



**GEOHERMICA Initiative & CETPartnership TRI4  
Workshop in Dublin 10/10/2023**

# **Scenarios for Integration of Medium-depth Geothermal in an Evolving District Heating System**

## **Case Study Geneva, Switzerland**

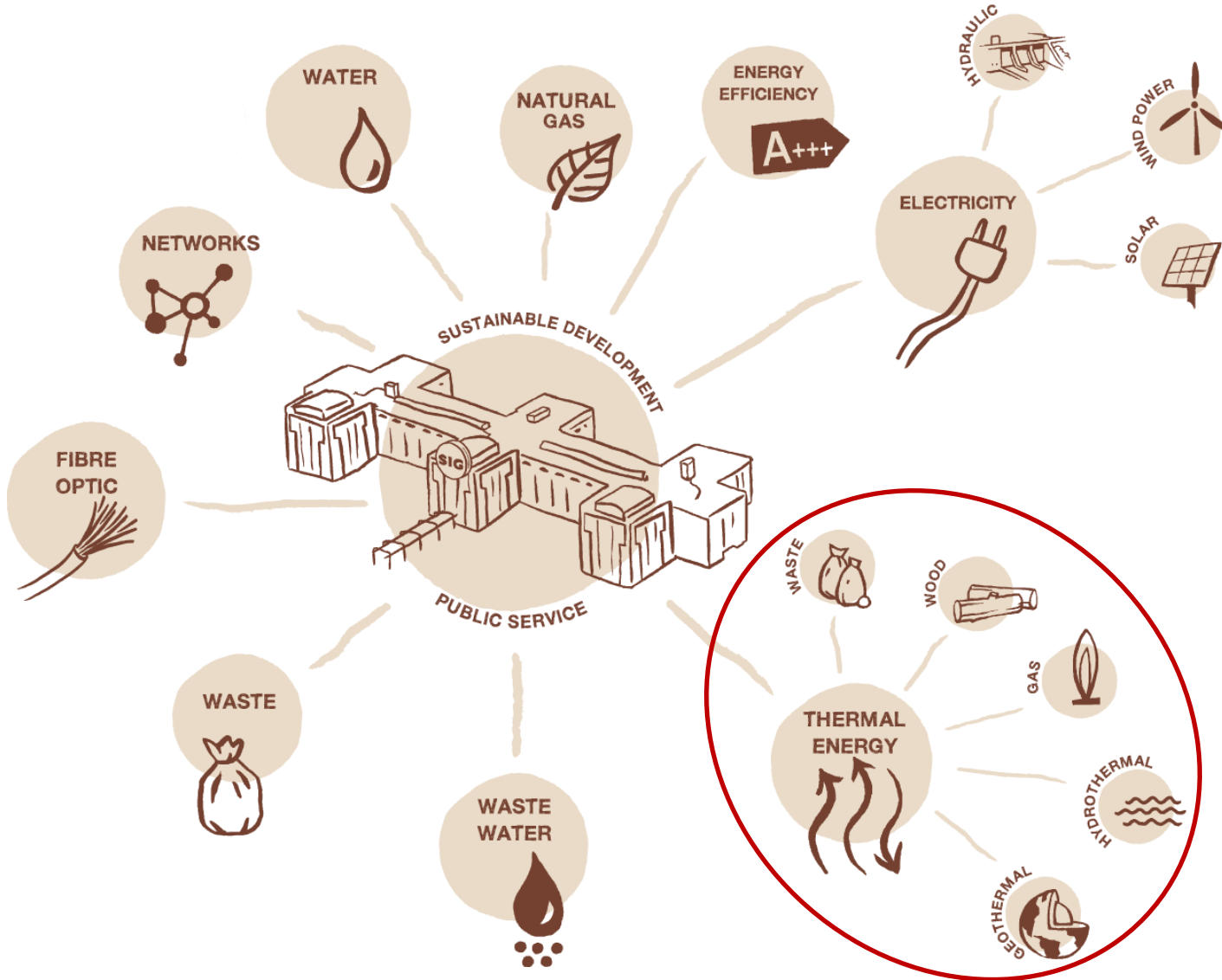
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Services industriels de Genève



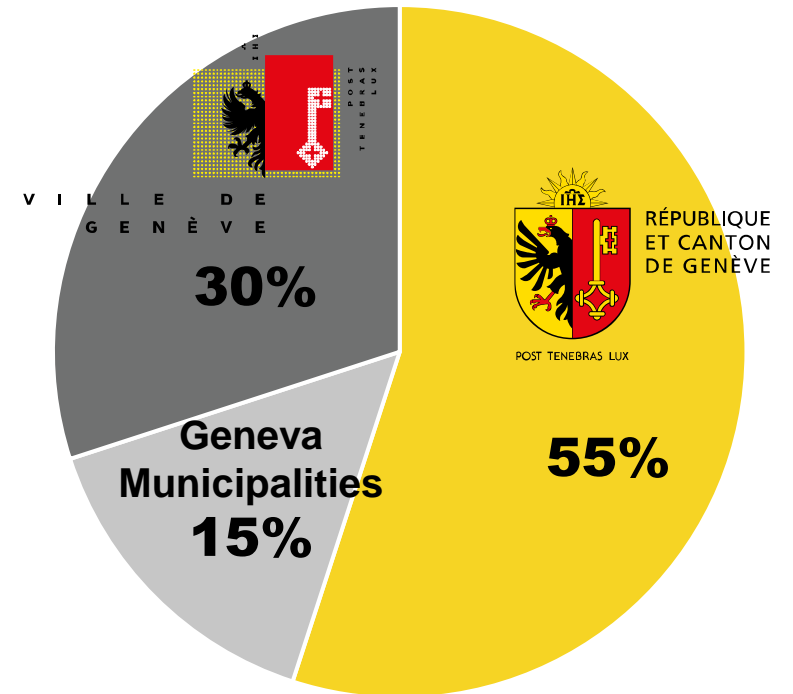
# SIG: Activities and Ownership



## Activities



- ? 100% public company
- ? Capital of CHF 100 million
- ? Owners:



# Canton of Geneva, Switzerland



Population in 2023: 520'000

Area: 282 km<sup>2</sup>

## Final energy consumption in 2018

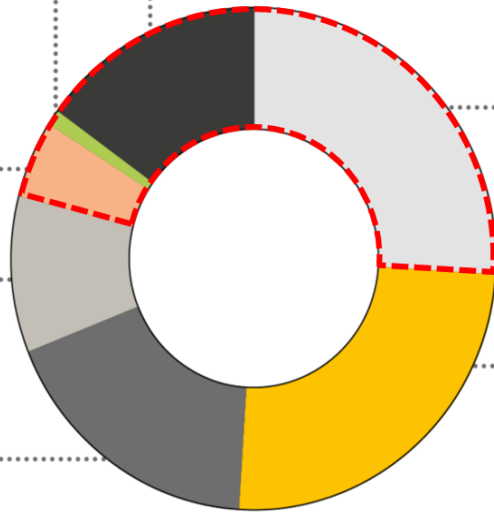
**Almost half of the energy consumed is for heating**

