Project summary

Yearly event 2022: April 14th

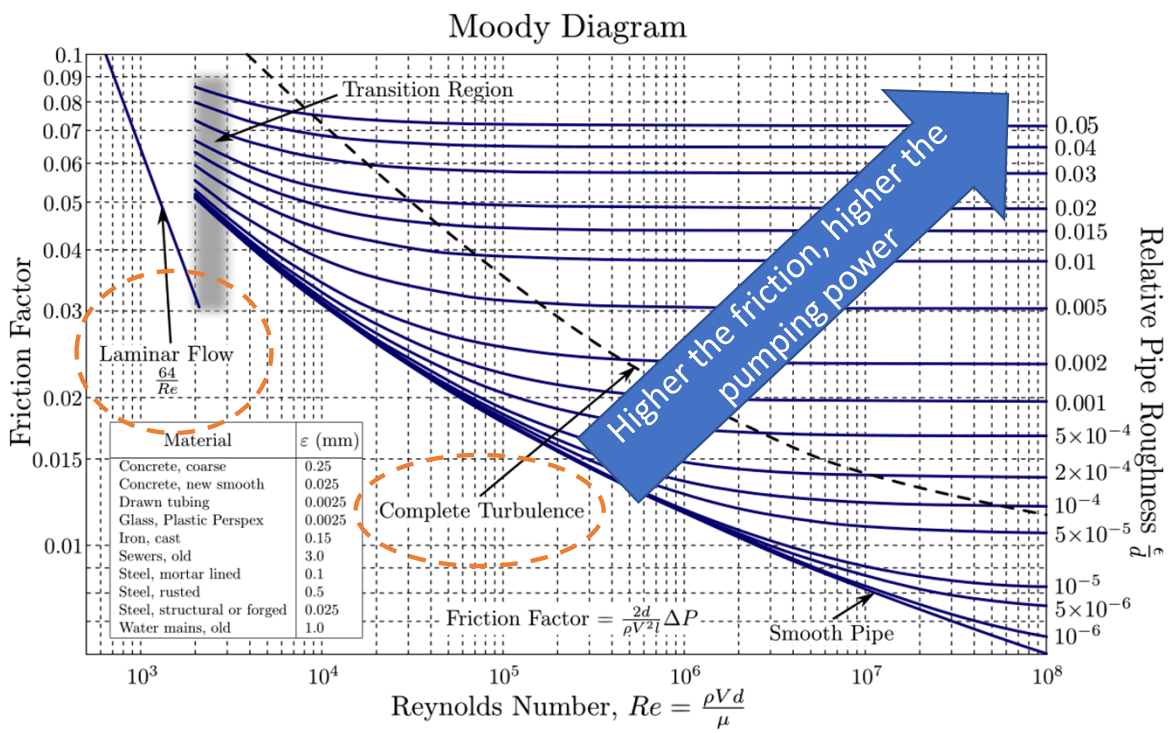
Presenter: Pejman Shoeibi Omrani

DRAGLOW

- MOOI subsidy program (funded by Netherlands Enterprise Agency, RVO)
- Drag reduction in geothermal and district heating systems to lower investment and operational costs
- 3 years program, 11 partners

