
# WARM

A presentation for the Delft Geothermal Get Together

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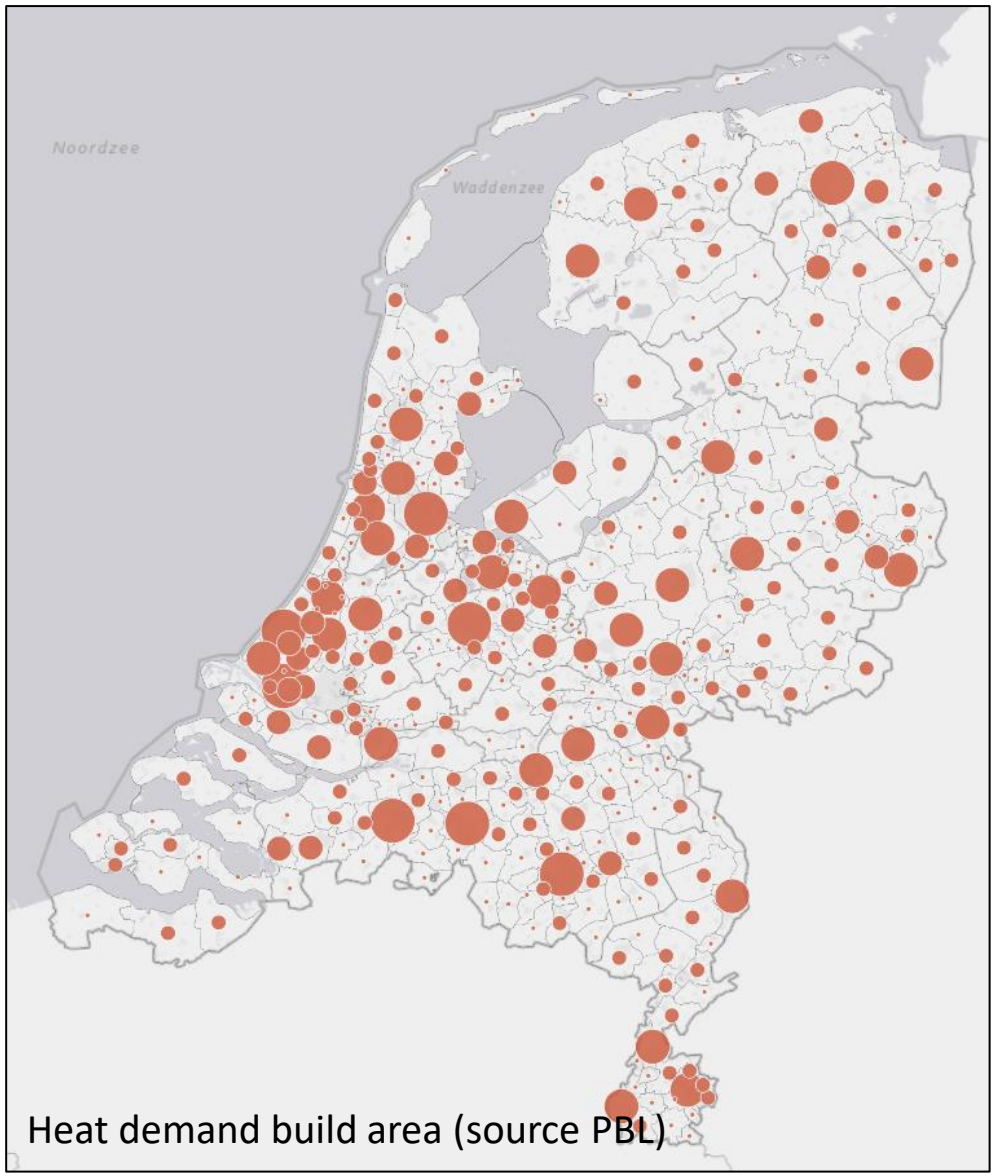
# WARM Project Introduction

- **Part of the Dutch climate agreement ambition is to replace the gas heating systems for 1.5 mln houses with sustainable energy before 2030**
- Municipalities will take the lead in this process
- By end 2021 the  municipalities will prepare a Transition Vision how to achieve this goal per neighbourhood
- Geothermal energy plays an important role in this Vision (Roadmap)
- Municipalities participate in RES regions



Heat demand build area (source PBL)

# RES (Regional Energy Strategy)

- The Netherlands is subdivided  in (RES) regions. Each RES involves provinces, water boards, municipalites, network owners, industry, citizens' initiatives and civil organisations, or anybody who has a stake in the energy transition with respect to electricity and heat.
- The RES is an instrument to discus and imply the spatial integration of the energy transition with social involvement.
- The RES goal is to achieve long term cooperation between the different stakeholders to support energy transition measures
- **WARM is a project to give a tool to the RES regions to understand chances and plan for geothermal heat extraction.**
- EBN awarded the WARM study to the PanTerra/Berenschot combination

RES regions in Netherlands

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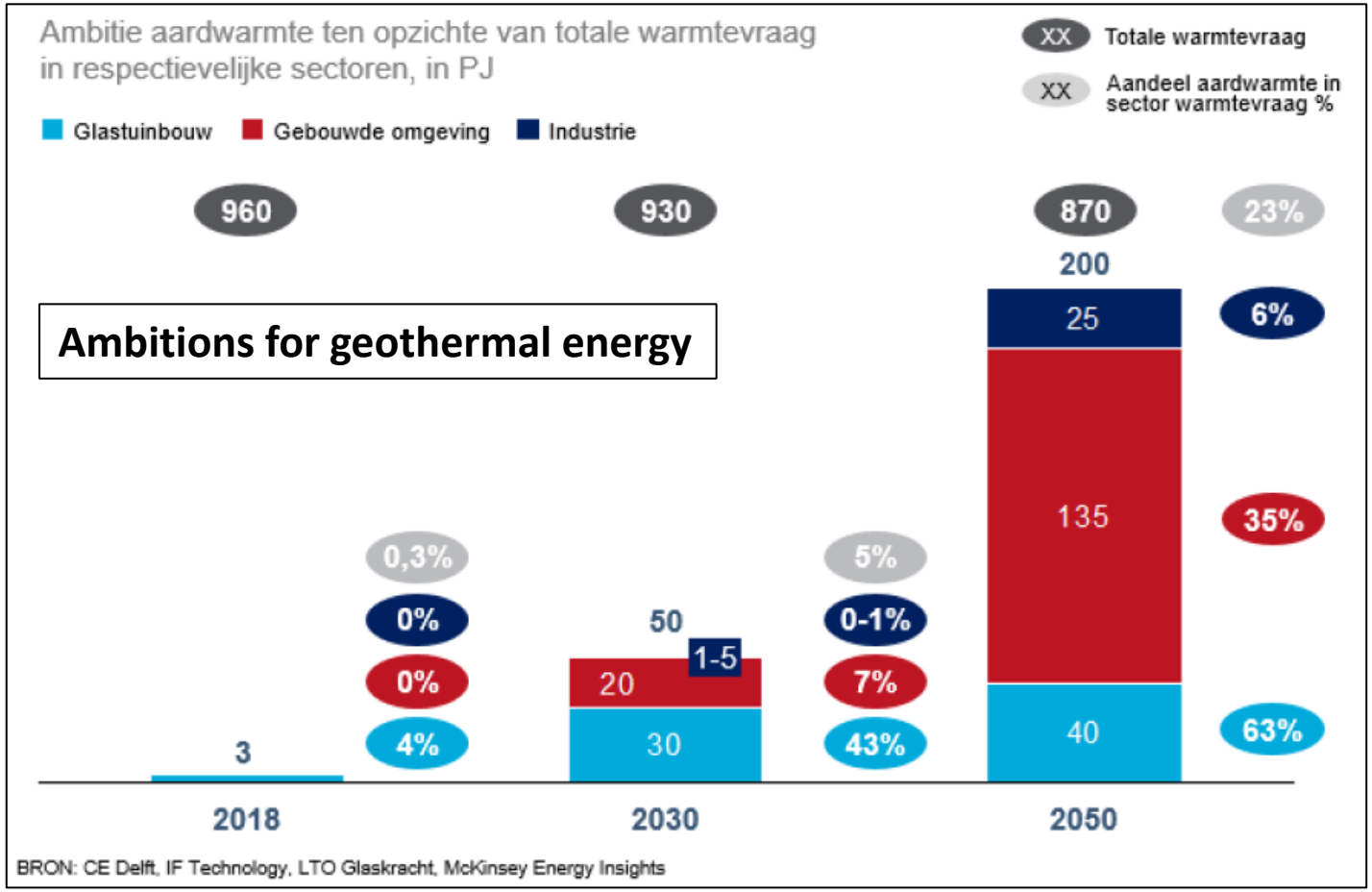
# Geothermal development in the Netherlands




**Ambitions for geothermal energy**

Expectation Masterplan Aardwarmte, EBN et al 2018
50 PJ in 2030, 200 PJ in 2050


Current doublets (20 in operation) and planned doublets (14)
Red = greenhouses,
Green = build environment
*Source: Platform Geothermie*

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# What is WARM?

