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Budapest Geothermal Energy Summit:

Geothermal opportunities in district and industrial heating in Hungary

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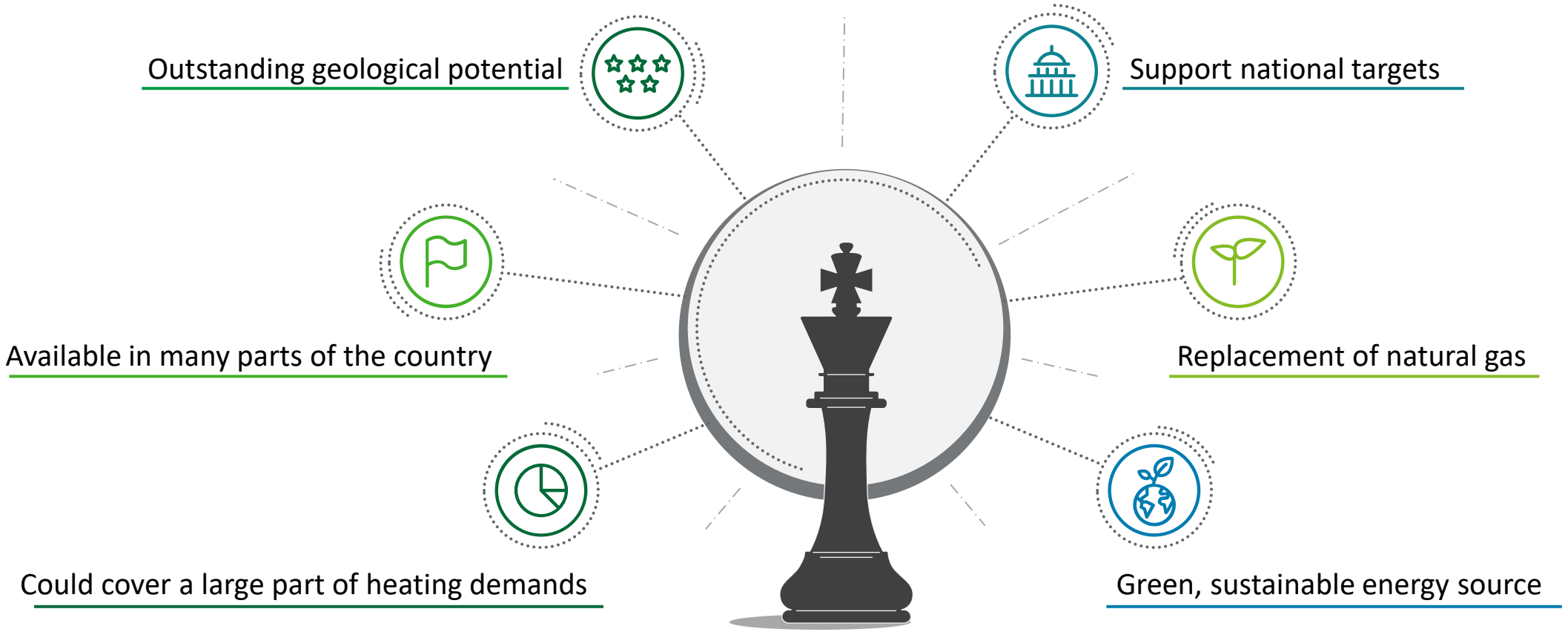
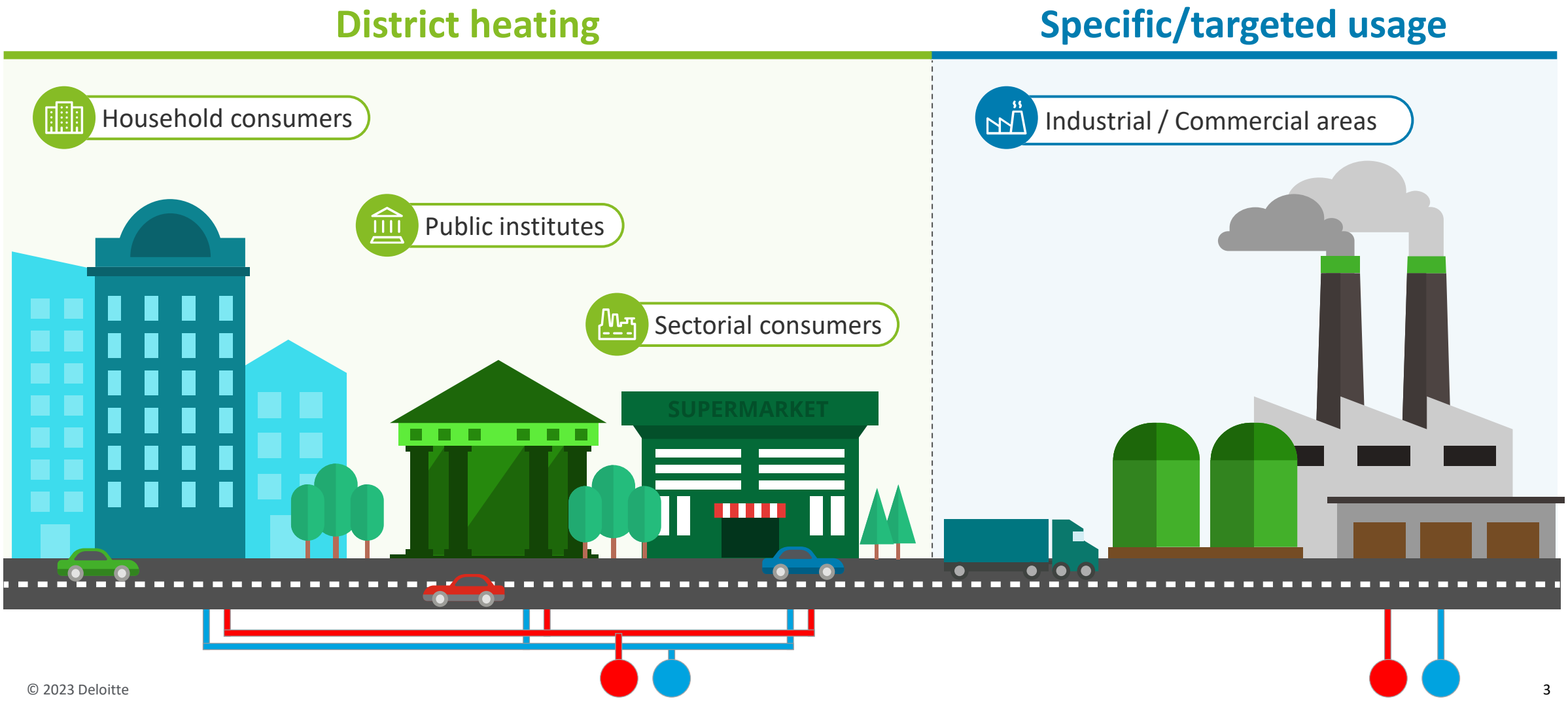
The importance of using geothermal energy