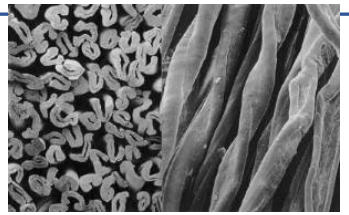
Pressure drop in pipe systems

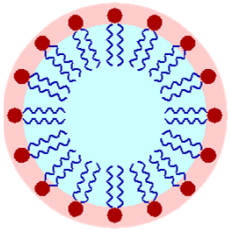
Friction in the pipelines

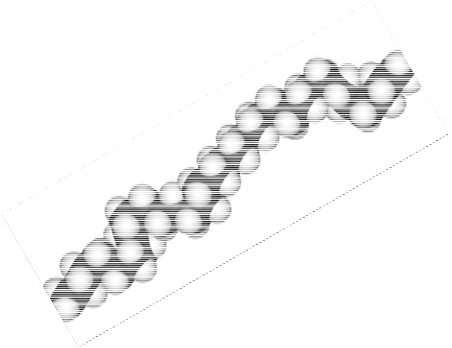


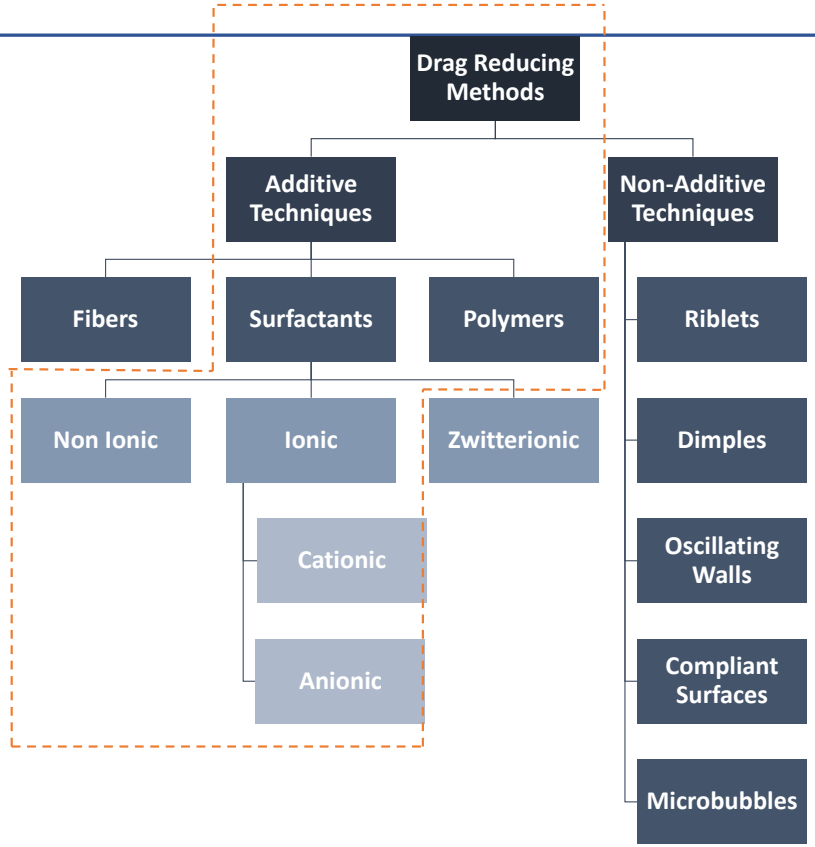
Material	ε (mm)
Concrete, coarse	0.25
Concrete, new smooth	0.025
Drawn tubing	0.0025
Glass, Plastic Perspex	0.0025
Iron, cast	0.15
Sewers, old	3.0
Steel, mortar lined	0.1
Steel, rusted	0.5
Steel, structural or forged	0.025
Water mains, old	1.0