- WARM is the acronym for “**W**aarde van **A**ardwarmte en **R**egionale **M**ogelijkheden” or “Value of Geothermal Heat and Regional Opportunities”
- **The goal of WARM is to integrate the potential of the sub-surface according to play-based concepts with the demand and heat network opportunities at surface**
- The integration will help the RES regions in their transition strategy and decision

# Methodology

- Input data based on ThermoGIS grids and other public data sources (PBL, Vesta-MAIS)
- Selected seven aquifers from Dinantian to Tertiary
- Prepared play-based maps for each aquifer
- Prepared Common Risk Segment (CRS) Maps per aquifer and per parameter
- **Integrated the CRS maps to a single combined potential (CCRS) map per aquifer**
- Combined the CCRS map with the surface heat demand and infrastructure
- Calculated economic applications for geothermal heat applications
- Present the results as maps per RES region

# Aquifer characteristics and selection criteria

- What are the critical aquifer characteristics for a good geothermal project?

  **These are Temperature, Thickness and Permeability**

- Applied cut-offs to select poor, average and good aquifer potential using a traffic light system

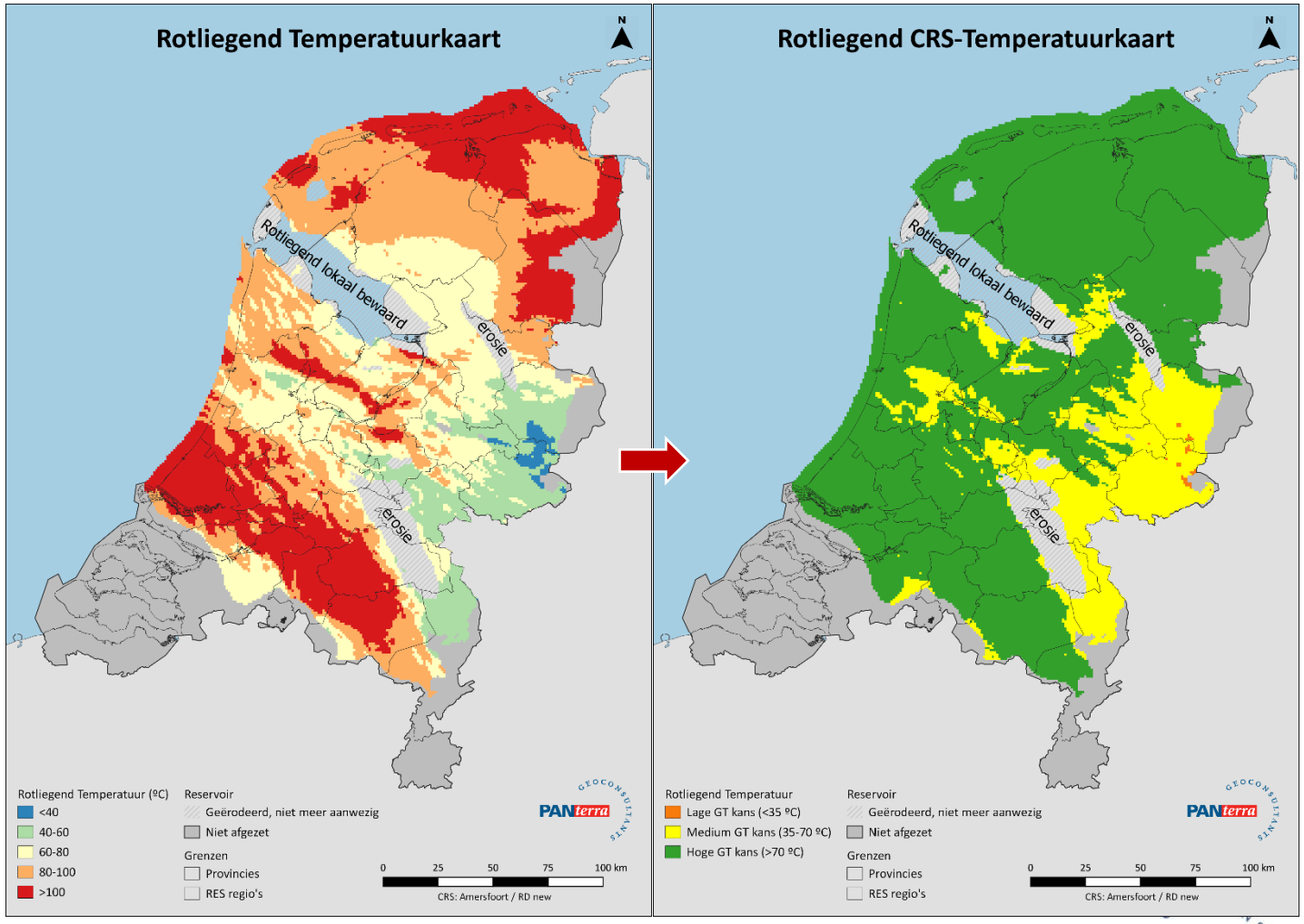
| | | | |
|---|---|---|---|
| Temperature | < 35 $^0$C | 35 – 70 $^0$C | > 70 $^0$C |
| Thickness | < 30 m | 30 – 60 m | > 60 m |
| Permeability | < 60 mD | 60 – 120 mD | > 120 mD |

- The Rotliegend will be used as an example

# Rotliegend Play - Temperature

- Left: The Rotliegend temperature map from ThermoGIS. This maps resembles largely the depth map, combined with variation in temperature gradient.
- Right: The resulting CRS map which indicates temperature classes. Orange is hardly presence because of the depth of the Rotliegend.

| < 35 $^{0}$C | 35 – 70 $^{0}$C | > 70 $^{0}$C |
|---|---|---|

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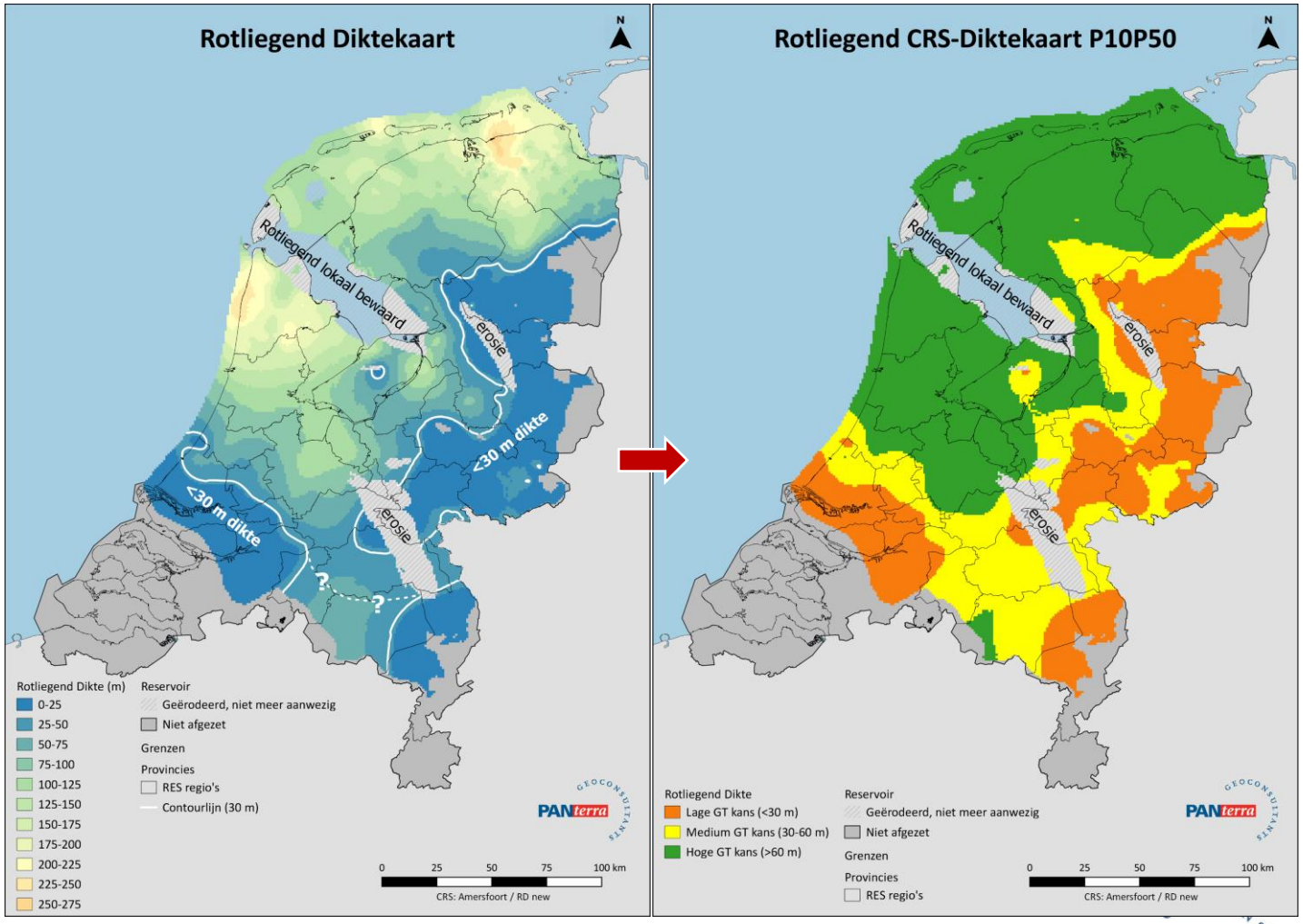
# Rotliegend Play - Thickness

