Thermal Urban Energy Systems

Phil Vardon
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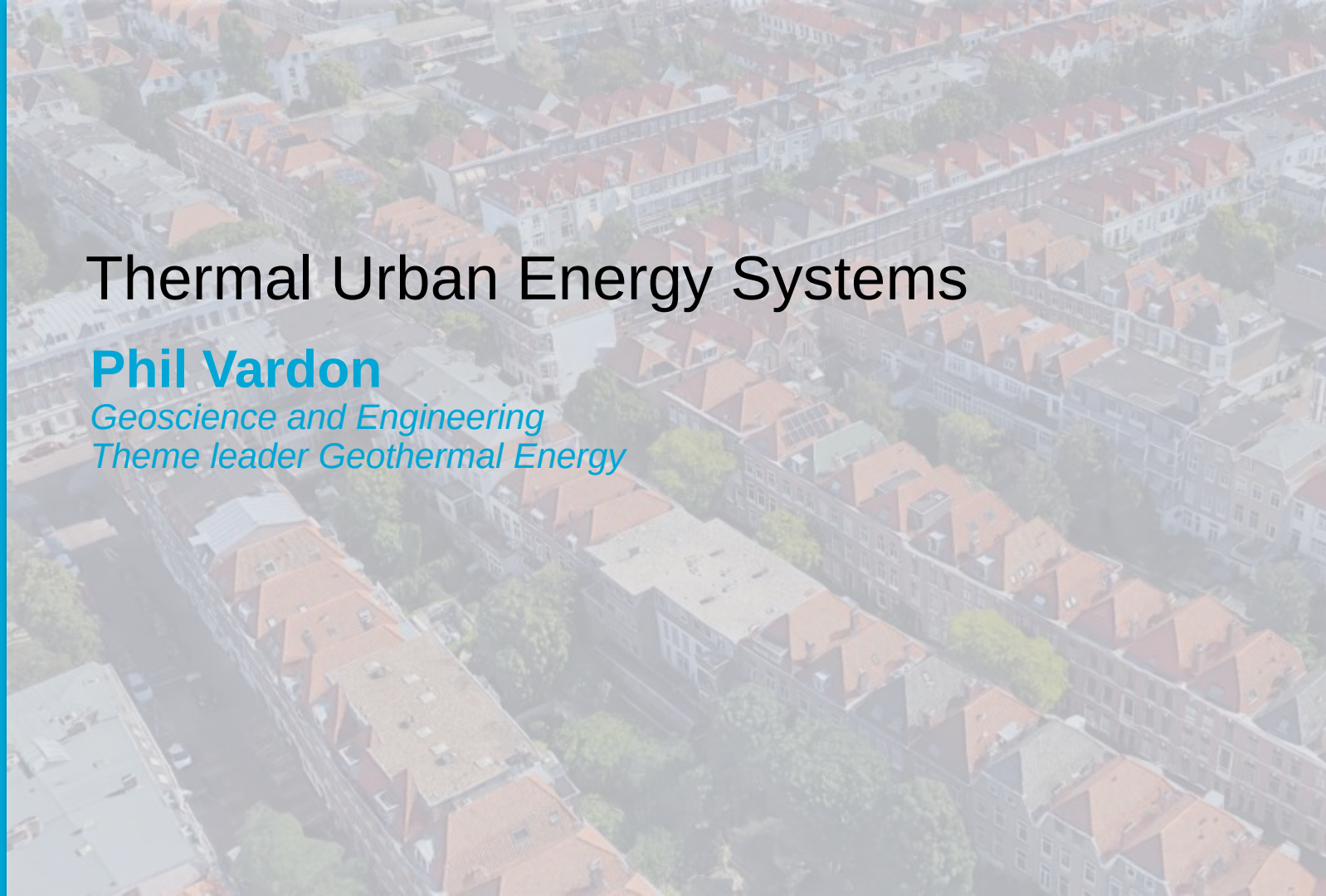
Theme leader Geothermal Energy



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‘The right heat in the right place at the right time’

What is the right heat?

