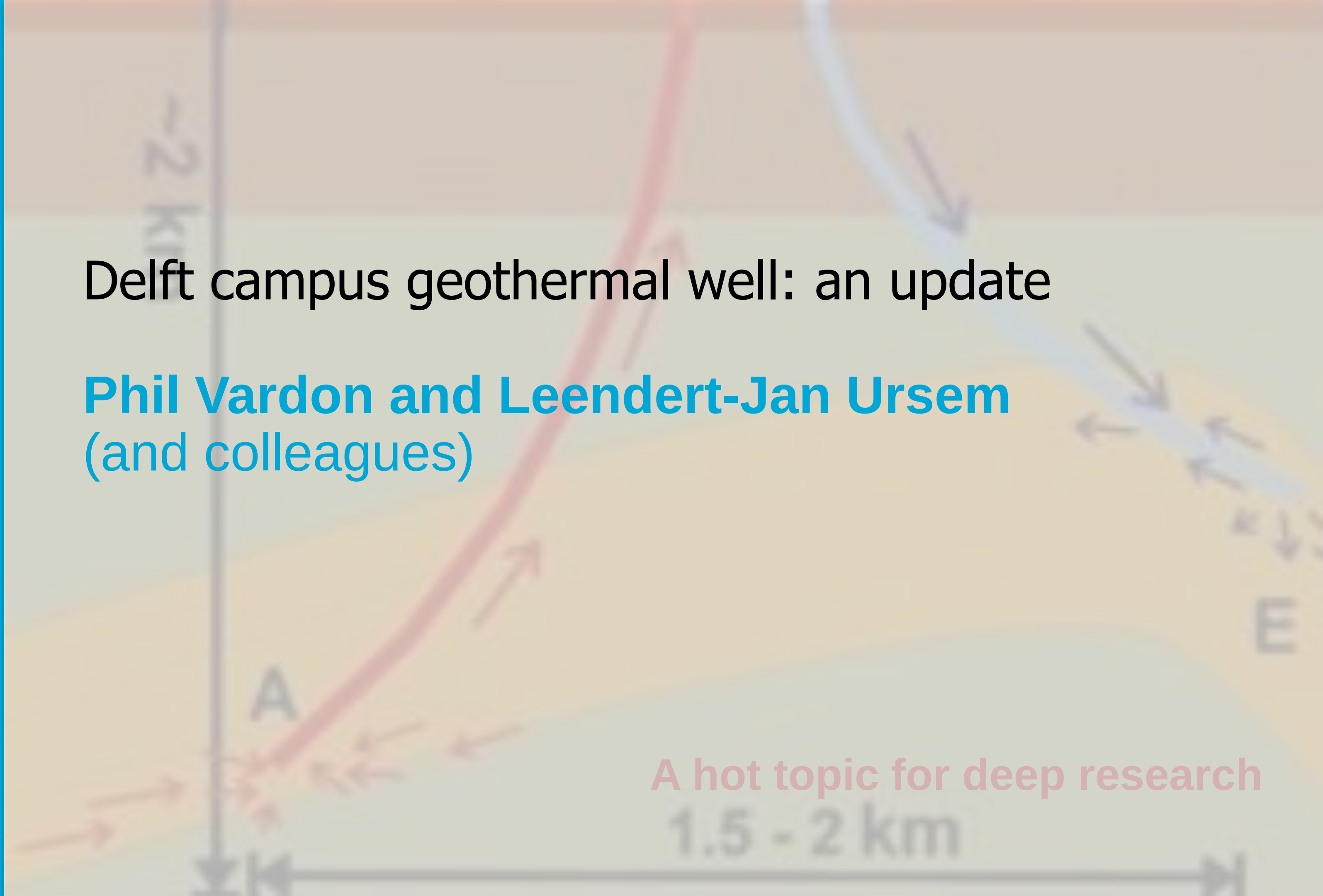
Delft campus geothermal well: an update

Phil Vardon and Leendert-Jan Ursem
(and colleagues)

A hot topic for deep research



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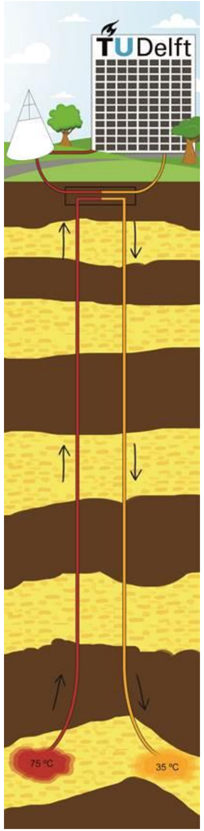
DAPwell: Living laboratory

Science

Operations



Knowledge

Heat

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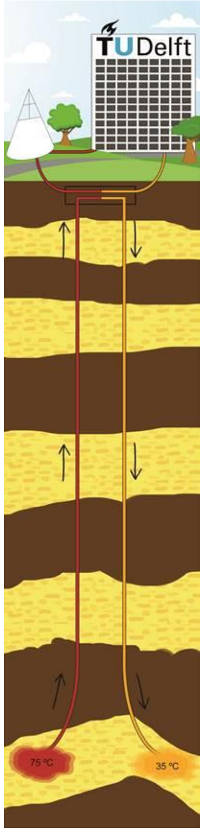
DAPwell: Living laboratory

Science

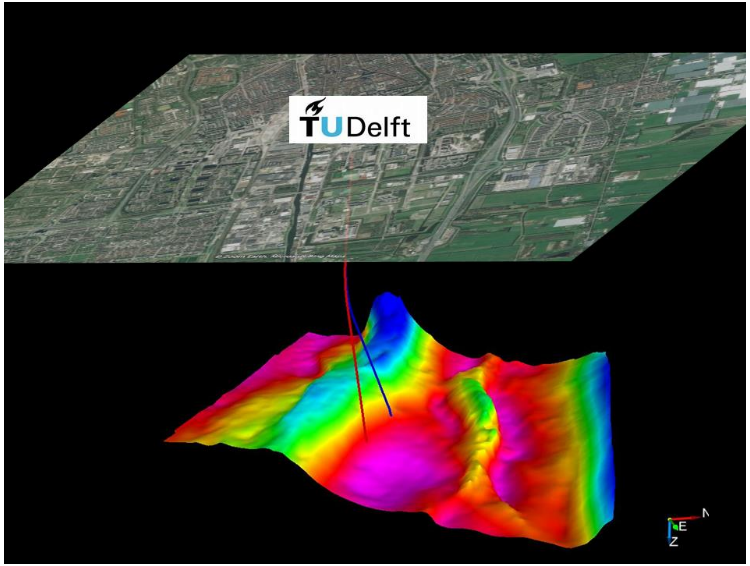
Operations



- ~€6m of research infrastructure planned.
- Operational funding (PhD students).

- Commercial business plan.
- Phased implementation: supply heat to campus, extend heat grid, supply heat outside campus.
- Company in process of being formed, with university and other partners.