- Left: The Rotliegend thickness map from ThermoGIS, with superimposed the 30m boundary

- Right: The resulting CRS map which indicates thickness classes




| < 30 m | 30 – 60 m | > 60 m |
|---|---|---|

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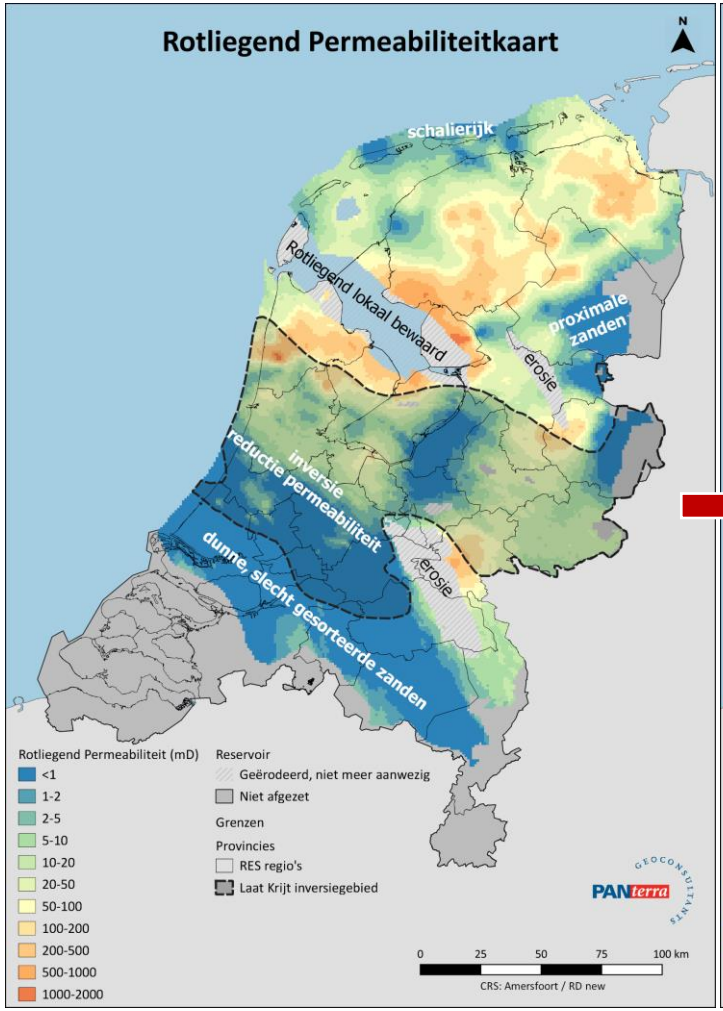
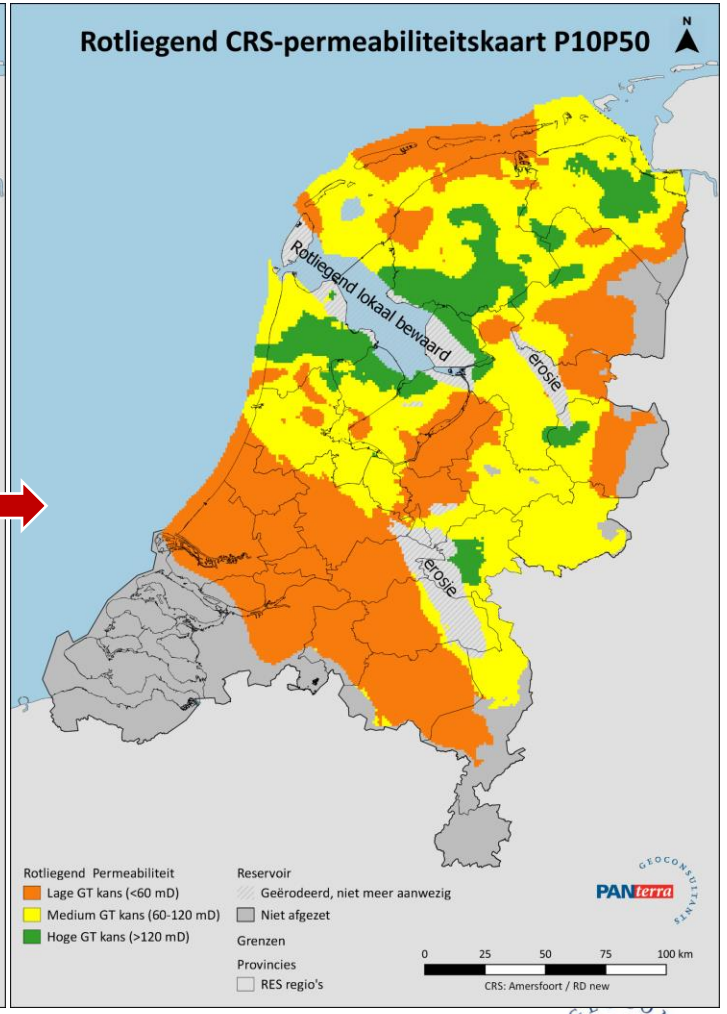
# Rotliegend Play – CRS Map Permeability

- Left: The Rotliegend permeability map from ThermoGIS, with superimposed the facies map

- Right: The resulting CRS permeability map with the traffic light class system

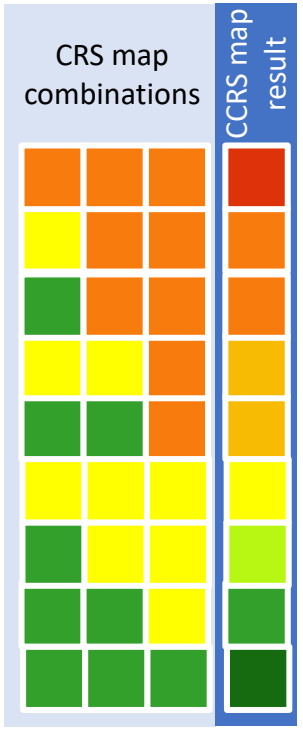



| < 60 mD | 60 – 120 mD | > 120 mD |
|---|---|---|

# Rotliegend Play – Combined CRS Maps

- The three CRS maps are combined into one CCRS map showing the potential for the Rotliegend aquifer.
- **The map shows that mostly the northern and western half of the Netherlands is suitable for Rotliegend geothermal application**



