Geothermal Initiatives at the University of Calgary

Roman J. Shor

CREWES Annual Meeting
December 7, 2023

Agenda

Introduction to the **Energi Simulation Centre for Geothermal Systems Research**

What is **Geothermal Energy**?

The **University of Calgary District Energy System**

A **Geothermal Solution**

A testing & demonstration **proposal**

Energi Simulation Centre for Geothermal Systems Research

Research focuses

- Exploration Geology and Geophysics
- Thermal and Fluid Flows in Reservoirs
- Drilling and Well Designs
- Thermodynamics and Energy Conversions
- Sustainability, Social License and Indigenous Perspectives
- Geothermal Policy and Law

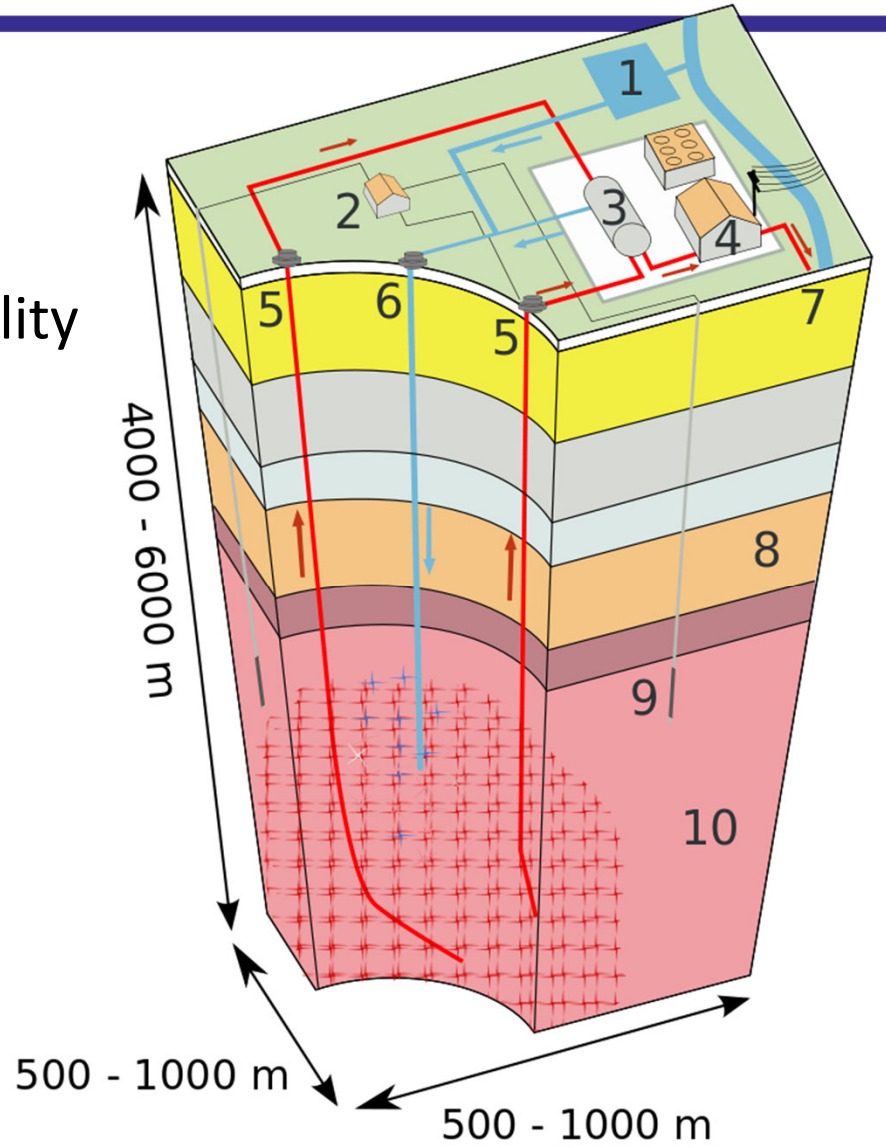
GeoS
ENERGI SIMULATION CENTRE FOR GEOTHERMAL SYSTEMS RESEARCH

Energi Simulation Centre for Geothermal Systems Research
May Workshop - 2023