Research: DAPwell



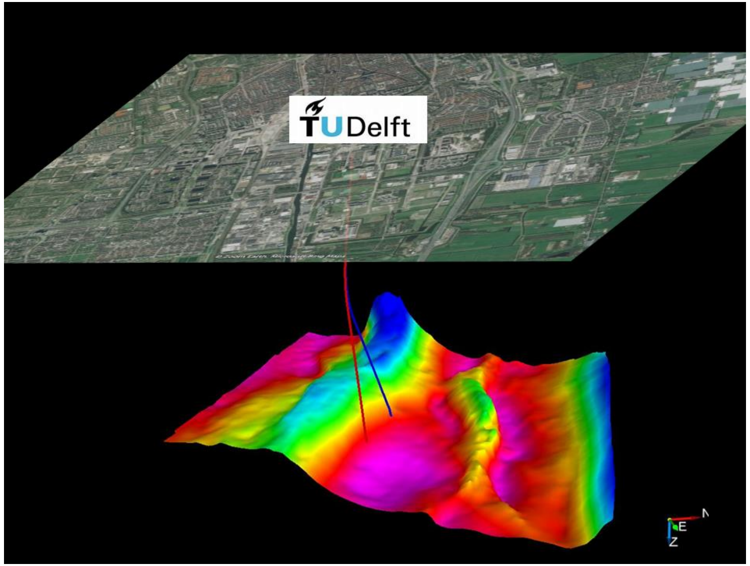
Current research questions

How much energy can be delivered? What is the long term flow and heat flow behaviour?

How can we best monitor geothermal projects? For energy, for surface impacts.

How do (new) materials perform? Geothermal fluids, geochemical processes, reservoir material, casing materials.

Research: DAPwell



Research activities

Prediction: models, control

Behaviour: thermo-hydraulic-chemical

Geology: cores >300m

Monitoring: geophysics, fibre optics, flow, highly monitored well

Impact of activities at surface

Materials: testing casing material, monitoring of processes

Integrated: to campus, urban

Progress and planning

The facility is being put in place

October 2021

- Signing of various contracts with partners
- Long lead items procurement begun

November 2021

- SDE++ re-submission (ongoing process, but dates after dependent)

February to June 2022

- Realisation of drilling location
- Detailed design complete
- Heat and gas delivery contracts updated
- Open Warmtenet Delft decision made
- Central heat pump centre decision made
- GTD final decision made

