ITGBES TOOL FOR CLOSED-LOOP GSHP SYSTEMS DESIGN

Groenholland Geo Energiesystemen BV

GEO ENERGY SYSTEMS GROENHOLLAND

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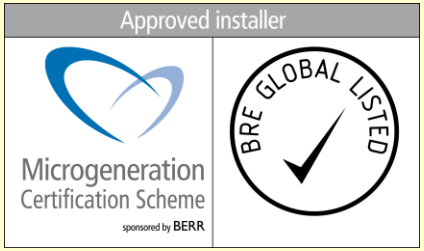
INTRODUCING GROENHOLLAND BV

- **Groenholland BV Amsterdam; incorporated 1990**
- **Groenholland UK Ltd; incorporated 2001**

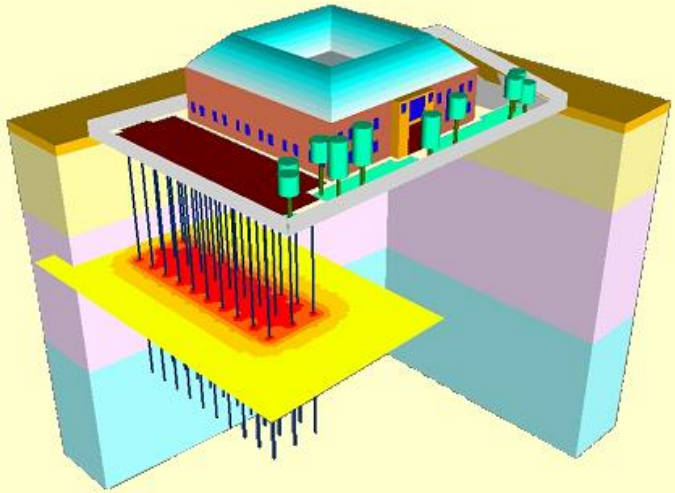
- Background in Earth Sciences and Engineering Geology
- Since 1996 Shallow geothermal R&D
- Since 2003 Design & build turn key projects
- EU projects: FP6, FP7, **GEOTech, Geofit, Geoboost (H2020)**
- Active in IEA annex 20 & 21, TKI topsector programma (NL)
- TC 451 European Norm Commission, NL national delegate
- Training courses (NL) & European GSHP involvement (EGEC)



GSHP – BHE : APPLICATION & DESIGN

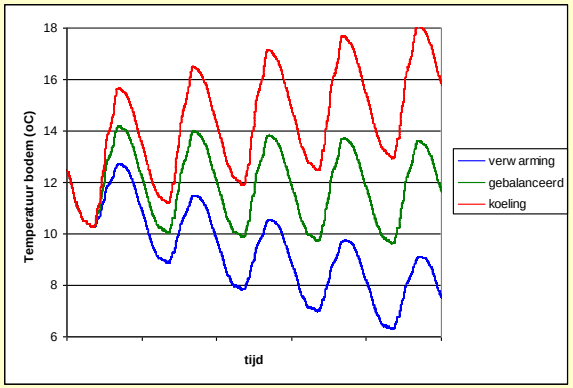
Small scale, individual design

Larger scale, individual design



Information required for design

- Energy information, annual profile (MWh)
- Energy information, peakload (kW)
- Geothermal parameters
  - Conductivity
  - Heat capacity
  - Temperature



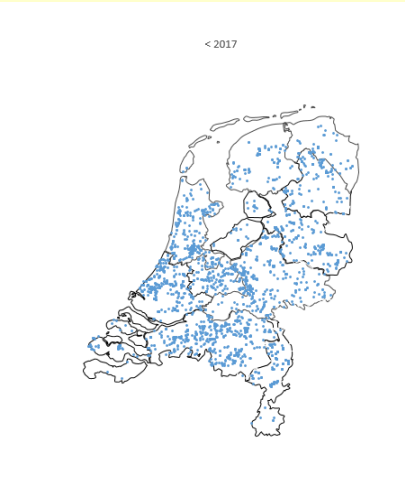
Long term thermal effect

2023: >100.000 GSHP SYSTEMS (NL)