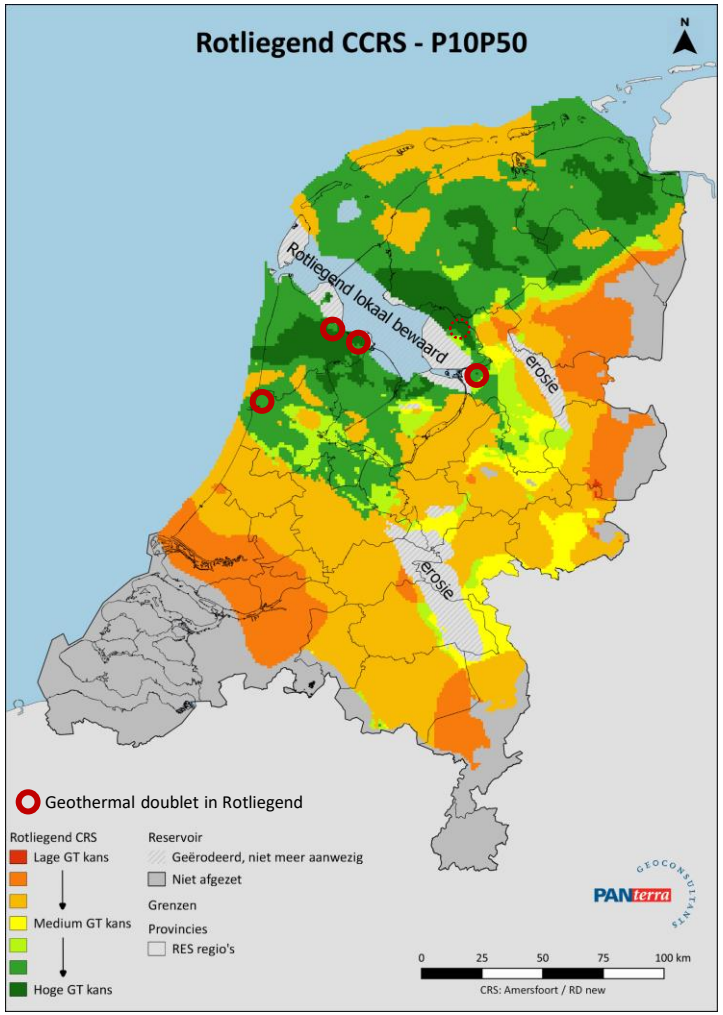

Temperature CRS

+

Thickness CRS

+

Permeability CRS

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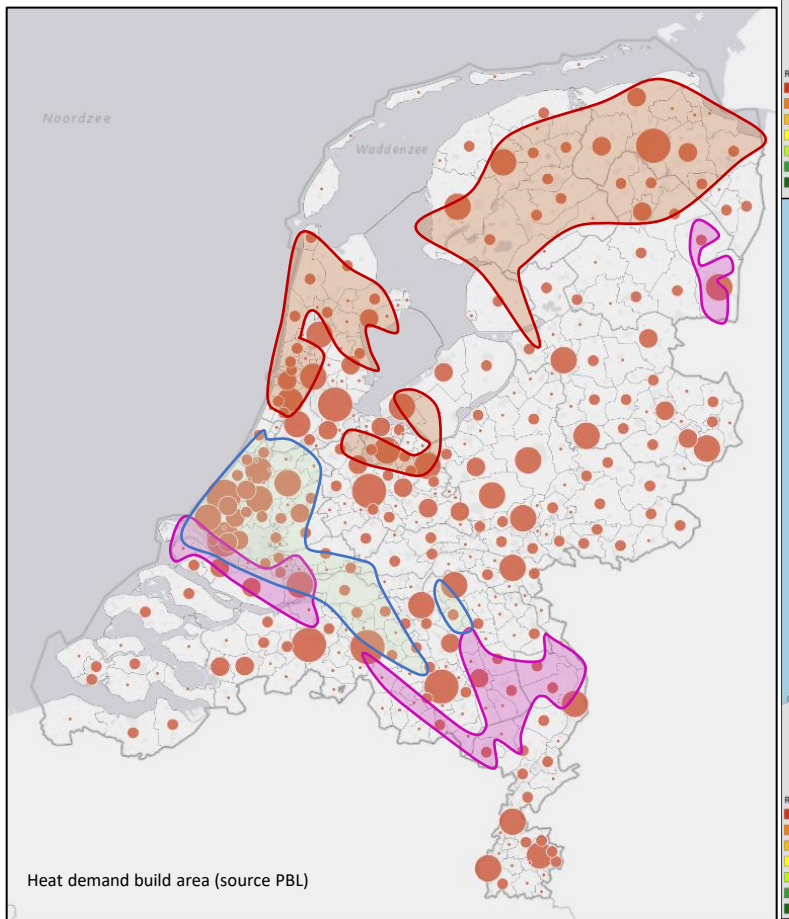
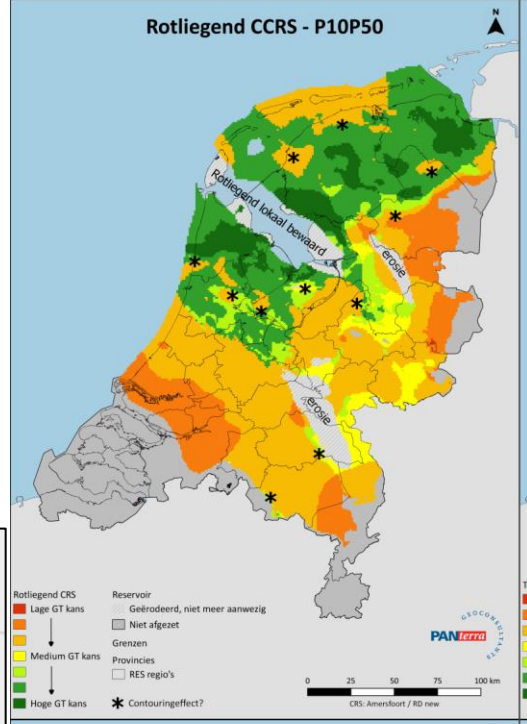
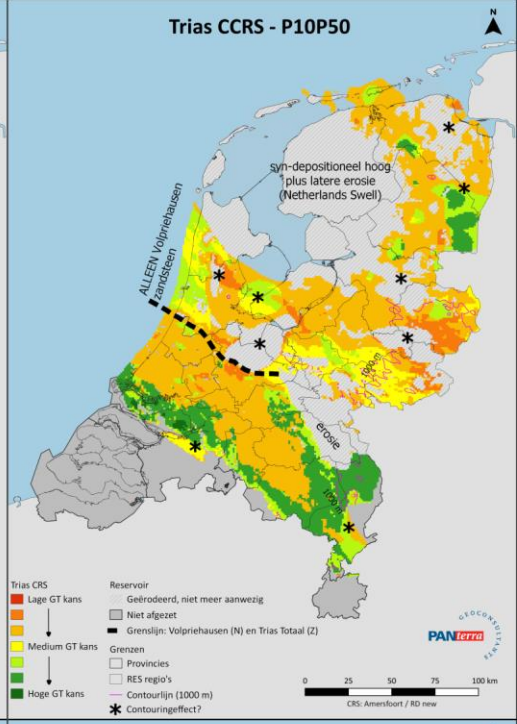
# Final CCRS results for the Netherlands

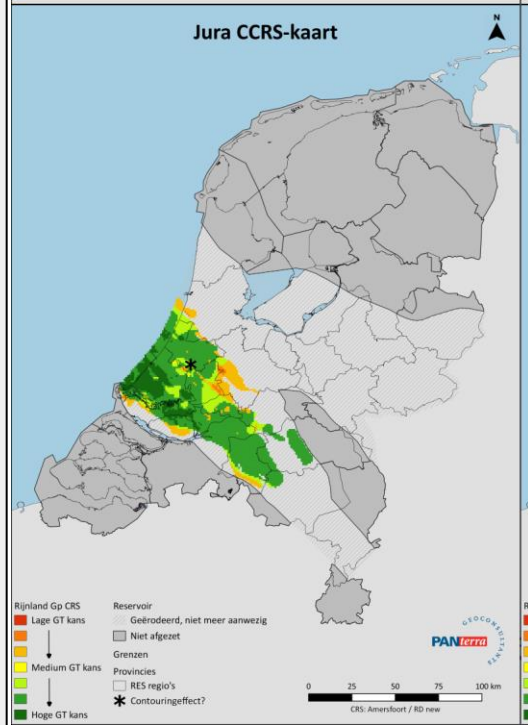
- The CCRS maps of the four most interesting aquifer targets are shown to the right
- The map to the left shows that a large part of the Netherlands with heat demand for the build area can be covered with geothermal heat from RO, JU/CR and TR

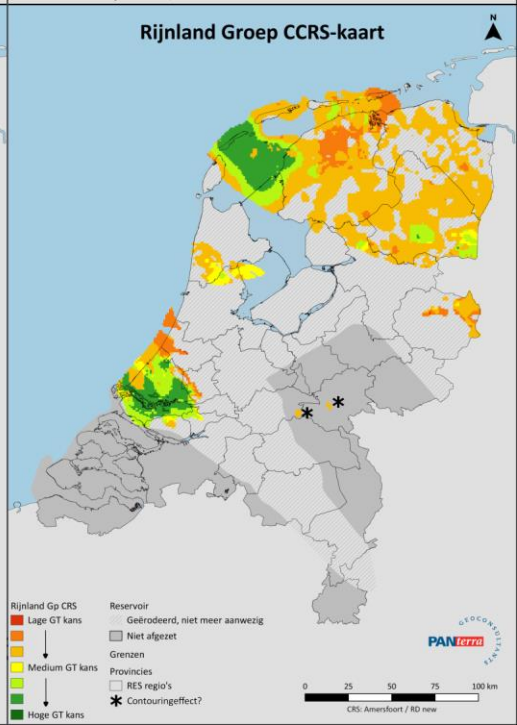


Heat demand build area (source PBL)