Directors: **Apostolos Kantzas** and **Aggrey Mwesigye**

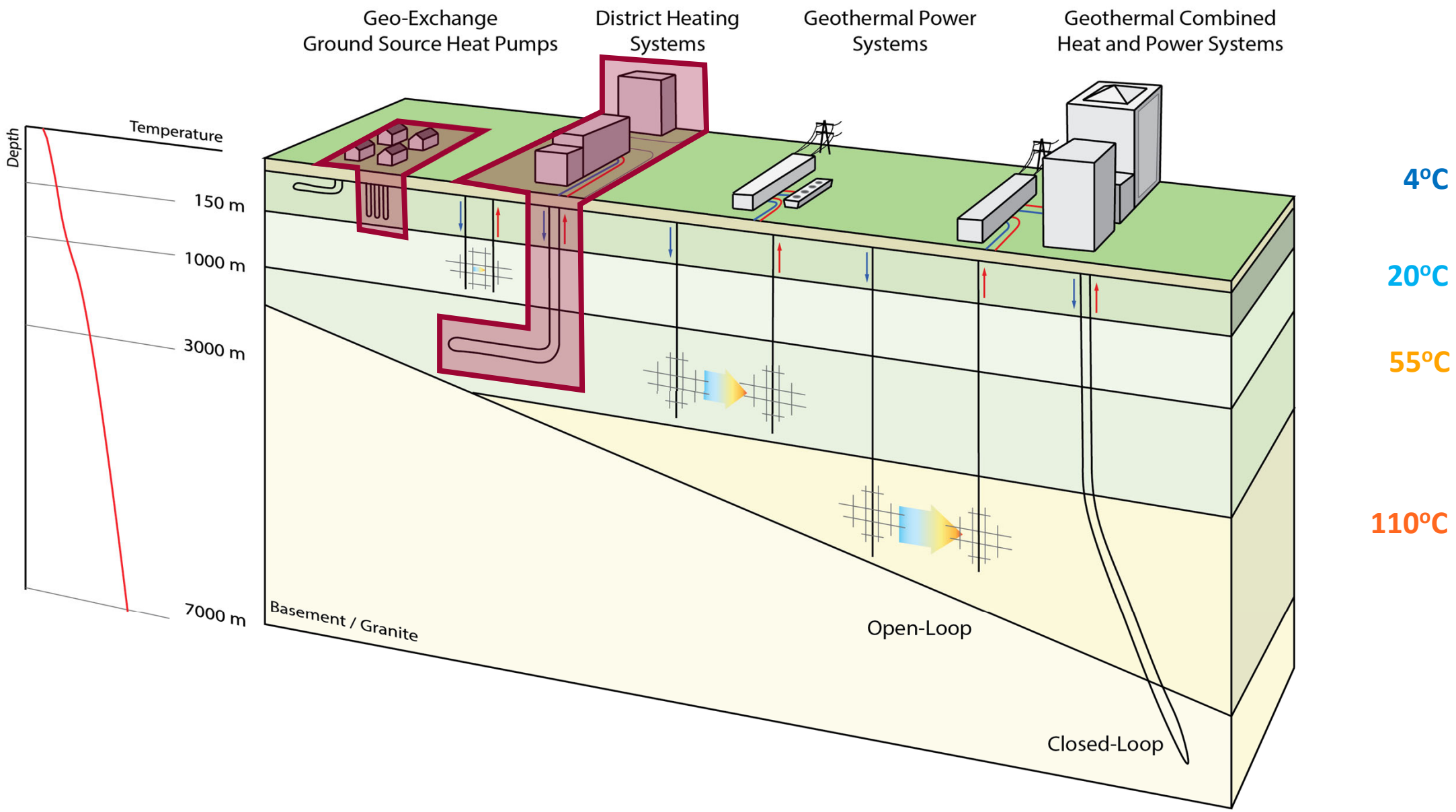
Geothermal Systems

- What is needed?
  - A thermal reservoir
    - Thermal conductivity & working fluid permeability
  - Conduction / convection for recharge
  - Subsurface access (wells)
  - Conversion of heat to power
  - Use of waste / latent heat



Source: Wikipedia, *Enhanced geothermal system*

Geothermal Systems



University of Calgary District Energy System

Cogeneration system for combined heat and power (CHP)

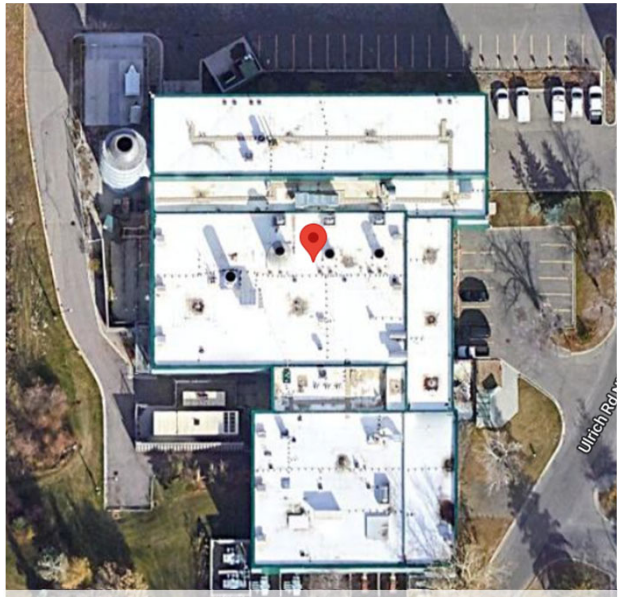
- 14 MW natural gas turbine
- Heat recovery system + supplementary boilers
- District heating system

Energy demand (annual)

- Power: 85 GWhe/year
- Heat: 147 GWht/year
- Cooling: 52 GWht/year

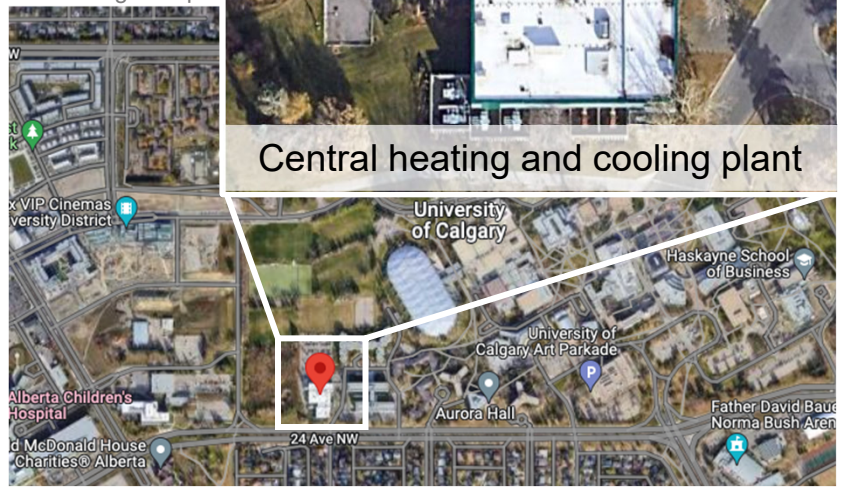
Emissions (annual)

- 72,000 tonnes CO2-eq.