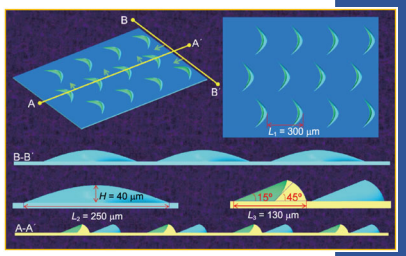
Drag reduction mechanisms

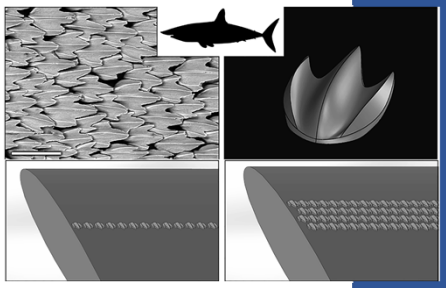


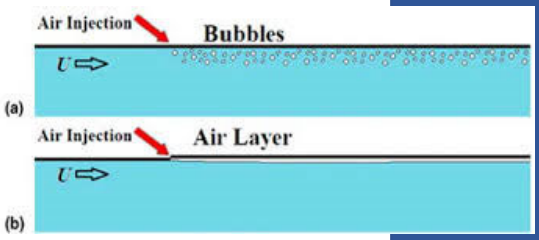






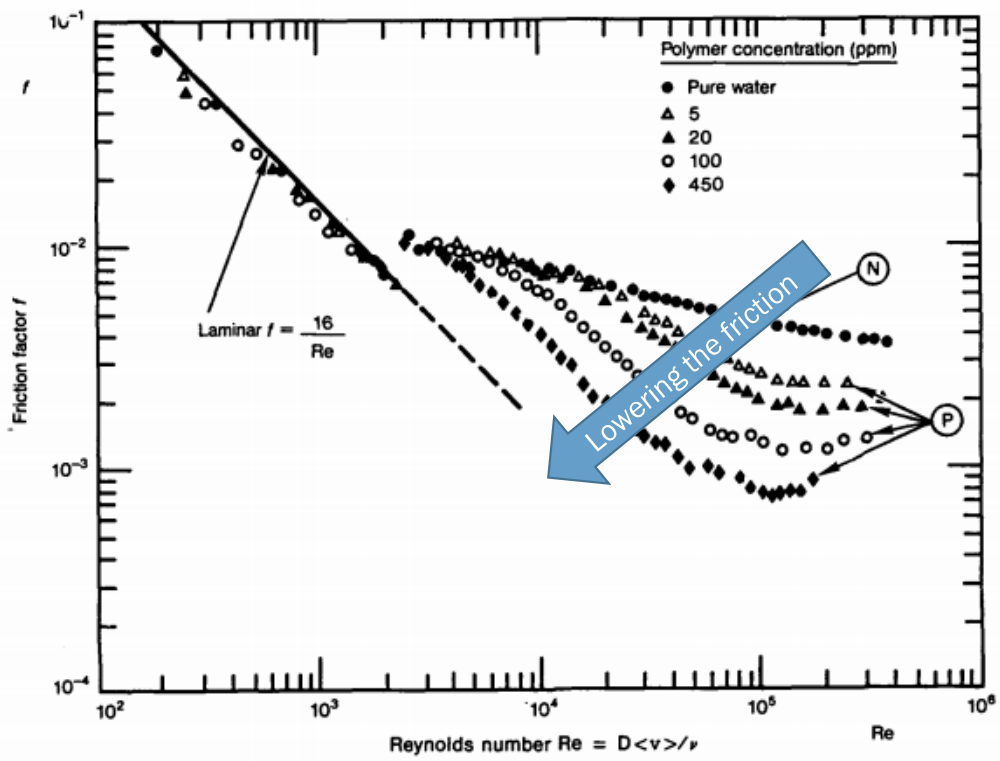


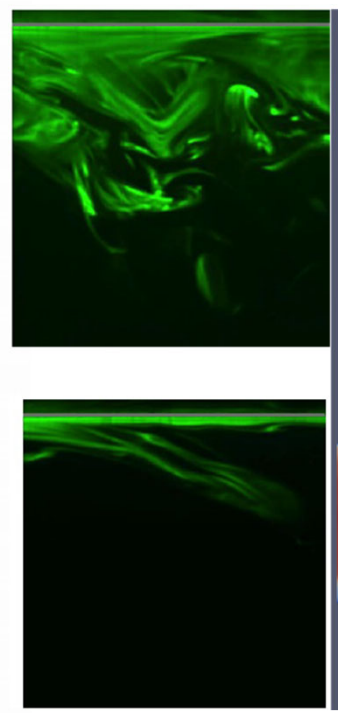


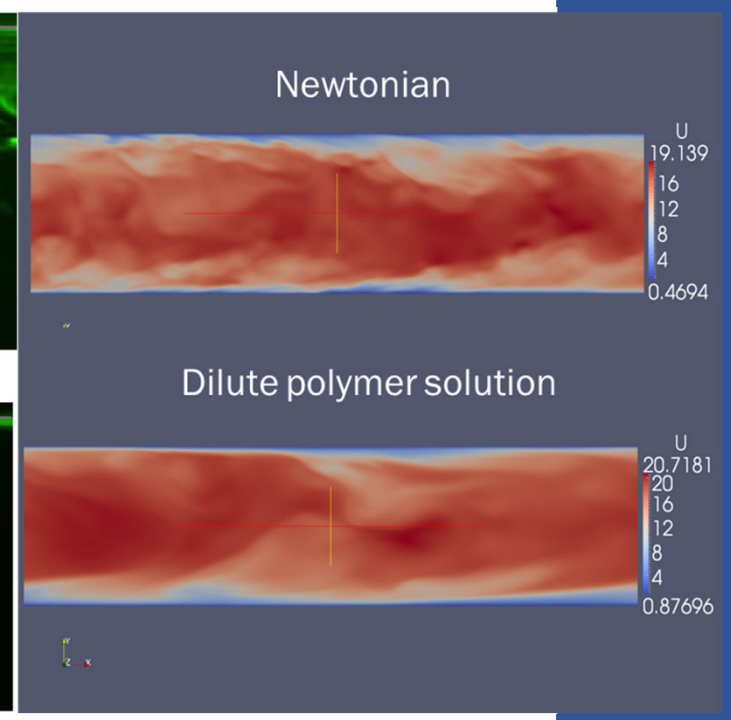


DRA and state-of-the-art

Discovered in 40s by Toms