**Biomass, heat pumps and solar**  
127 GWh (1%)

**District heating**  
545 GWh (5%)

**Kerosene**  
1081 GWh (10%)

**Diesel & Gasoline**  
1970 GWh (18%)

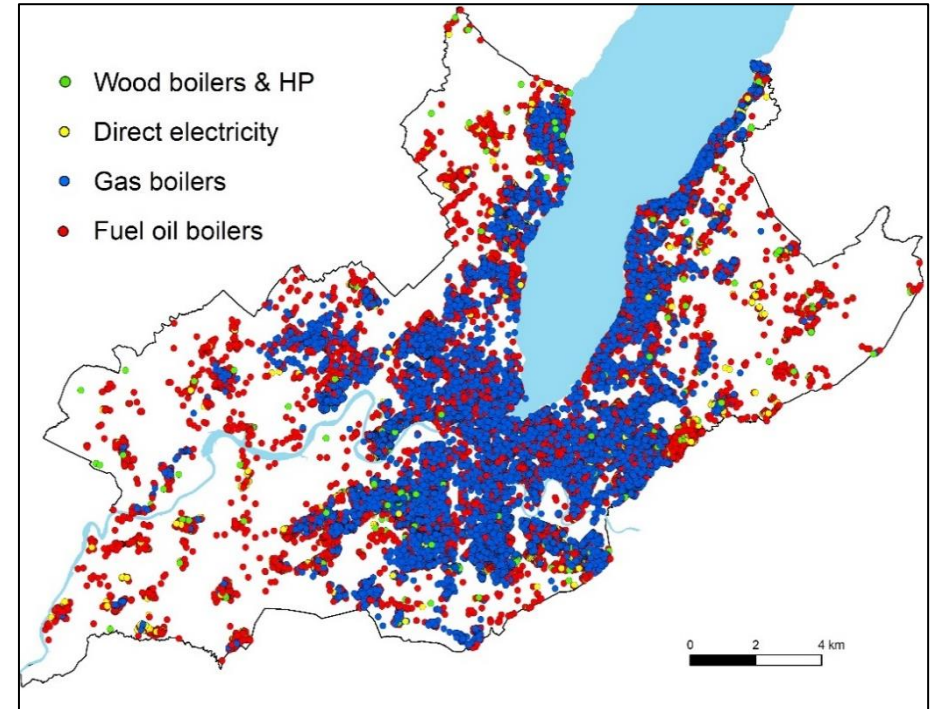


**Fuel oil**  
1665 GWh (15%)

**Natural gas**  
2939 GWh (26%)

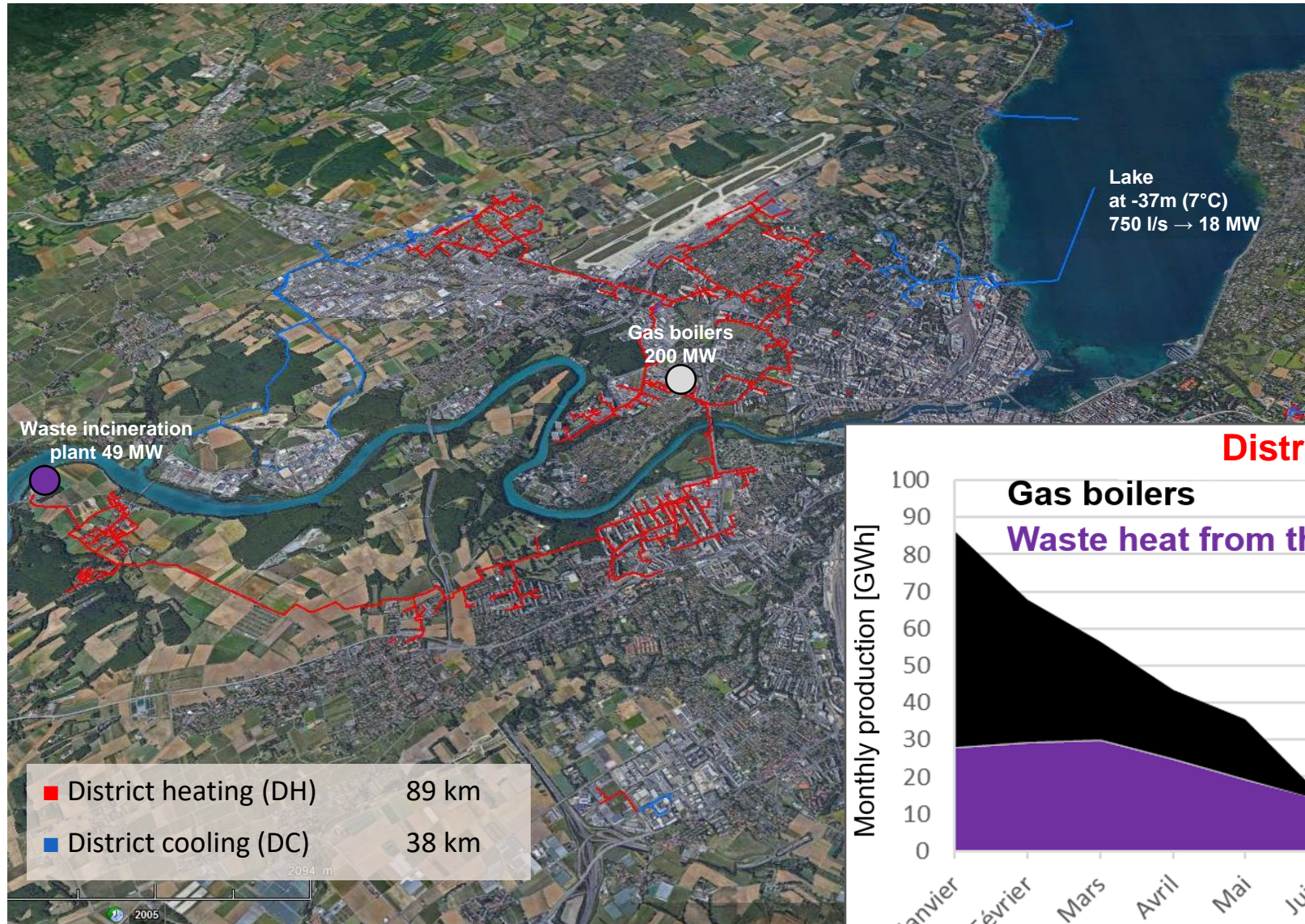
**Electricity**  
2814 GWh (25%)

## Heat supply



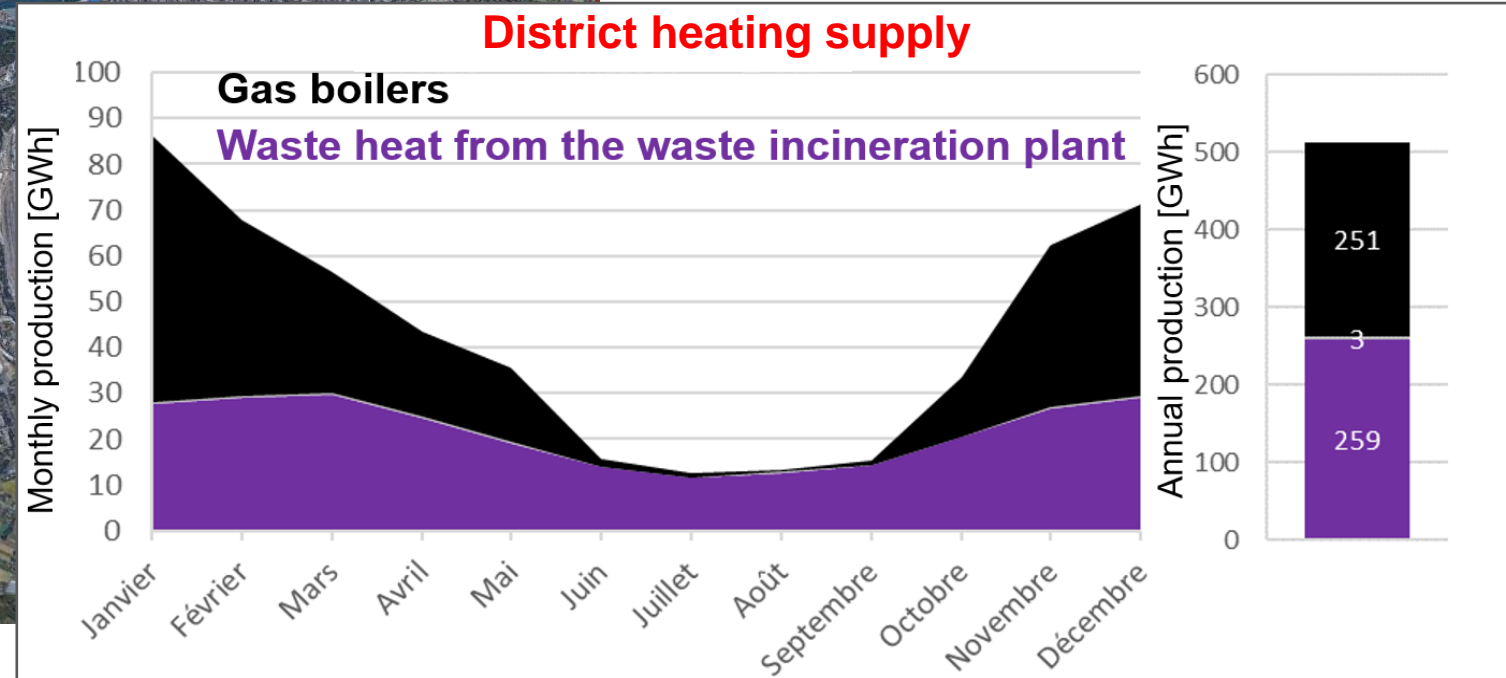


# Main district heating & cooling networks today



? **District cooling (lake)**  
developed in the International Organisation district

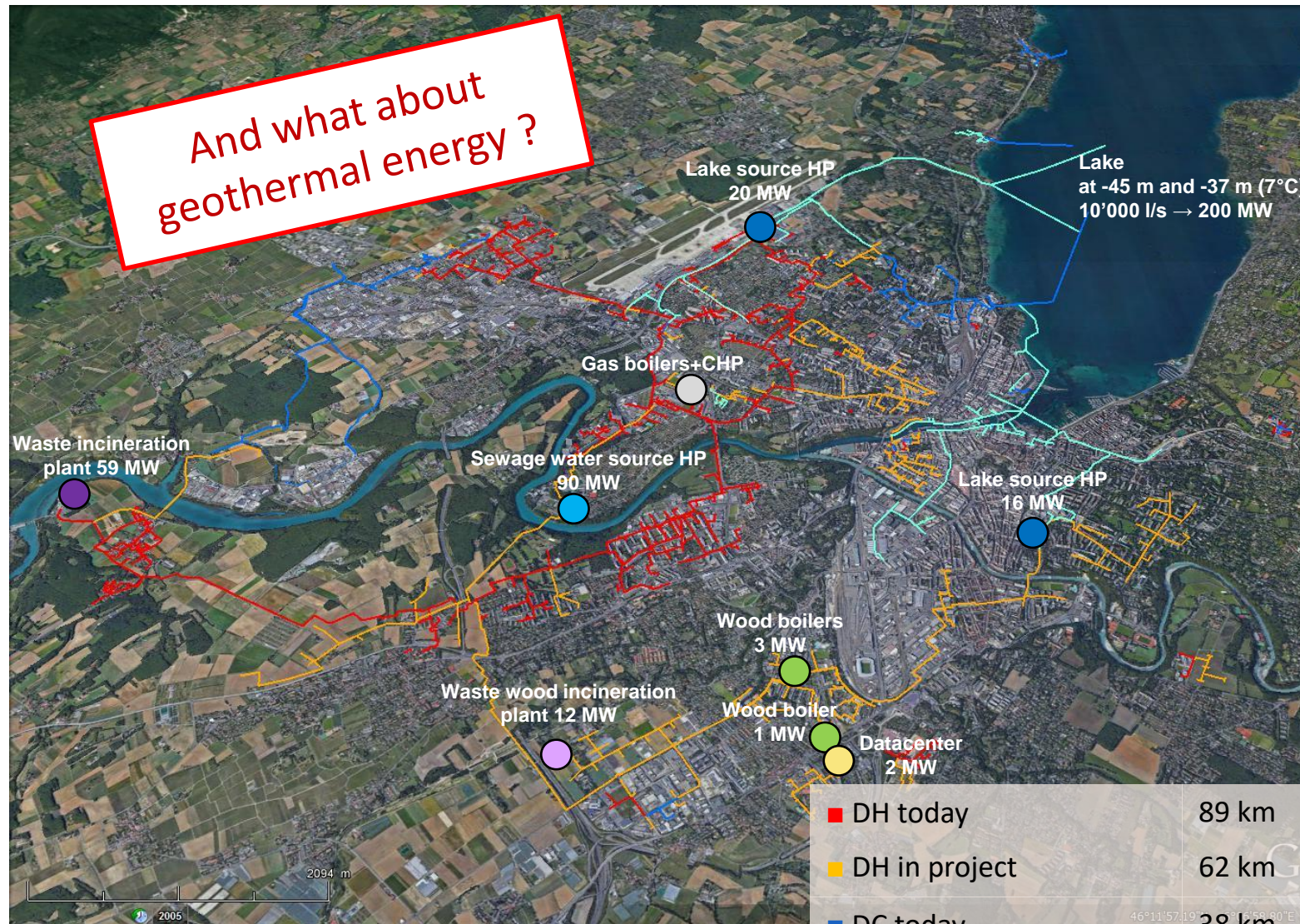
? **District heating**  
developed in the North West suburbs