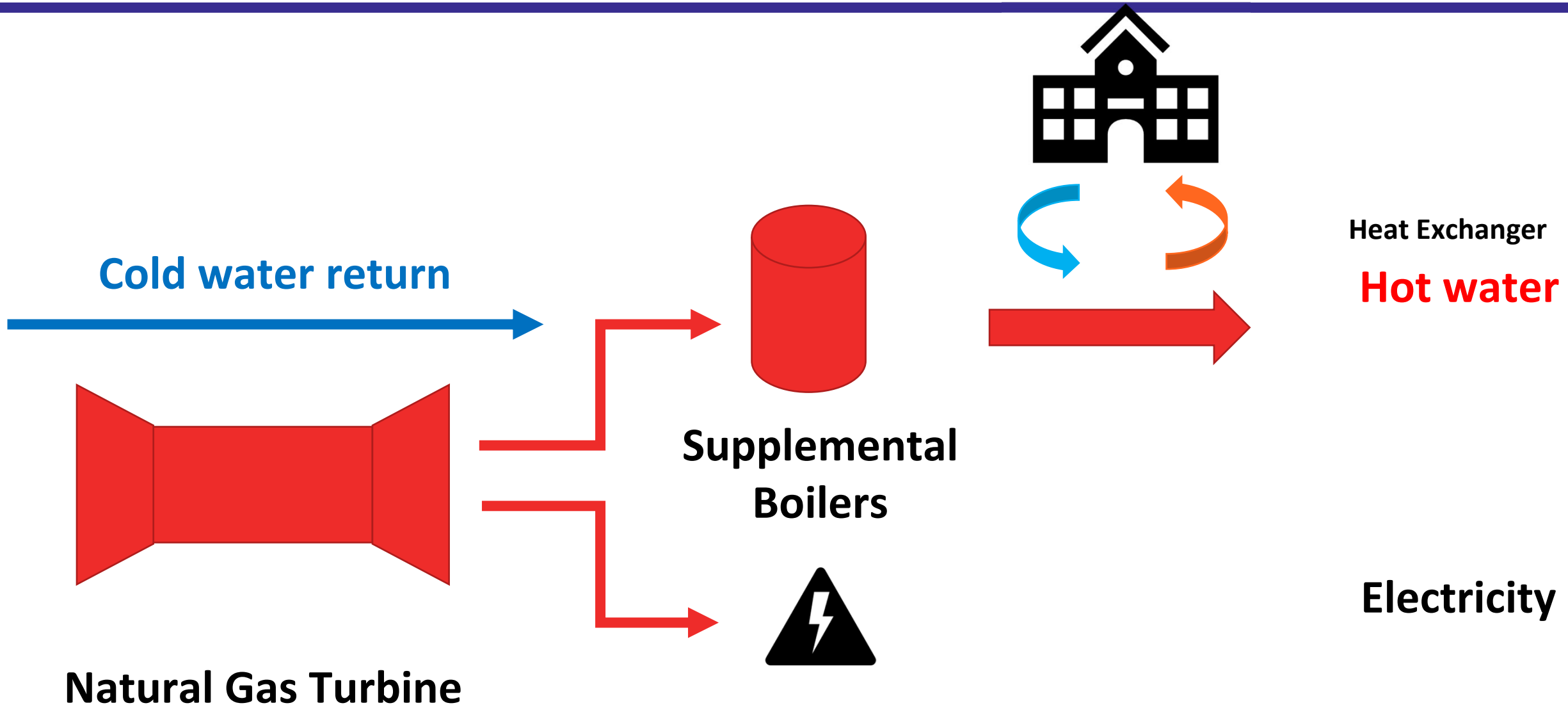


Central heating and cooling plant

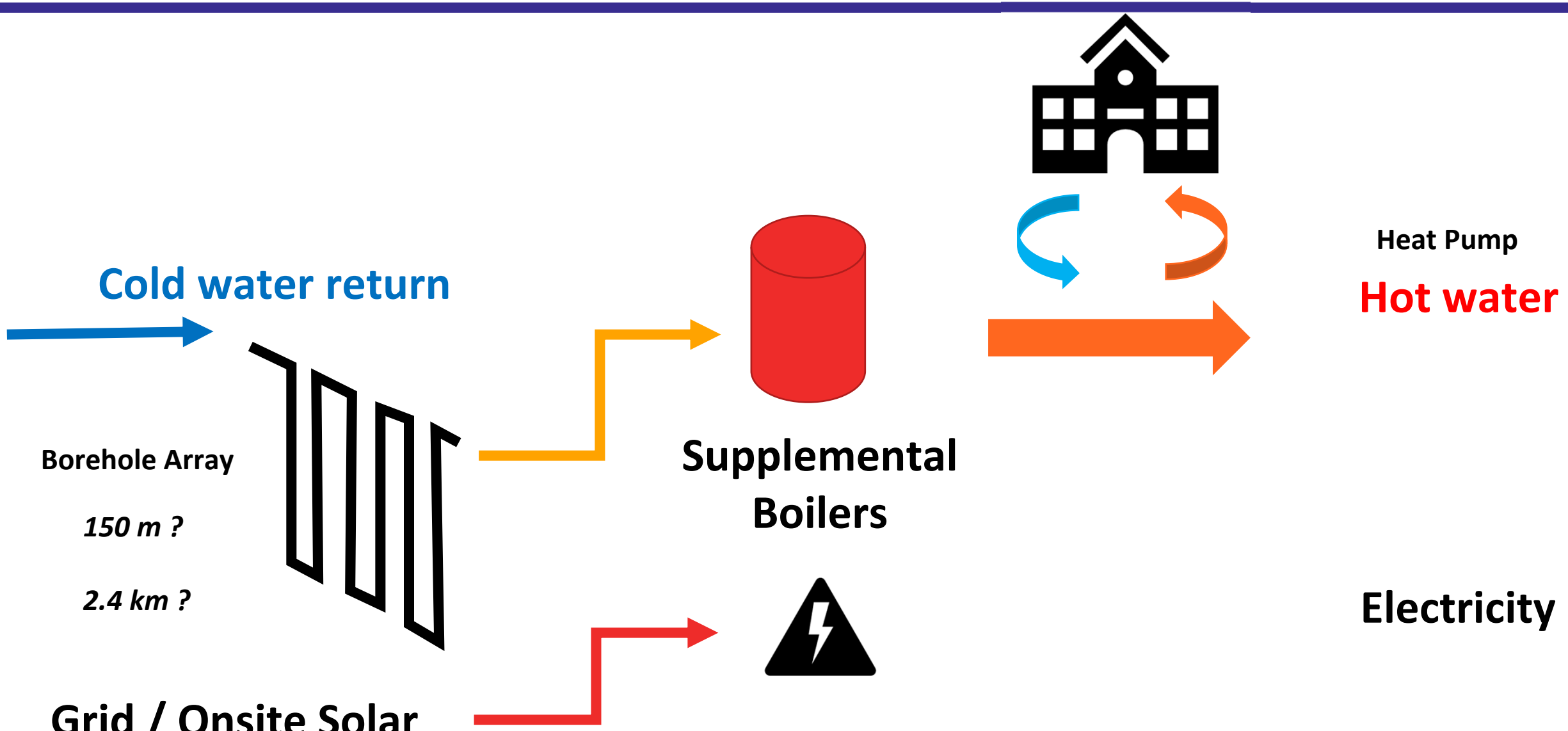
From: Google Maps



Current System



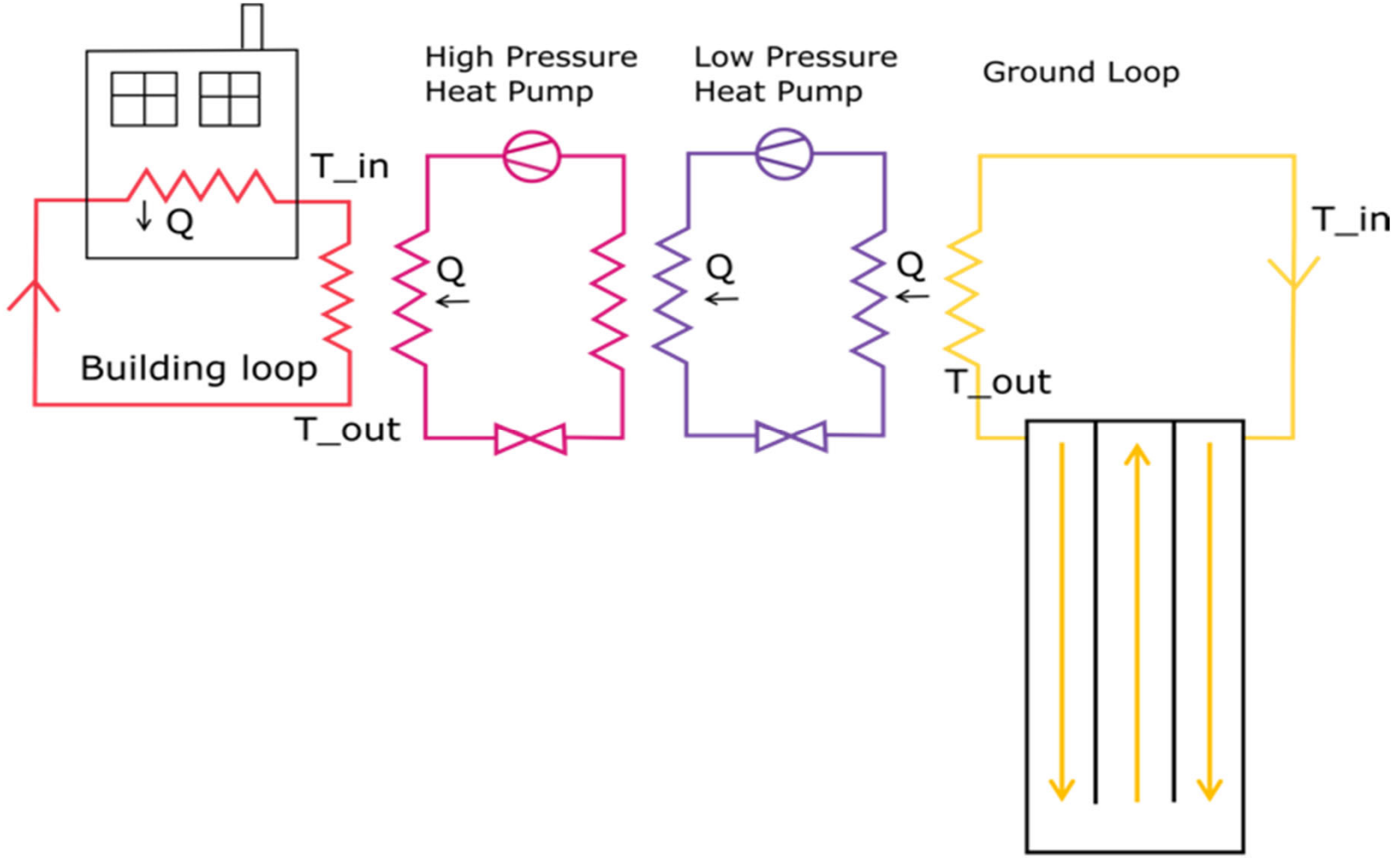
A Geothermal Solution



Surface Systems