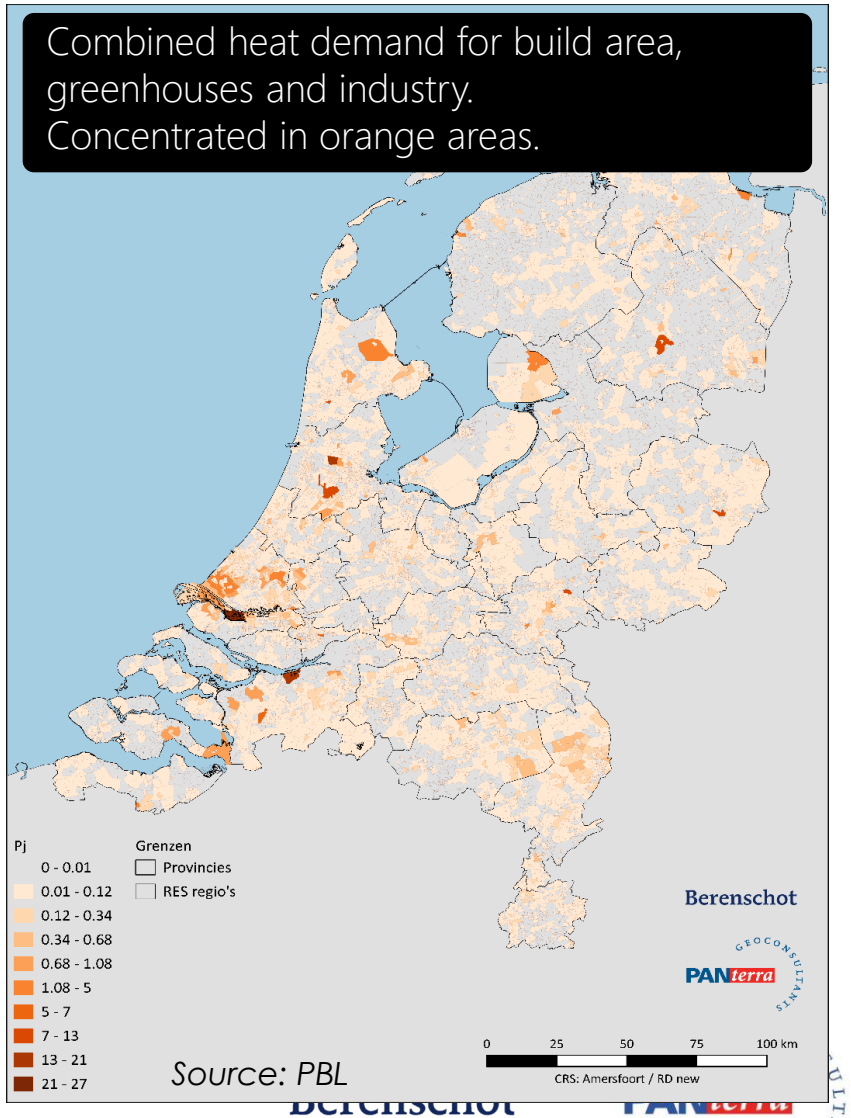



# Potential for geothermal heat – surface demand

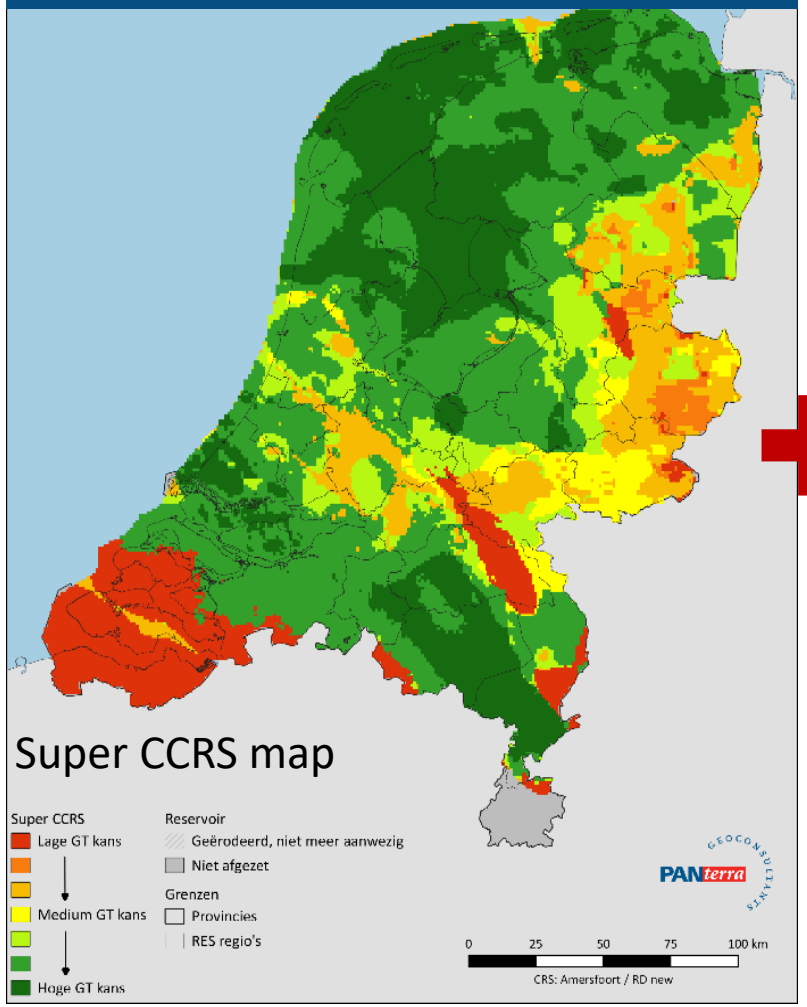
- Three sectors have a heat demand that can be supplied with geothermal heat
- Experience mainly in greenhouse gas sector
- Total heat demand is approximate 585 PJ.

| Gebouwde omgeving | Glastuinbouw | Industrie met warmtevraag < 100 °C |
|---|---|---|
| 290 PJ (2030) | 95 PJ (2019) | 200 PJ (2013) |