Geothermal developments can contribute meeting national energy targets and some of residential heat demand at a higher level as well as serving industrial energy interests



The potential use of geothermal energy in Hungary

The distribution of geothermal energy for heating purposes can generally be divided into two groups, regulated district heating and individually targeted usage



Overview of the Hungarian district heating system 1/2

The Hungarian district heating system supplies 17% of the country's households with heat and hot water

Towns supplied with district heating

Source: HEPURA: Data of the Hungarian district heating sector 2021

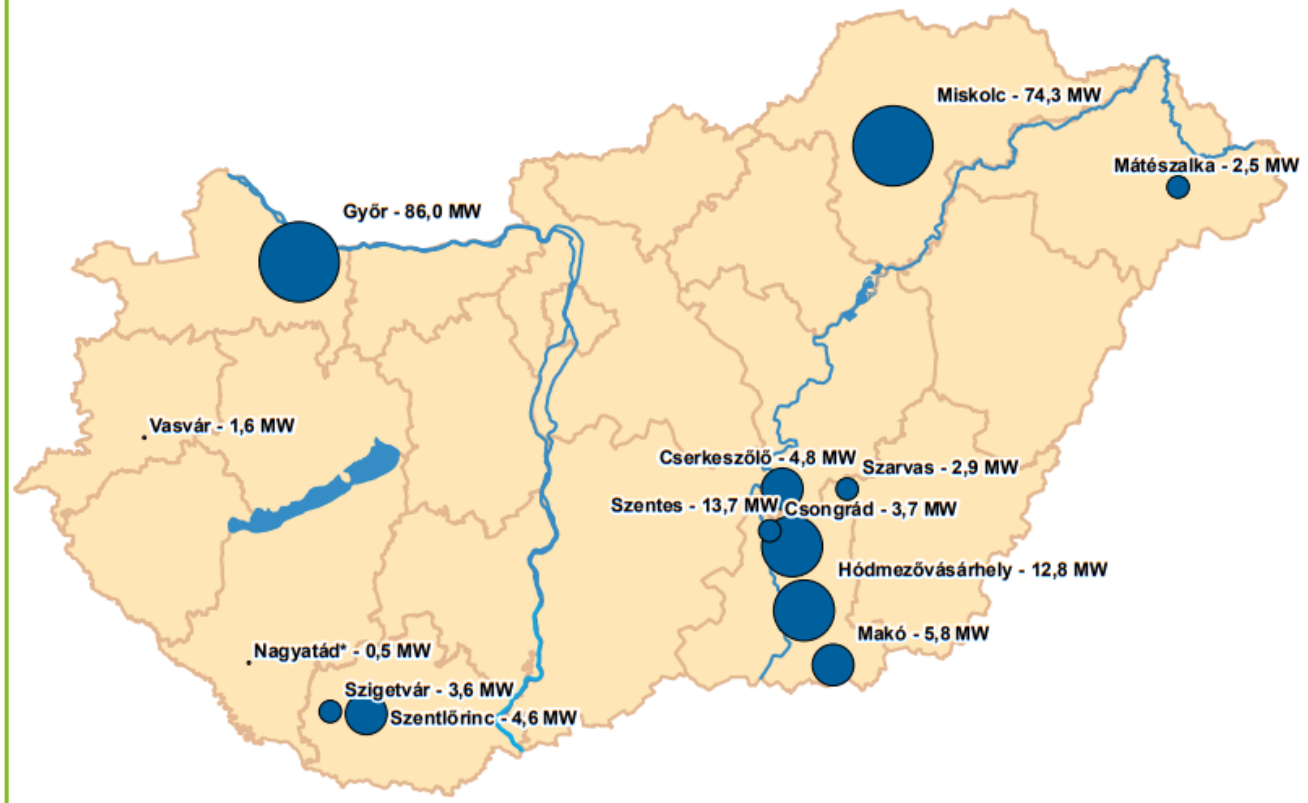
The Hungarian district heating system provides

- 90 towns
- 700 000 households
- (about 17% of the total households)
- highly Budapest-centric
- also concentrated in major towns

Overview of the Hungarian district heating system 2/2

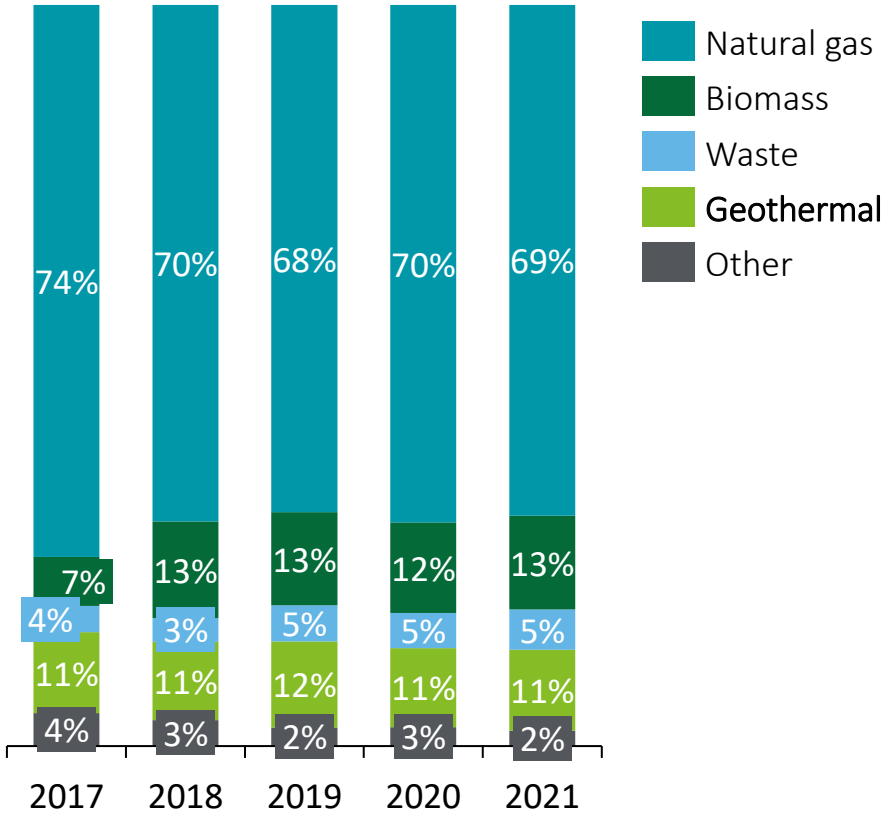
Domestic district heating production relies heavily on natural gas, but there are already good examples for geothermal solutions in district heating