Overall system integrates three subsystems:

- Subsurface geothermal system
- Heat pump
- Building heat loop



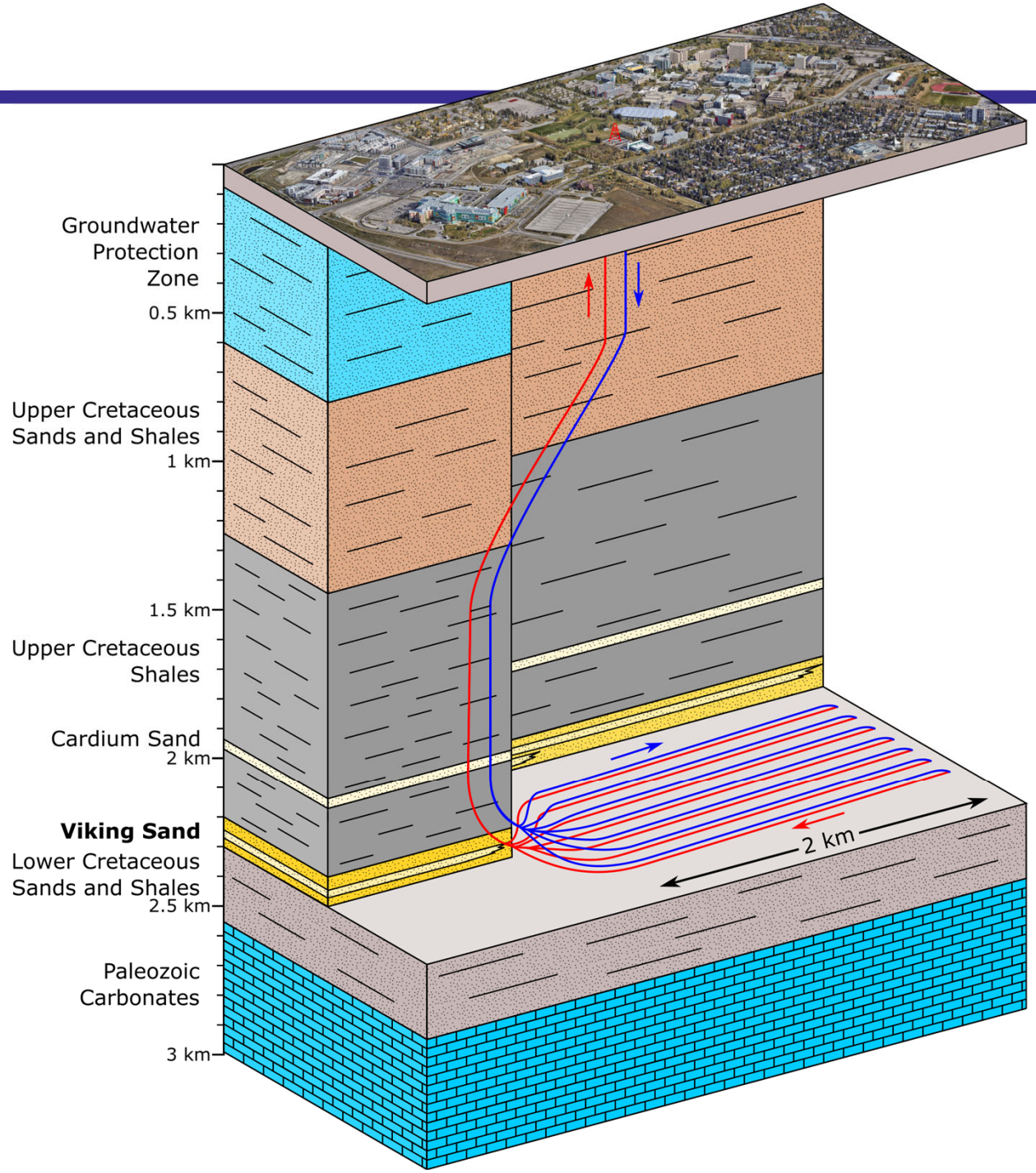
A full campus system

Potential to offset **90%+** of heating load with 30 horizontal wells pairs in a **closed-loop** design.