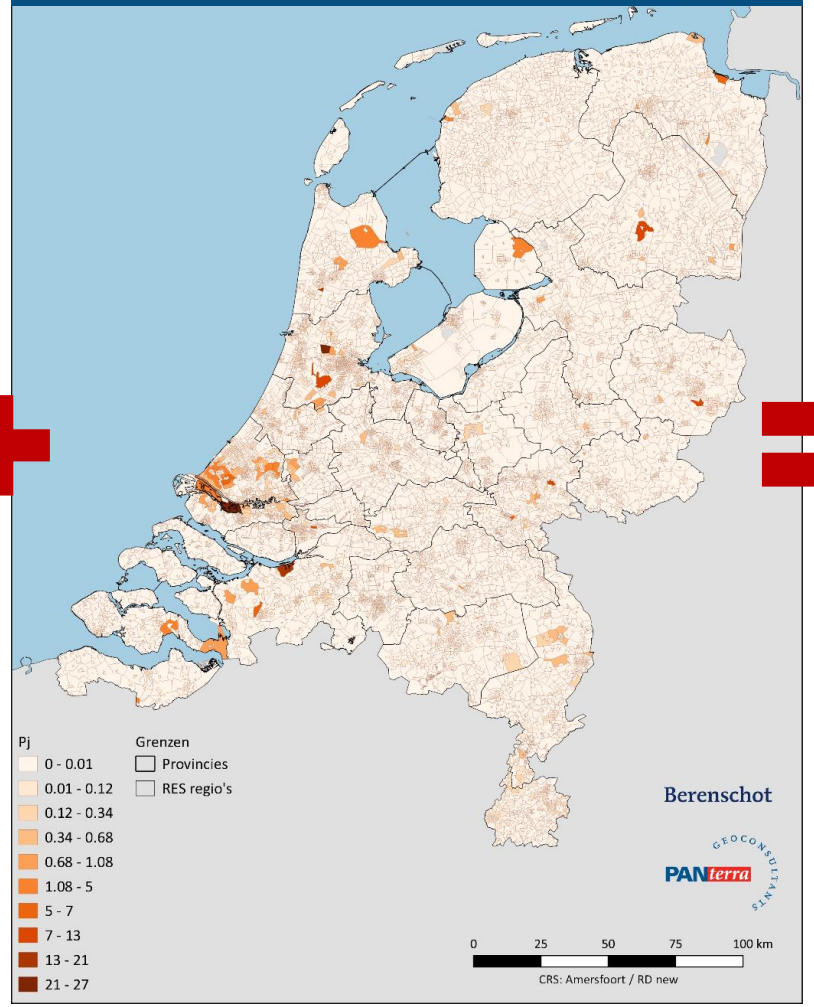


# Integration with surface data

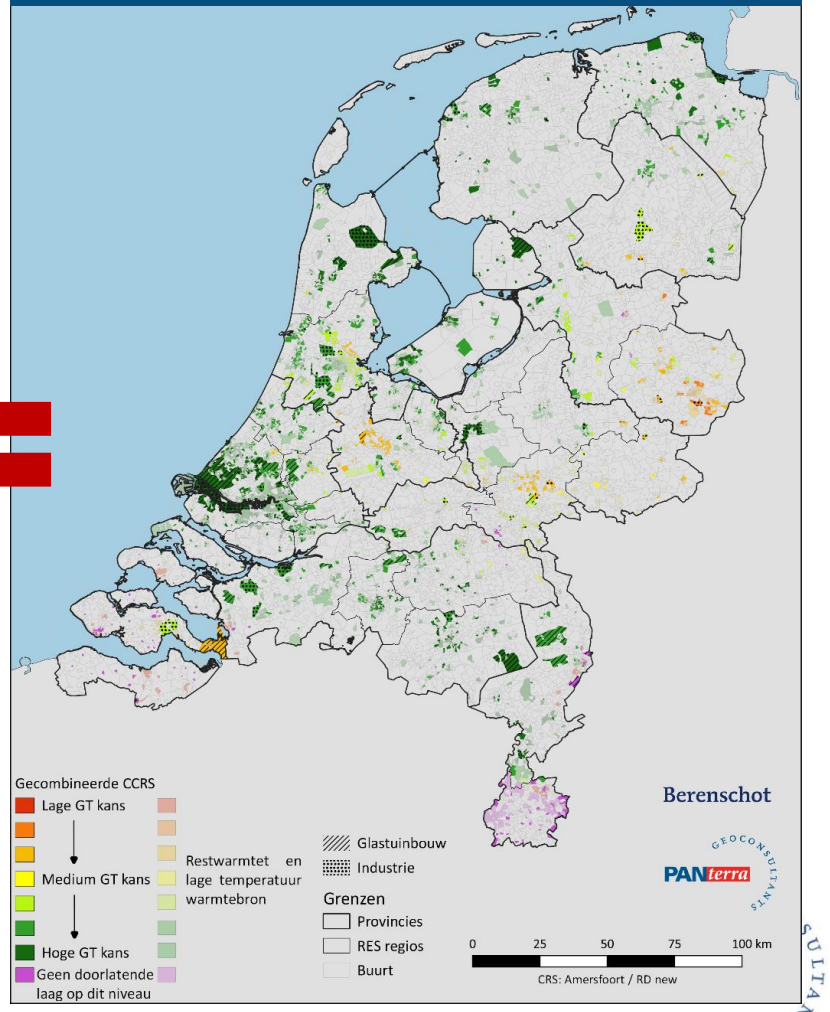
## Subsurface




## Surface

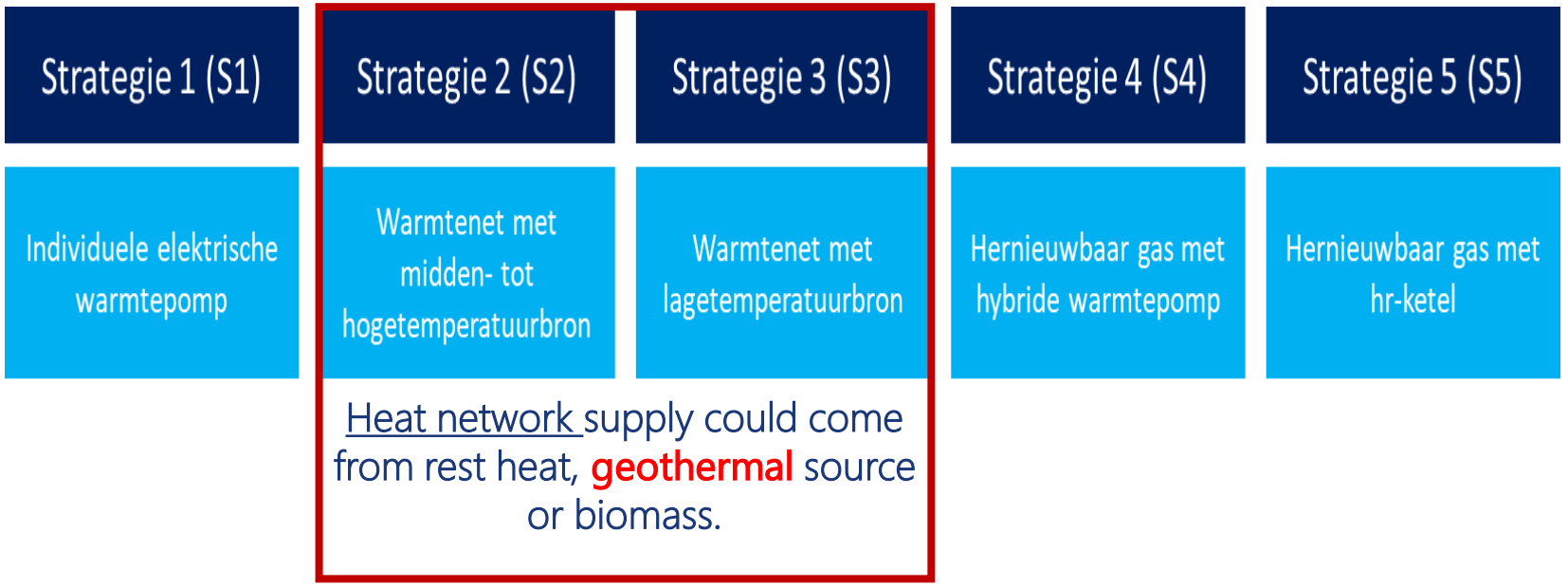



## Combined CCRS



# Competition for Geothermal Heat (Build Area)

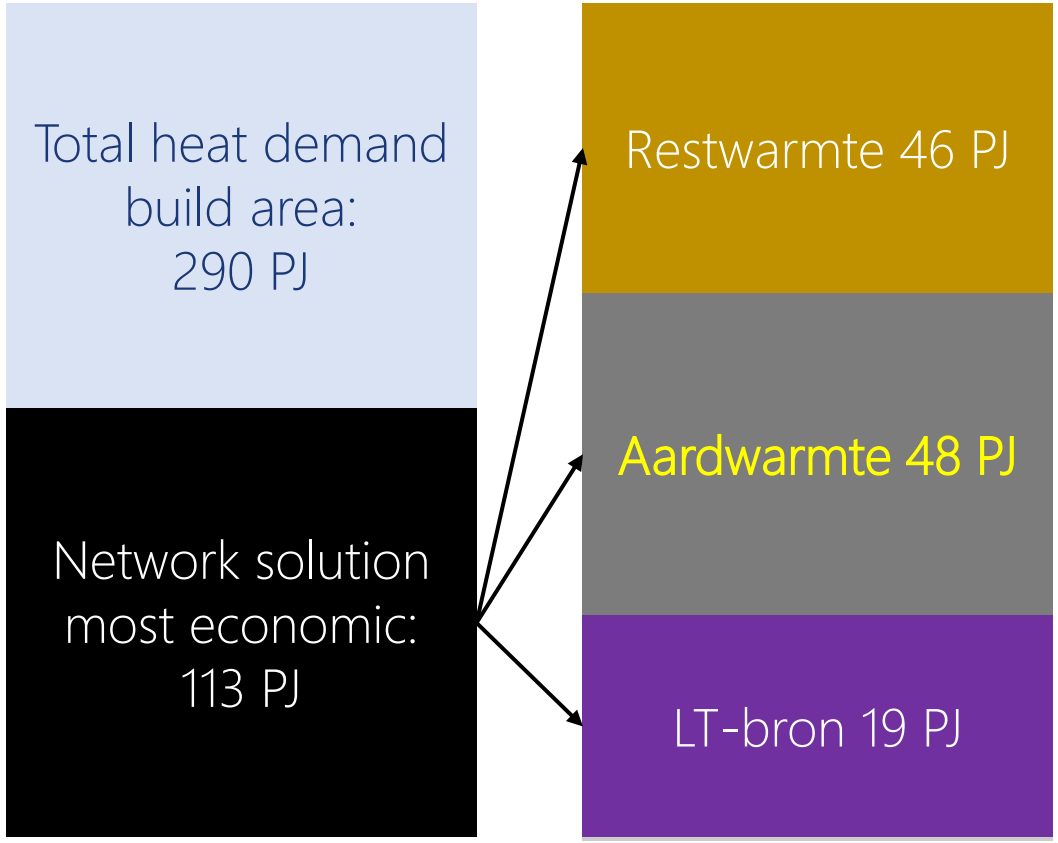
- Several strategic options (Strategy 1 - 5) are compared
- Drilling cost are expected to decrease with 30% in 2030 (IF, TNO, Berenschot study)
- Economics for these alternatives are calculated
- Economic input data from public sources like Vesta-MAIS and PBL