Available heating capacity of geothermal heat producers by towns



Source: HEPURA: Data of the Hungarian district heating sector 2021

Share of energy sources used in heat production



Source: HEPURA: Data of the Hungarian district heating sector 2021

The advantages of district heating and geothermal district heating

The key advantages of geothermal heat generation are the low cost of heat production and the green and sustainable nature of the energy source

Advantages of the district heating

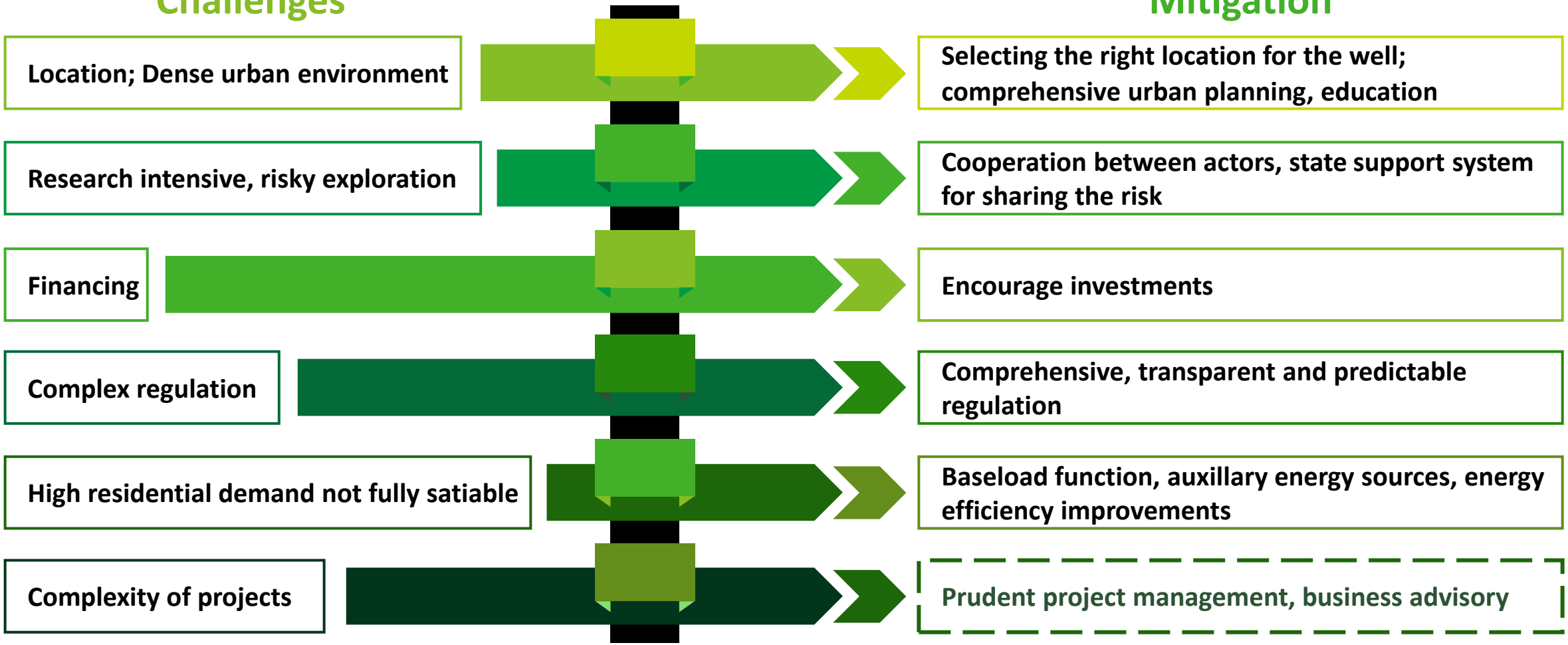
- Community heating solution
- Economies of scale
- Easier to increase the share of renewables
- Comfortable for residential use

