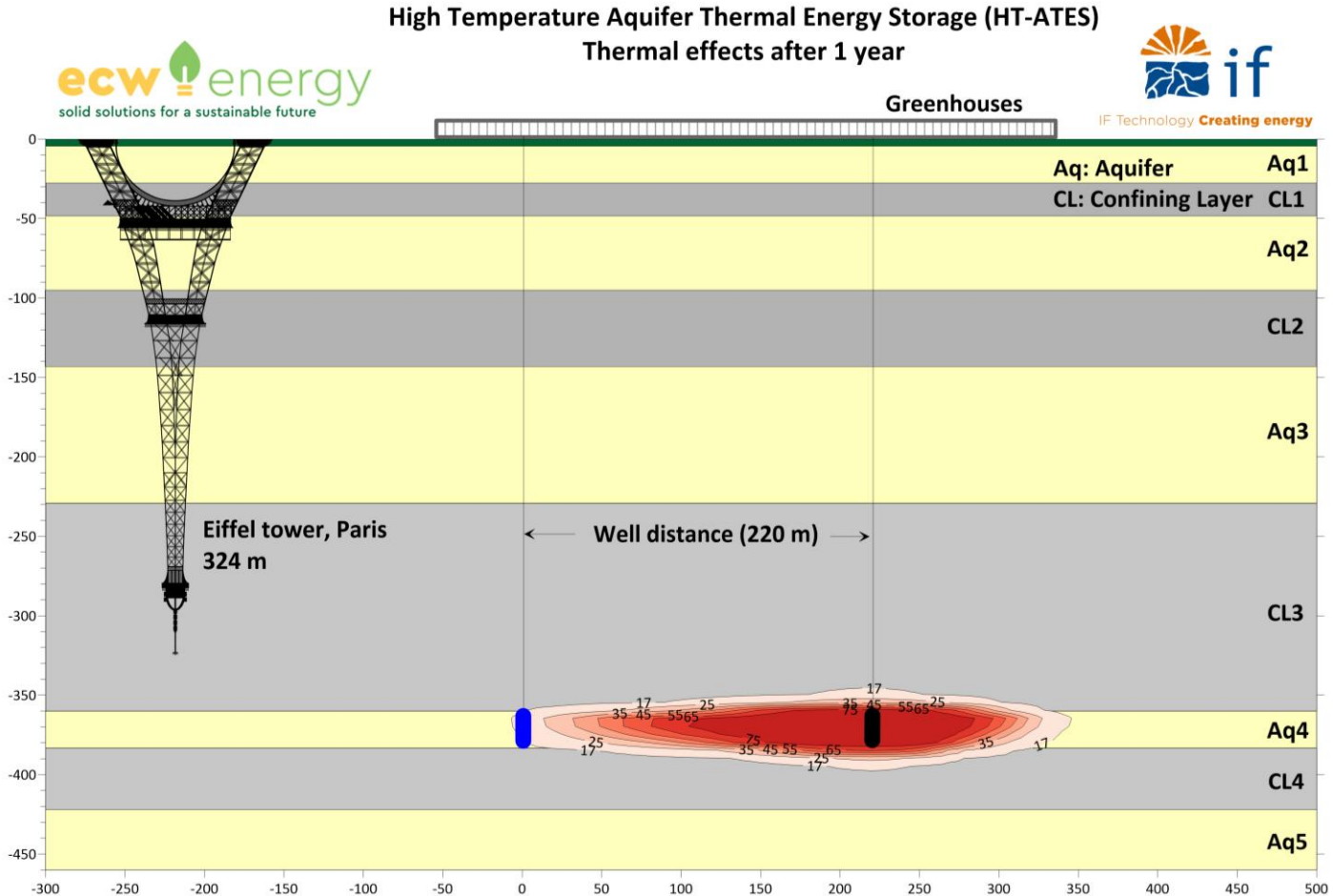
Criteria for succesful HT-ATES application

Geothermica - IEA Event
April 20th 2023

Peter Oerlemans, IF Technology



Peter Oerlemans

Professional Career: Hydrogeologist at IF Technology (since 2018)

Education: Hydrogeology (MSc) at Utrecht University, NL

Specialization: HT-ATES

- Geological feasibility
- Modelling studies (thermal effects)
- Permit
- Exploitation (Groundwater monitoring and analysis, optimizations)

Contact

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Critical success factors for HT-ATES

Central question: Under what conditions can HT-ATES be applied succesfully?

Scope: HT-ATES in Dutch shallow subsurface (unconsolidated, <500 mbgs)

We assess this through 4 angles:

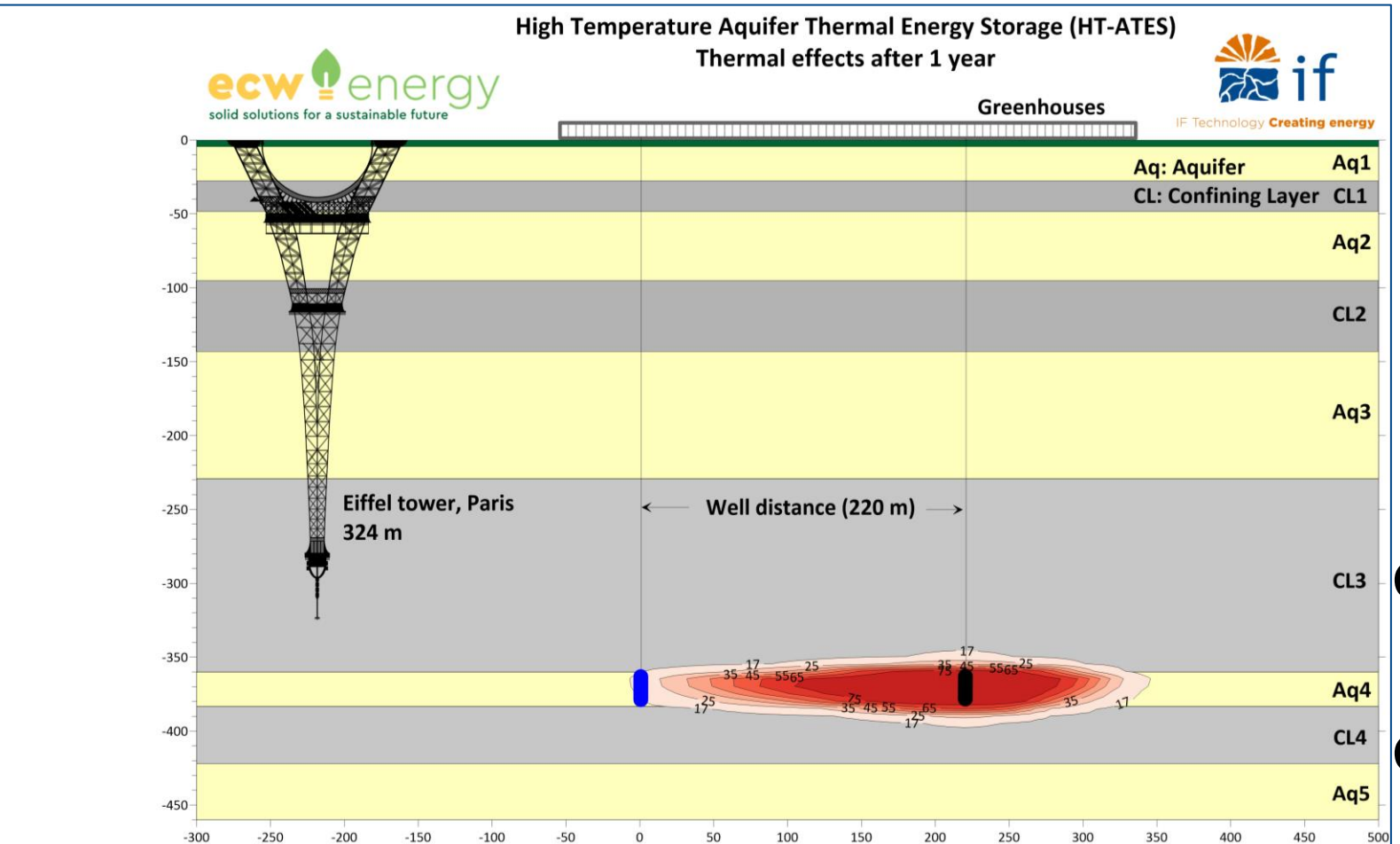
1. Suitable Geology
2. System integration
3. Legal considerations
4. Technical performance

Finally, what are challenges for HT-ATES in NL, to meet these 4 criteria?

Critical success factors for HT-ATES (1)

1. **Suitable geology**

What subsurface properties are needed for successful HT-ATES operation?



Clay cap → limit heat losses

Aquifer → well capacity

Clay base → limit heat losses

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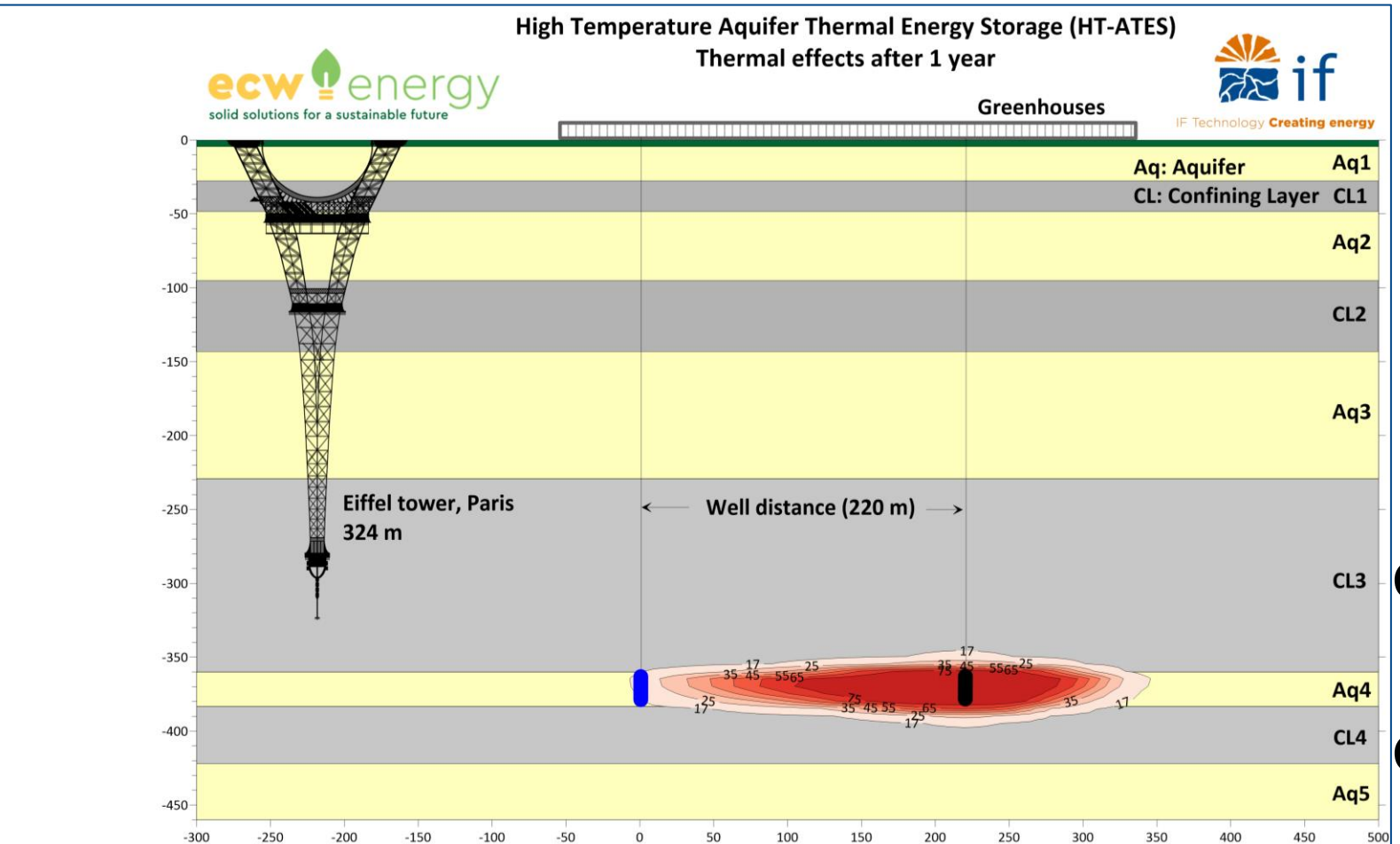