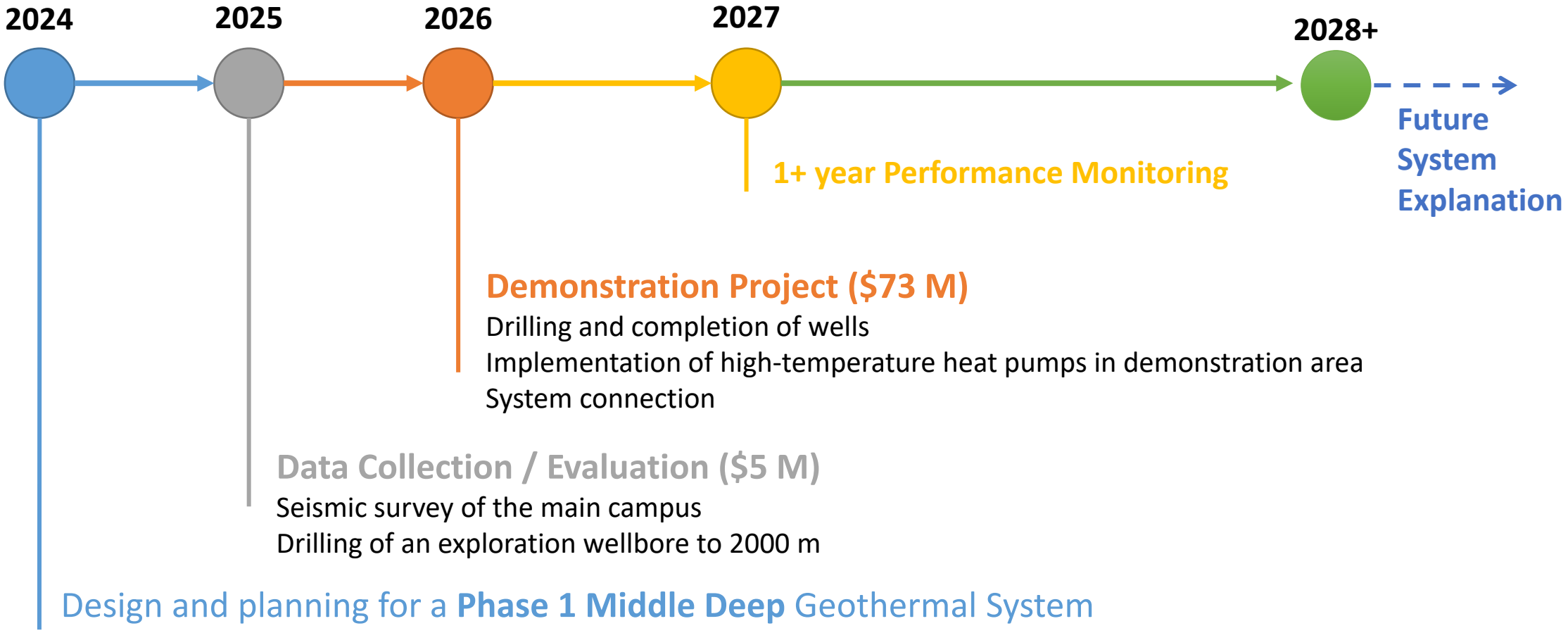
Why closed-loop?