# Future development of the district heating system

And what about geothermal energy?



■ DH today	89 km
■ DH in project	62 km
■ DC today	38 km
■ DC in project	31 km

? Targets for 2030:

## District cooling

- Cooling sales 150 GWh
- Heating sales 150 GWh (through decentralized HP)

## District heating

- Heat sales 1,000 GWh
- Production mix: 80% from waste heat & renewable energy

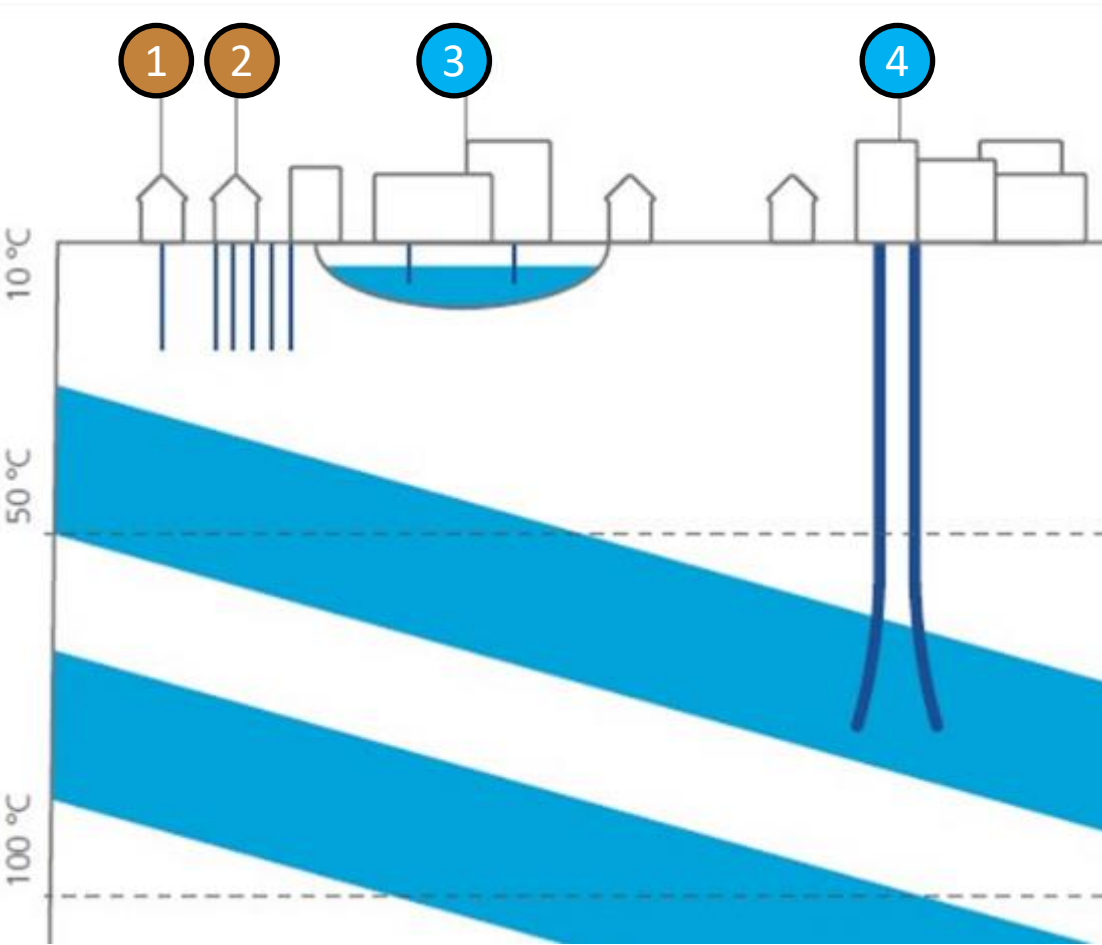
? Major network extensions

? New production facilities based on renewables

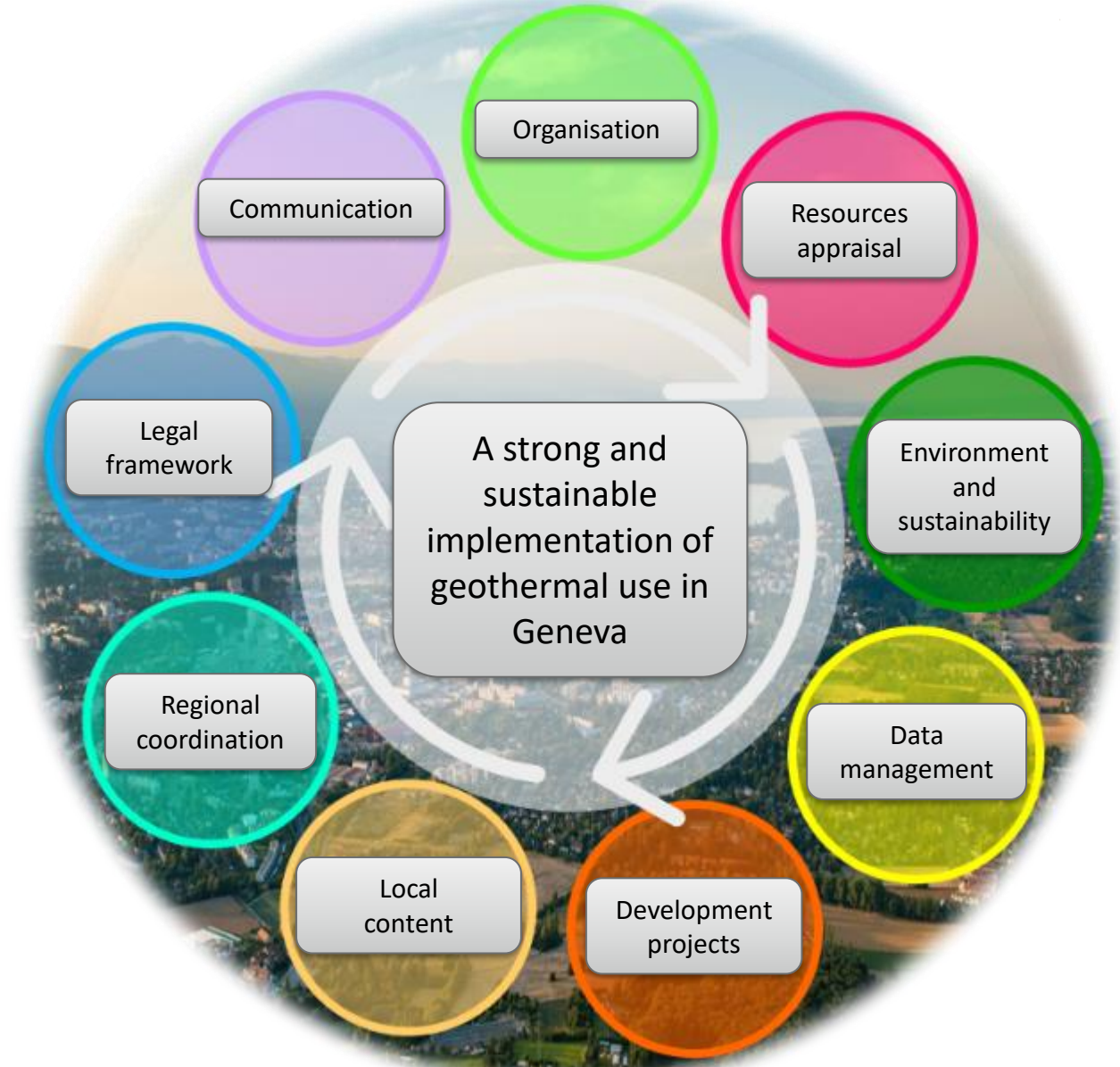
? ~ 100-150 million CHF of investments per year during the next decade