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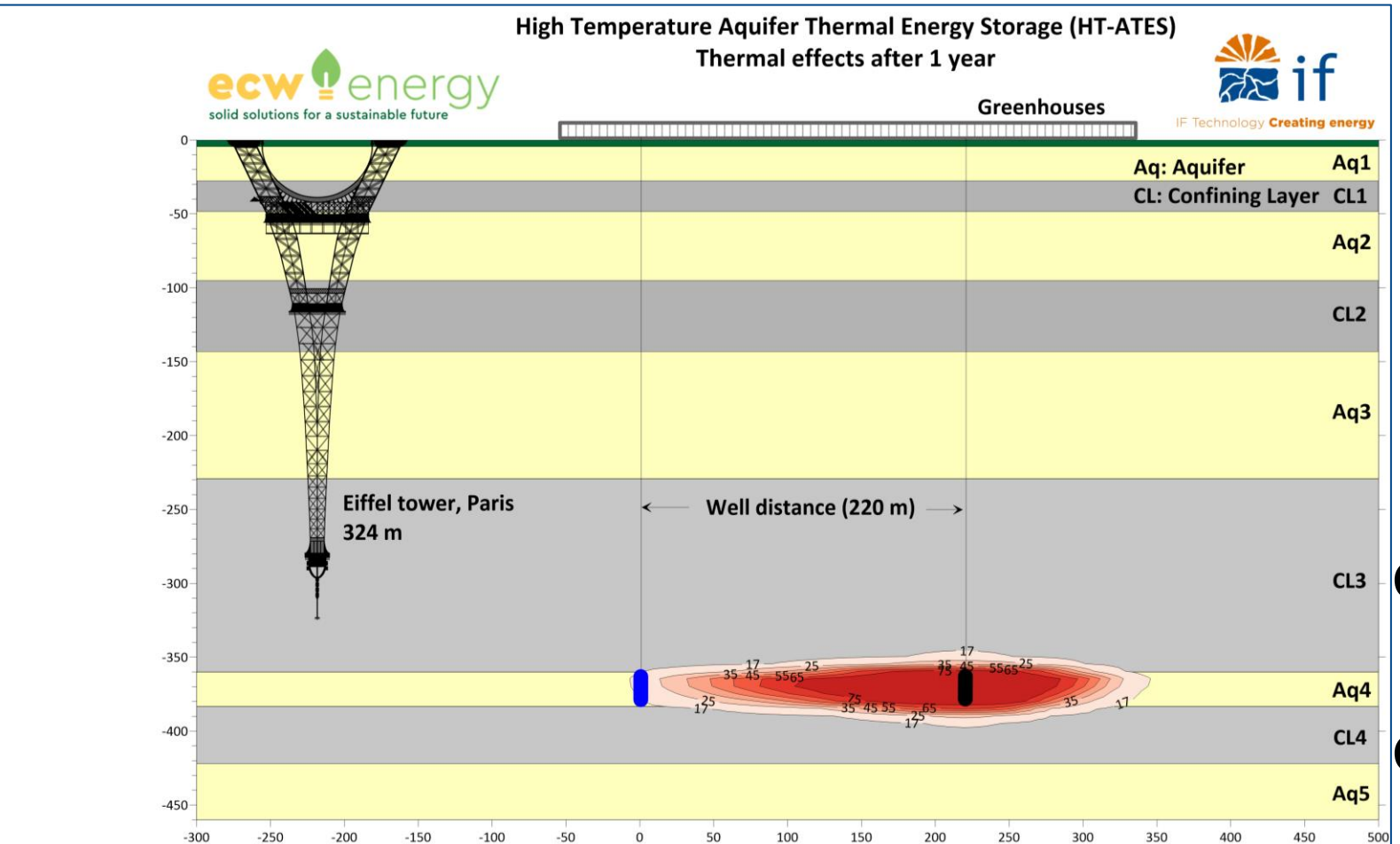

GEOTHERMICA heatstore

Lessons Learned Geothermica HEATSTORE:

- Storage aquifer needs Cap layer
- Perform Test Drilling

Clay cap → limit heat losses

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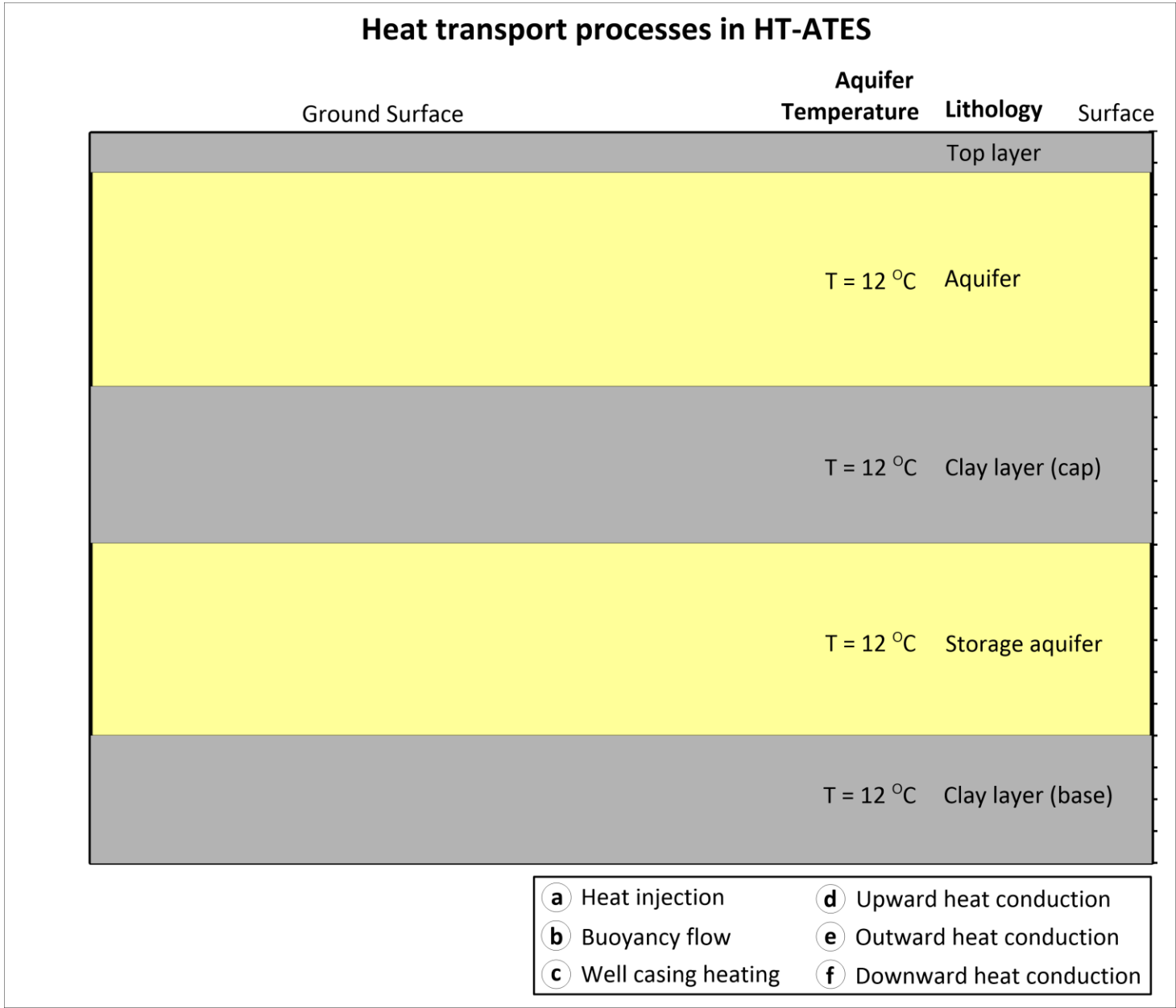

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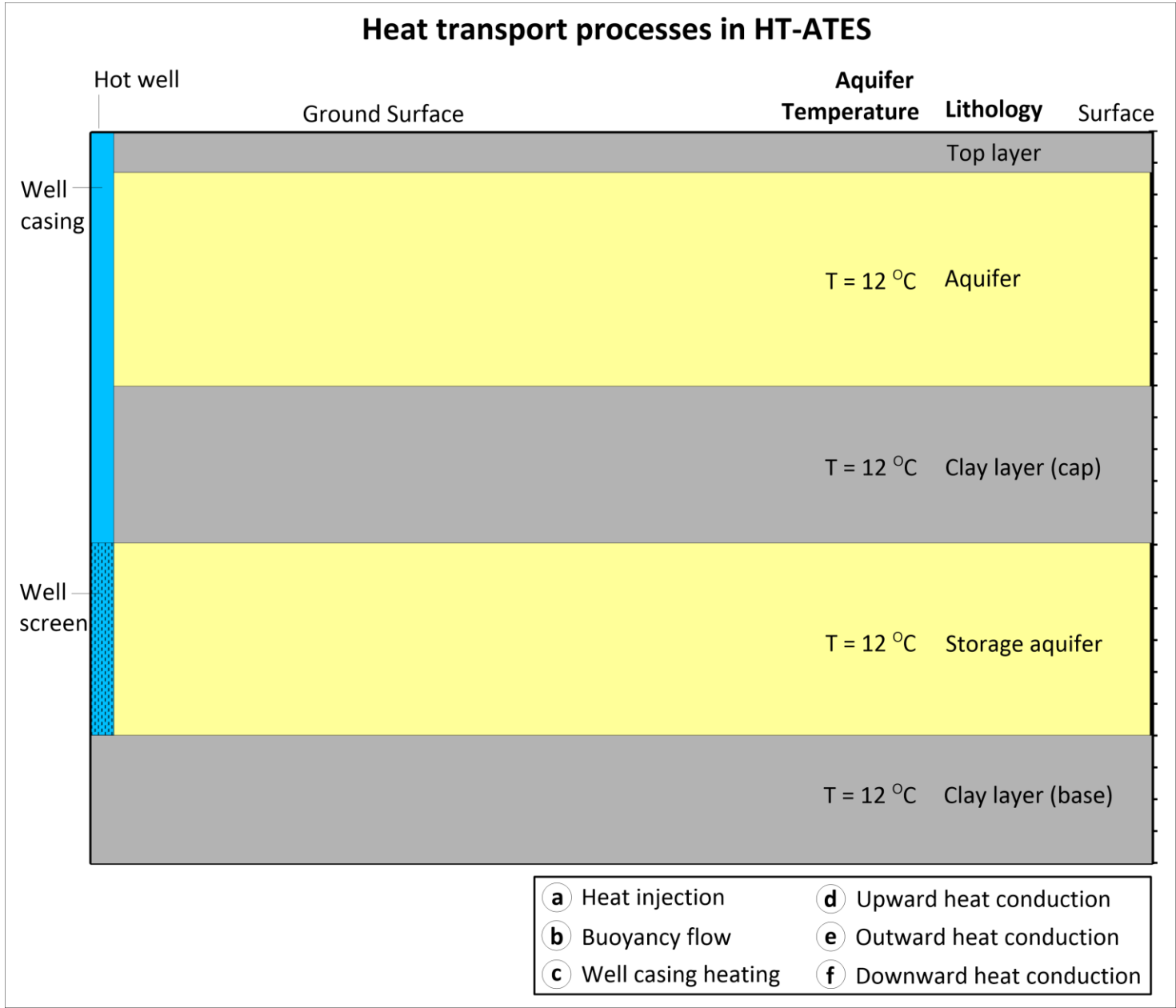