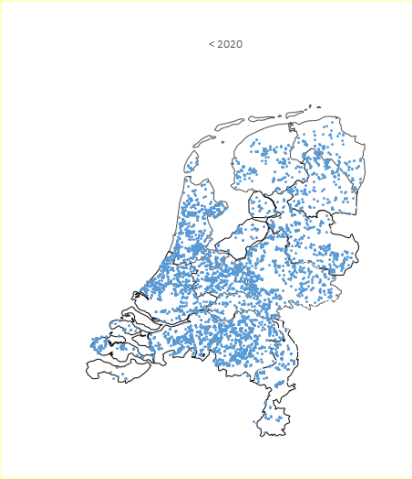
<2013

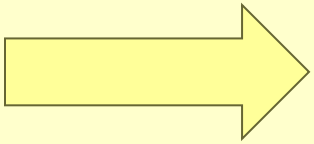
2015

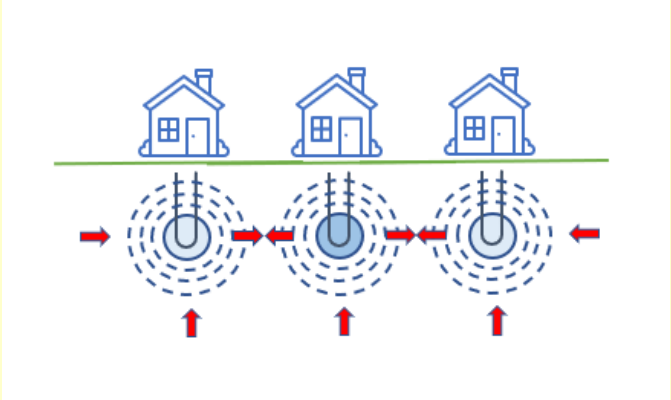
2017



2020

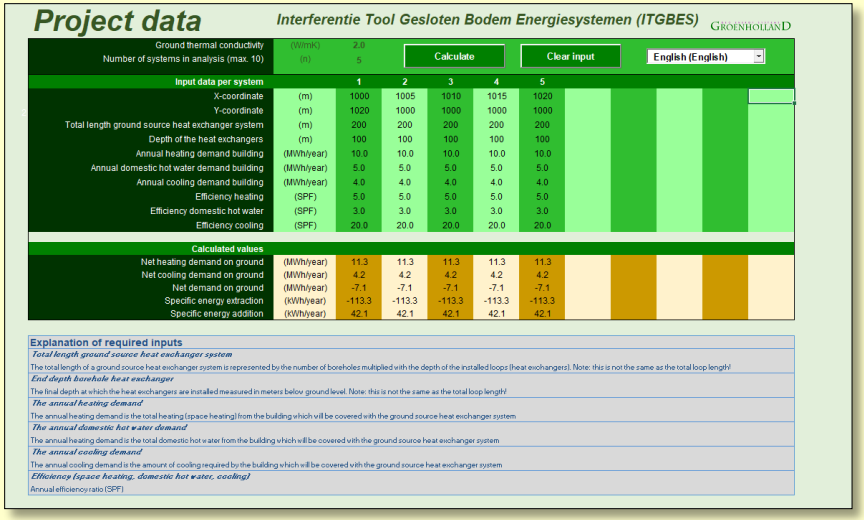






INTRODUCING ITGBES.com

- Due to expected rise of the number of systems: introduction of new law in NL in 2013 on shallow geothermal systems, requiring interference calculations.
- **2013**: Groenholland developed 1st interference assessment for ministry of infrastructure and environment
- **2019**: Groenholland developed of a standardized Excel application for Ministry of Infrastructure and Water Management based on the Finite line source (FLS) model
- **2023**: ITGBES.com as design support tool for international GSHP community



Project data — *Interferentie Tool Gesloten Bodem Energiesystemen (ITGBES)* — GROENHOLLAND

Ground thermal conductivity (W/mK) 2.8 | Number of systems in analysis (max. 10) (n) 5 | Calculate | Clear input | English (English)