# Expected geothermal contribution: 30% of thermal needs in 2050



Mainly with shallow and medium-depth groundwater (3 and 4)

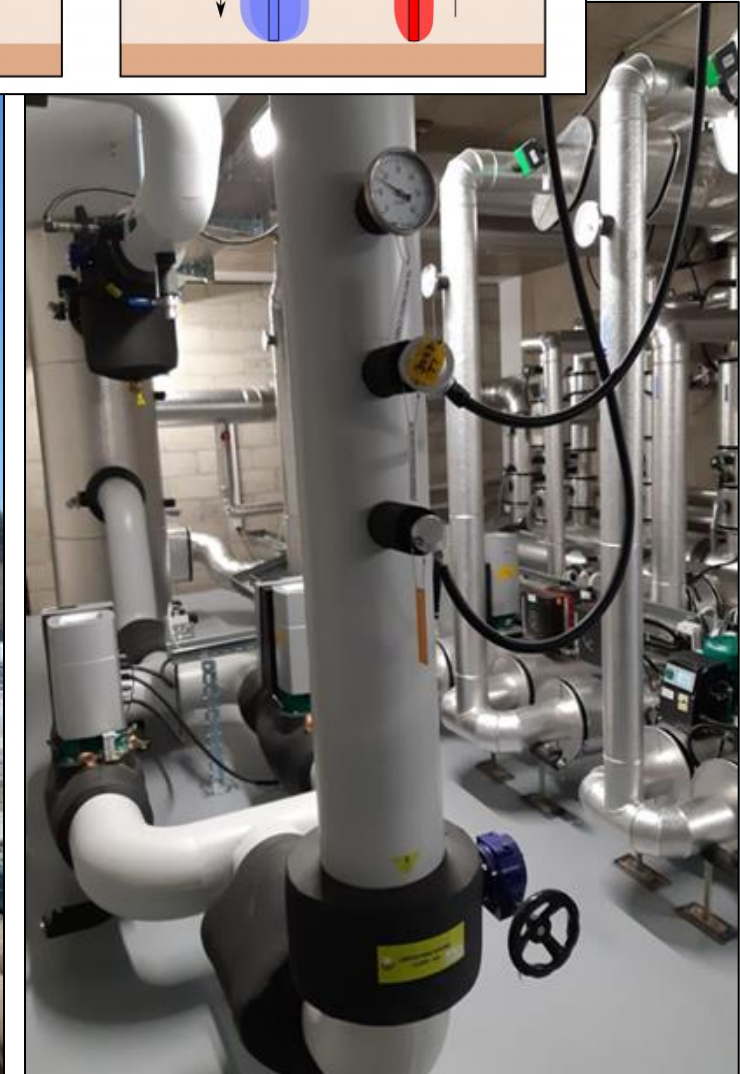
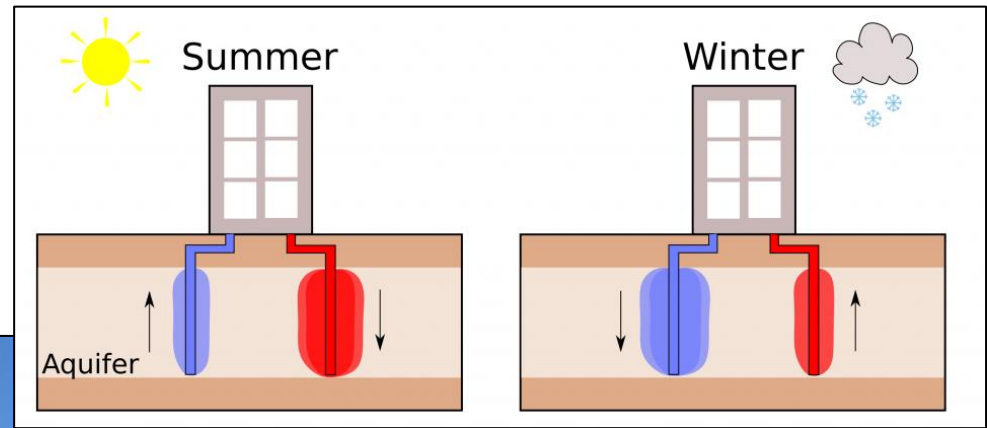




# Decentralized shallow geothermal energy

Increasing development of projects using shallow aquifers for heating, cooling, and storage

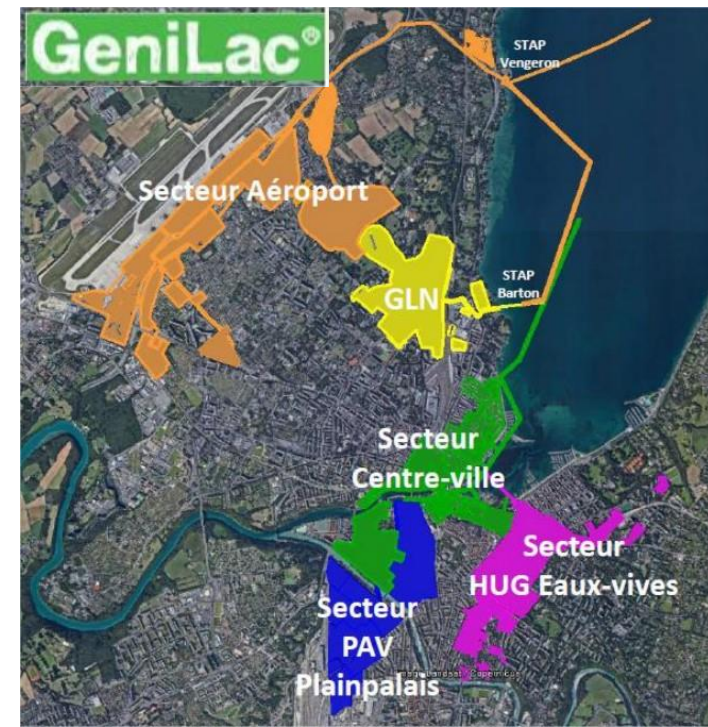
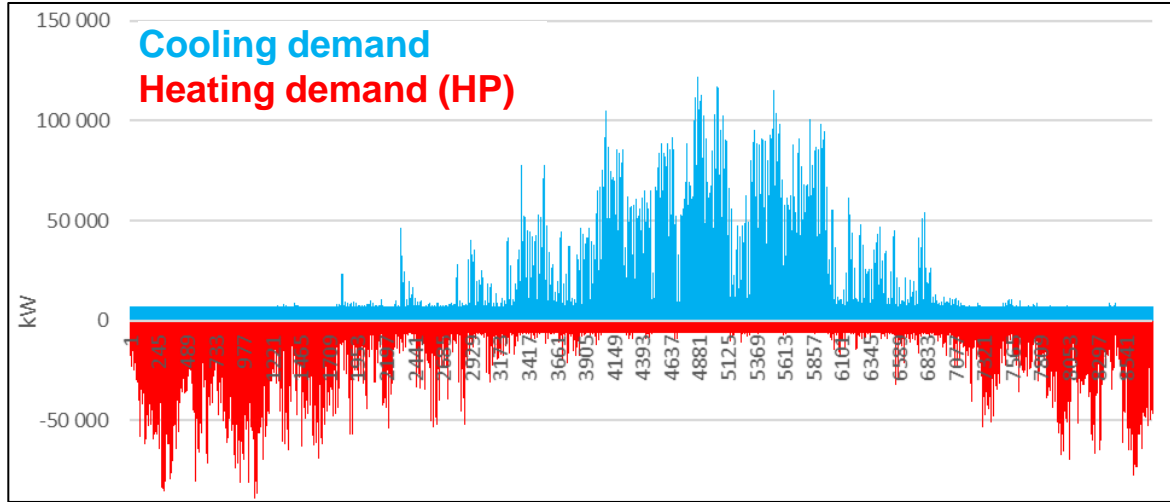
Shallow quaternary aquifers (< 100m depth)





# District cooling network

Primarily using the lake as heat source (winter) and sink (summer)



But shallow geothermal wells also connected for temperature regulation and LT seasonal heat storage