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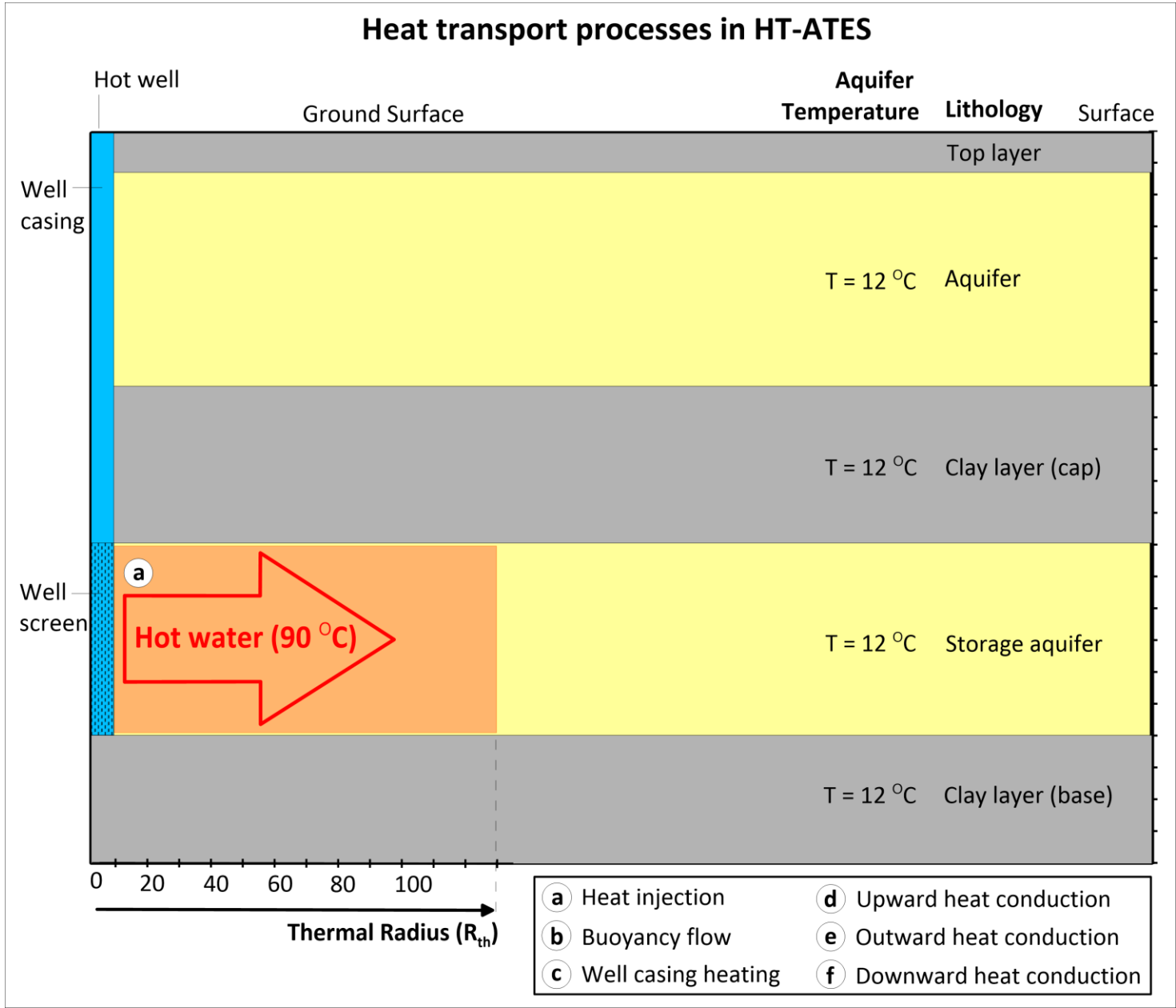

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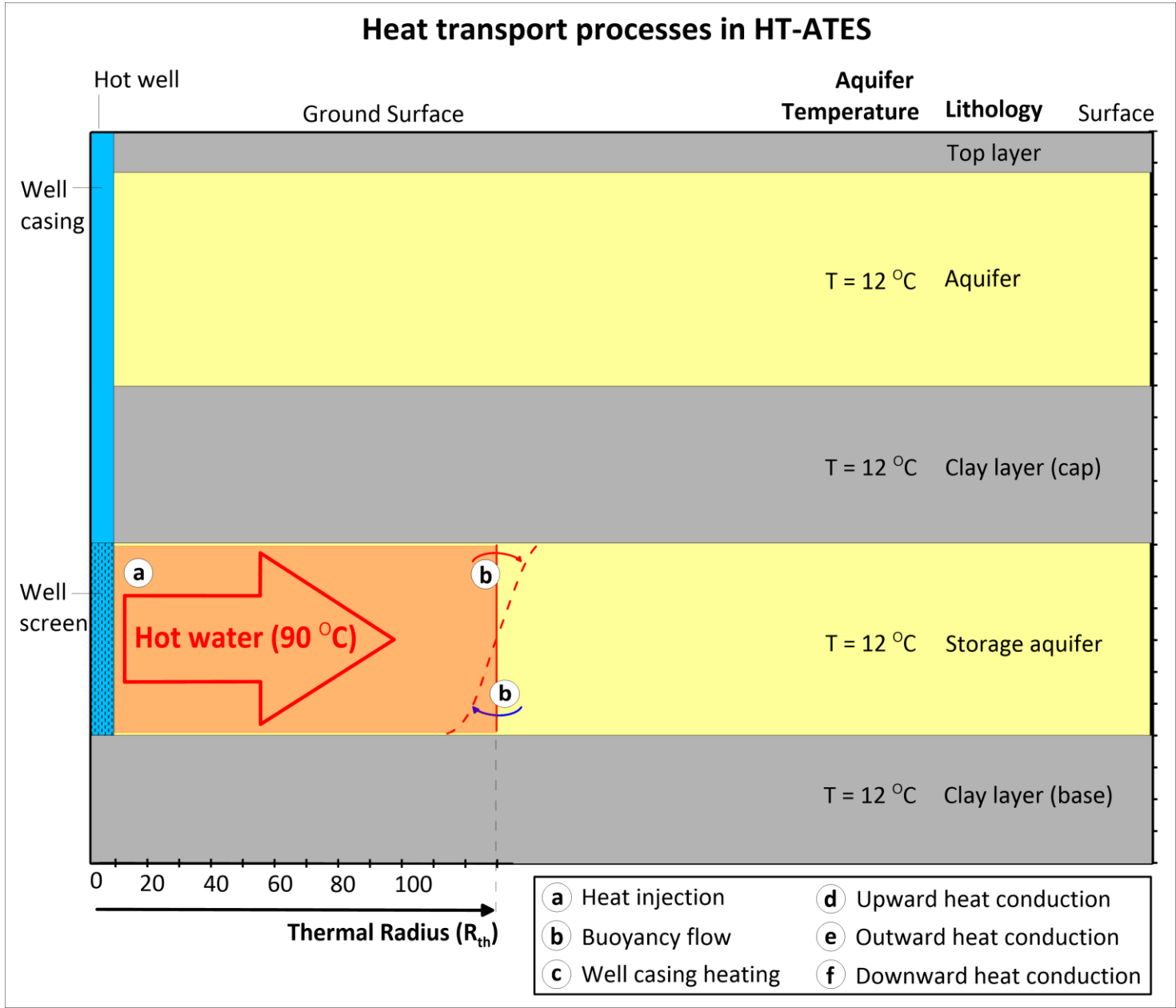

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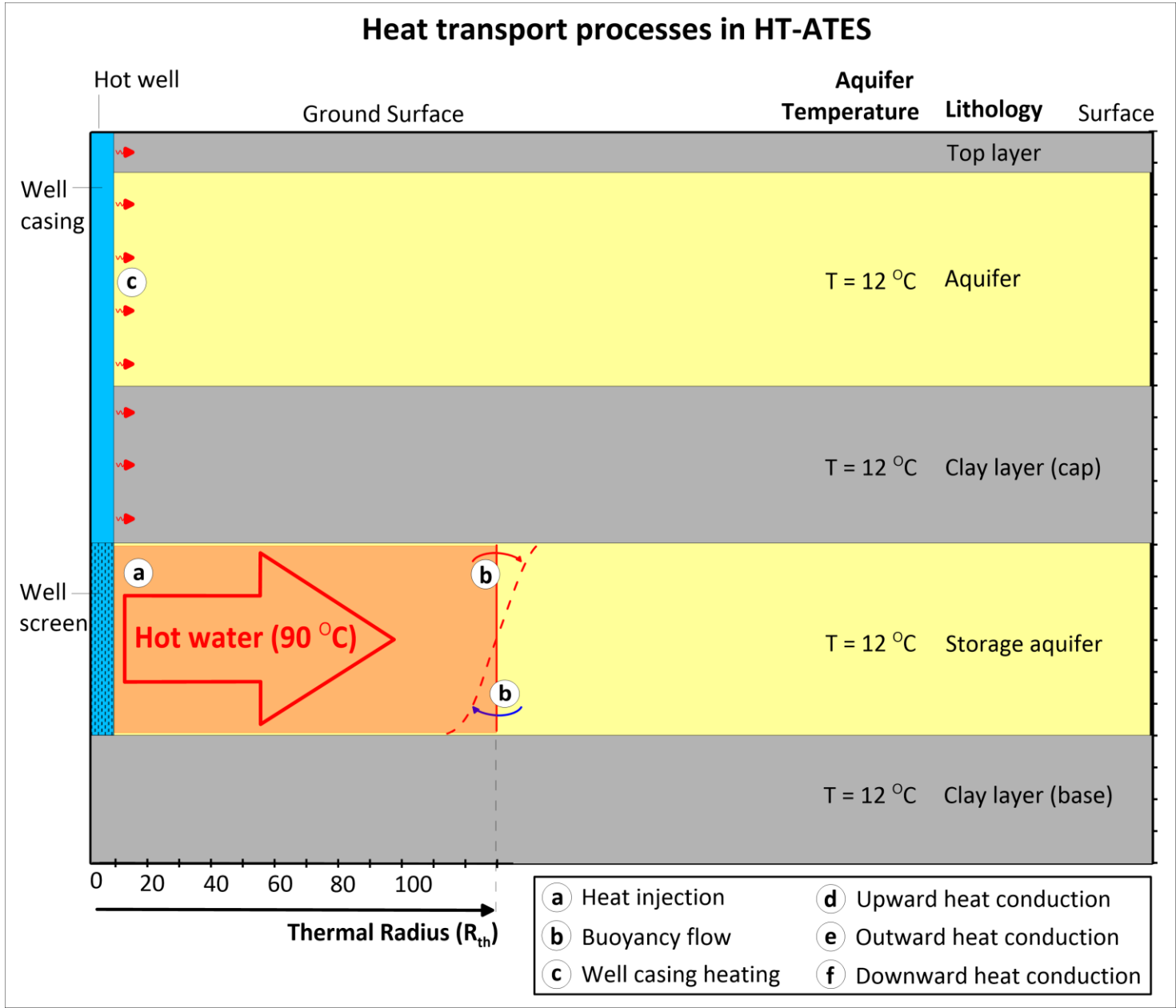