DRA Mechanisms

Suppressing the turbulent structures

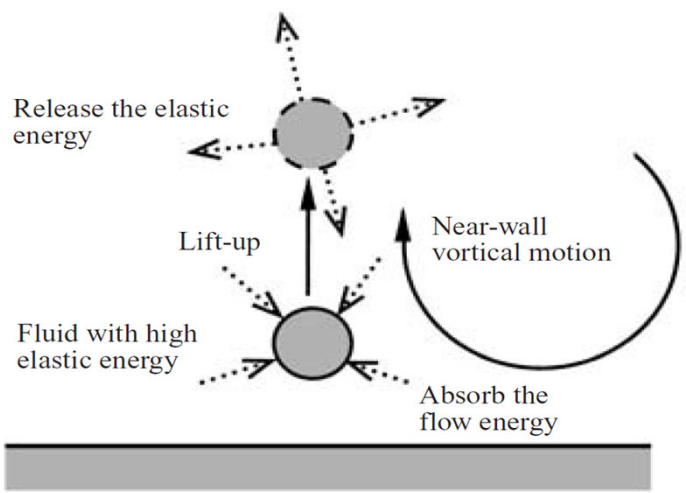
Reducing the velocity gradients near the wall region (also reduce heat transfer)

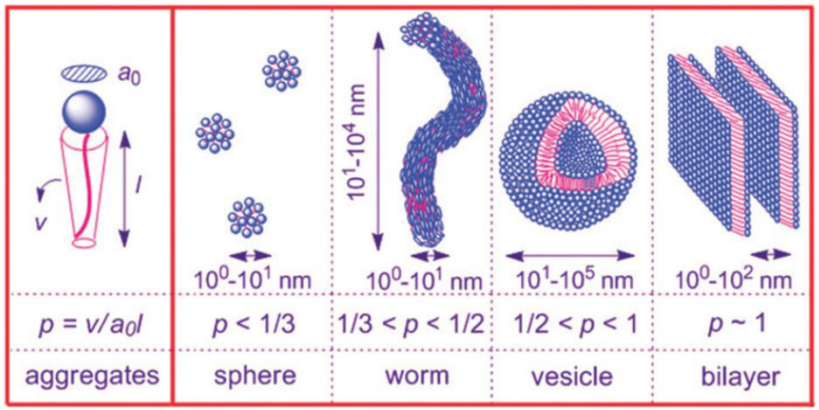
Polymer

- Most effective (small concentrations required)
- Measured drag reduction up to 80%!
- Degraded by large shear (pumps)