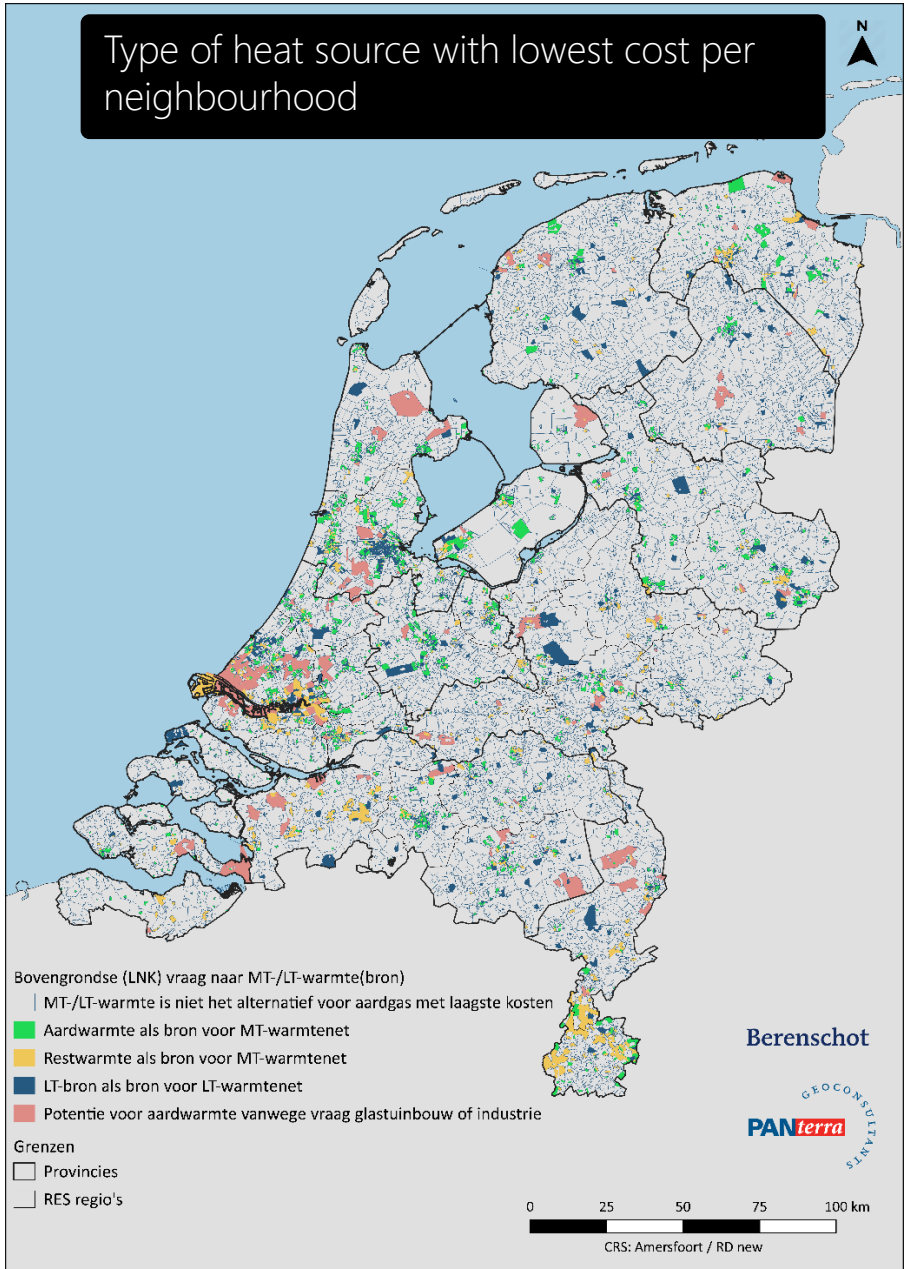

- A comparable analysis is carried out for greenhouses and industry

# Surface potential build area, demand split

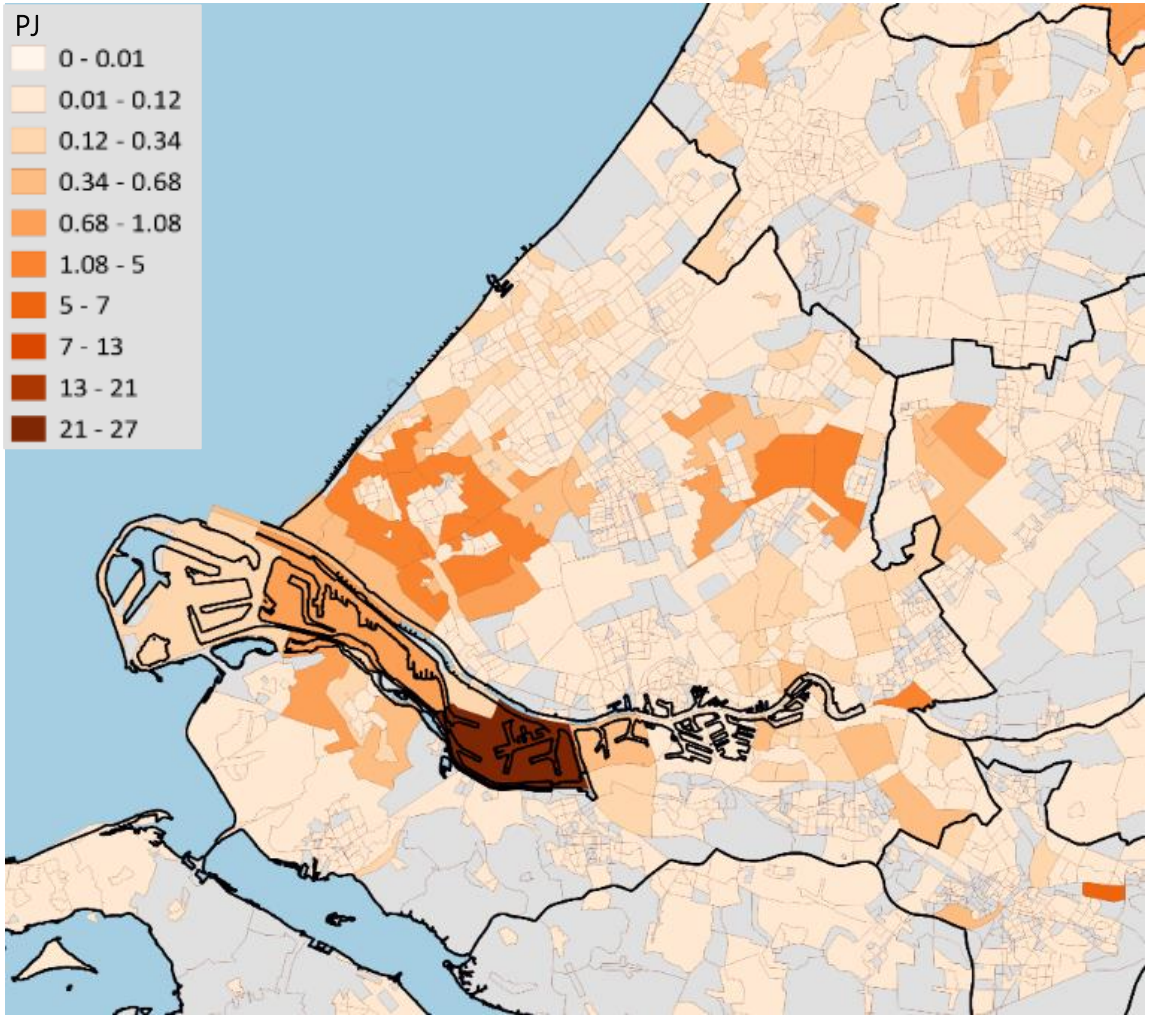
- This analysis gives insight in heat demand corrected for economic parameters



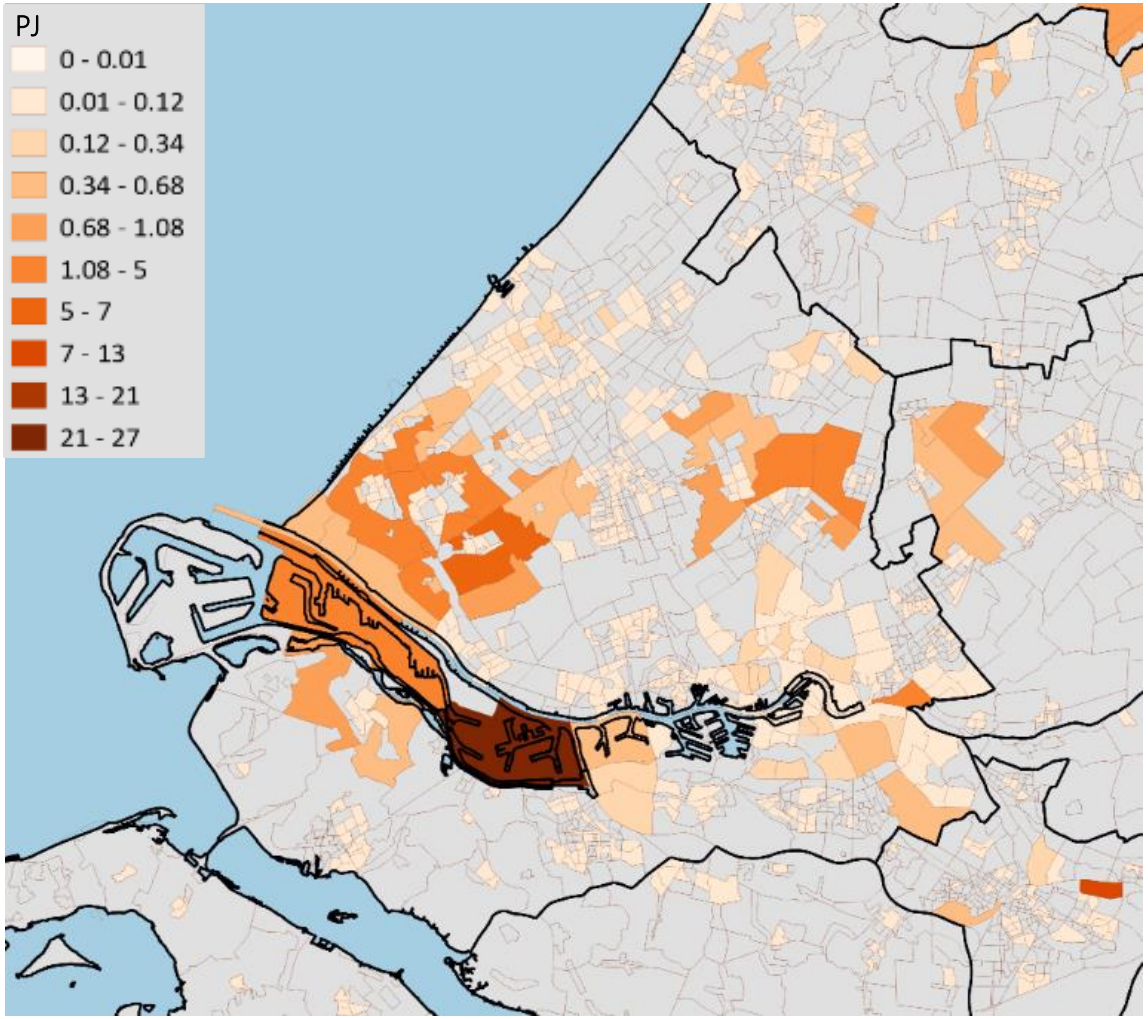

- Geothermal energy is cheapest alternative in 17% of total demand



# RES-detail study: example Rotterdam Den-Haag




Total heat demand in region in PJ (build, green houses, industry)