Input data per system		1	2	3	4	5
X-coordinate	(m)	1000	1005	1010	1015	1020
Y-coordinate	(m)	1020	1000	1000	1000	1000
Total length ground source heat exchanger system	(m)	200	200	200	200	200
Depth of the heat exchangers	(m)	100	100	100	100	100
Annual heating demand building	(MWh/year)	10.0	10.0	10.0	10.0	10.0
Annual domestic hot water demand building	(MWh/year)	5.0	5.0	5.0	5.0	5.0
Annual cooling demand building	(MWh/year)	4.0	4.0	4.0	4.0	4.0
Efficiency heating	(SPF)	5.0	5.0	5.0	5.0	5.0
Efficiency domestic hot water	(SPF)	3.0	3.0	3.0	3.0	3.0
Efficiency cooling	(SPF)	20.0	20.0	20.0	20.0	20.0
Calculated values						
Net heating demand on ground	(MWh/year)	11.3	11.3	11.3	11.3	11.3
Net cooling demand on ground	(MWh/year)	4.2	4.2	4.2	4.2	4.2
Net demand on ground	(MWh/year)	-7.1	-7.1	-7.1	-7.1	-7.1
Specific energy extraction	(kWh/year)	-113.3	-113.3	-113.3	-113.3	-113.3
Specific energy addition	(kWh/year)	42.1	42.1	42.1	42.1	42.1

Explanation of required inputs

Total length ground source heat exchanger system
The total length of a ground source heat exchanger system is represented by the number of boreholes multiplied with the depth of the installed loops (heat exchangers). Note: this is not the same as the total loop length!

End depth borehole heat exchanger
The final depth at which the heat exchangers are installed measured in meters below ground level. Note: this is not the same as the total loop length!

The annual heating demand
The annual heating demand is the total heating (space heating) from the building which will be covered with the ground source heat exchanger system

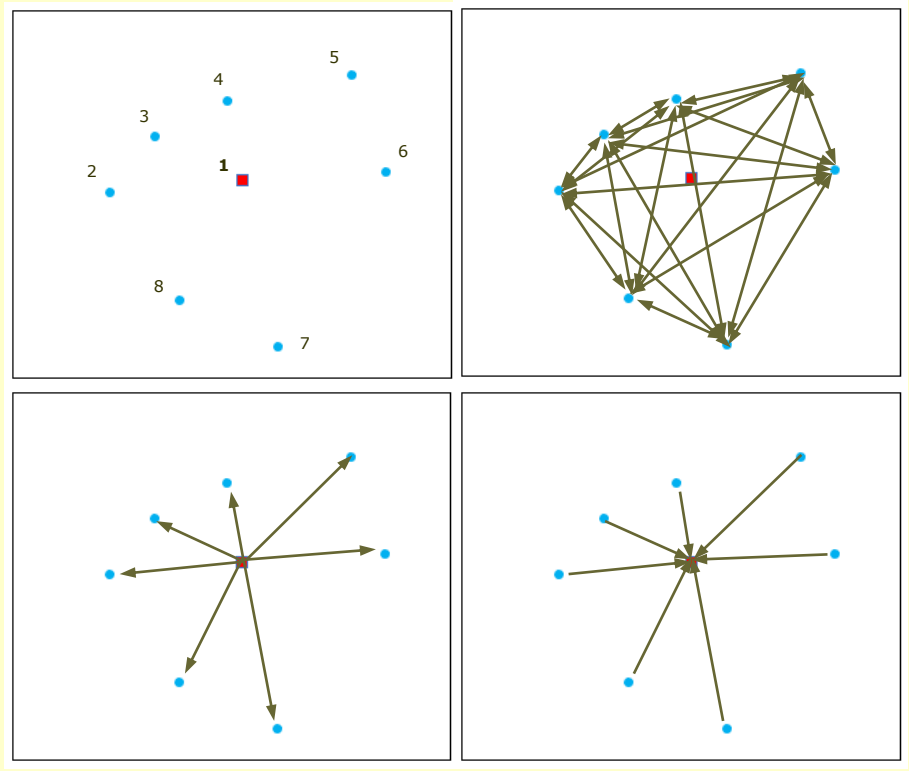
The annual domestic hot water demand
The annual heating demand is the total domestic hot water from the building which will be covered with the ground source heat exchanger system

The annual cooling demand
The annual cooling demand is the amount of cooling required by the building which will be covered with the ground source heat exchanger system

Efficiency (space heating, domestic hot water, cooling)
Annual efficiency ratio (SPF)