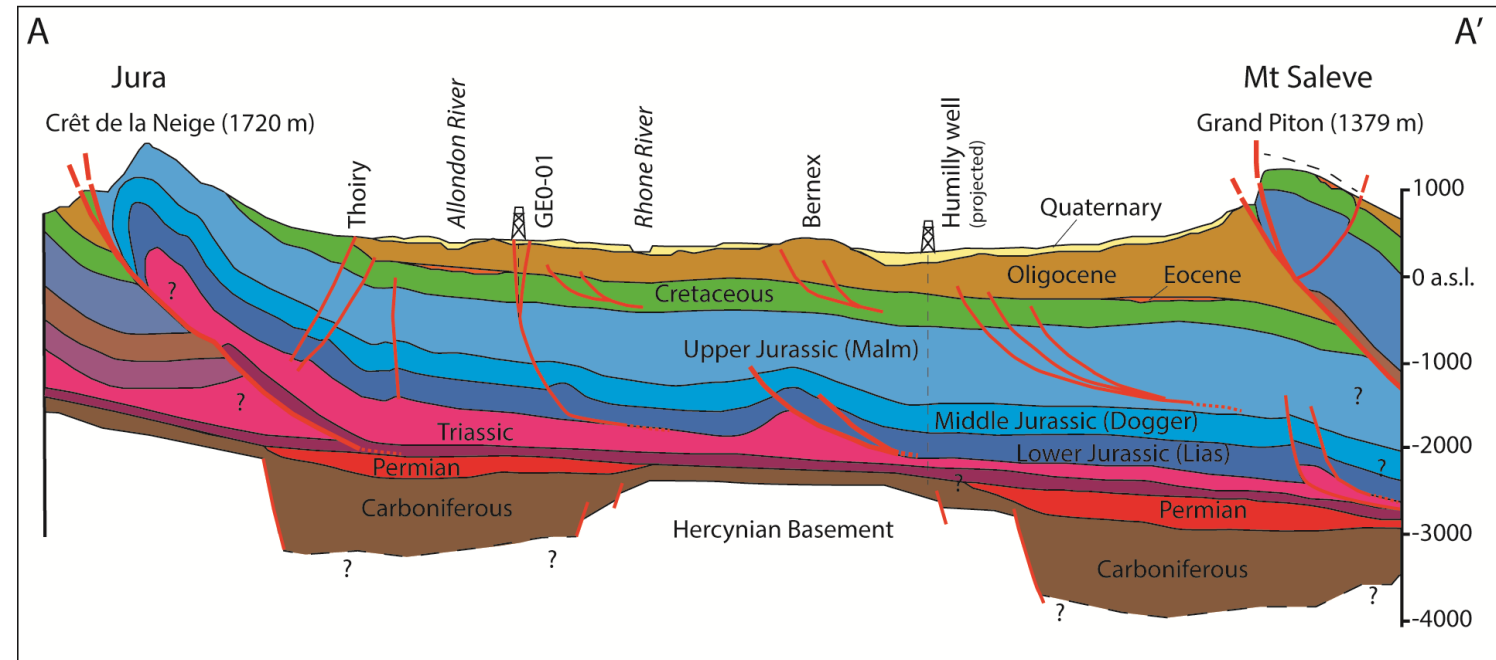
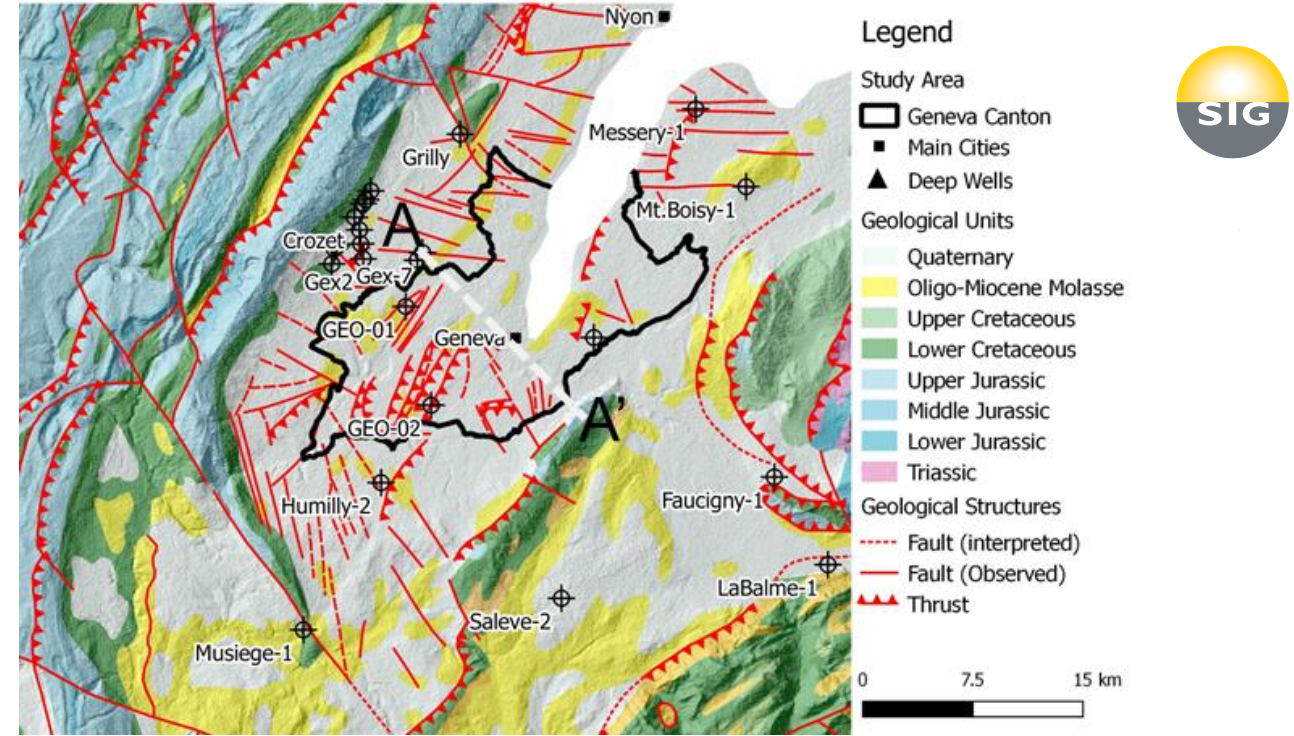


# Medium-depth geothermal potential

❓ Promising aquifers between 500 and 2500m in karstified and/or fractured mesozoic carbonates units

❓ Expected temperatures: 30-90°C  
(geothermal gradient 30°C/km)

❓ Still a gap in subsurface knowledge  
→ Launch of an exploration program



# Medium-depth geothermal potential under investigation



## Well G<sub>Eo</sub>1 in 2018

744 m depth  
50-70 l/s at 34°C

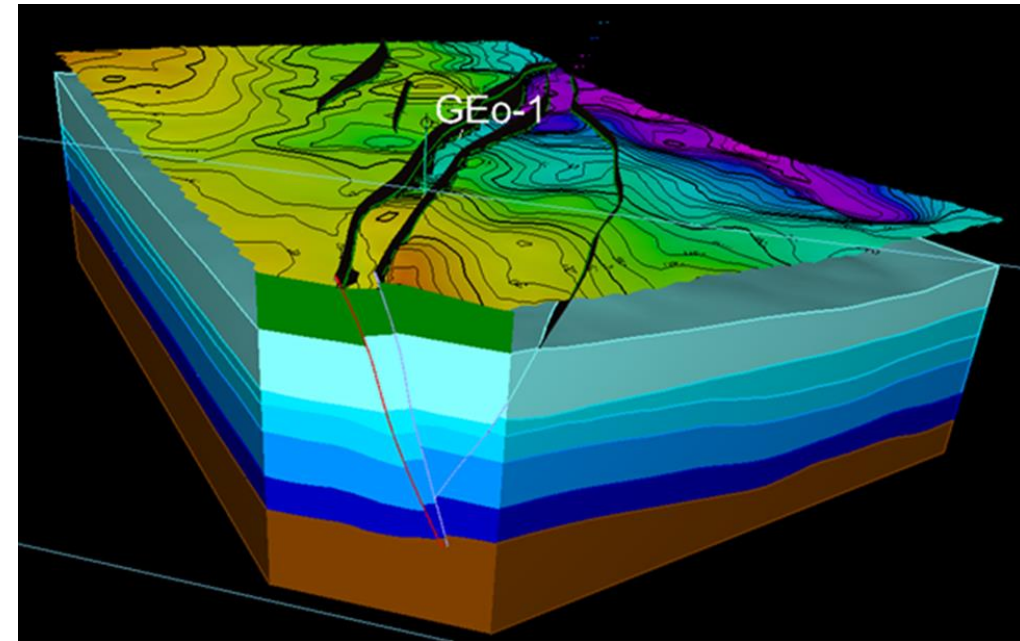


## Well G<sub>Eo</sub>2 in 2020

1456 m depth  
< 1 l/s at 53°C



3D seismic campaign in 2022  
187 km<sup>2</sup>  
15 million CHF (60% federal subsidies)