August 2022

- Drilling first well

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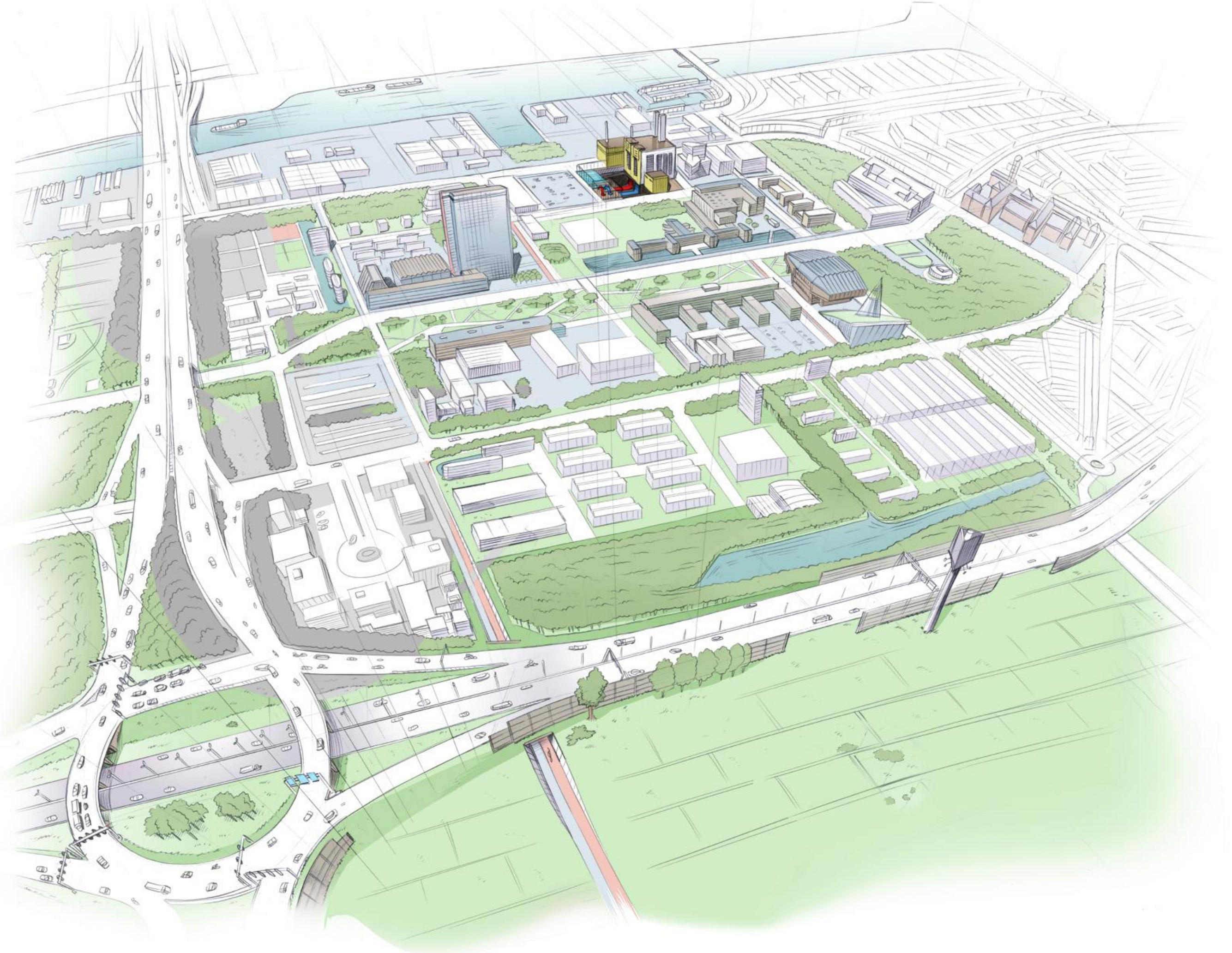
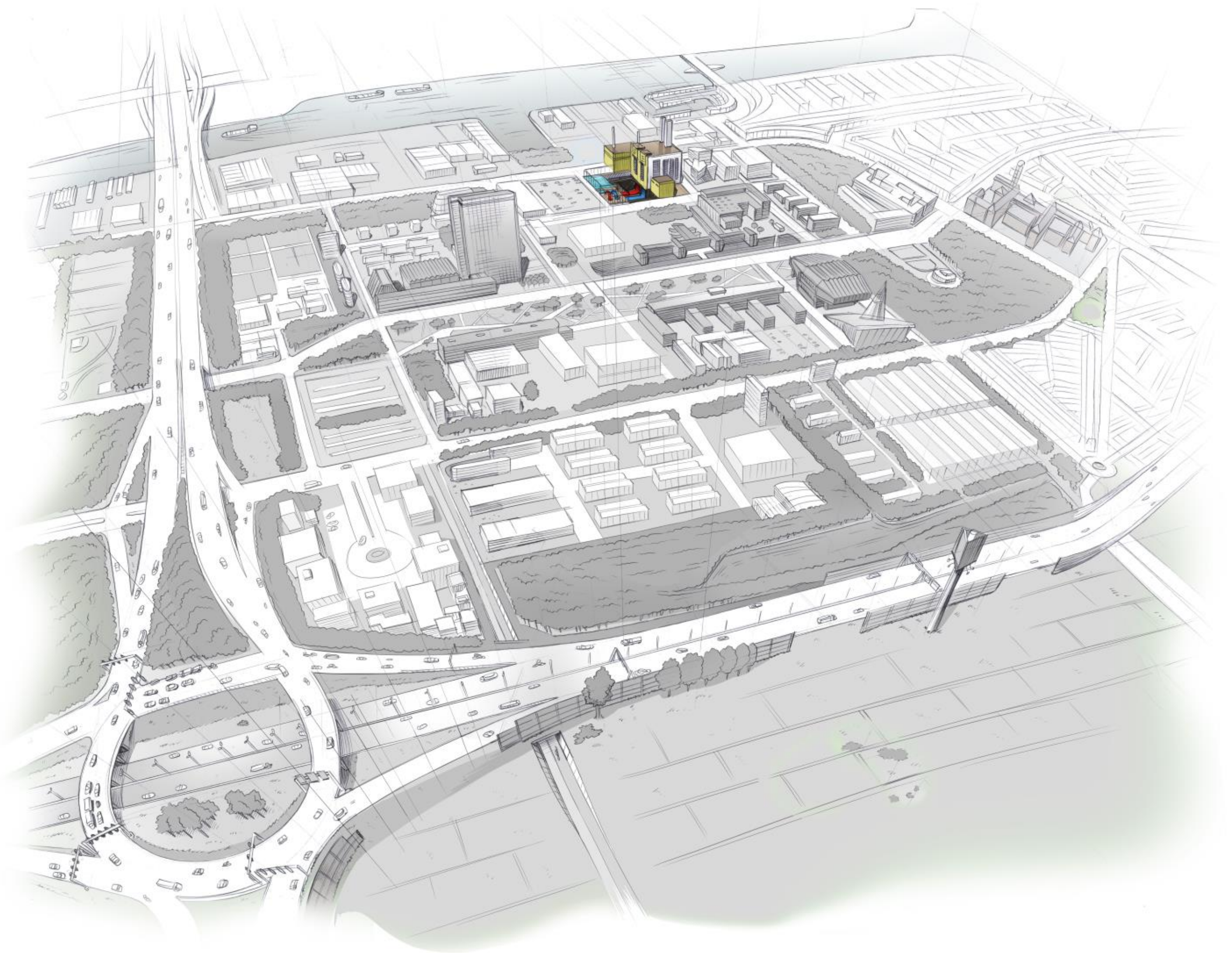
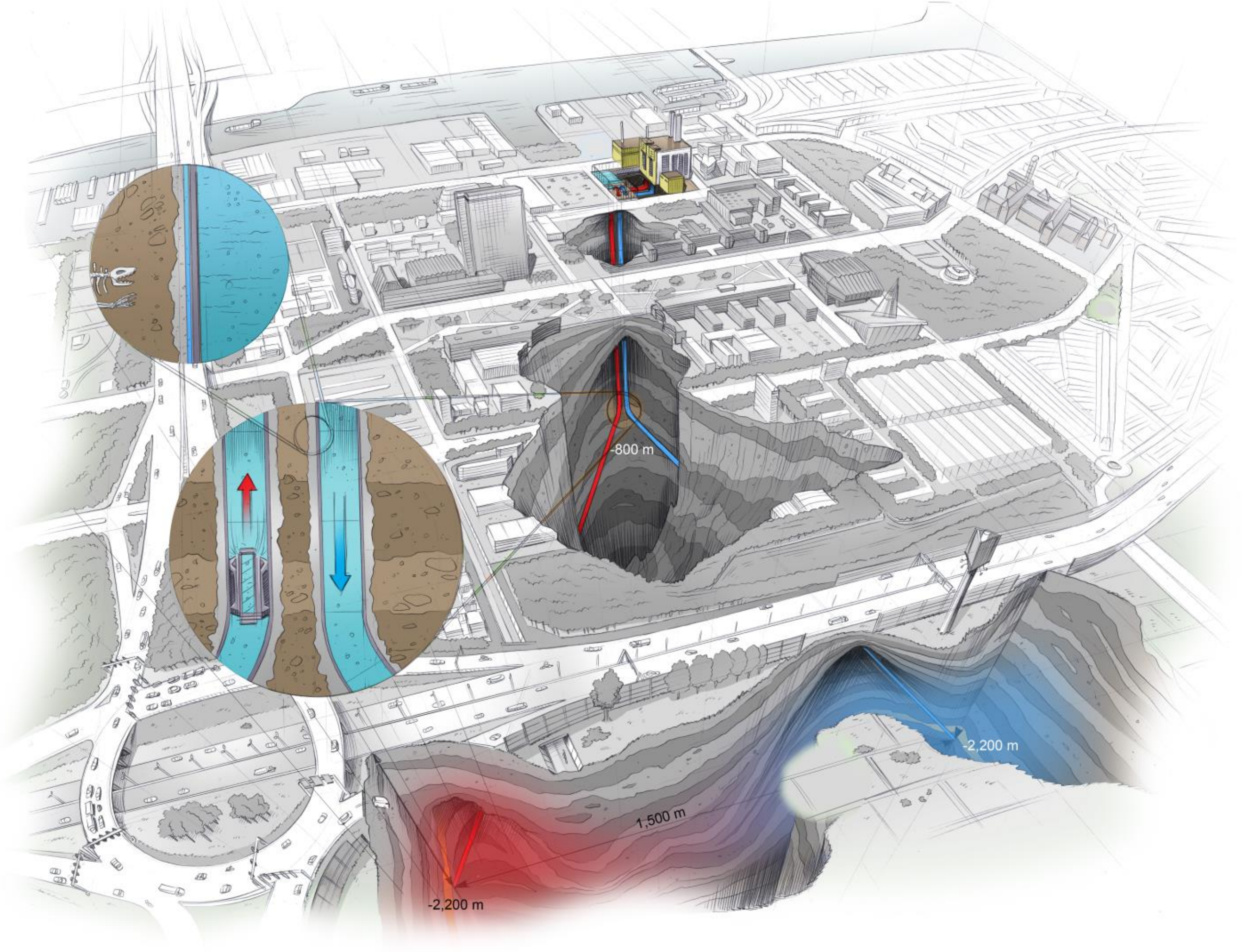