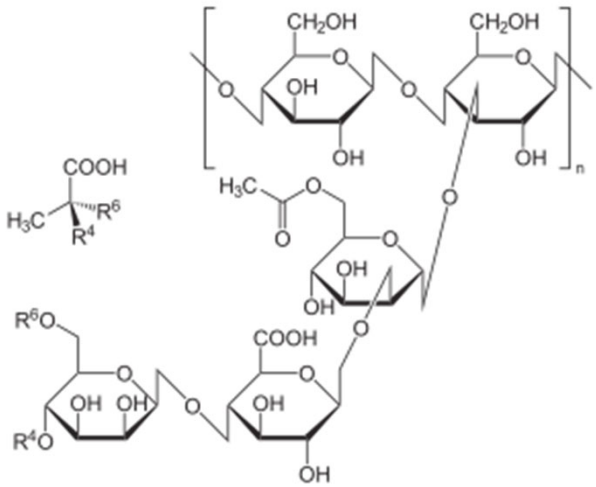
Surfactants

- Larger concentration + additive required
- Aggregates/micelles need to be formed



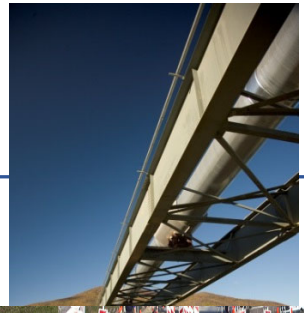


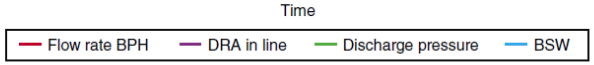
Example of DRA



DRA Applications

- **Trans- Alaska pipeline**;
  - 23% drag reduction with only 10 ppm
  - Removing one pumping station
- **Offshore installation**;
  - Oil flow: 18200 bbl/d to 23160 bbl/d (27%)
  - Slugging reduction
- **Fire fighting**;
  - Hamburg, New York and Paris
- **District heating/cooling;**
  - Curious? Next presentation ☺





E. D. Burger, et al., "Flow increase in the Trans Alaska pipeline through use of a polymeric drag-reducing additive", JPT, 1982
T. Dujmovich, A. Gallegos, "Drag reducers improve throughput, cut costs", 2005
Saeki, T., Flow Properties and Heat Transfer of Drag-Reducing Surfactant Solutions. Developments in Heat Transfer, 2011

Why geothermal and district heating?

- Transition towards gas-free neighborhoods
- Rapid growth in the developments of geothermal & district heating systems by 2050
  - Masterplan Aardwarmte: share of geothermal 22% of total heat demand
  - Up to 700 geothermal wells to be realized

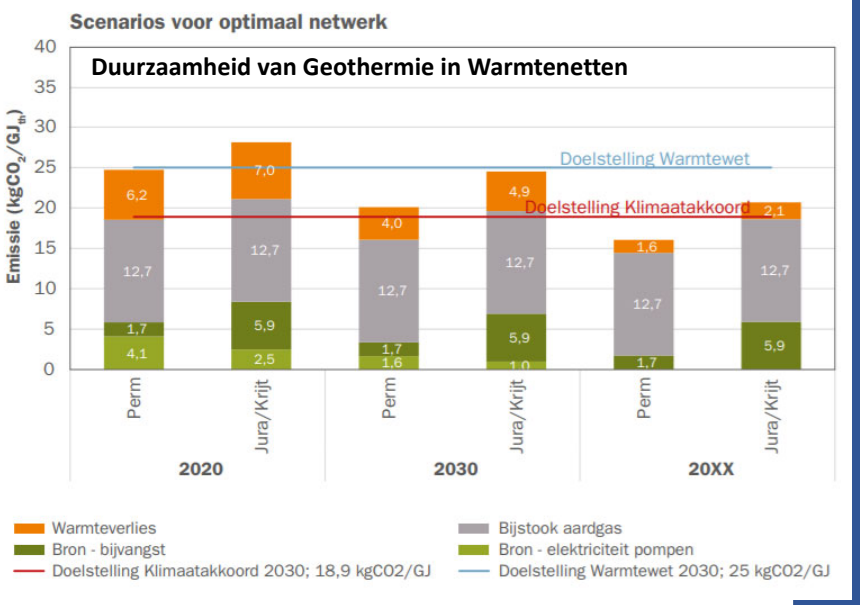
- Integral cost reduction options to be sought accelerating the growth of geothermal and district heating systems
  - CAPEX: Large diameters in wells and pipeline systems
  - OPEX: Pumping power consumption, thermal losses in the lines