H_2S *… an Alberta problem*

Reservoir Temperature:
65 - 75°C



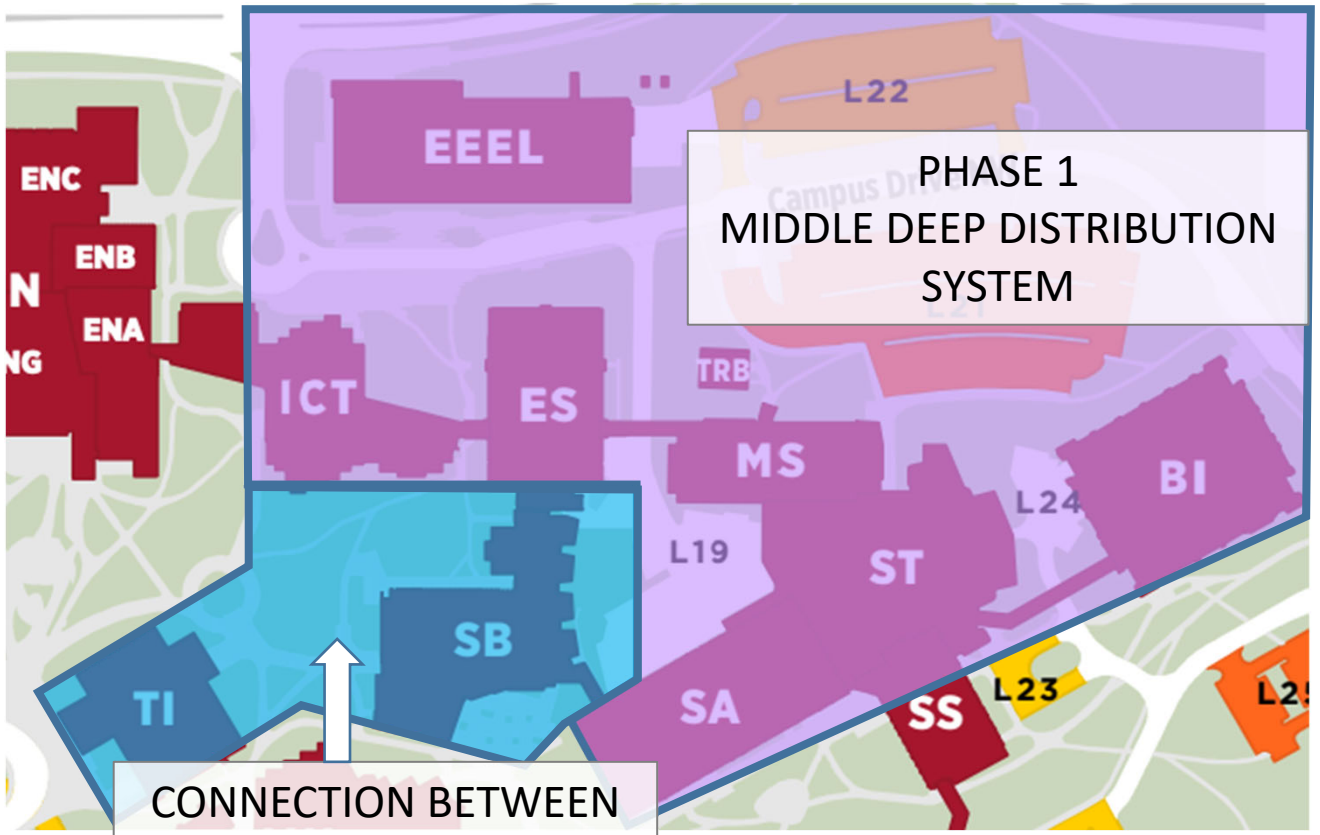
Implementation Strategy



Stage 1 Demonstration

Stage 1 Demonstration Project Potential

NE corner of campus



PHASE 1
MIDDLE DEEP DISTRIBUTION SYSTEM

CONNECTION BETWEEN OLD AND NEW SYSTEM

Hot water – provided by the new system
Chilled water – provided by reversing the high temperature heat pumps

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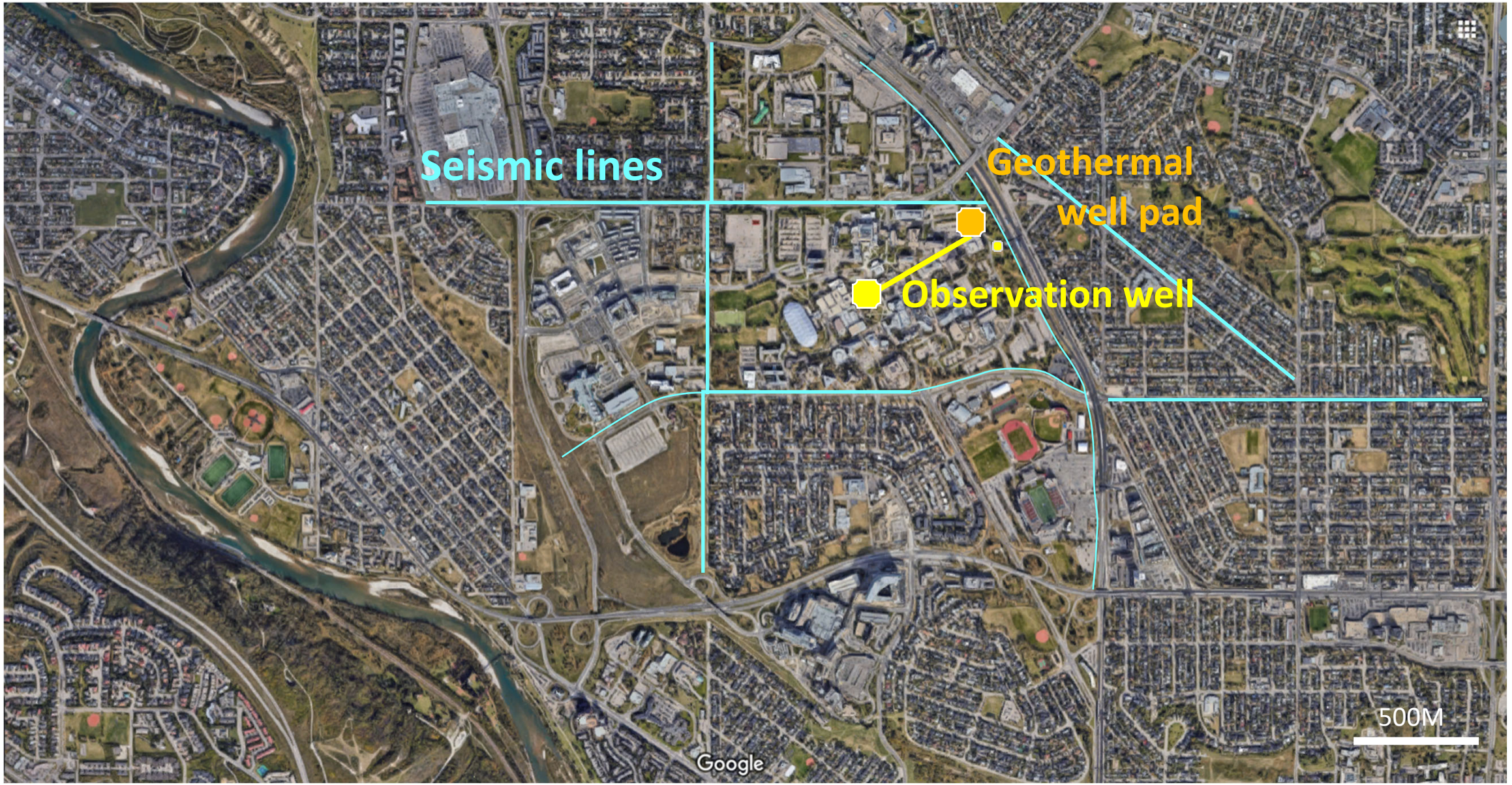
Balanced annual heat extraction and rejection of the geothermal system

Two areas hydraulically separated

Interconnection between systems – existing infrastructure to provide redundancy to the new system