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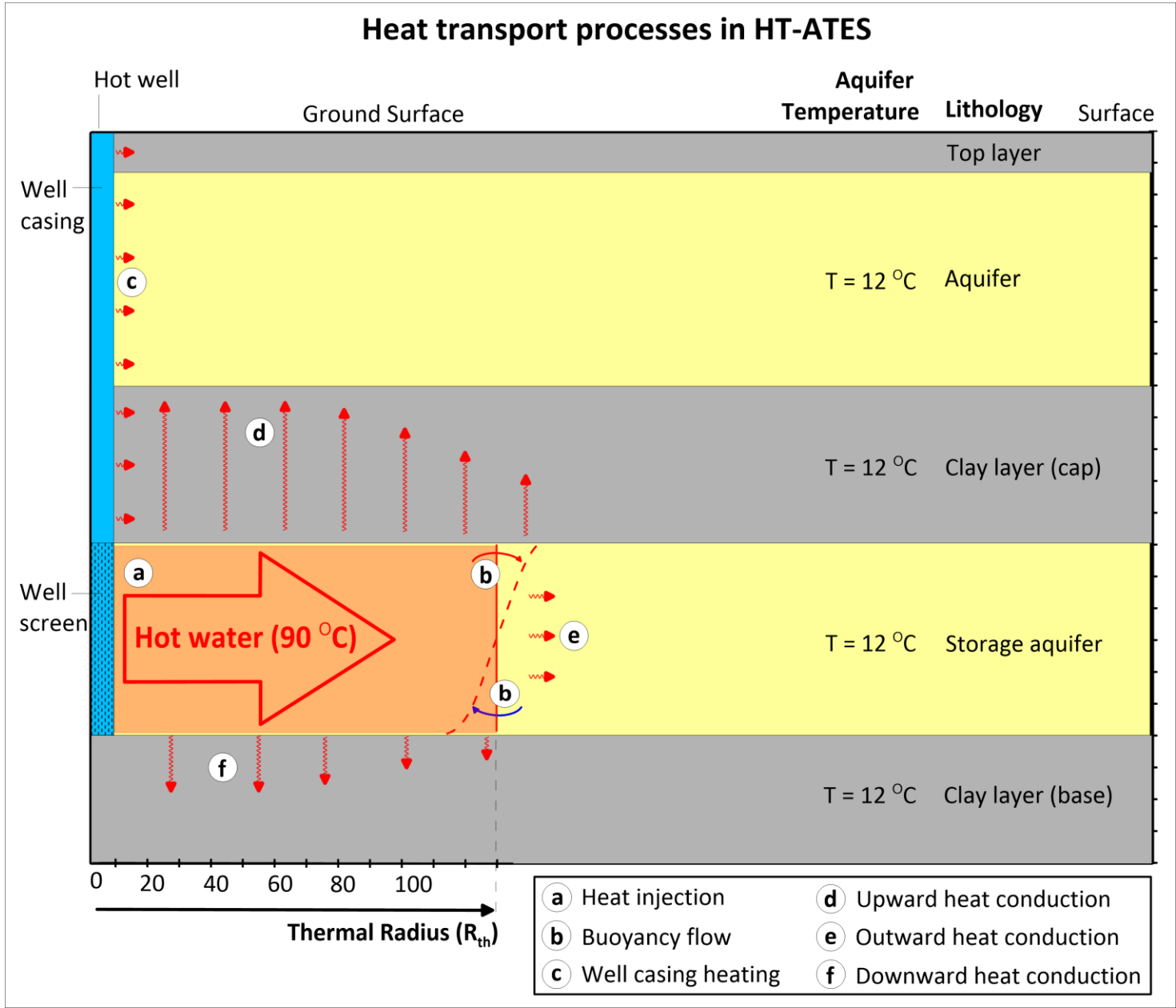


Critical success factors

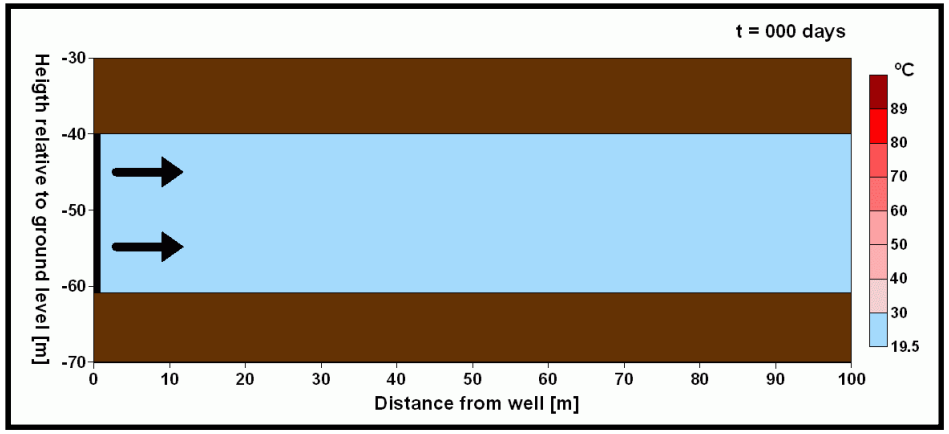
1. **Suitable geology**

What subsurface properties are needed for successful HT-ATES operation?

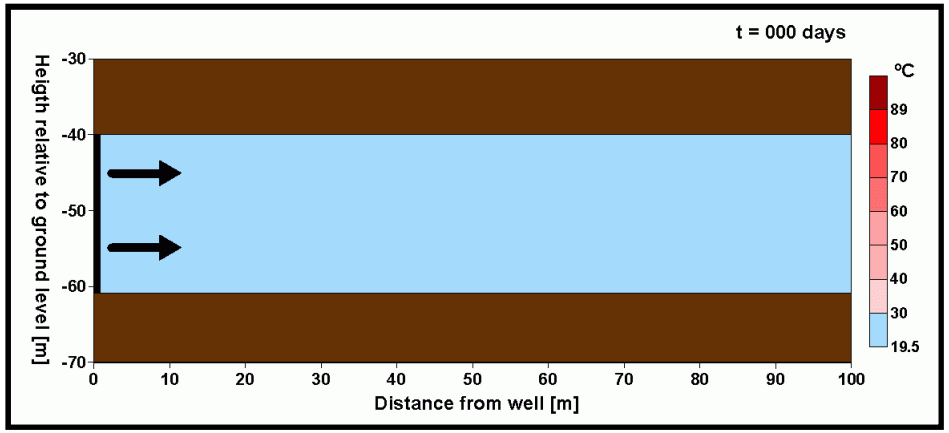
Buoyancy flow strongly controls storage efficiency!

Relevant in unconsolidated (permeable) sediments, with high permeabilities (>1 Darcy)

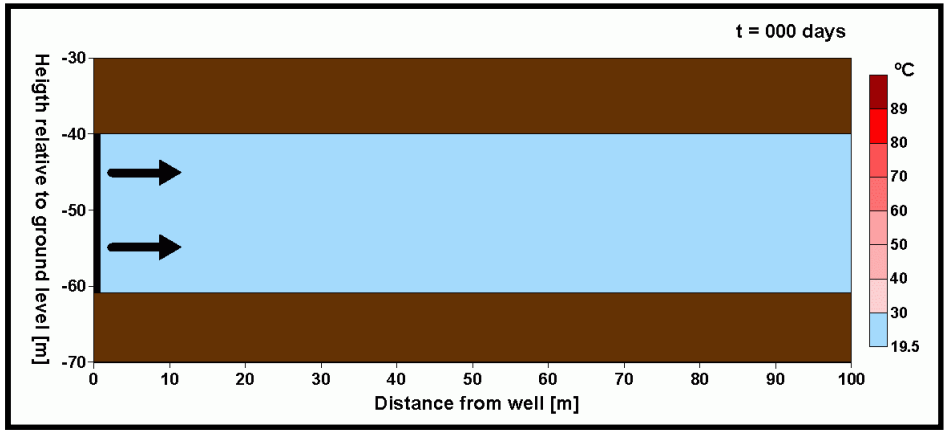
k_h = 50 D
k_v = 25 D



k_h = 15 D
k_v = 1,5 D



k_h = 0.5 D
k_v = 0.1 D



Critical success factors for HT-ATES (2)

2. System integration: *What requirements apply to the energy system, for optimal HT-ATES performance?*

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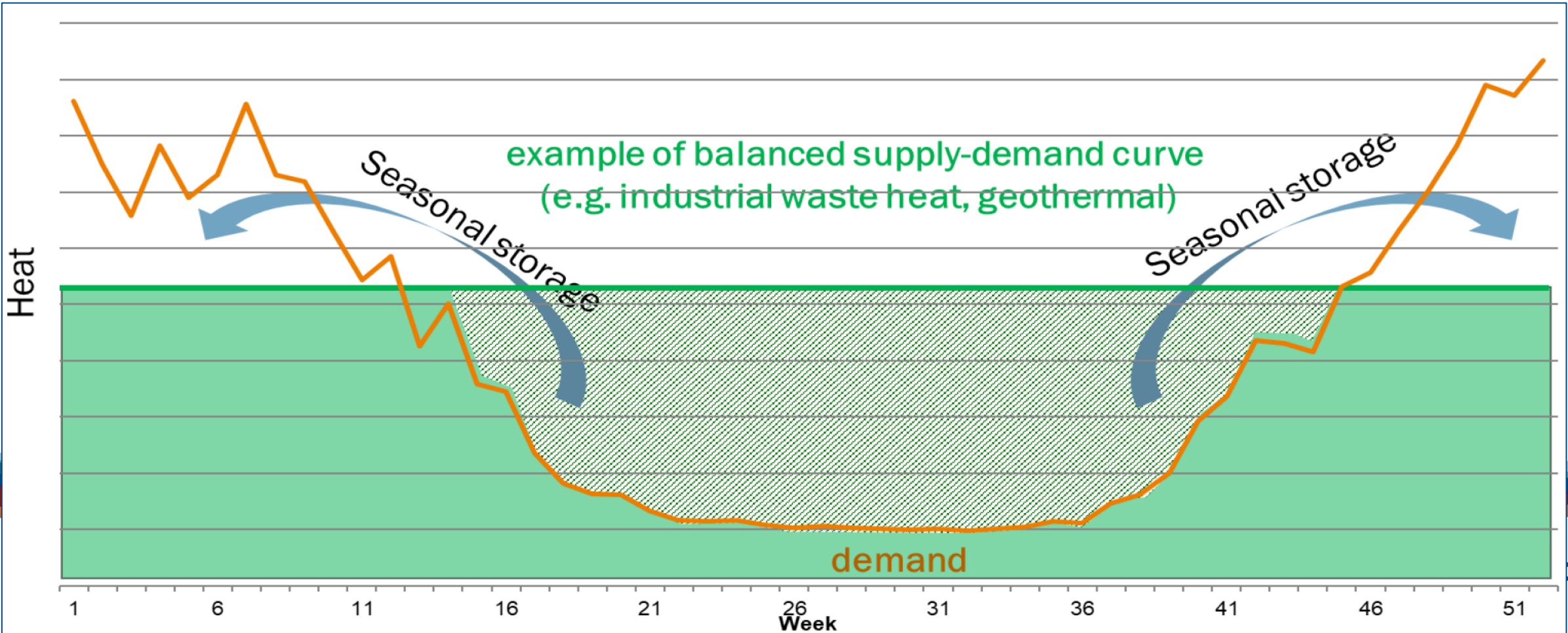
- How deep is 'The bathtub'? The need for heat storage:



Critical success factors for HT-ATES (2)