Advantages of the geothermal district heating

- Support national strategic targets
- Weather independent
- Low and predictable operating costs
- Safe and predictable energy supply
- Marketable expertise

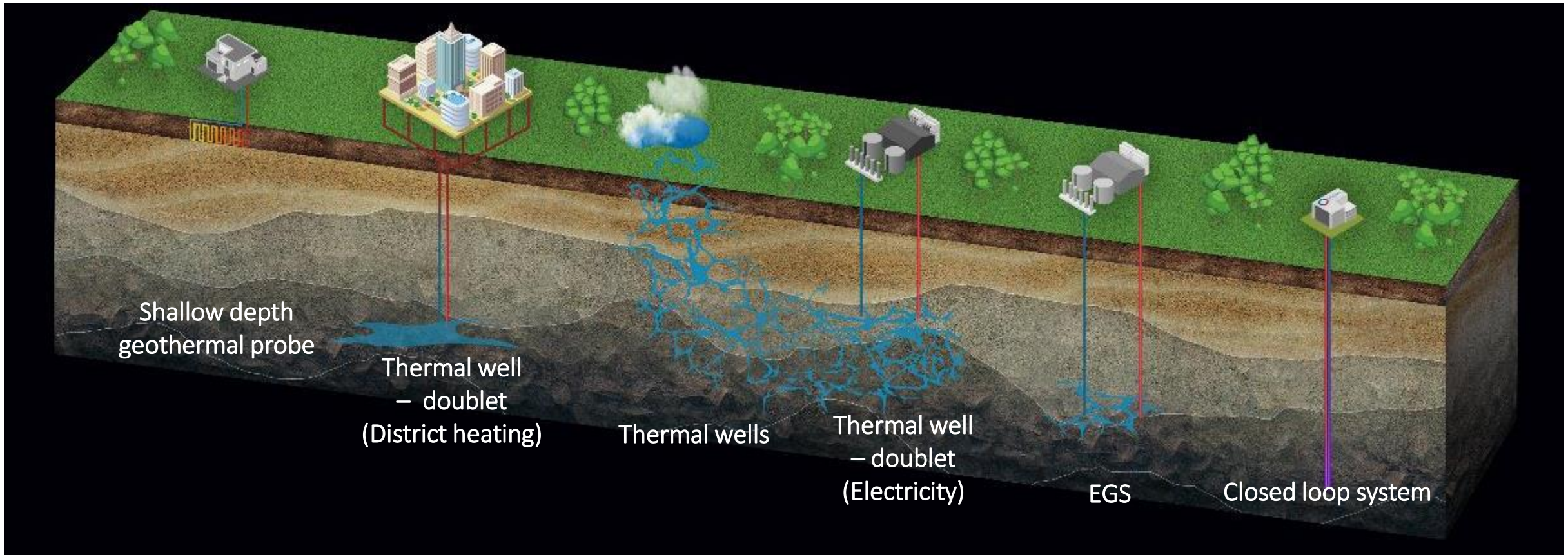
Challenges for geothermal district heating

The main challenge for district heating system is the complexity of development, but when in operation, operating costs of a geothermal power plant are extremely low, and long-term prices are competitive



Targeted use of geothermal energy for industrial / commercial heating

Geothermal energy is not suitable for the production of technological heat, but it can be used to meet other industrial heating needs, with a choice of different solutions, coupled with optimal use



Source: MS Energy Solutions Kft.