Stephan Timmers, Total Shot Productions





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Coring

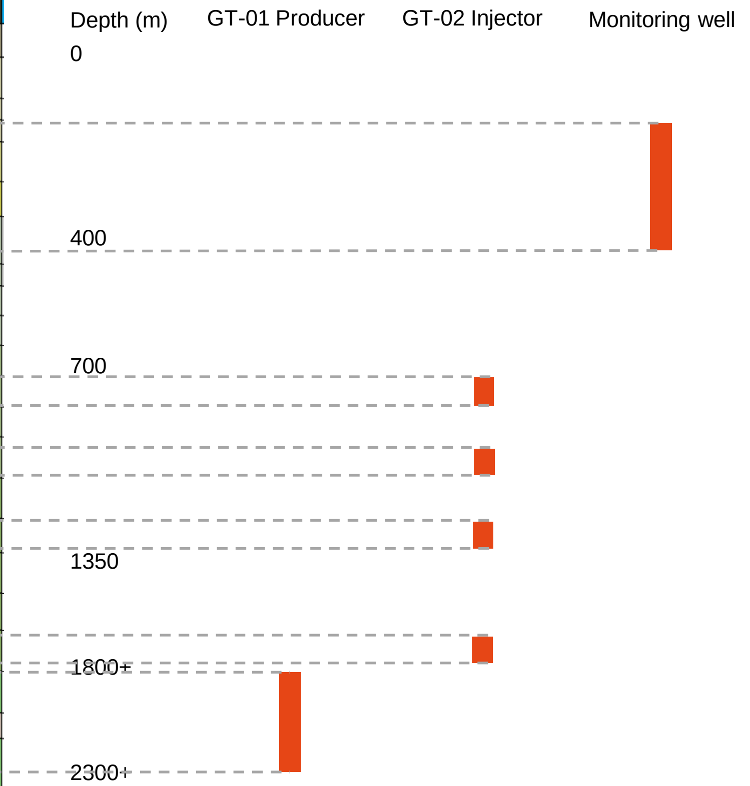
Target reservoir {

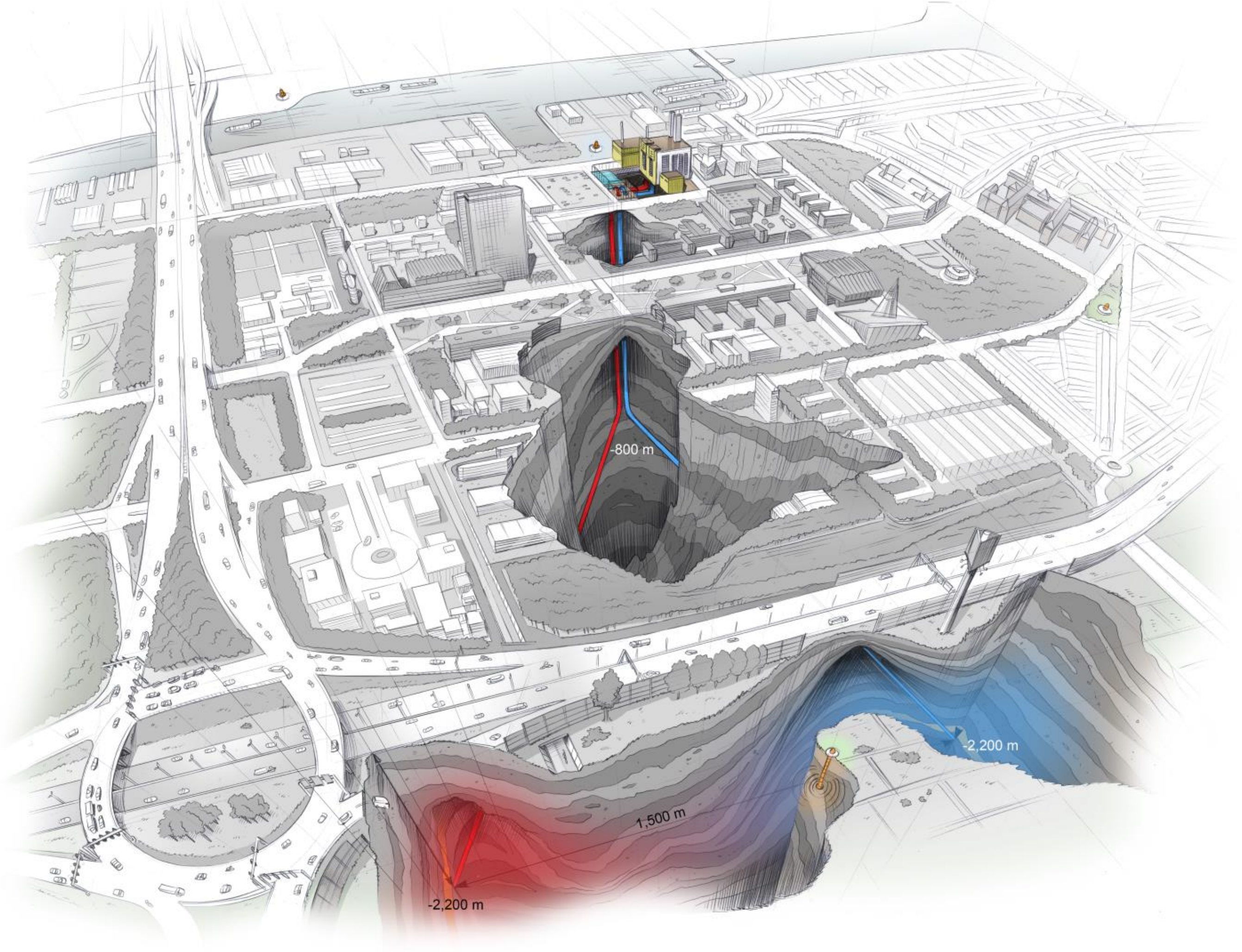
Lithostratigraphic Column Delft

Julien Smeulders

Group	Period	Formation	Epoch/ Age	Member	Lithology
Upper North Sea NU	Quater- nary	Maassluis NUMS	Early Pleistocene		Deposits of coastal sands, very fine to medium coarse, calcareous, shell and wood bearing, mica rich. Within the Formation some sandy layers of clay or clay lenses are present. GR-response goes slightly up going into the Oosterhout Fm.
	Tertiary	Oosterhout NUOT	Pliocene		Succession of sands, sandy clays, and grey & greenish clays. The glauconite content is much lower than that of the Breda Fm.
		Breda* NUBA	Miocene		Sequence of marine, glauconitic sands, sandy to silty clays. In places a green to black glauconite-rich layer occurs at the base.
Middle North Sea NM		Rupel NMRF	Oligocene	Rupel Clay* NMRFC	Heavy grey to dark brown clays that become more silty towards basis and top. It is rich in pyrite, contains hardly any glauconite and calcium carbonate tends to be concentrated in the septaria layers. The clays grade into sands towards the basin edge.
Lower North Sea NL		Landen NLLF	Eocene	Landen Clay NLLFC	Generally dark-green, hard, flaky clay, somewhat silty, containing glauconite, pyrite and mica. The basal part of the member can be marly and therefore lighter in colour.
Chalk CK	Upper Cretaceous	Ommelanden CKGR	Turonian - Danian		Succession of white, yellowish-white or light-grey, fine grained limestones or limey chalks, in places argillaceous. Layers of chert nodules are common over thick intervals. In the base section, tongues of sand can occur and karst could have been developed!
		Texel CKTX	Cenomanian	Plenus Marl CKTXP	Interval of white to light-grey, locally pinkish limestones and marly chalks with some marly intercalations.
				Texel Marlstone CKTXM	White to light-grey (locally pinkish) limestones, marls and marly chalks.
				Texel Greensand CKTXG	Greenish, glauconitic, calcareous sandstones with intercalated marls.
Rijnland KN	Lower Cretaceous	Holland KNGL	Late Albian	Upper Holland Marl KNGLU	Light-grey and red-brown marls, and is characterised by a carbonate content which gradually increases towards the top.
				Middle Holland Claystone KNGLM	Grey and/or red-brown calcareous shaly claystone with a distinctly lower lime content than the under- and overlying members.
			Early Albian	Holland Greensand KNGLG	Alternation of greenish grey, very glauconitic, very fine- to fine-grained, argillaceous sandstones, locally silt-stones with calcareous or sideritic cement, and olive-grey claystones.
			Early Aptian	Lower Holland Marl KNGLL	Grey and red-brown marl or calcareous, fissile claystone, frequently with intercalated bituminous claystone beds. On wire-line logs the unit is recognisable by its relatively low GR-response.
		Vlieland Sandstone KNNS	Late Barremian to Early Aptian	De Lier Sandstone KNNSL	Alternation of thin-bedded, very fine- to fine-grained argillaceous sandstones, generally glauconitic and lignitic, and sandy claystones, commonly glauconitic and with shell fragments and frequent bioturbation.
			Late Barremian	Vlieland Clay KNNCM	Dark brownish-grey to grey claystone. Mica and very fine lignitic matter are common. The formation is very silty to sandy with many intercalated siltstone and very fine sandstone beds.
			Late Hauterivian to Mid Barremian	Berkel Sandstone KNNSB	Sandstone, light-grey, very fine- to fine- and medium- to coarse-grained, locally gravelly, lignitic, locally glauconitic or with sideritic concretions. Especially in the upper part of the member calcareous cemented beds are common.
			Late Hauterivian to Early Barremian	Berkel Sand/Claystone KNNCC	Alternation of fine-grained, argillaceous sandstones and brown-grey silty to sandy claystones. Locally sideritic concretions are present.
			Hauterivian	Rijswijk Sandstone KNNSR	Light- to medium-grey sandstones with a very fine to medium and locally gravelly grain size; mica, lignitic matter and siderite concretions are common. Locally, lignitic claystone beds are present.
Schieland SL		Nieuwerkerk SLDN	Late Valanginian to Early Hauterivian	Rodenrijs Claystone SLDNR	Medium- to dark-grey, silty to sandy lignitic claystones and lignite/coal beds. Locally mollusc shells are present. Siderite spherulites and concretions are common. The member shows a characteristic serrate pattern on wireline logs.
			Valanginian	Delft Sandstone SLDND	Light-grey massive sandstone sequence, fine to coarse-gravelly, fining upward, lignitic.
			Ryazanian to Valanginian	Alblasserdam SLDNA (incl. Pijnacker Sandstone)	A succession of dark to light grey, red and variegated clay- and siltstones, fine to medium grained sandstones with bed thicknesses up to a few metres, and massive, thick-bedded, coarse grained sandstones. Coal and lignite beds are associated with the grey claystones. Dispersed lignitic matter, siderite spherulites and concretions are common.