2. System integration: *What requirements apply to the energy system, for optimal HT-ATES performance?*

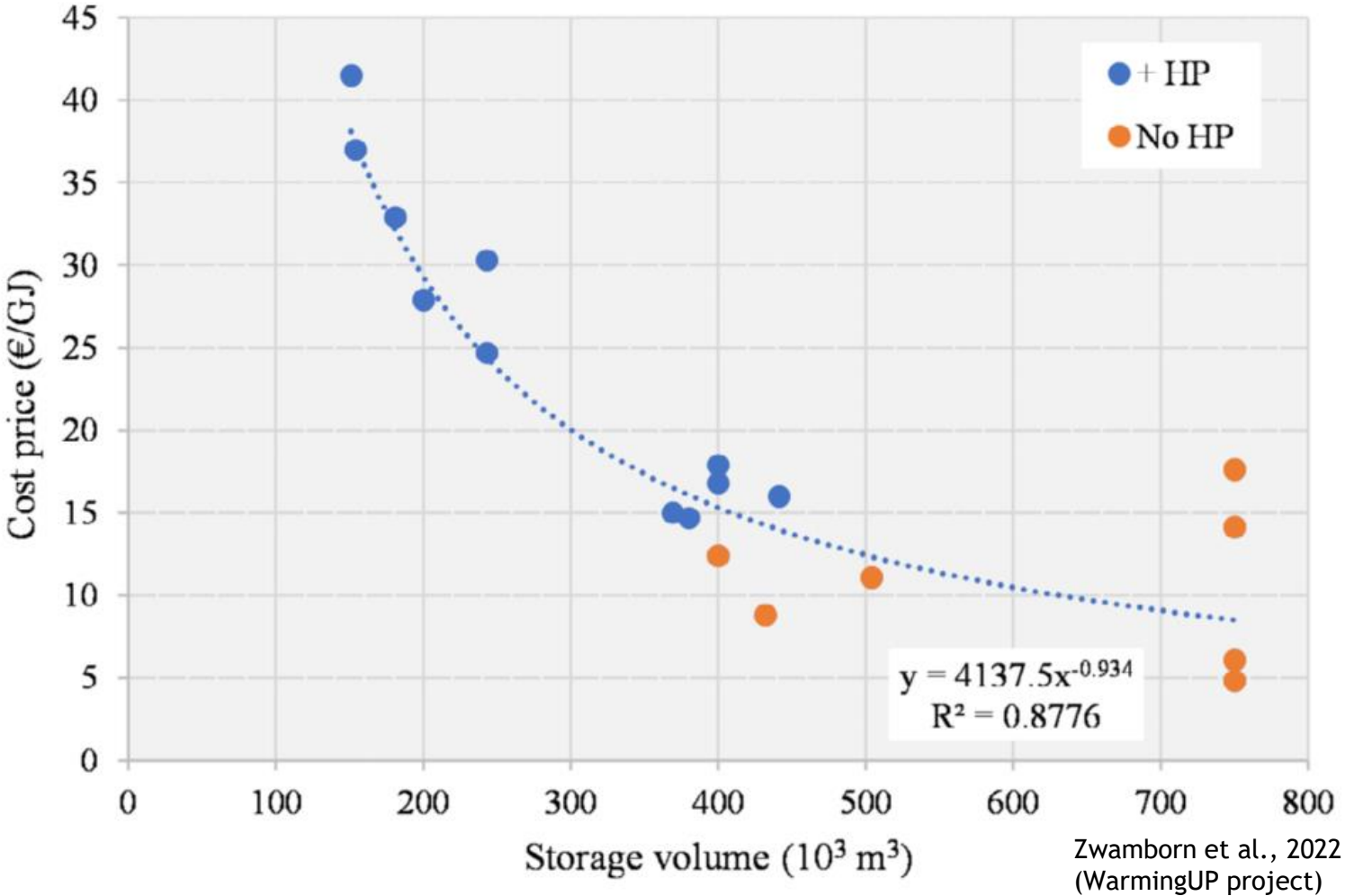
- 'Bigger is Better'

GEOTHERMICA heatstore

Lessons Learned Geothermica HEATSTORE:

HT-ATES in Dutch unconsolidated aquifers:

>250.000 m³/season



Zwamborn et al., 2022 (WarmingUP project)

Critical success factors for HT-ATES (2)

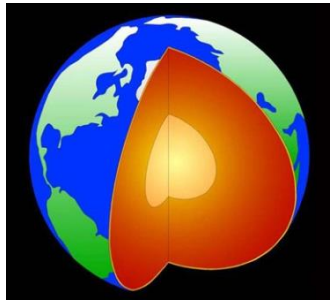
2. System integration: *What requirements apply to the energy system, for optimal HT-ATES performance?*

- Sustainable & affordable heat source

Waste heat

Power-to-Heat

Geothermal heat



Solar heat

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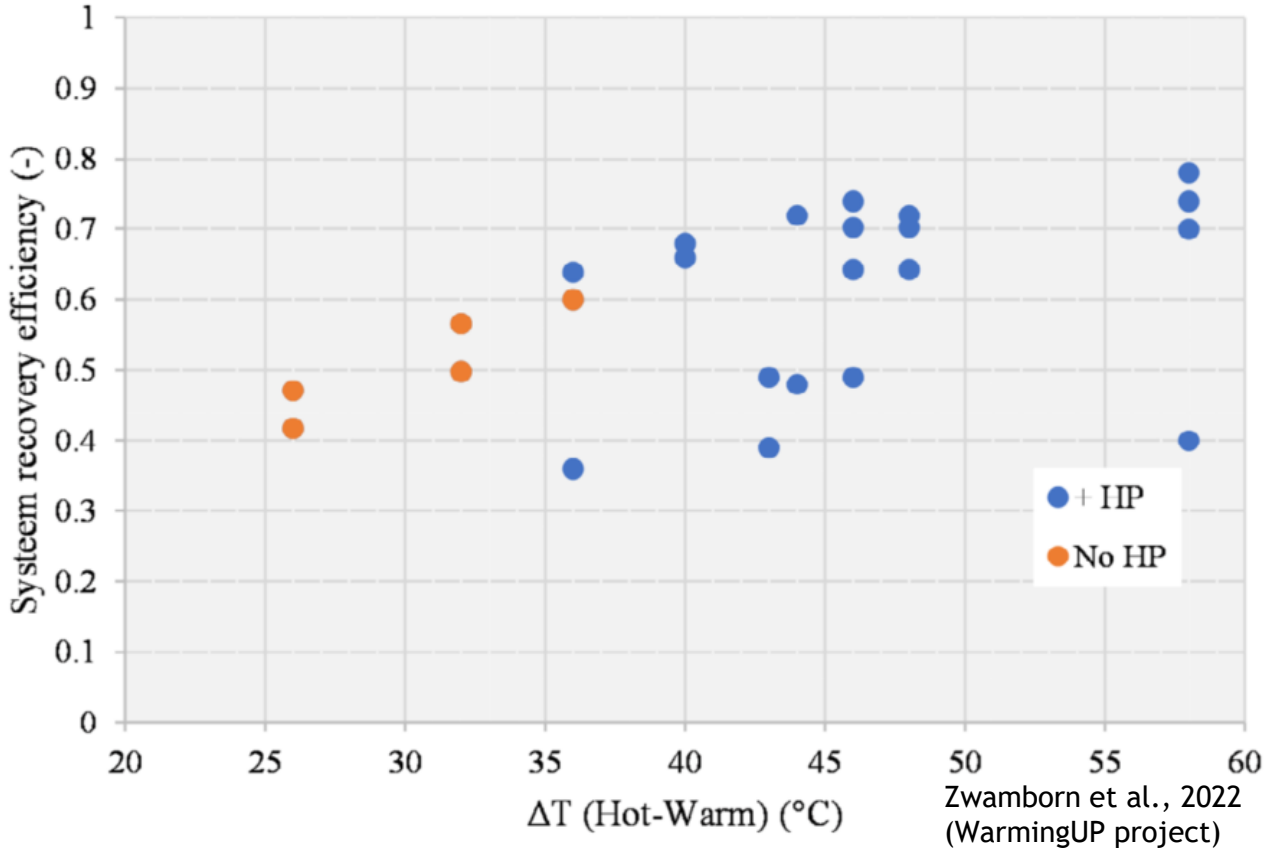
- Usable temperatures: ‘How low can you go?’



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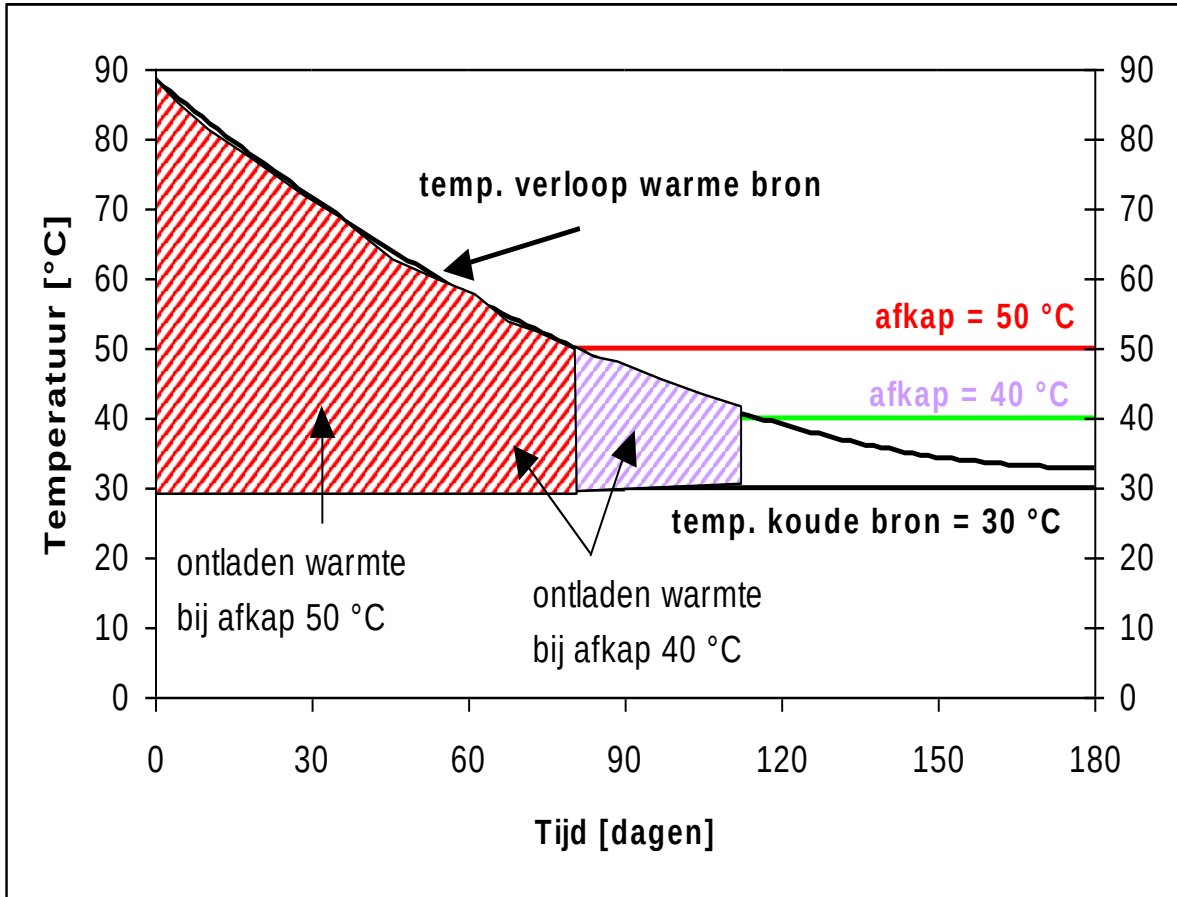