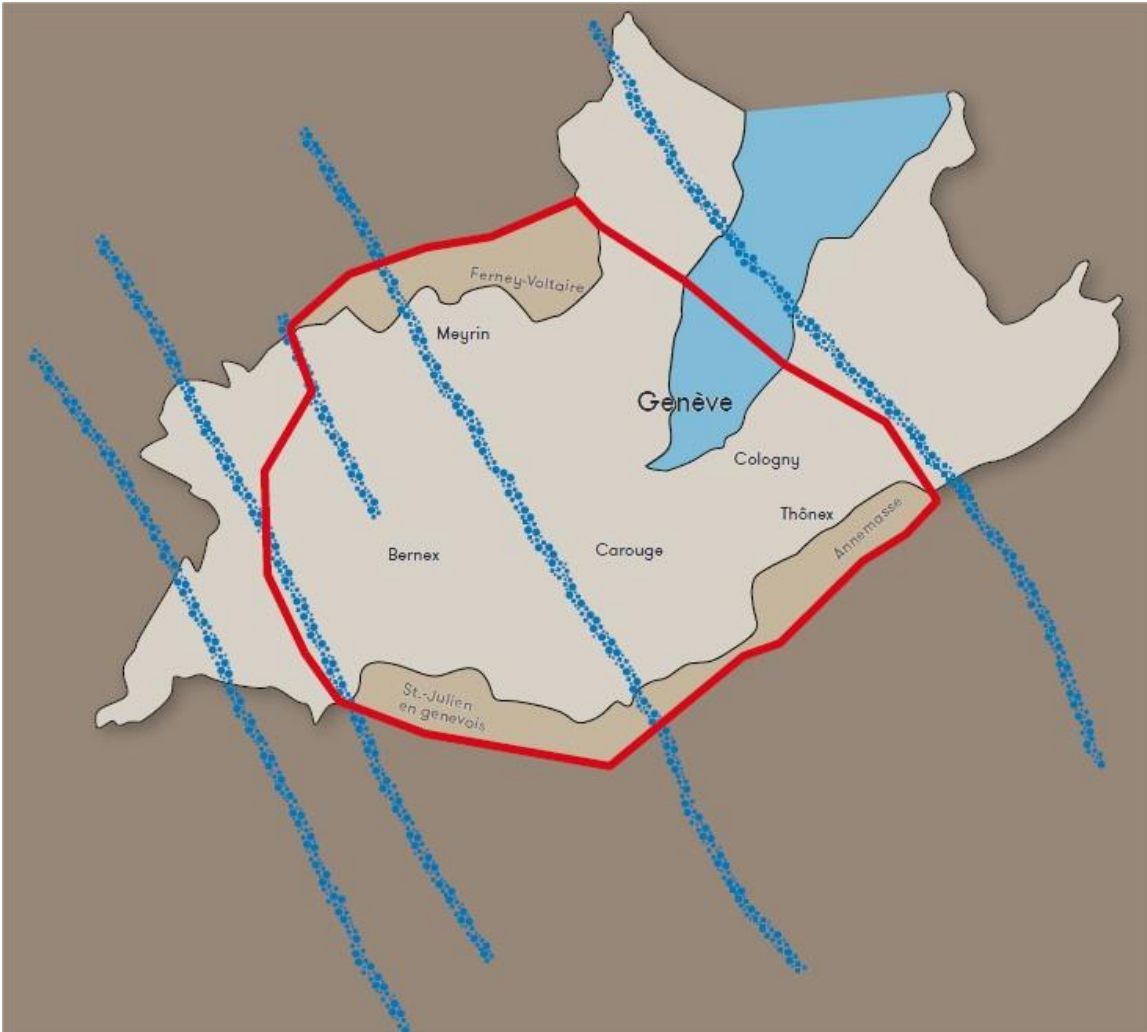




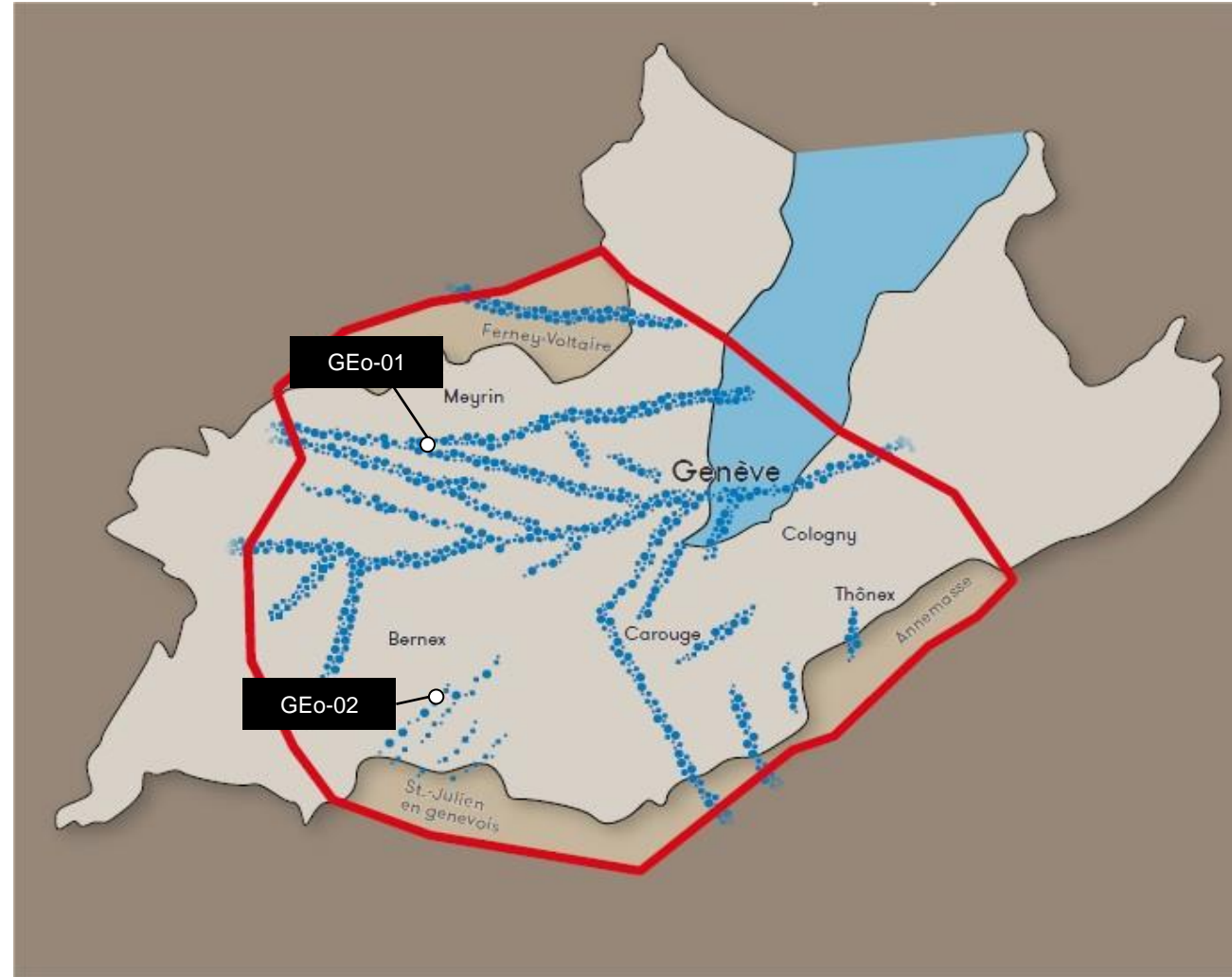
# Major geological discoveries



## Presumed fault orientation before the 3D seismic campaign



## Actual fault orientation

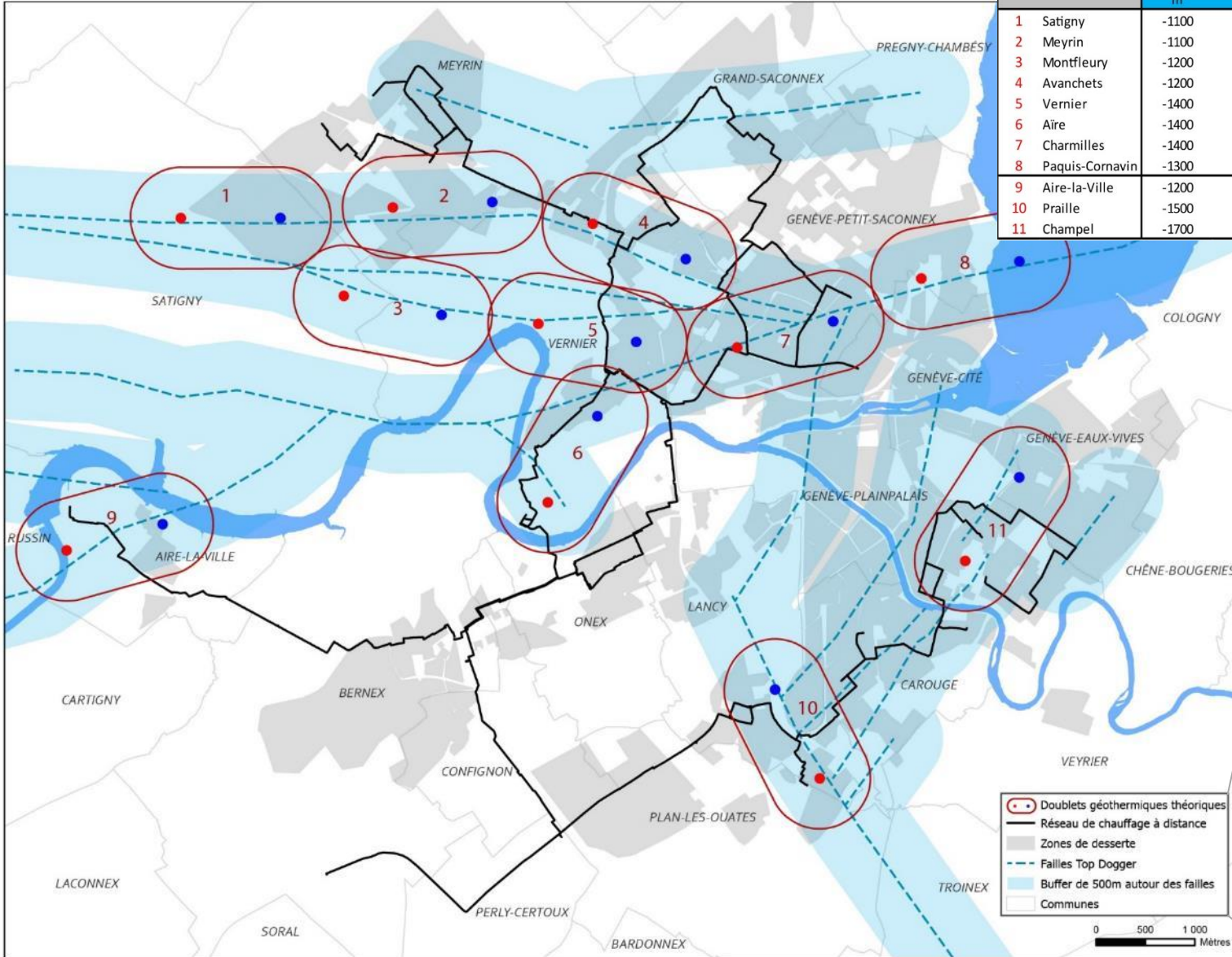



# Medium-depth geothermal potential

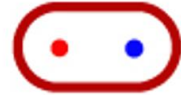


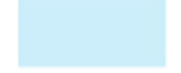
## Theoretical potential



SECTEURS		AQUIFERE DU MALM					AQUIFERE DU DOGGER				
No	Nom	Profondeur m	Température °C	Débit l/s	Puissance sans PAC (réinjection à 50°C) MW	Puissance avec PAC (réinjection à 30°C) MW	Profondeur m	Température °C	Débit l/s	Puissance sans PAC (réinjection à 50°C) MW	Puissance avec PAC (réinjection à 30°C) MW
1	Satigny	-1100	48	20-60	0	2.0 - 6.1	-1700	68	20-60	1.5 - 4.5	3.7 - 11.2
2	Meyrin	-1100	48	20-60	0	2.0 - 6.1	-1900	75	20-60	2.1 - 6.2	4.3 - 12.9
3	Montfleury	-1200	52	20-60	0.1 - 0.4	2.4 - 7.1	-1900	75	20-60	2.1 - 6.2	4.3 - 12.9
4	Avanchets	-1200	52	20-60	0.1 - 0.4	2.4 - 7.1	-1900	75	20-60	2.1 - 6.2	4.3 - 12.9