Urban Seismic Survey Concept



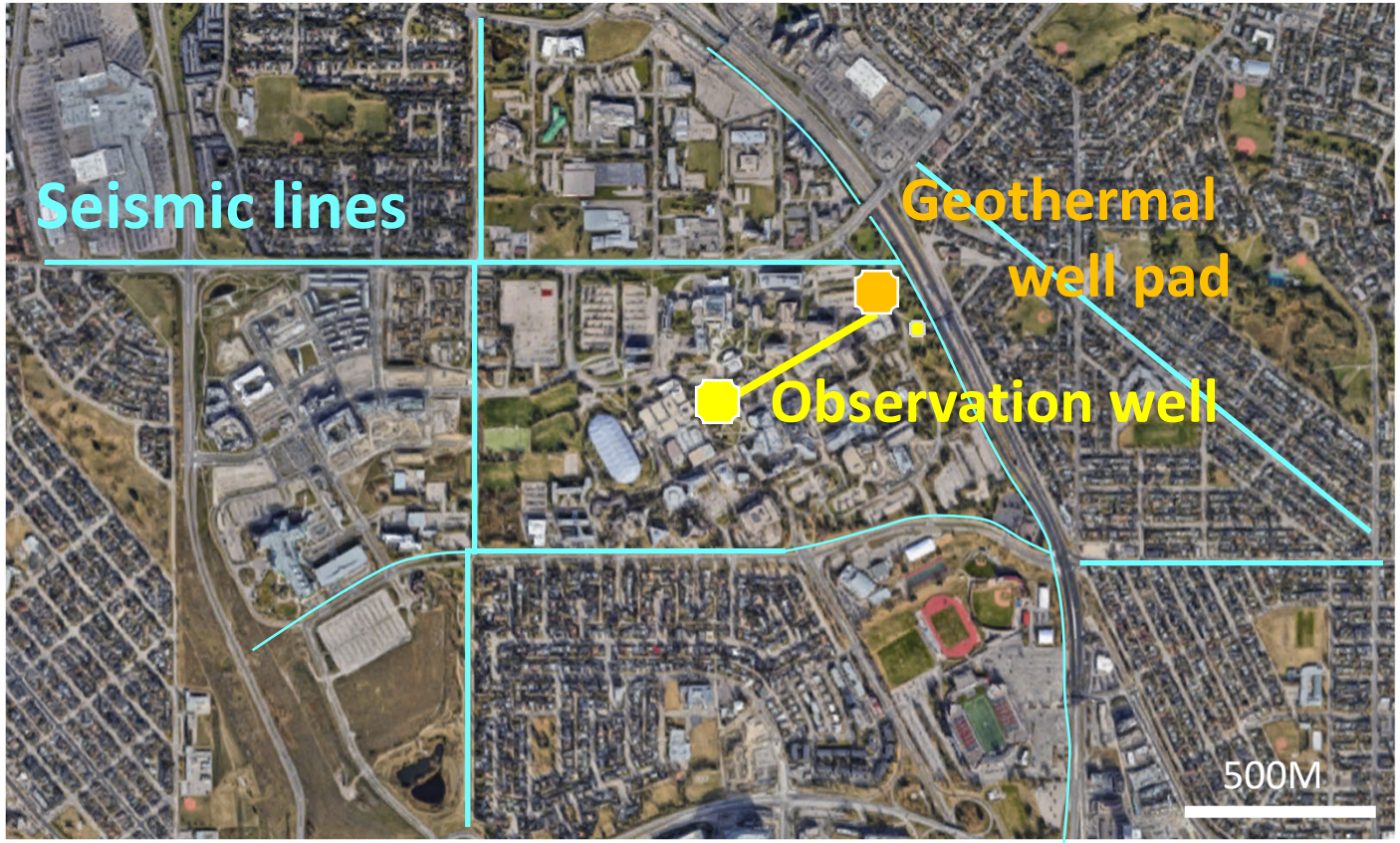
Geology/Geophysics Testing Program

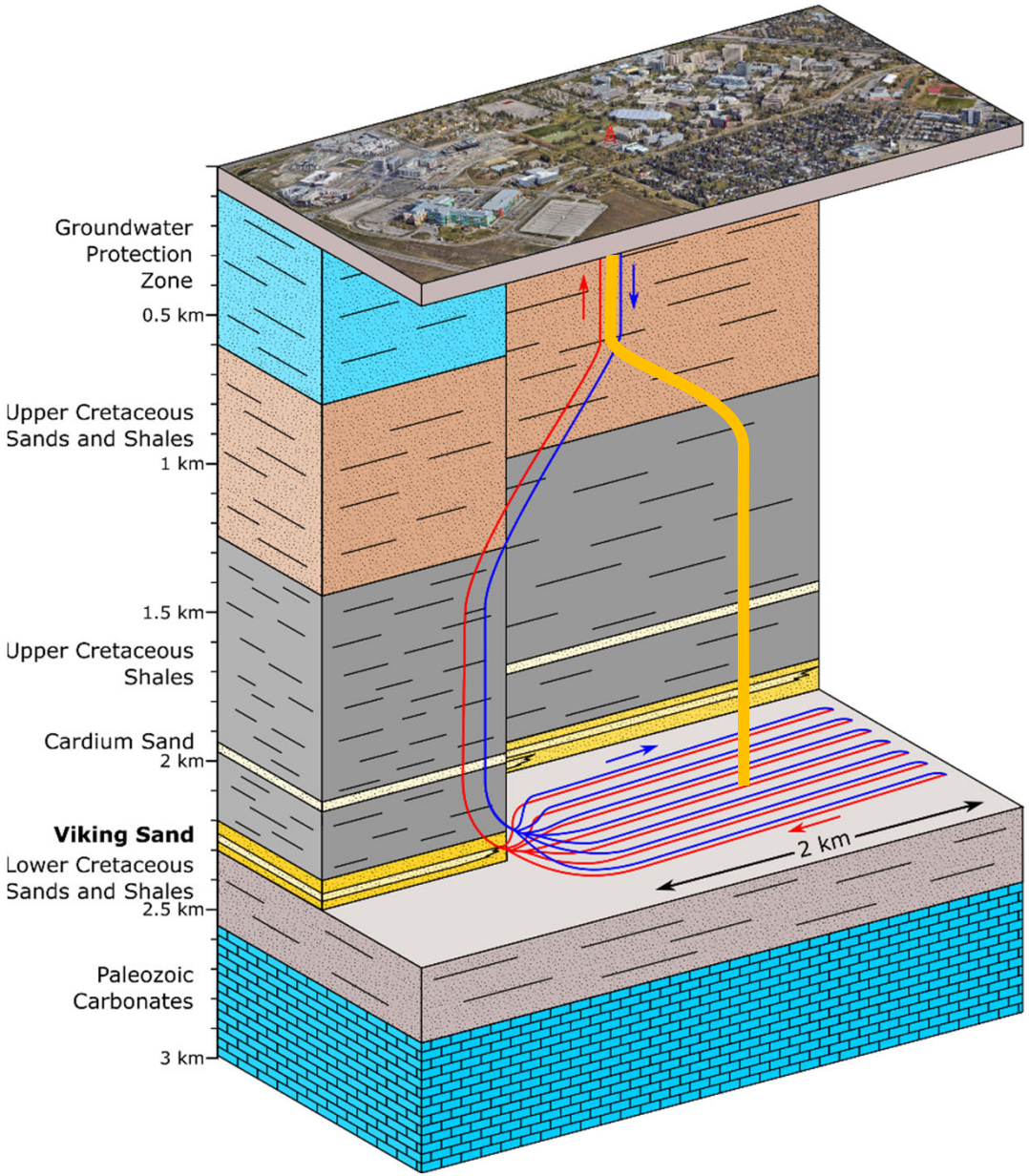
Drill cored vertical pilot well in central area