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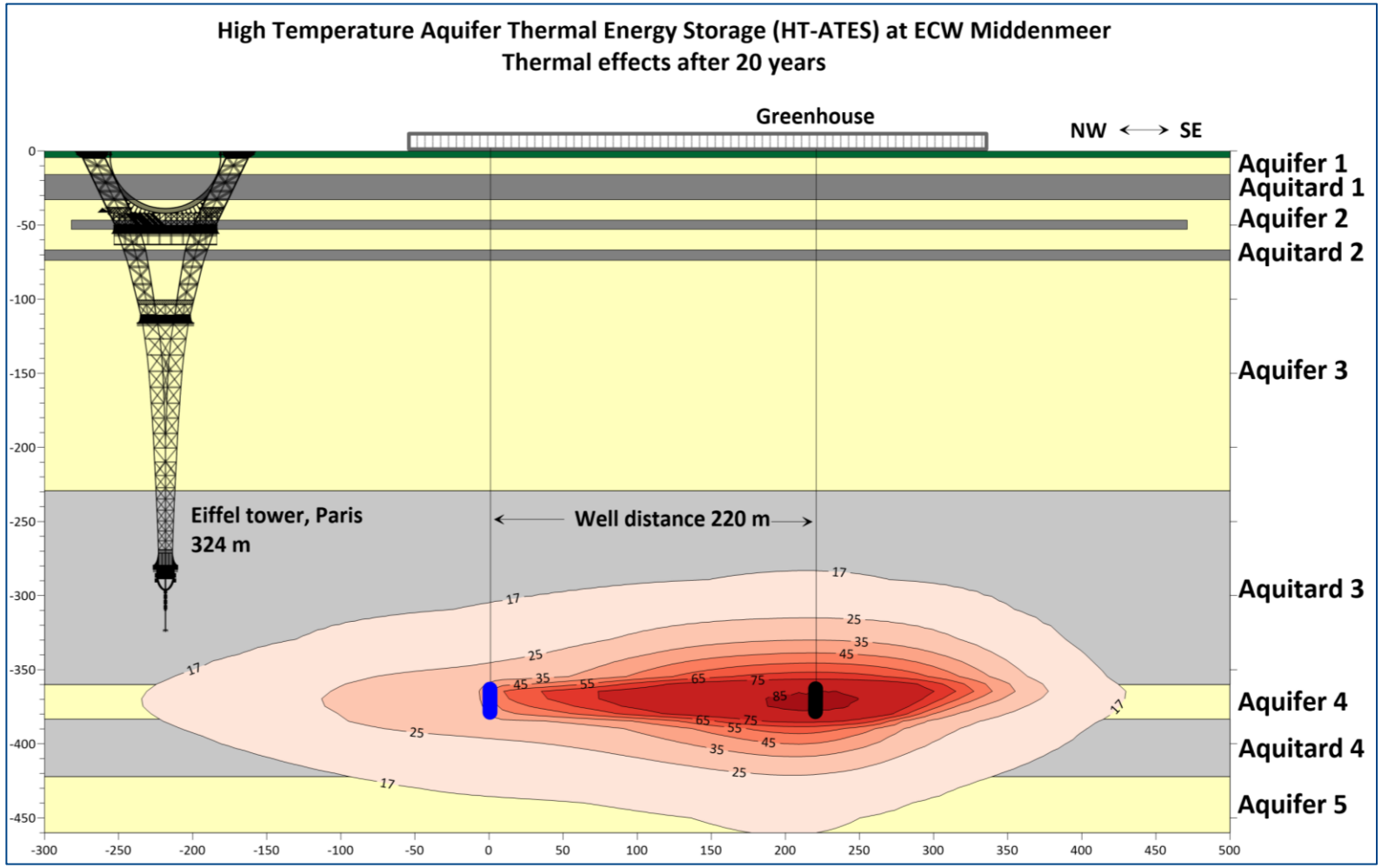
- Surface effects acceptable?



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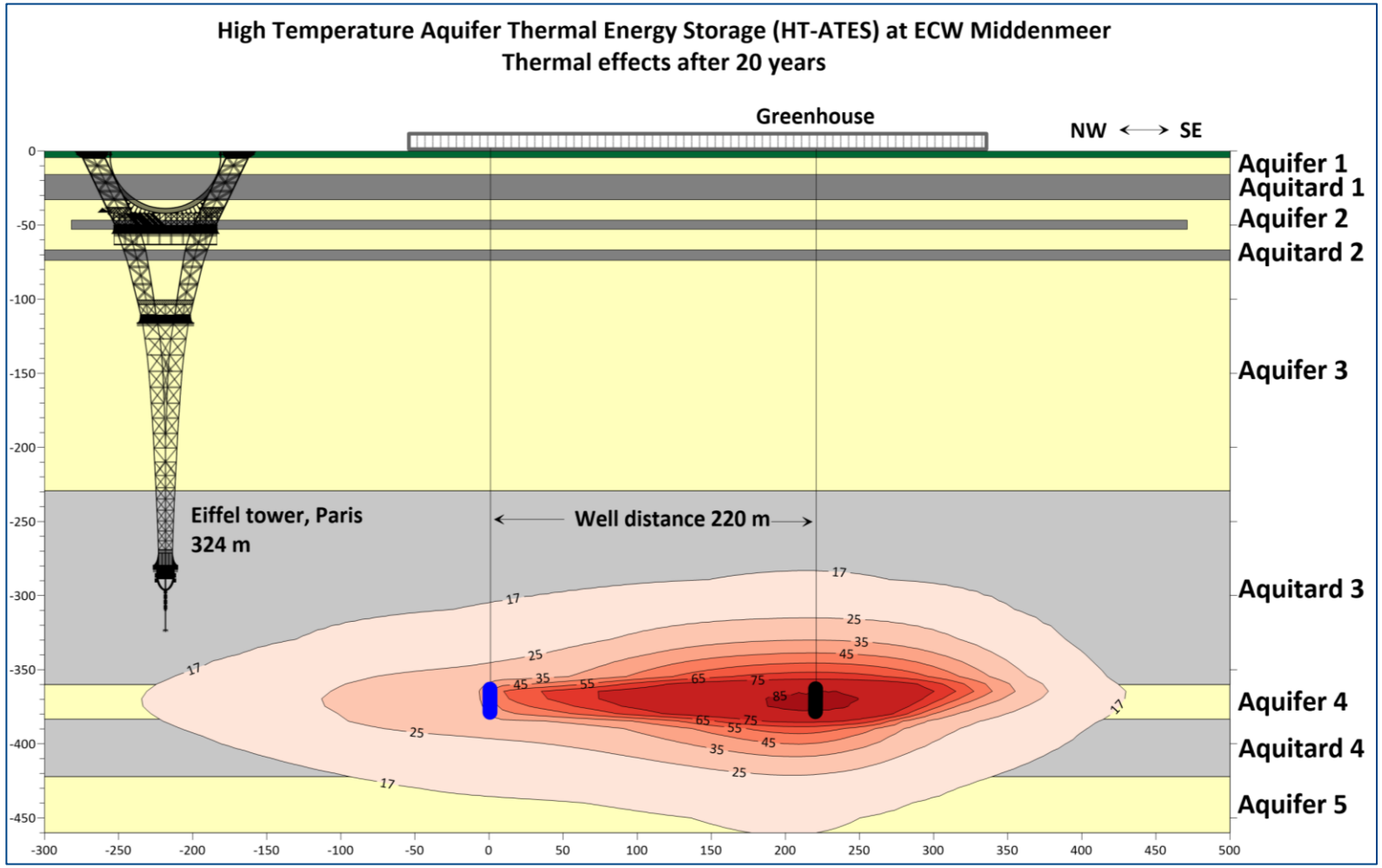
- Fresh or saline groundwater?



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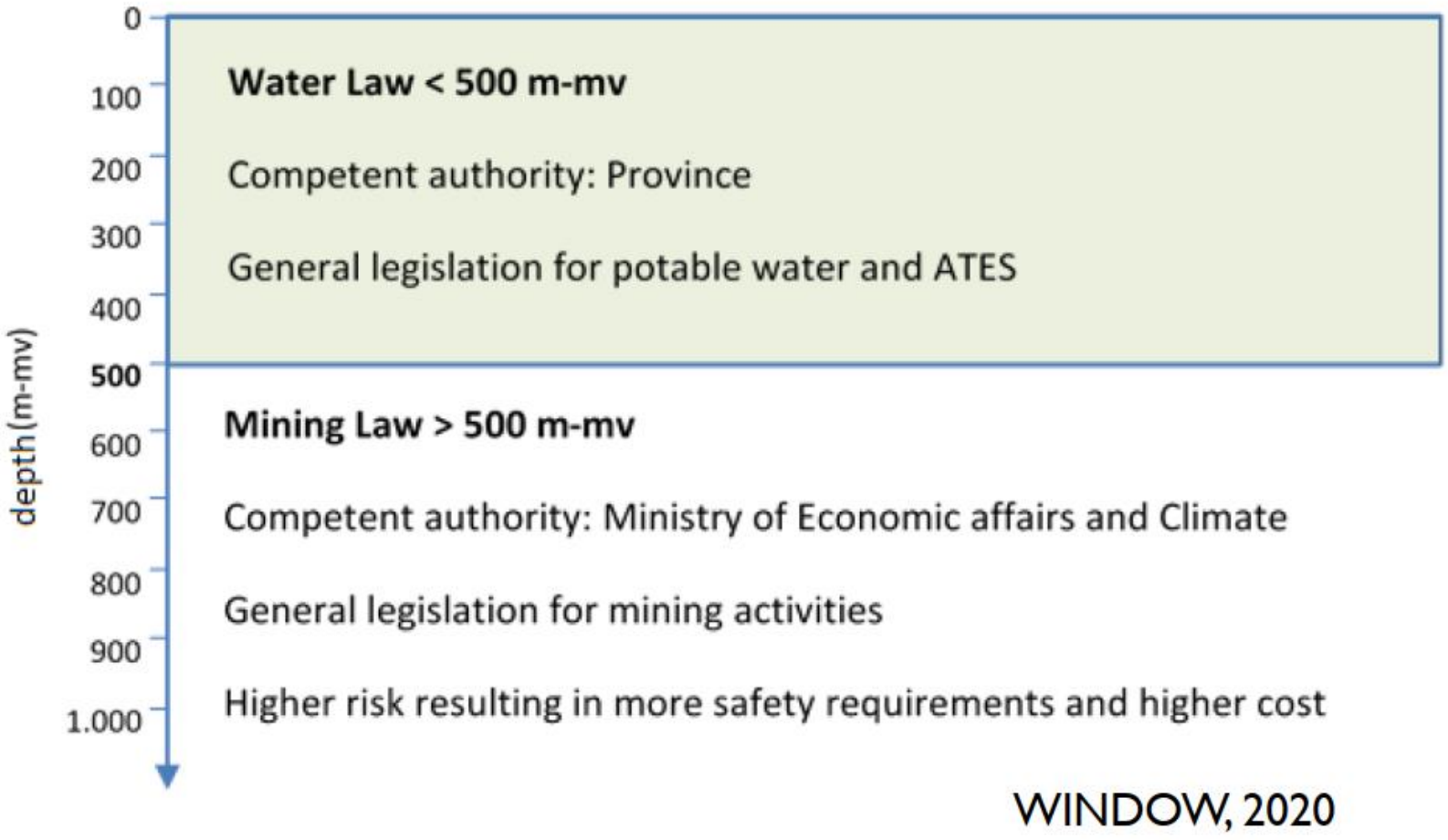
- Legal framework,
  Assessment Framework for permits



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- Other groundwater users?
- What policies apply for HT-ATES permit?