The advantages of targeted geothermal industrial / commercial heating

Using geothermal energy for heating creates predictable and affordable costs and contributes to companies' green objectives

Advantages

- Predictable heating costs
- Security of energy supply
- Meeting corporate ESG objectives
- Several technologies are available
- Less regulated than district heating

Challenges

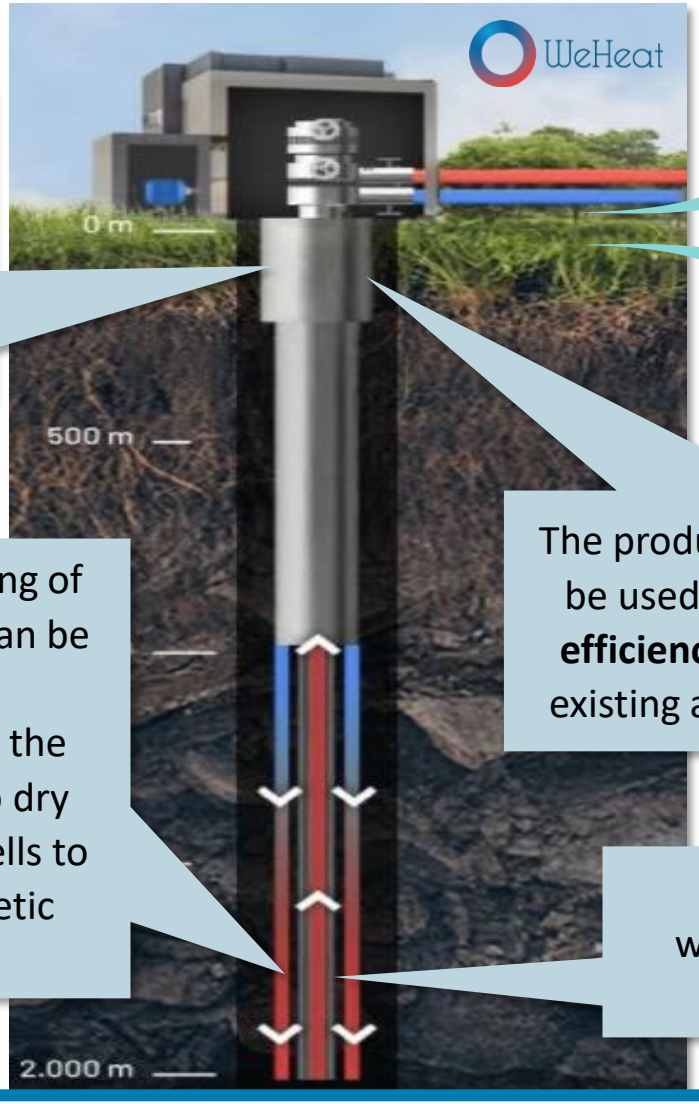
- Financing
- Complex, risky exploration
- Find the right technology solution

Technology fit for purpose

Closed loop system

The WeHEAT technology is a DEEP geothermal probe operated in a fully closed loop system, implemented in the wellbore structure of deep dry holes or specially designed new deep drills

300-900 kW automatic and programmable heating system with modern control, providing green energy without CO2 emissions



Heating of large buildings and industrial halls

Heating of sports facilities and residential parks

Greenhouse heating, agricultural heating

The produced geothermal heat can be used for heating with a **>90% efficiency** and can be adapted to existing and new heating systems.

No need for expensive drilling of new wells, the technology can be installed in existing 1.5-2.5 km idle deep wells, the technology allows for deep dry holes and depleted deep wells to be reused again for energetic purposes.

It is a **fully closed system** with normal water circulation and without extraction of the underground water.