Figure 4: Lithostratigraphic columns of producer and injector





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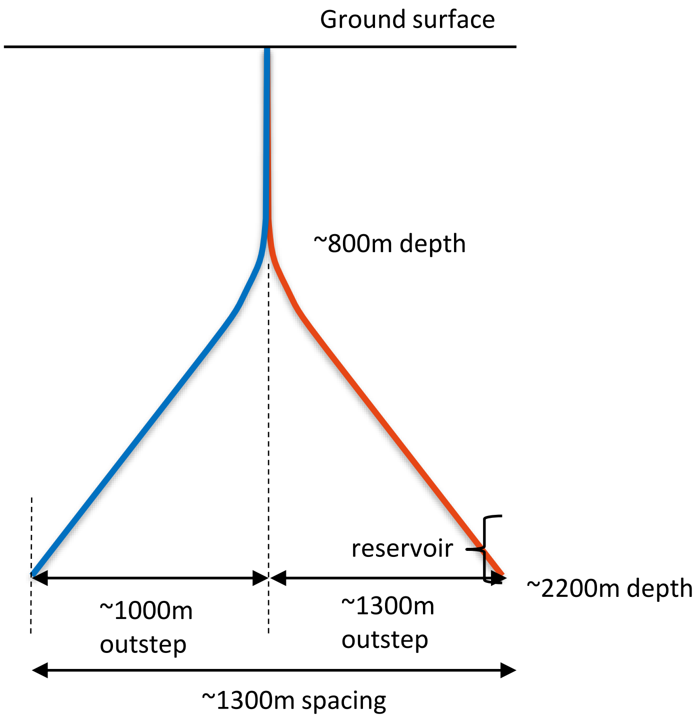
Concept (monitoring) wells locations