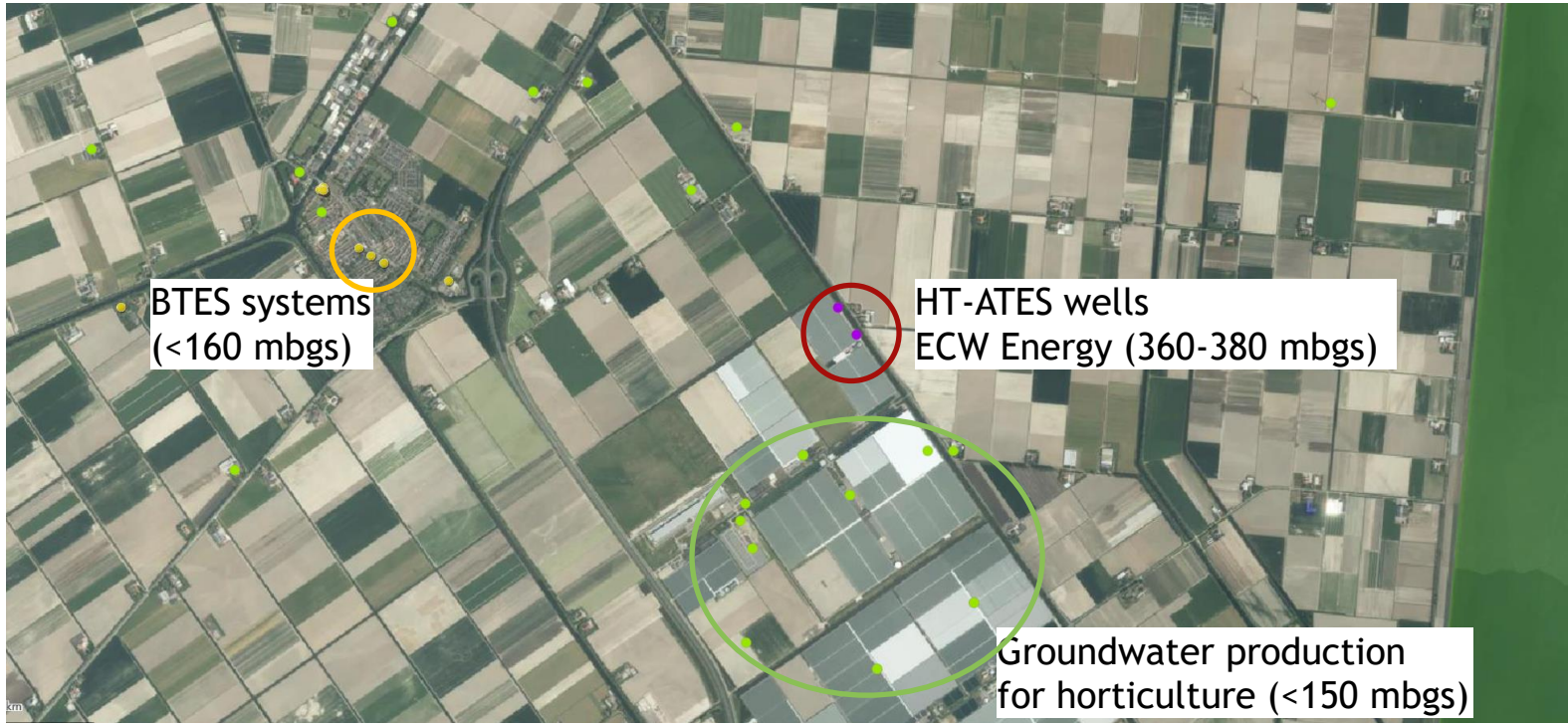
GEOTHERMICA heatstore

Lessons Learned Geothermica HEATSTORE:

- Experience in full-scale HT-ATES permit application

- Experienced permitting authority is very helpful

→ Educate authorities about effects, pro-actively!



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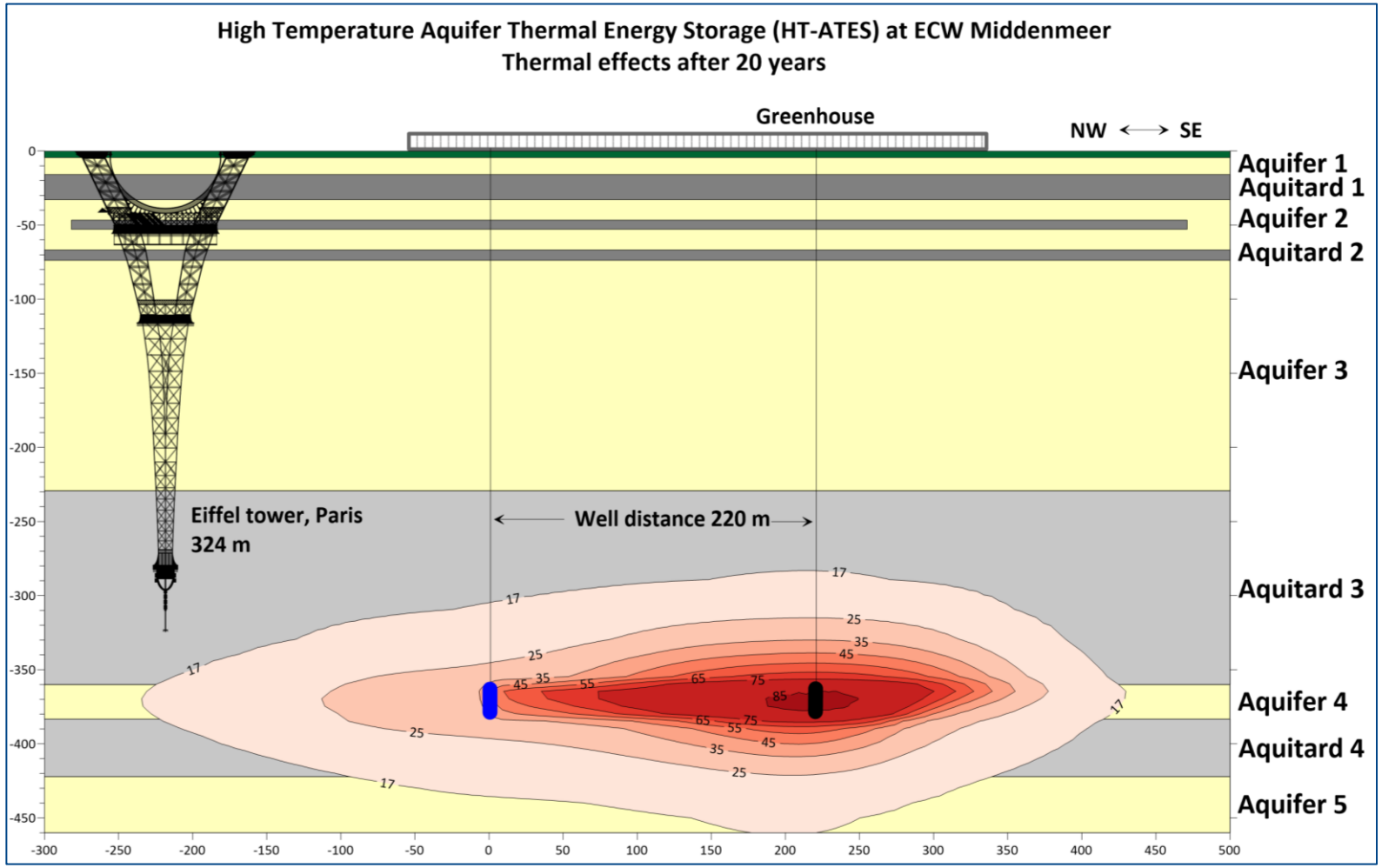
✓ @ ECW Energy



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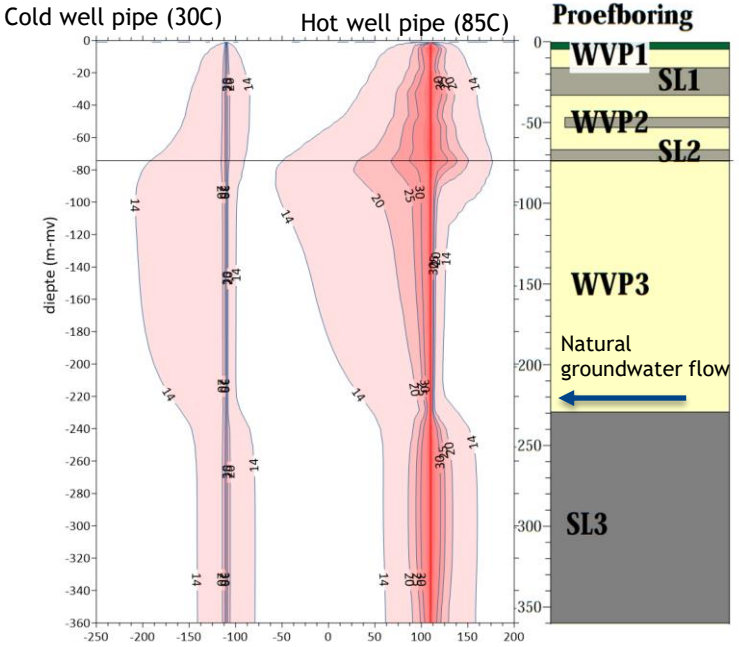
Clogging by sand production	Tests and sand filtering
Heat losses through well casings	Insulated well pipes



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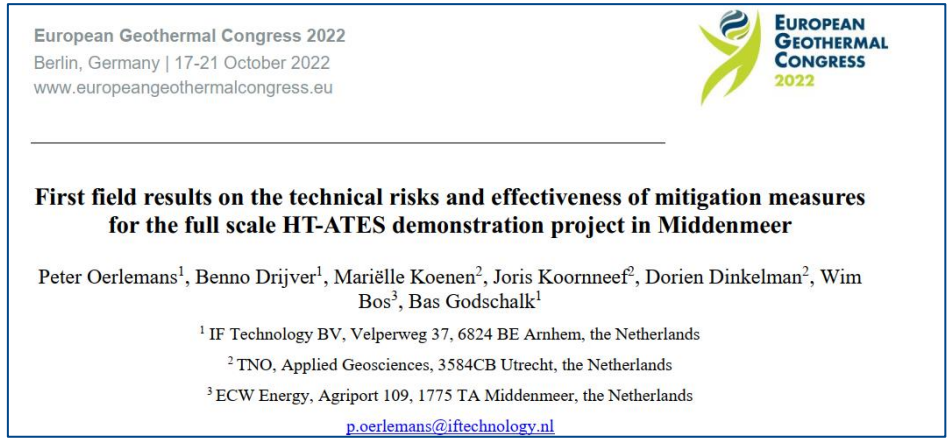
First field results on the technical risks and effectiveness of mitigation measures for the full scale HT-ATES demonstration project in Middenmeer



European Geothermal Congress 2022
Berlin, Germany | 17-21 October 2022
www.europeangeothermalcongress.eu

EUROPEAN GEOTHERMAL CONGRESS 2022

First field results on the technical risks and effectiveness of mitigation measures for the full scale HT-ATES demonstration project in Middenmeer

Peter Oerlemans[1], Benno Drijver[1], Mariëlle Koenen[2], Joris Koornneef[2], Dorien Dinkelman[2], Wim Bos[3], Bas Godschalk[1]

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Summary: Criteria & Challenges for successful HT-ATES