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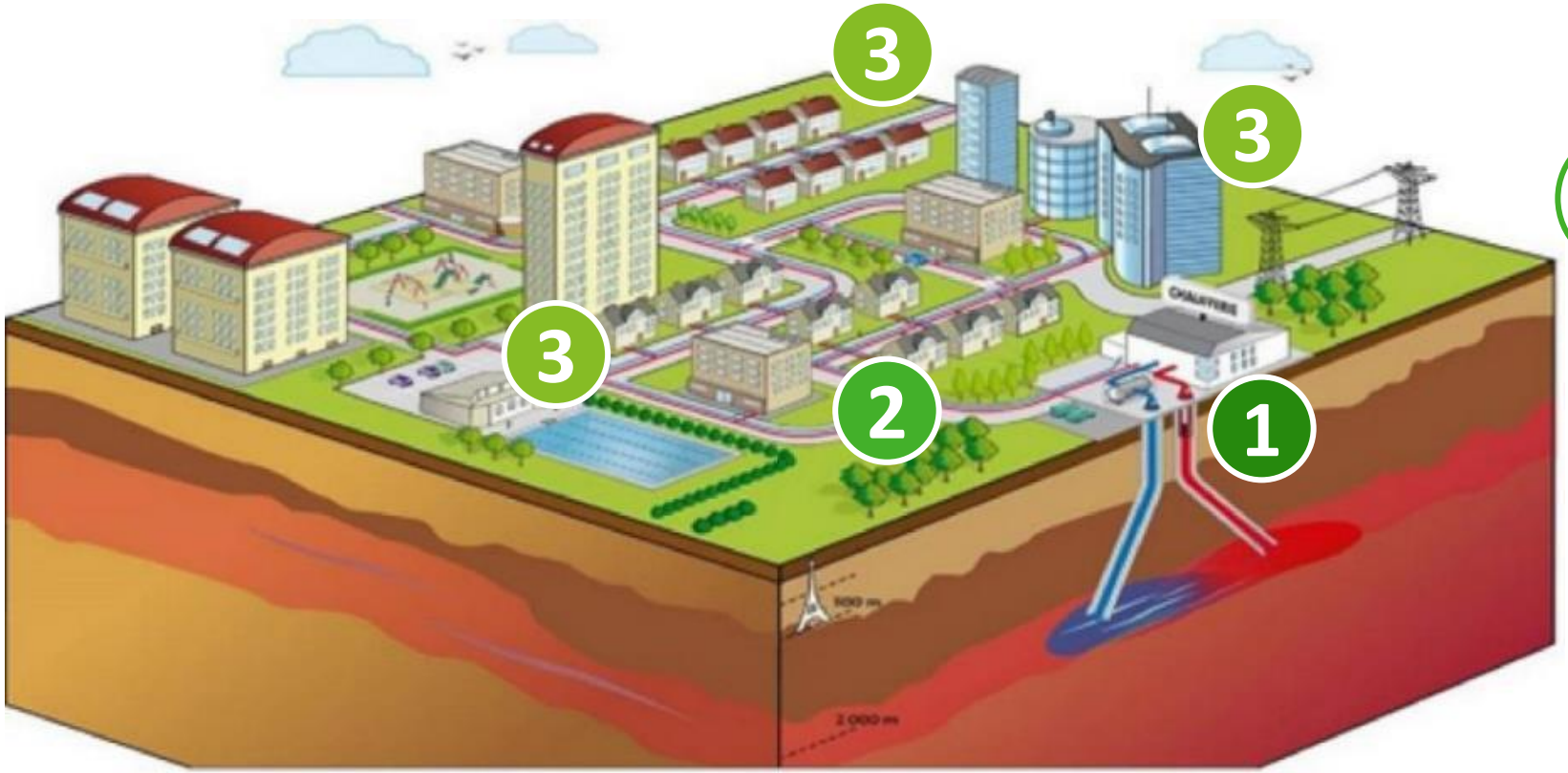
Operating scheme of the geothermal district heating system

Location of production and consumption is key for geothermal district heating supply



1 Heat generation

2 District heat supply

3 Market (heat consumption)

Source: MS Energy Solutions Kft.

Technological options for the use of geothermal energy for heating

Factors \ Technology	Conventional geothermal system (shallow geothermal, thermal water utilization)		Enhanced Geothermal System (EGS)	Closed loop heat circulating system
Unit cost - CAPEX (USD/kW)	1 500 – 2 400 USD/kW (existing well)	4 000 – 4 500 USD/kW (new drills)	1 500 – 4 500 USD/kW (new drills)	700 – 1 000 USD/kW (per existing wellbore)*
System deployment lead time w/o licensing	< 1 year (6-12 months)	> 1 year (18-24 months)	> 1 year (1-3 years)	< 1 month (3-7 days)
OPEX (USD/annum)	Moderate (3 500 – 17 000 USD)		Significant (35 000 – 70 000 USD)	Minimal (150– 200 USD)
Environmental impact	Significant (drilling, water extraction, -treatment, - injection)		Moderate (deep drilling, hydraulic fracking, filling and treatment, closed loop)	None (no drilling, water extraction and usage of hazardous chemicals, closed loop)
Available heat output (MW)	Moderate (1,5 – 4 MW)		High (10-15 MW)	Moderate (0,3 – 0,9 MW)
Administrative procedures, licensing	Mining inspectorate and other authorities		Mining inspectorate and other authorities	Building permitting only
Utilization	Heating (heating and hot water)		Electricity generation and heating	Heating (heating and hot water)
Geological risk (geological probability)	Low	Moderate	High	None