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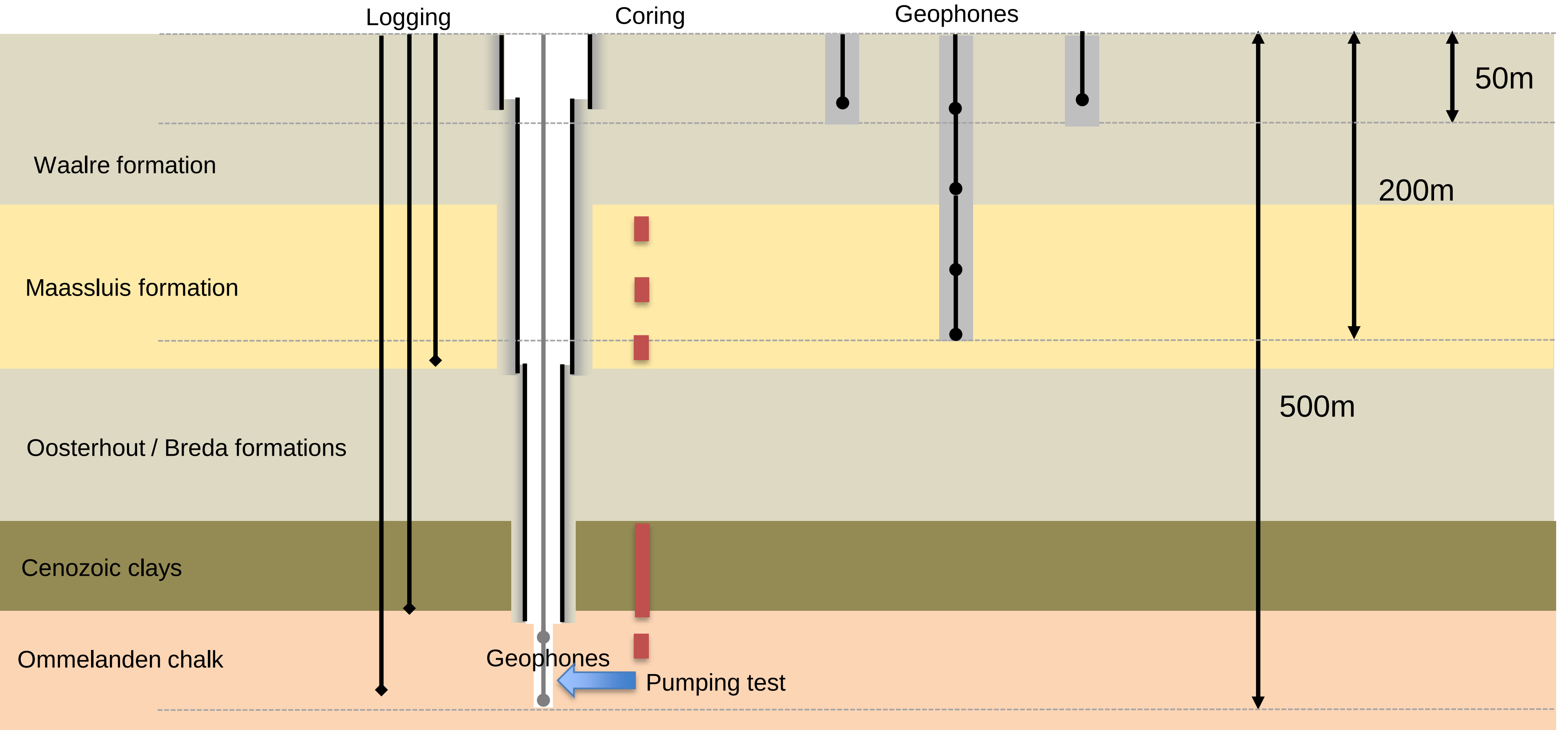
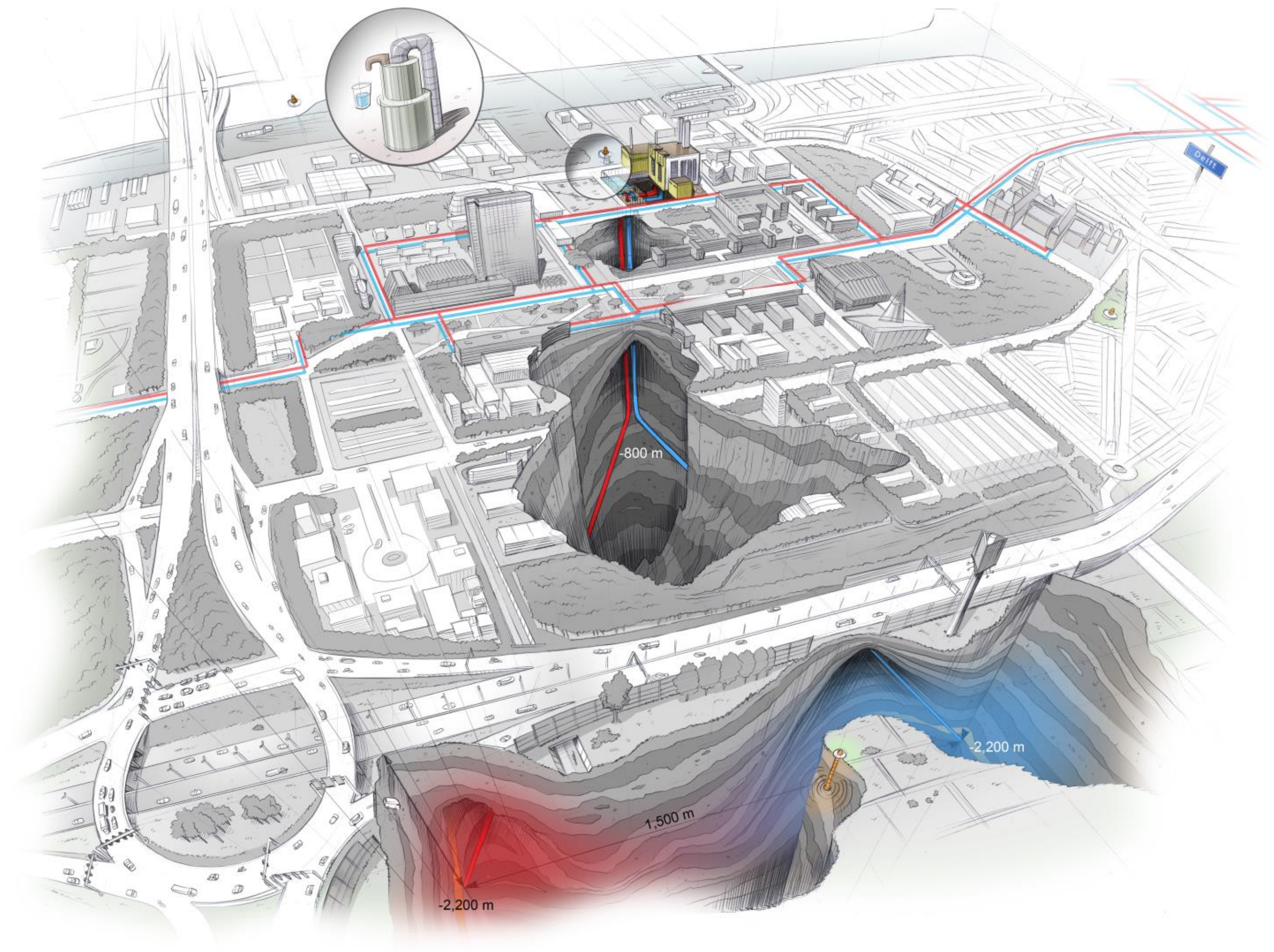
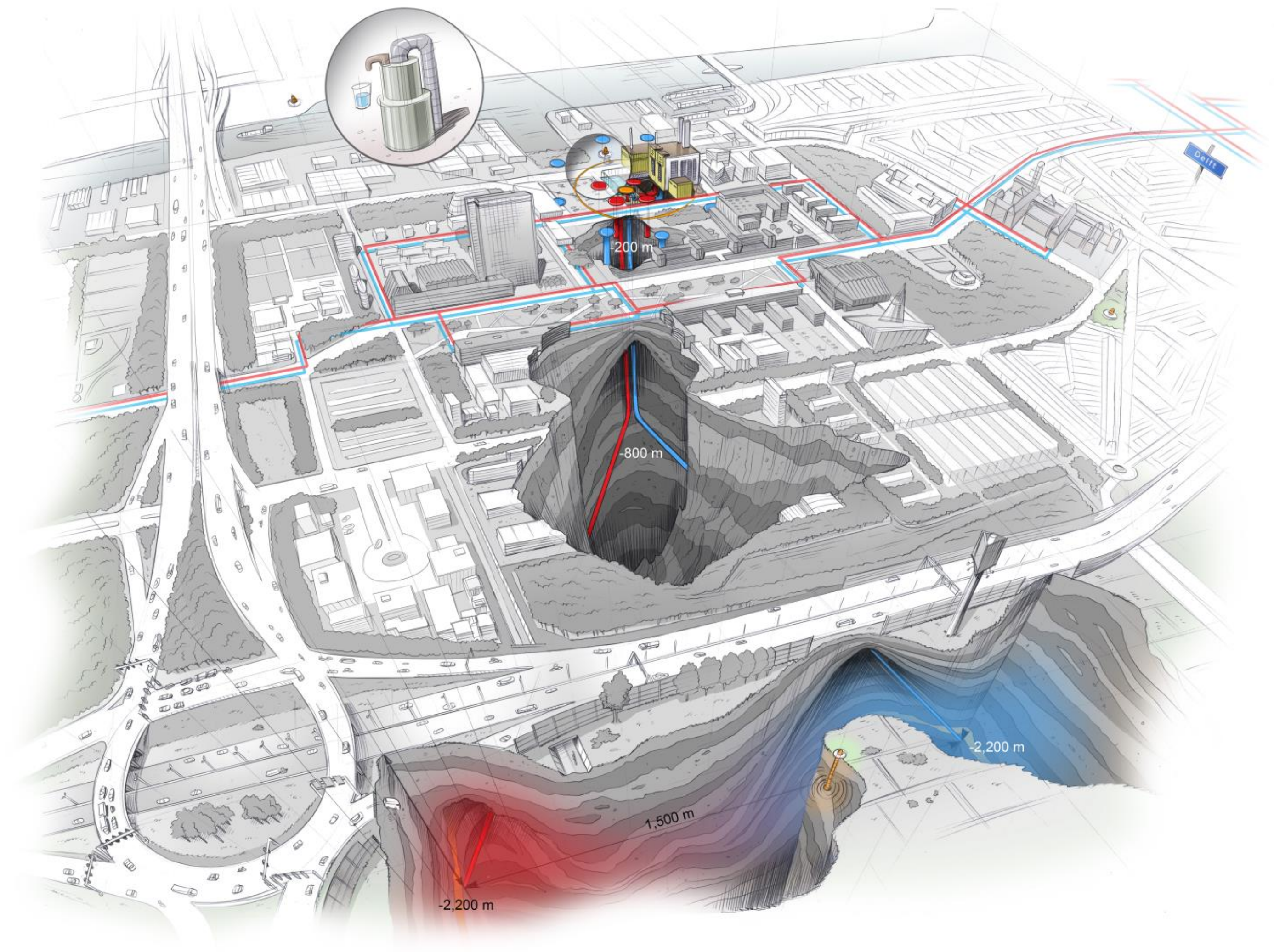
Multi-use Monitoring well – Delftse Hout