	Criterion	Challenges
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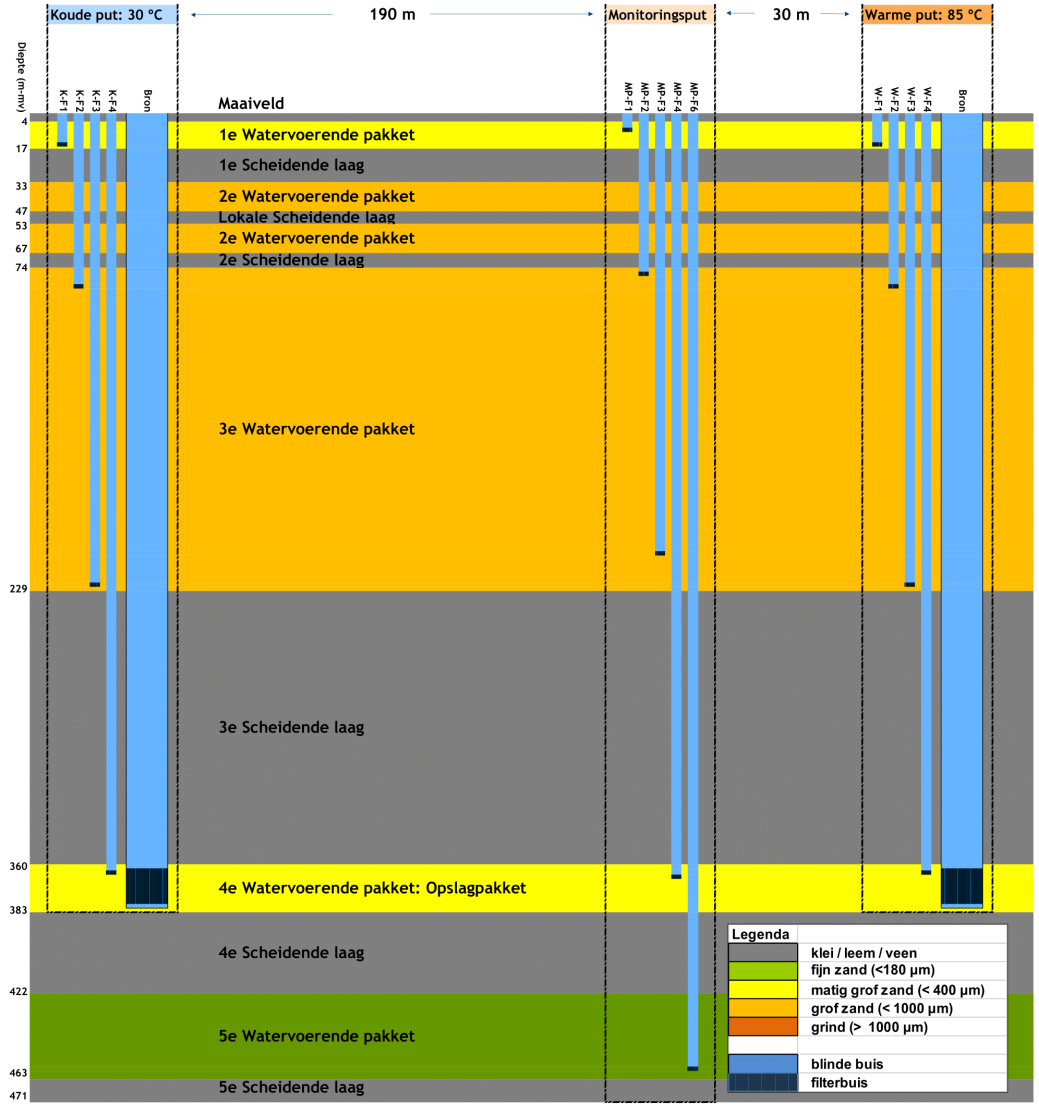
→ To be tackled in future research & demonstration projects

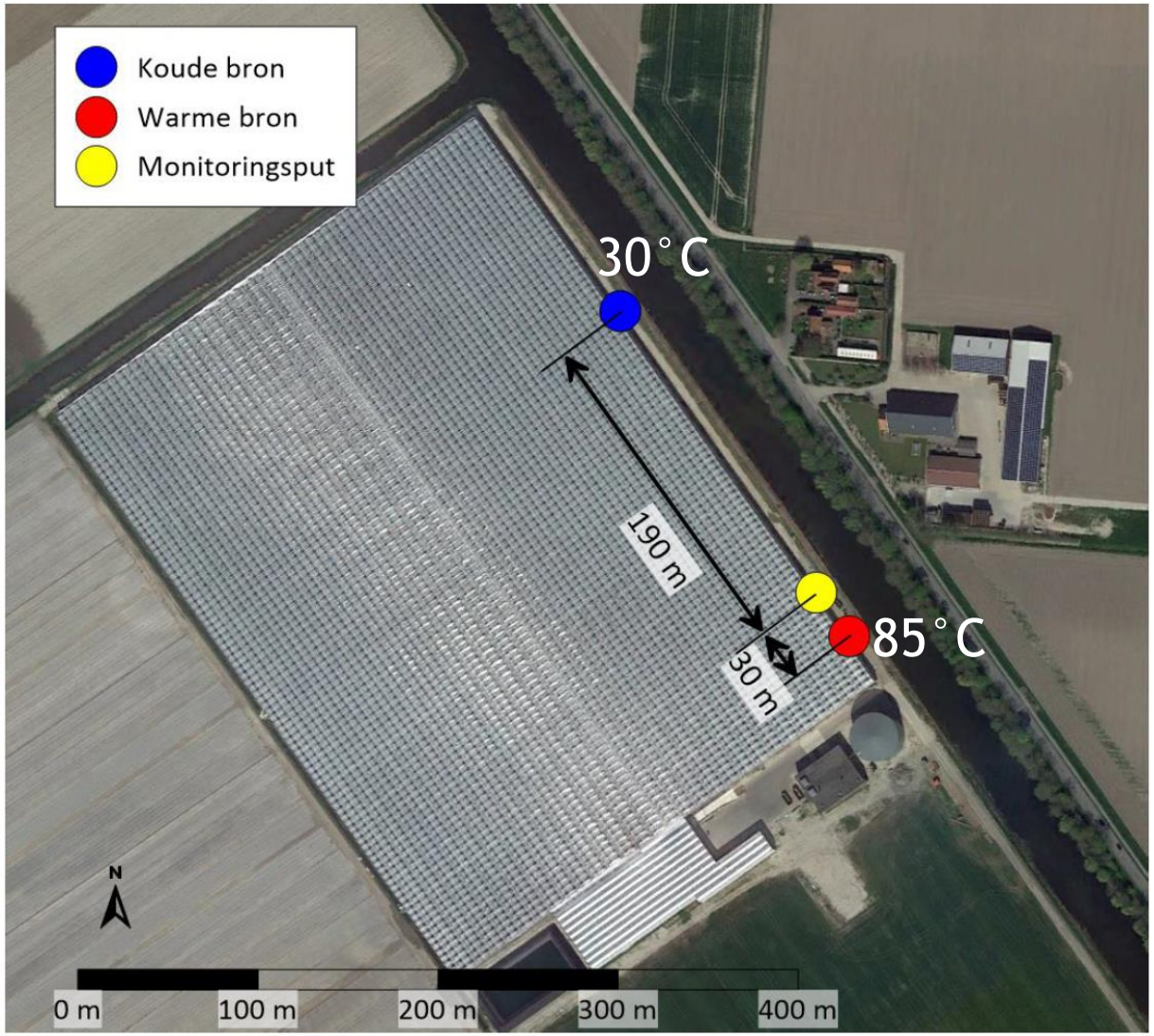
Lesson Learned

"Learning by doing!"

Hoe ziet het HTO-systeem er nu uit?



Putconfiguratie HTO ECW Energy Middenmeer (niet op schaal).
ECW Energy & IF Technology, 2021



IF Technology, 2020

Hoe ziet het HTO-systeem er nu uit?

Boorwagen

Composiet put, met glasvezel DTS kabel

HT-bron met peilbuizen

Foto’s: IF Technology

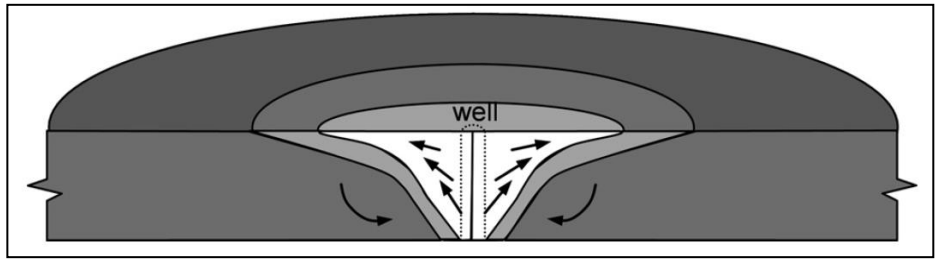
Thermische effecten cyclus 1 (2021-2022)

Meting bij meetput (30 m van W-bron)

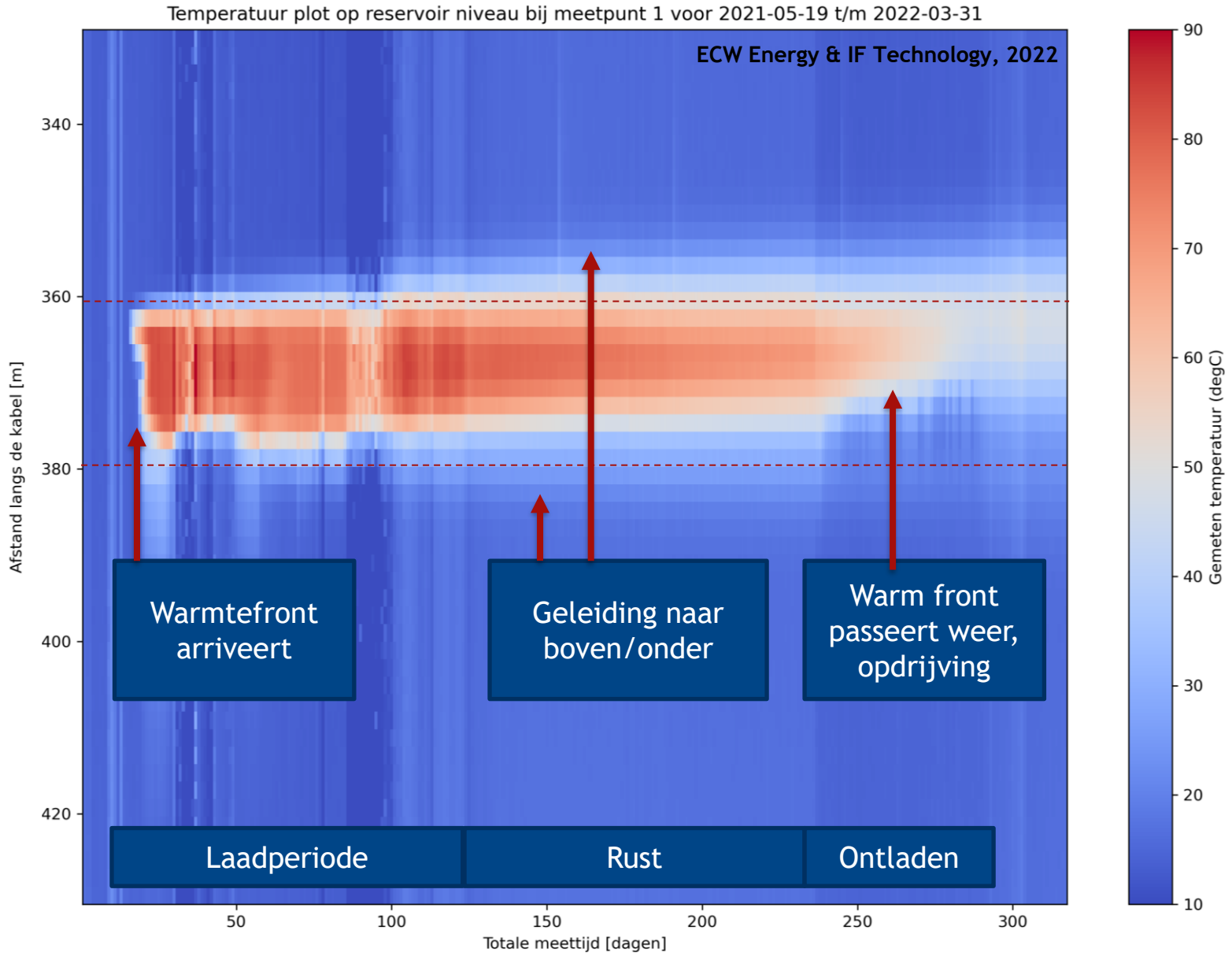
Warmtetransport processen:

- Stroming (injectie bij W-bron)
- Warmtegeleiding
- Opdrijving van warmte

Verder: enige ruis op de lijn



Ward et al. 2009

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