Geothermal reservoir characterization

Ensure optimum landing of HZ wells

Will serve as observation/monitoring well





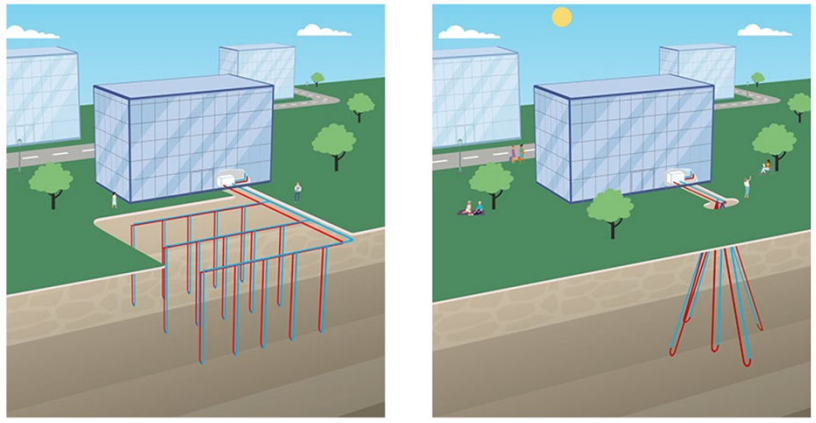
Making Geothermal a ‘showpiece’

SLB’s Celsius – geoexchange system in Boston

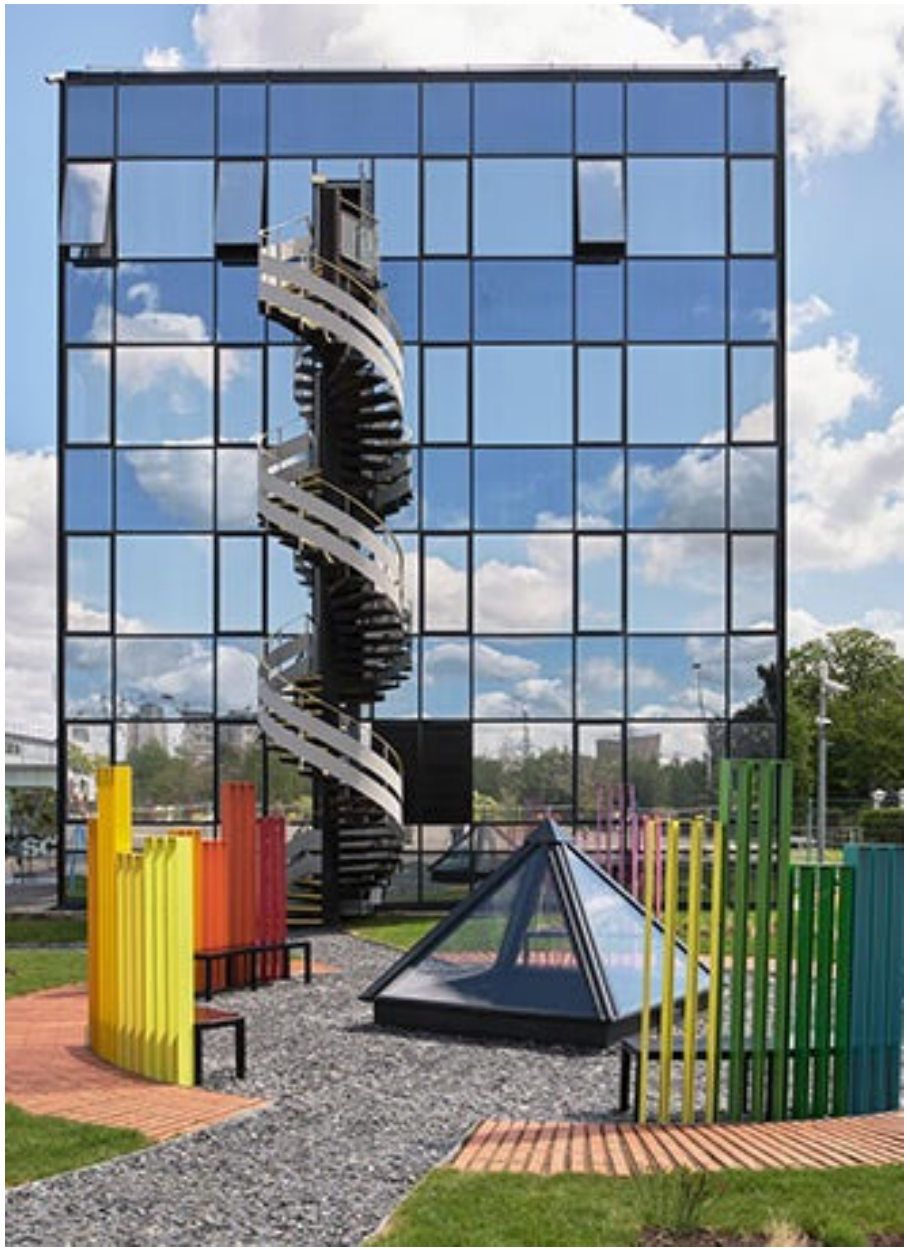
https://sponsored.bostonglobe.com/celsius-energy/geothermal-energy-boston/

Wellheads contained in a glass pyramid in a small park

Utility room indoors or underground



Standard vertical geoenergy solutions (left) require a large installation footprint. Celsius Energy’s pyramid shaped design (right) reduces surface footprint by up to 90 percent, making geothermal heating and cooling feasible even in dense urban areas.



What is next?

Early **2024**

- Engineering design & demonstration proposal
- Application to Emissions Reduction Alberta TIER program for funding

Mid/late **2024**

- Planning a seismic acquisition program

Summer **2025**

- Potential data collection??

Reach out to **Kris Innanen** if you are interested in partnering!