Delft
-800 m
-2,200 m
1,500 m
-2,200 m



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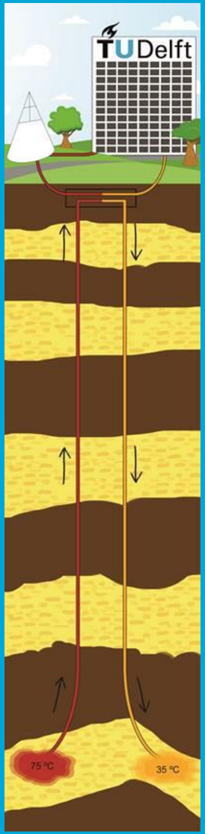
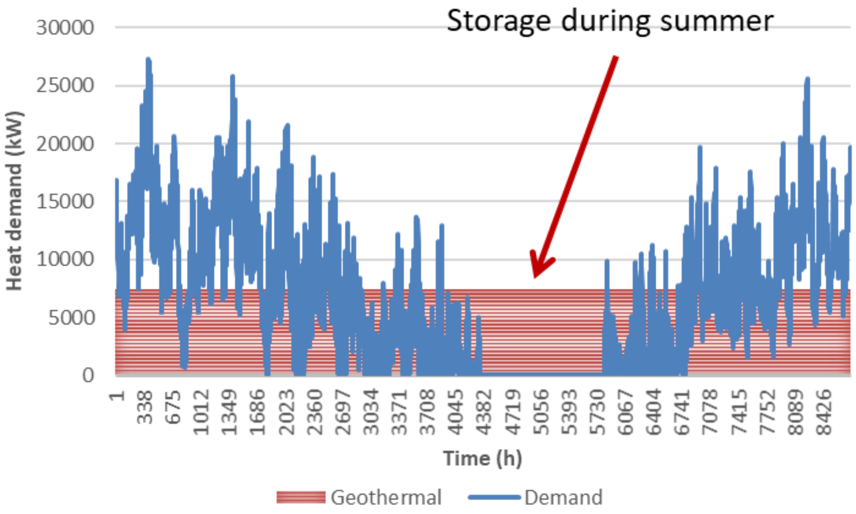
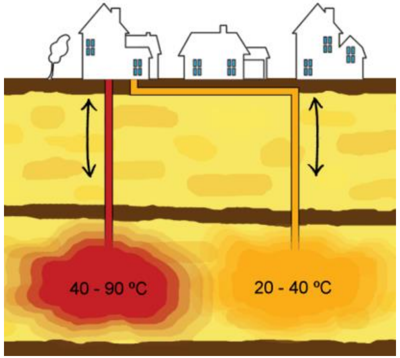


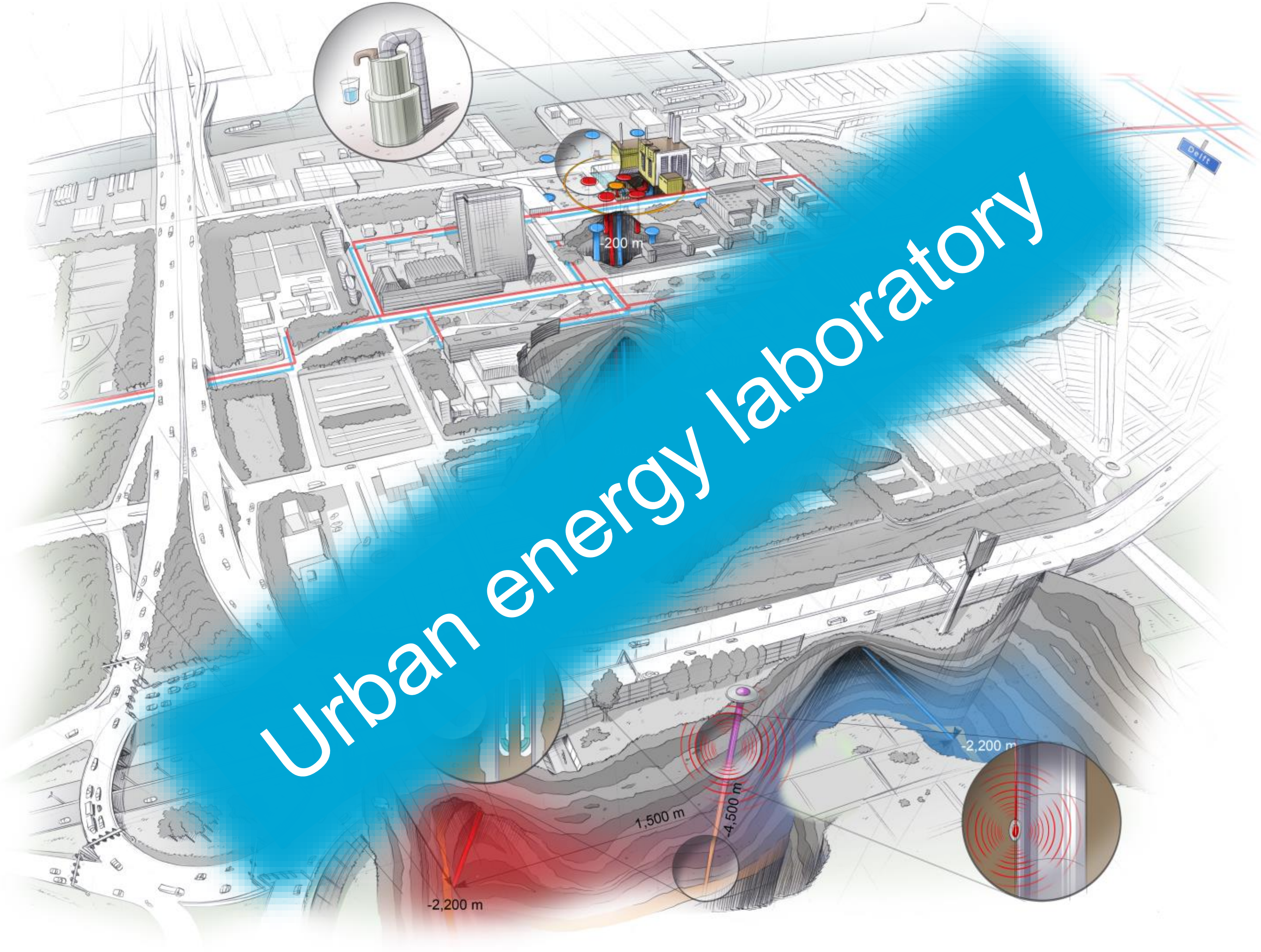
HT-ATES





- Projections:
  - Geothermal well reduces heat CO_2 emissions by **~60%**
  - HT-ATES reduces CO_2 by **~30%**
  - Useful heat supply increased from project by up to **~70%**
- SDE++ ‘friendly’

Urban energy laboratory



A geothermal campus

For a geothermal country?