- Smaller diameters to reduce the cost of manufacturing and drilling by 15-20%, reaching 500-700 M€ (in view of 700 doublets in 2050)
- Smaller the diameters, larger the pumping power to realize the same thermal power
- Reduction of pump power in existing fields

Could green and environmentally friendly DRA be a solution to this challenge?

Potential gain

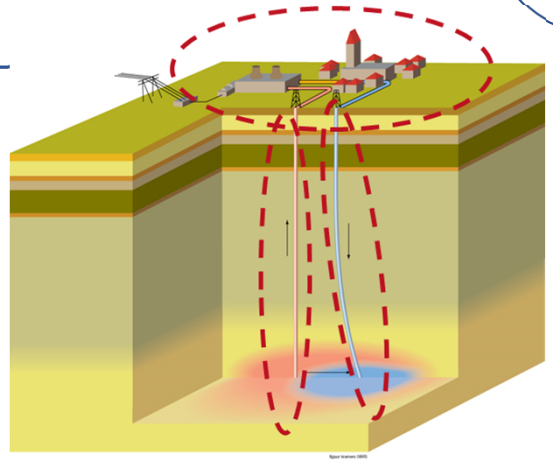
- Reduction in the pumping power of existing geothermal and DHC
- Reduction in the CAPEX (pipe/casing size) of new systems
  - Cost saving due to lower cost of materials for pipes, connections, …
  - Smaller excavating equipment and energy consumption
- Lowering the heat losses in the transport line
- Reduction in life-cycle CO2 footprint



Application to the heat supply and transport

- Suitability and effectiveness of available environmentally friendly DRAs for geothermal and DH conditions

- Differences in the type and requirements of the system
  - Temperature (up to 100 C in Geothermal, up to 120 C in DHC)
  - Broad temperature ranges
  - Salinity and thermal stability
  - Mechanical degradation due to ESP and pumps
  - Effectiveness while injected with other chemicals (inhibitors)
  - Heat transfer reduction
  - Impact on geothermal reservoirs
  - Durability of materials (DHC)
  - …



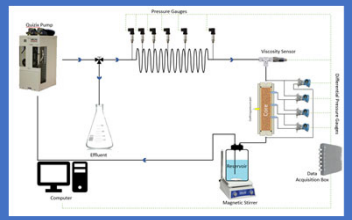
Brine component	Concentration (mg/l)	
	ROSL formation	Delft sandstone formation
Na (Sodium)	40,000-88,000	8,000-50,000
K (Potassium)	600-2,500	150-100,000
Ca (Calcium)	7,000-17,000	350-8,500
Mg (Magnesium)	1,000-2,200	240-1,200
Ba (Barium)	3-7	4-100
Sr (Strontium)	200-650	200-450
Fe (Iron)	25-700	0-100
Cl (Chloride)	8,000-160,000	12,000-85,000
SO_4 (Sulphate)	180-600	50-2,500
Pb (Lead)	0-3	0.01-13

Approach

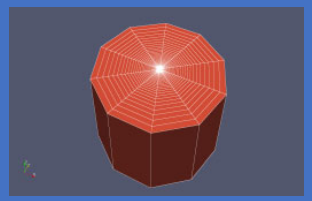
Chemical analytical and material properties testing