5	Vernier	-1400	58	20-60	0.7 - 2.1	2.9 - 8.7	-1900	75	20-60	2.1 - 6.2	4.3 - 12.9
6	Aire	-1400	58	20-60	0.7 - 2.1	2.9 - 8.7	-2100	81	20-60	2.6 - 7.9	4.8 - 14.5
7	Charmilles	-1400	58	20-60	0.7 - 2.1	2.9 - 8.7	-2200	85	20-60	2.9 - 8.7	5.1 - 15.4
8	Paquis-Cornavin	-1300	55	20-60	0.4 - 1.2	2.6 - 7.9	-2200	85	20-60	2.9 - 8.7	5.1 - 15.4
9	Aire-la-Ville	-1200	52	20-60	0.1 - 0.4	2.4 - 7.1	-1900	75	20-60	2.1 - 6.2	4.3 - 12.9
10	Praille	-1500	62	20-60	1.0 - 2.9	3.2 - 9.6	-2300	88	20-60	3.2 - 9.5	5.4 - 16.2
11	Champel	-1700	68	20-60	1.5 - 4.5	3.7 - 11.2	-2400	91	20-60	3.4 - 10.3	5.7 - 17.0



  
**Optimistic potential:  
9 doublets - total 72 MW**

-  Potential geothermal doublet
-  District heating network by 2045
-  Main faults
-  500m buffer around faults

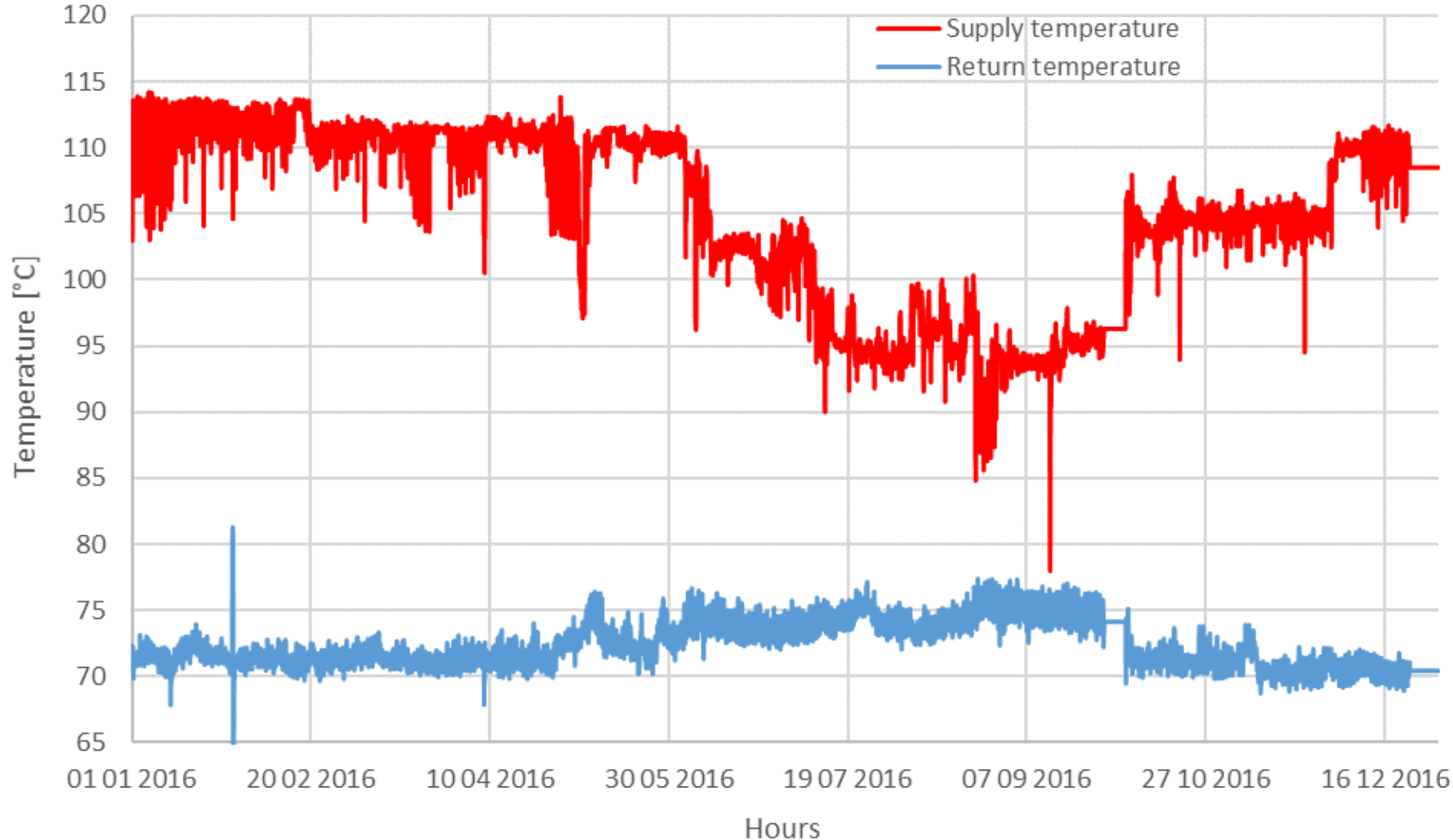


# District heating temperature levels



## Current DH temperature levels

- Strategic issue for the integration of renewables
- Optimization projet in progress