A hot topic for deep research

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Research activities

The initial facility is being put in place – all ideas welcome

- Focus now on baseline / operational measurements
- Various other (more fundamental) projects connect
- Other projects are being applied for….its a 30 year project

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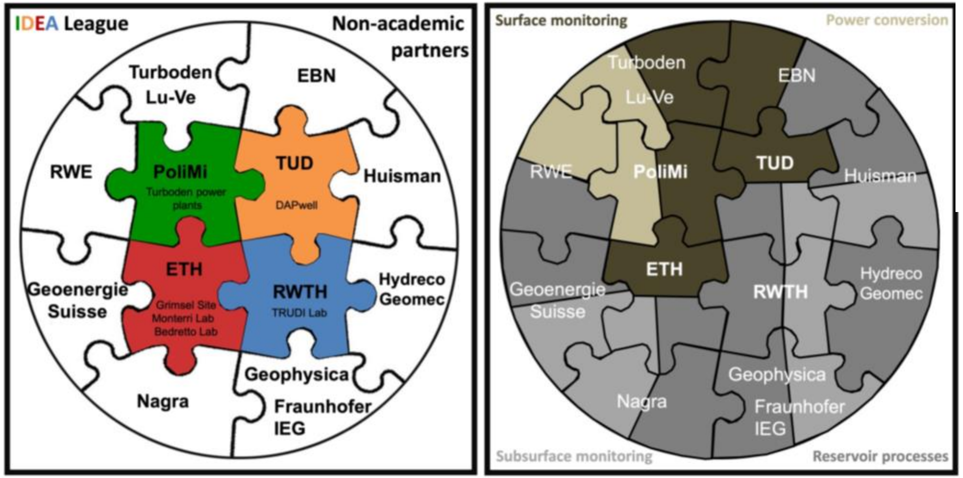
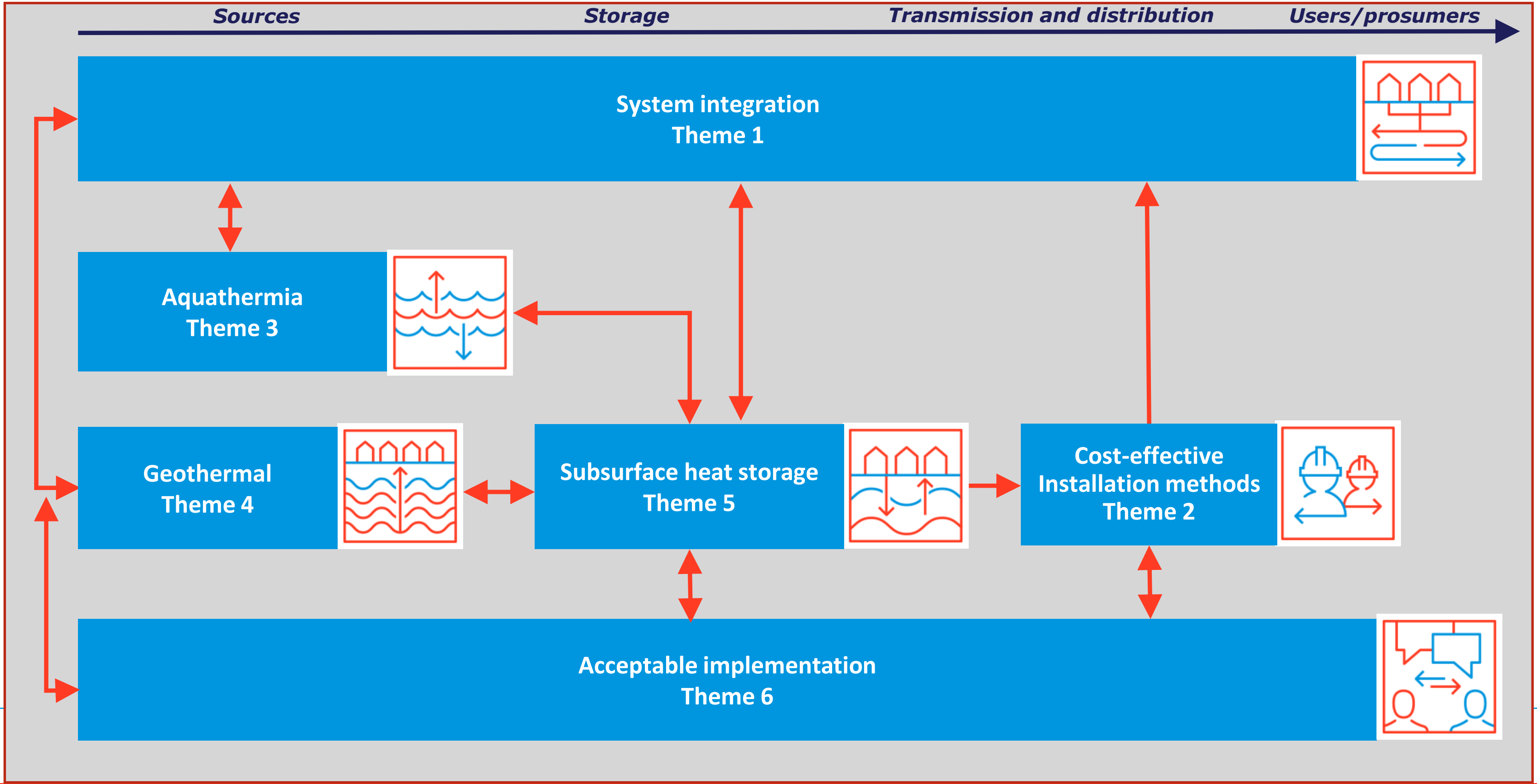
EASYGO – European Innovative Training Network ITN Project

Efficiency **a**nd **S**afety in **G**eothermal **O**perations

- Innovative Training Network
- European Joint Degrees (intended)
- 14 partners (4 academic +10 industry)
- 13 PhD-Projects
- University and industry secondments



Collective heating



Theme 4: project

WARMING UP

Monitor seismicity (4B) and hot/cold front (4C)

Monitoring: downhole and surface array installed as part of DAPwell (funded by EPOS-NL project).

- Key questions
  - How can acoustic and electromagnetic geophysics be used to best monitor seismicity and the hot/cold front?
  - How do these compare with other methods (e.g. TNO: pulse tests)?

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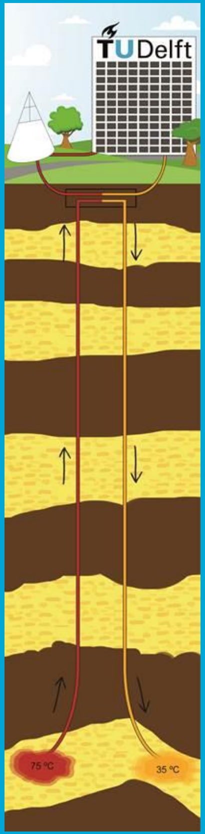
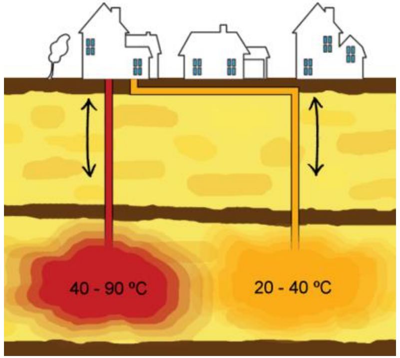
Theme 5 (WINDOW): project

WARMING UP

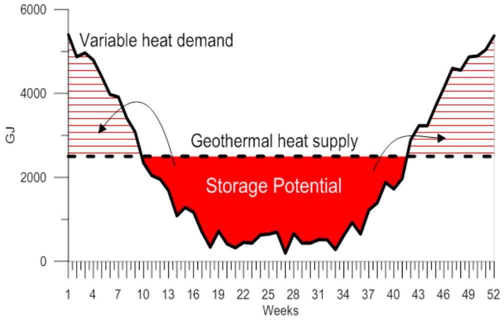
HT-ATES: efficiency and exploration





Logging and coring of monitoring well to 500m: monitoring well installed as part of DAPwell (funded by EPOS-NL project).

- Key questions
  - What parameters influence the efficiency of HT-ATES?
  - How can we best identify these parameters?



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