Heat demand corrected for economical cut-off

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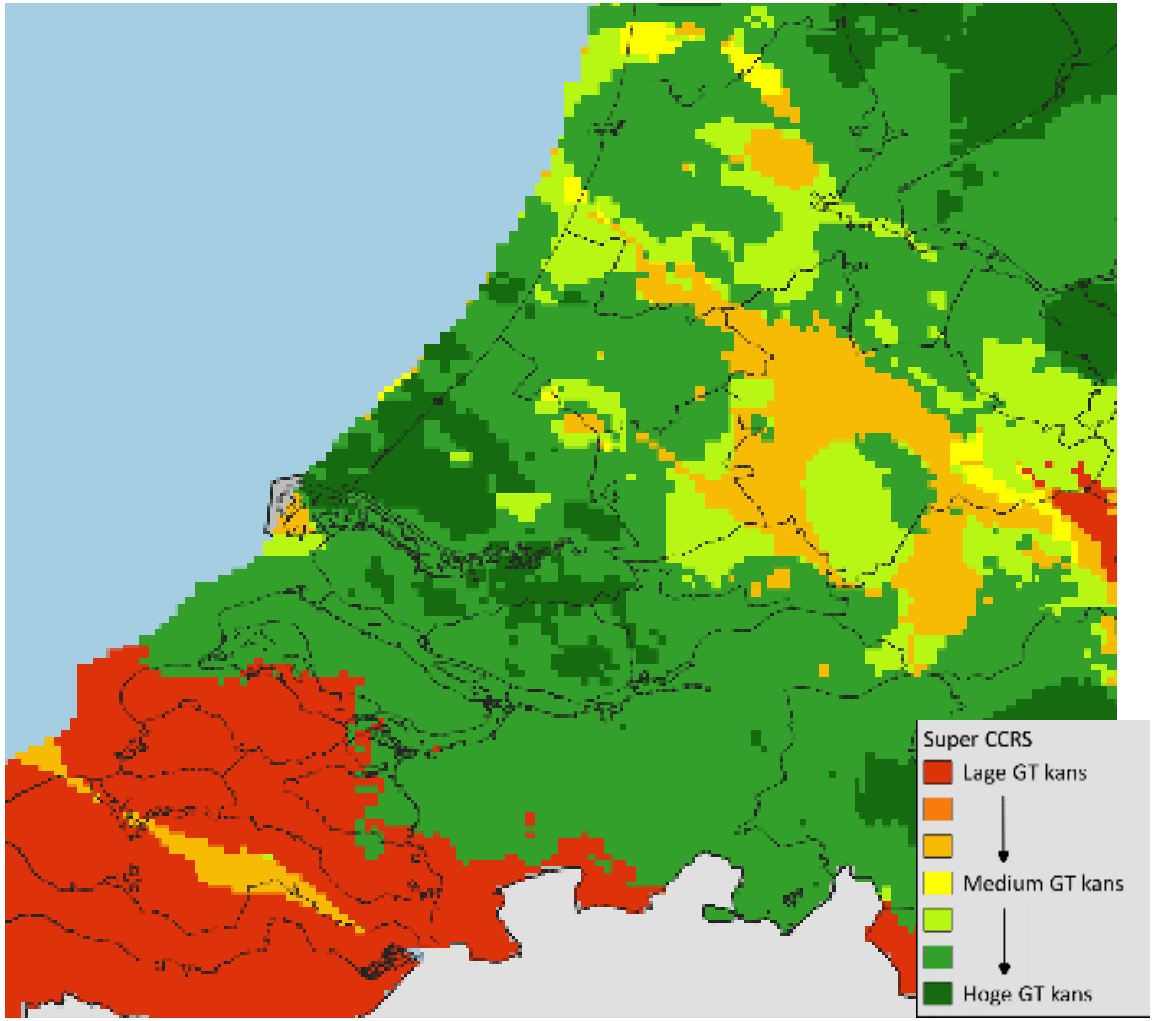
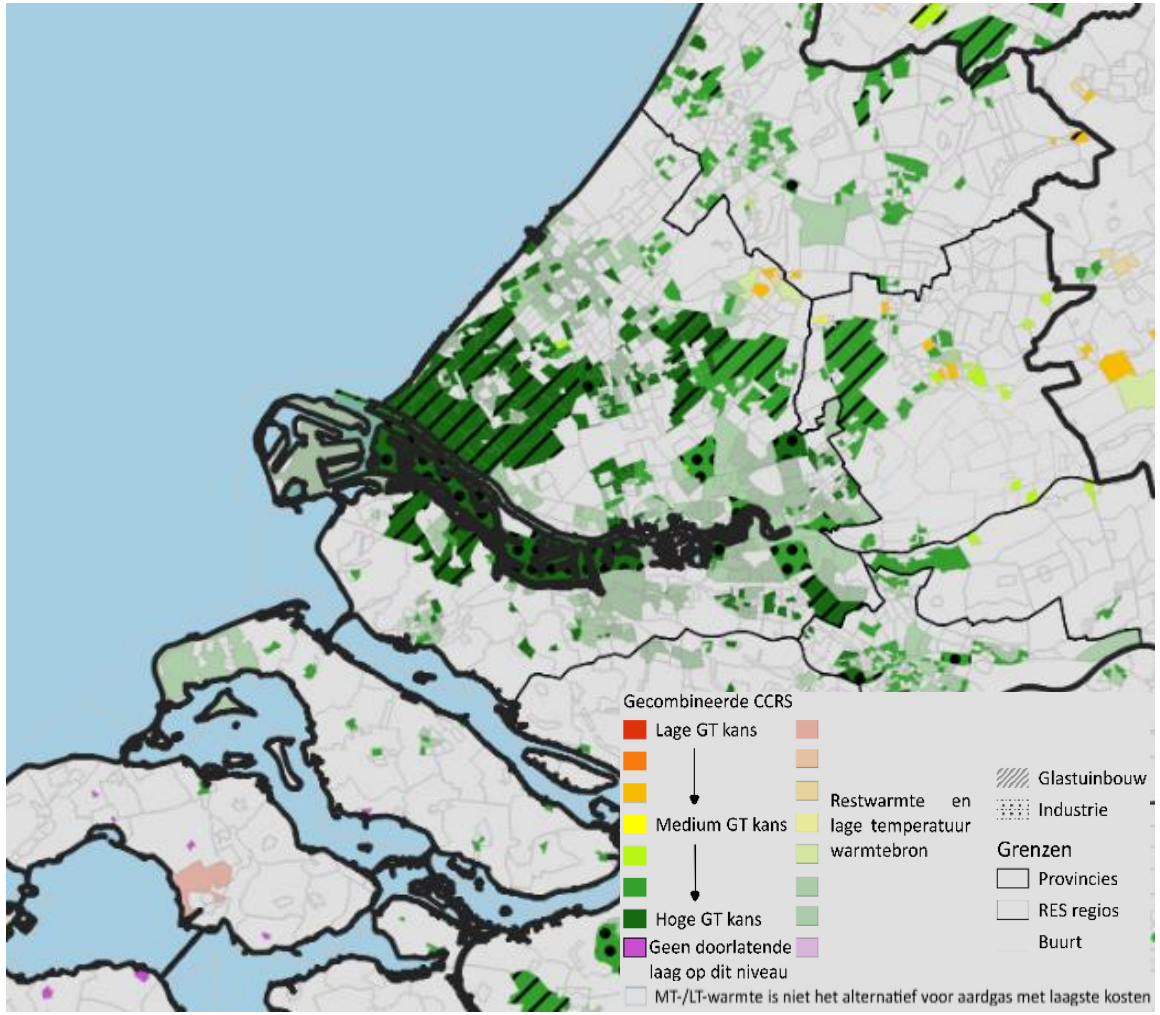
# RES-detailstudie: example Rotterdam Den-Haag




Super CCRS sub-surface map: Indicates combined succes of the sub-surface for geothermal drilling




Combined potential of surface and sub-surface

# Conclusions

- The goal of WARM to integrate the potential of the sub-surface with the surface demand and network opportunities is achieved, and forms a key source of information used by municipalities and the Regional Energy Strategy to create their 2030 roadmap
- A large part of the heat demand for the urban environment can be covered with geothermal heat
- Geothermal energy is a viable alternative for gas in the energy transition proces
- Technically about 48 PJ can be provided in a cost effective way by 2030, which is close to the 50 PJ ambition of the 2018 Masterplan (SPG et al.)
- To deliver 48 PJ in 2030 will require about 150-250 doubletten (300-500 wells) in the next ten years
- **Such an effort in a short time frame is only possible if the O&G industry will support such an investment with its organisational and technical skills and financial power**
- Download the report with ebn, **WARM** study**:** **https://kennisbank.ebn.nl/eindrapport-warm/**

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# With thanks to the team

- Han van Gils (project leader, PanTerra)
- Jan de Jager  (play based maps, Associate)
- Joachim Schellekens (Berenschot)
- Francesco Vinci (QGIS maps and geological input, PanTerra)
- Jan Willem Pronk (report review, Associate)
- Bert den Ouden (Manager Energy Berenschot)
- Nora Heijnen (project coordinator EBN)

**Think Green**

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