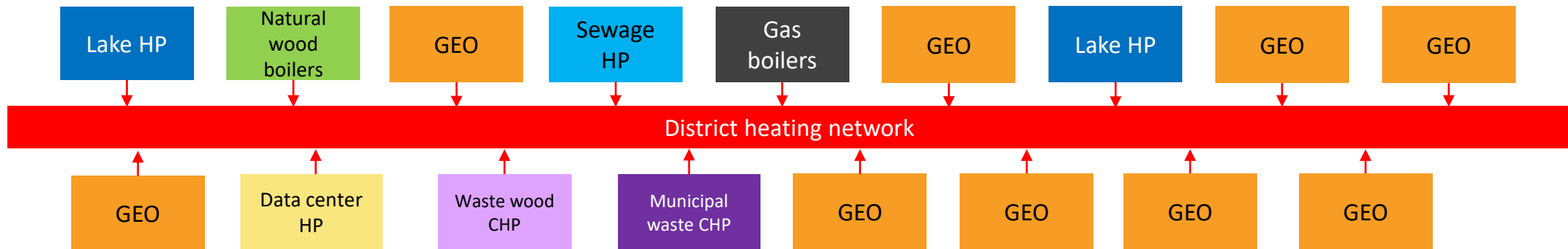
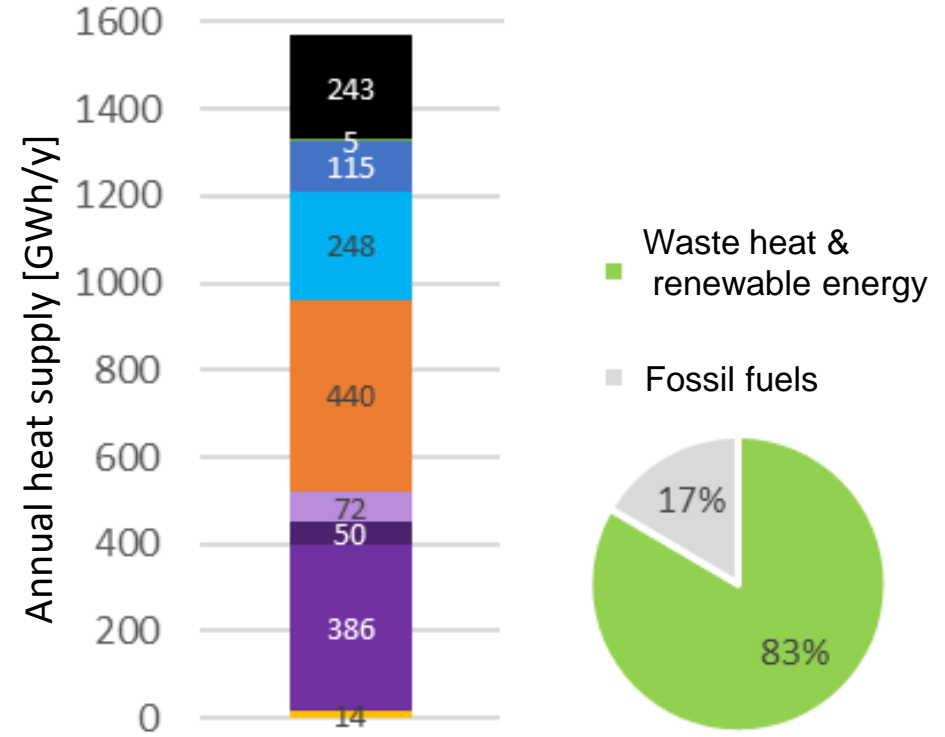
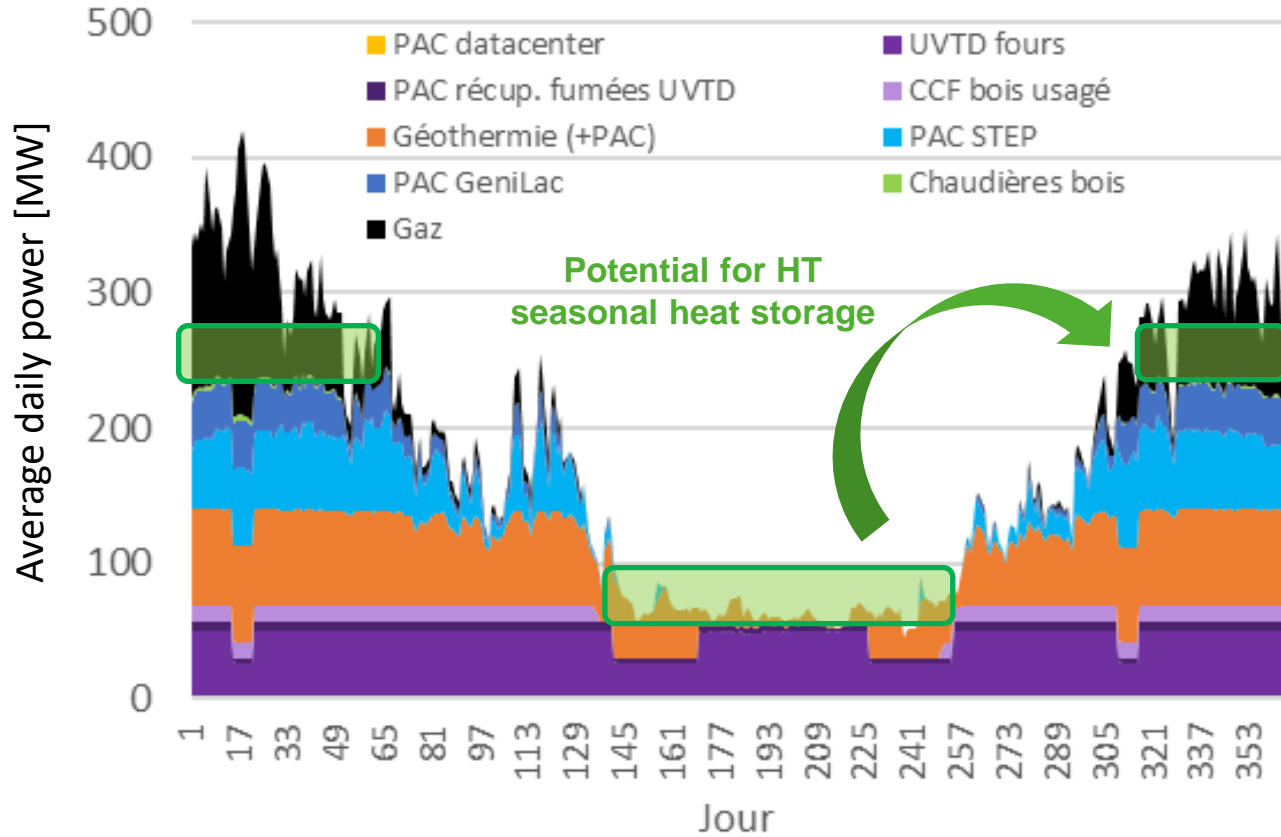


## Target for 2028

- ? T supply max 90 °C
- ? T return 40-50 °C

# District heating network heat supply in our reference scenario

2046





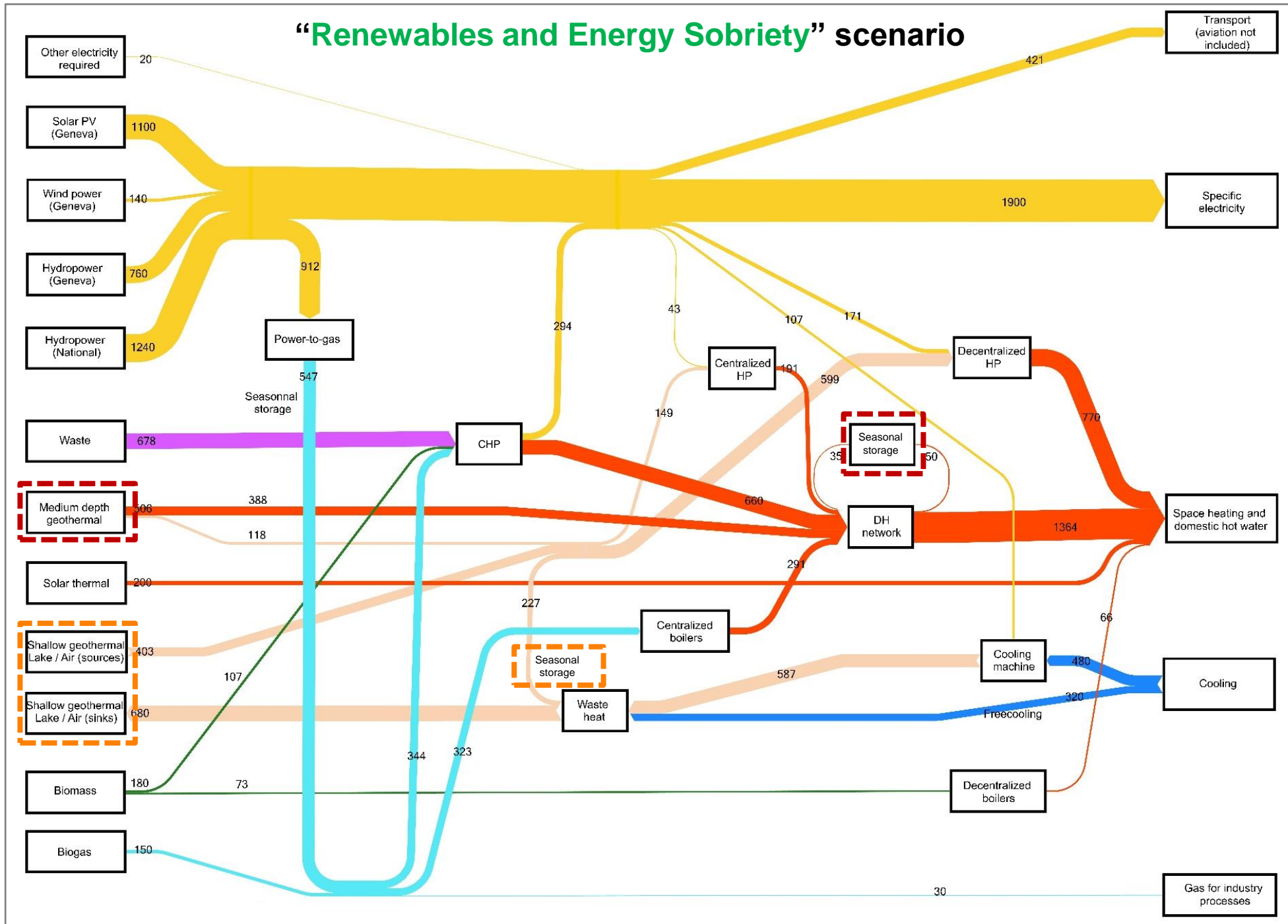
# Geneva energy supply in 2050

Medium-depth geothermal energy

Shallow geothermal energy

	Methane [GWh/an]
	Biomass [GWh/an]
	Solid waste [GWh/an]
	Electricity [GWh/an]
	Heat > 35°C [GWh/an]
	Heat < 35°C [GWh/an]
	Cooling [GWh/an]

## “Renewables and Energy Sobriety” scenario



### **?** Shallow geothermal energy

- Increasing development of projects for heating, cooling, and heat storage
- Option to deliver via decentralized projects or connect to low temperature networks

### **?** Medium-depth geothermal energy

- Validated geothermal potential!
- First geothermal plant project underway to confirm exploratory results
- Integration requires extension of the district heating network and optimization of temperature levels

### **?** Geothermal energy expected to represent 30% of thermal needs by 2050





## Thank you

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? **For more information:**

- Services industriels de Genève: <http://www.sig-ge.ch/>
- Programme GEothermies: <https://www.geothermies.ch/>

