- The concession rights in Vovodinia belong to the oil- and gas company NIS.



# The Sino-Icelandic geothermal R&D centre and university

## The Sino Icelandic Geothermal R&D Centre

- A collaboration between Sinopec, Arctic Green Energy and the National Energy Authority of Iceland
- To be domiciled in Xiongan
- Operates commercially, with all profits going towards geothermal R&D, which ultimately benefits SGE and its owners



## The Sino Icelandic Geothermal University

- A collaboration between Sinopec, Arctic Green Energy and the National Energy Authority of Iceland
- Icelandic professors are from the UN Geothermal University in Iceland, under the National Energy Authority, and Arctic Green Energy
- Classes have commenced in November 2019 with 40 students, and are forecasted to grow rapidly to a few hundred students per year from all over Asia
- Facilities and funding have been secured to cover the first semester

# The global energy transition

## The Problem

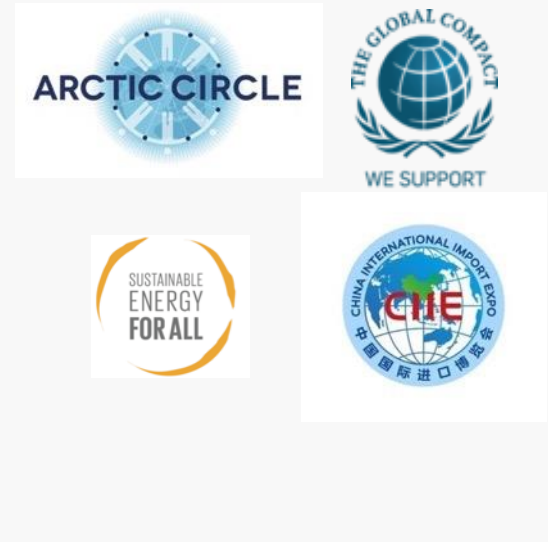
Heating cities is generating massive pollution, environmental damage, and deteriorating public health

## The Solution

GeoDH & GeoDC for heating and cooling cities with co-generation from other renewables

## The Team to Deliver

Exceptional track record as pioneer in large scale profitable geoDH



News and Events > News Releases >  
**ADB Signs Landmark Project with Icelandic, Chinese Venture to Promote Zero-Emissions Heating**

News Release | 22 March 2018 中文