Large scale flow loop performance assessment

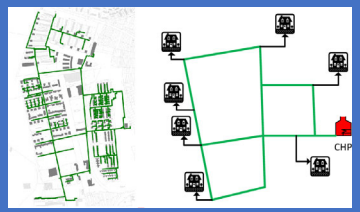
Flow in porous media testing



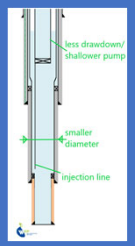
Reservoir and near-wellbore flow modelling



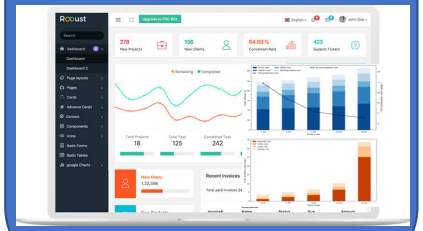
Heat networks system modelling and calibration



Guidelines for pilot and deployment

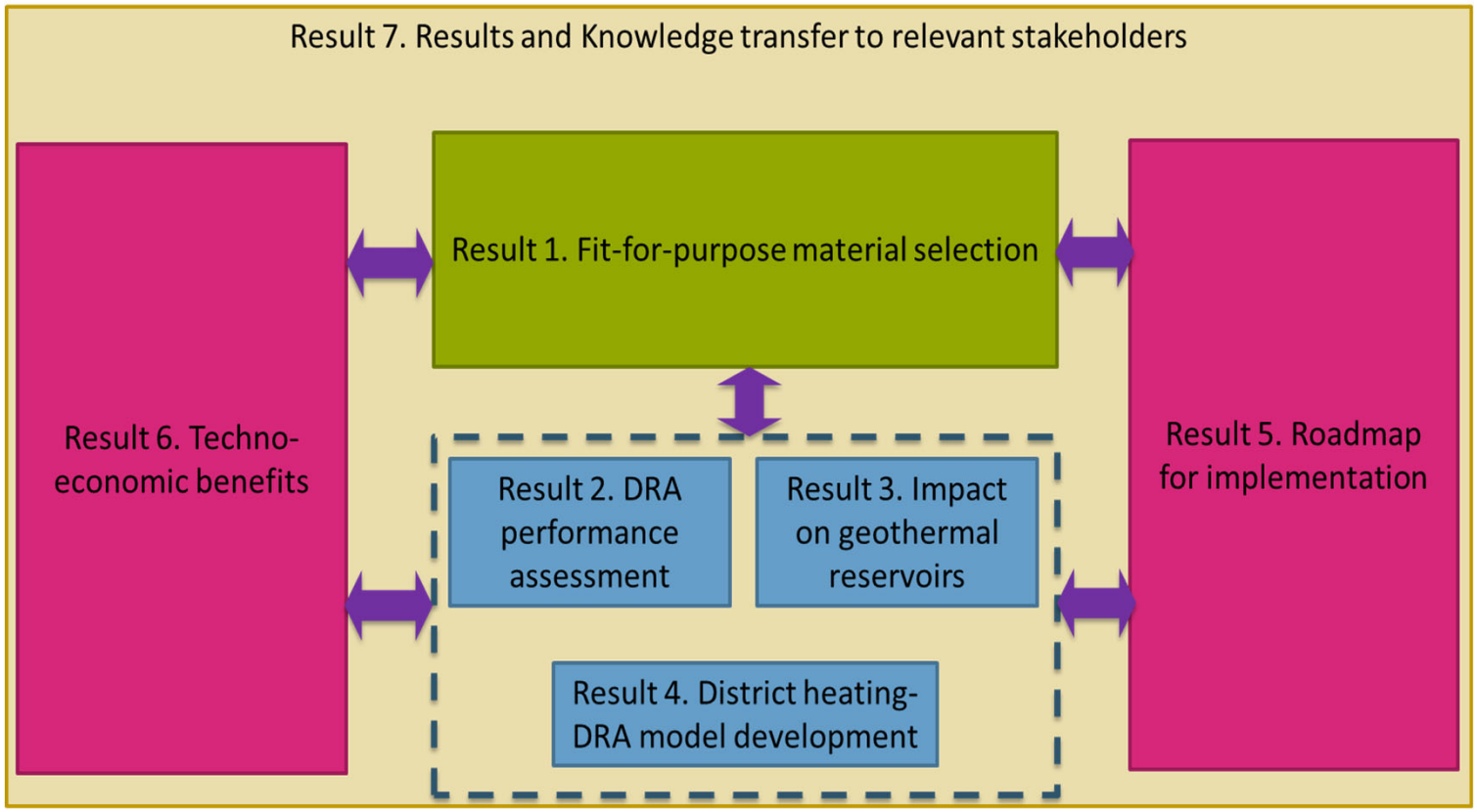


Techno-economic analysis



Dissemination

RESULTs' Interconnection

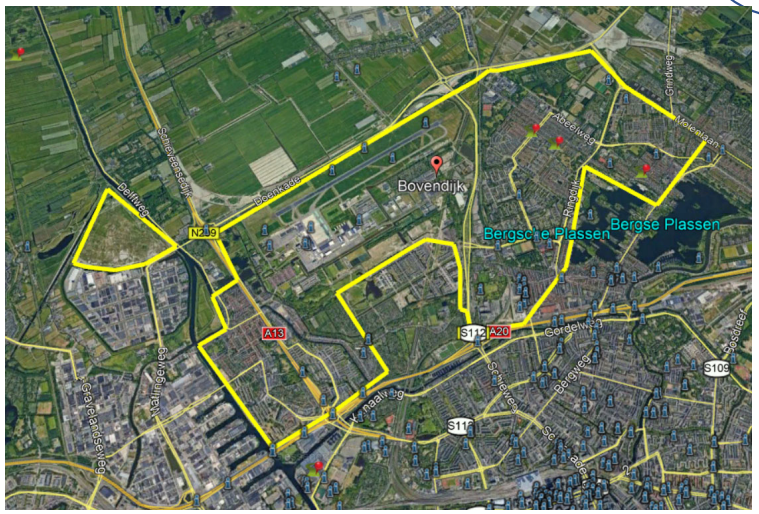


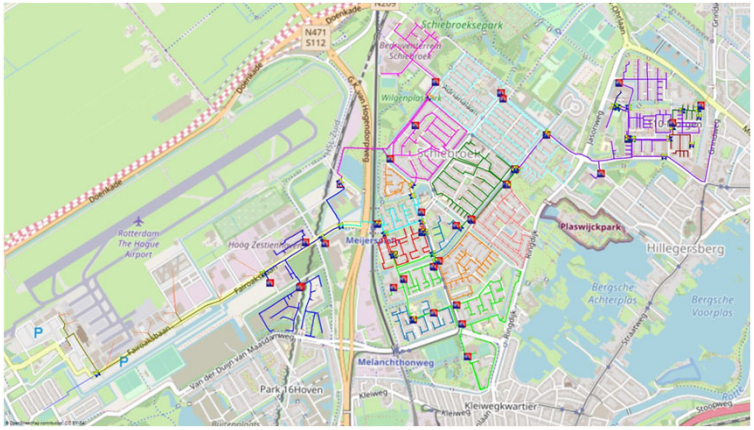
(Numerical) Demonstration case

- A reference case
  - 16000 houses/buildings
  - No available heat network
  - 2 data centers
  - Geothermal potential
  - Local PV solar panel developments
  - Heat demand ~ 470000 GJ/year

- ~ 80 km of the pipeline

- The impact of DRA will be evaluated on
  - CAPEX (piping/casing sizes, drilling and installation, insulation, number of pumping stations)
  - OPEX (pumping power, heat loss)
  - CO_2 saving





DRAG LOW

For more information

https://www.draglow.nl/