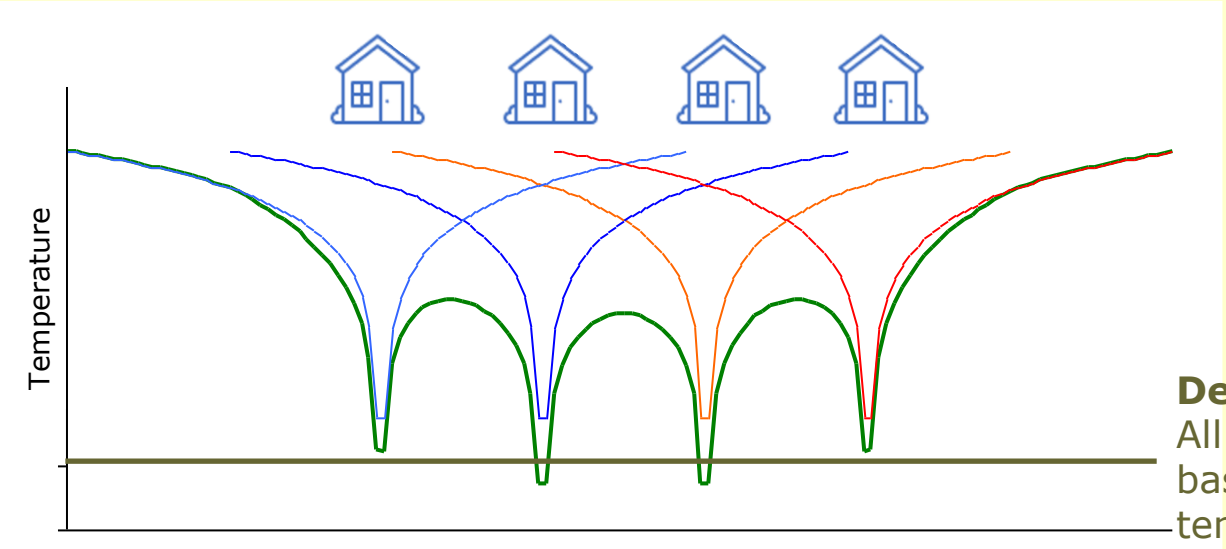
When to use ITGBES.com?

- **Example of application in practice for single house**
  - Multiple neighboring systems surrounding project
  - Account for thermal effects other systems >> optimize design



When to use ITGBES.com?

- **Integrated design of cluster of houses**
  - Standard design software calculates average BHE depth
  - ITGBES provides thermal effects specific to all BHE, based on spatial positions
  - Calculated effects can be used to optimize individual designs

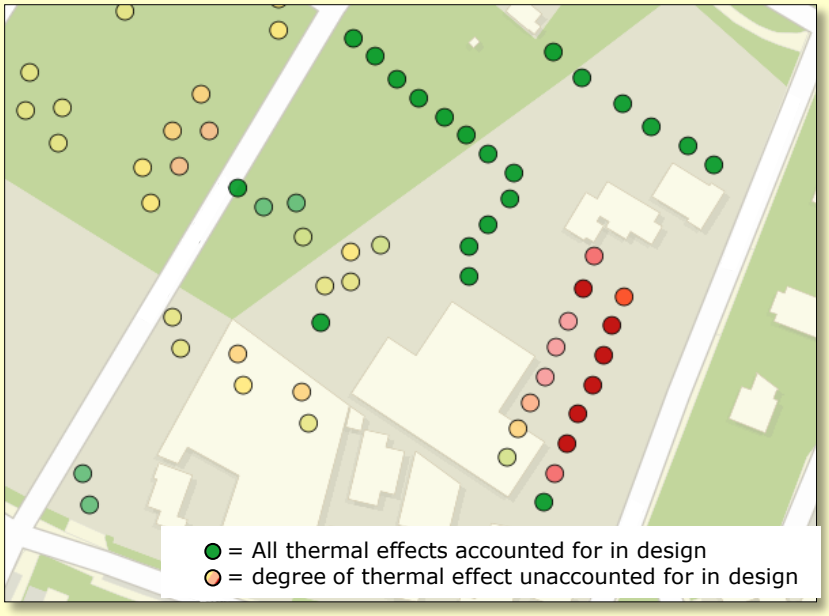


Design software:
All BHE same depth, based on average temperature response

When to use ITGBES.com?

- **With regards to specific regulatory demands**
  - ITGBES provides thermal effects specific to all BHE (both new and existing), based on spatial positions
  - Calculated effects can be applied to prove whether design meets imposed regulations (max. accepted temperature effects).
  - When regulations are not met

    >> Adjust design



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- **On the USB-stick:**
  - ITGBES.com excel tool, demo version
  - ITGBES.com manual
  - ENERSTOK 2018 paper introducing interference assessment
  - EGC 2019 paper introducing ITGBES-PRO