- Sustainability
  - Moving to more sustainable sources in time
- Efficient
  - Reduce primary energy consumption, i.e. reduce CO_2 emissions
  - Reduce costs
- Amount
  - Peaks in heat are high
  - Heat is ~50% of all final energy use, ~80% (excluding mobility) urban
- Integrated
  - The right temperature
  - From source to user
  - In new buildings / in old buildings
  - With other technologies
  - With other heat sources

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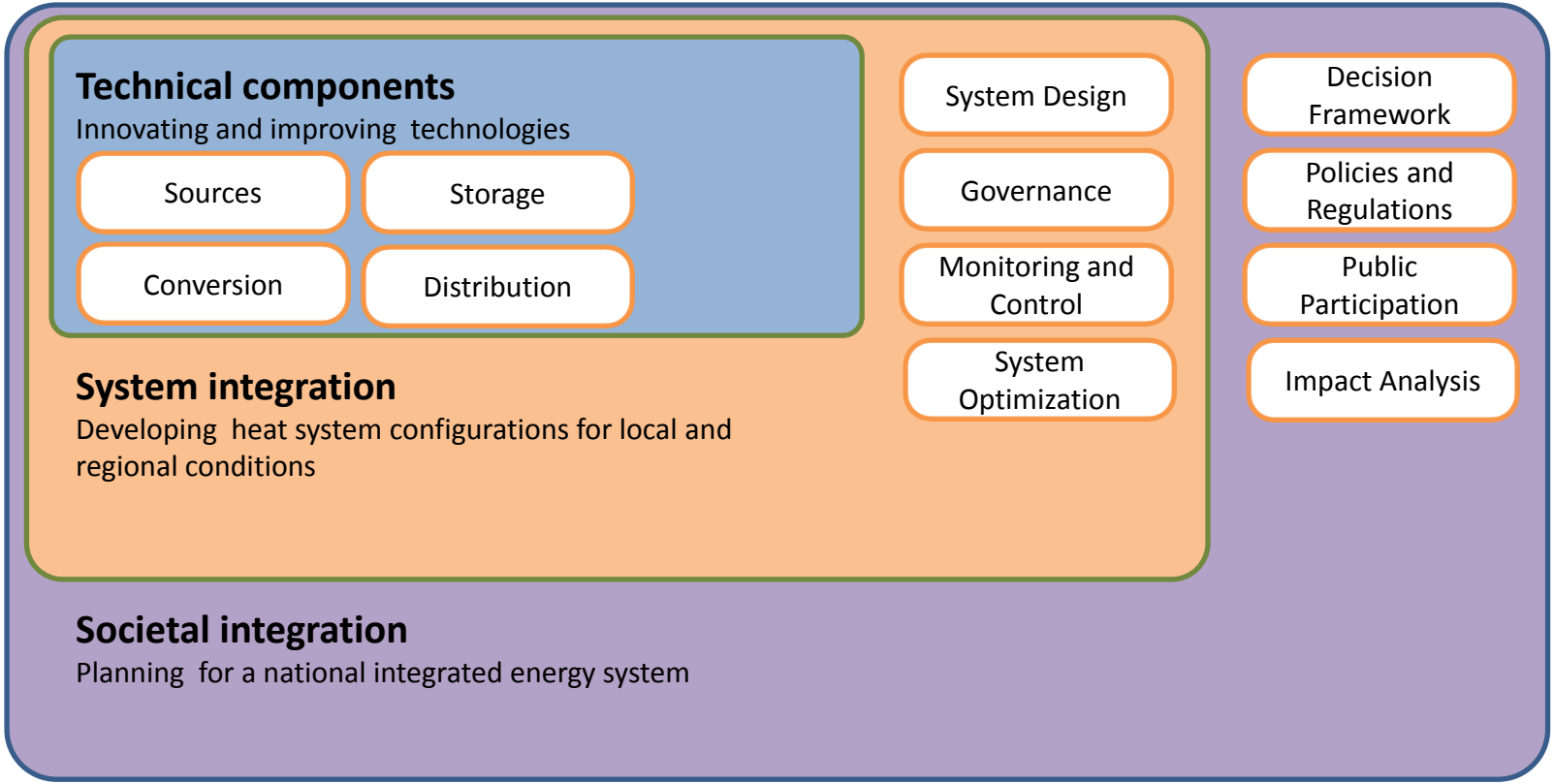
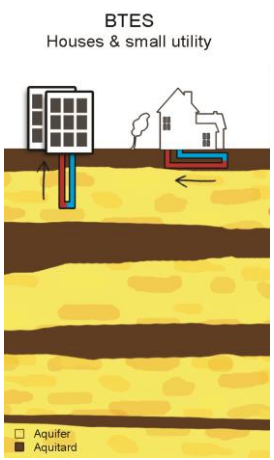
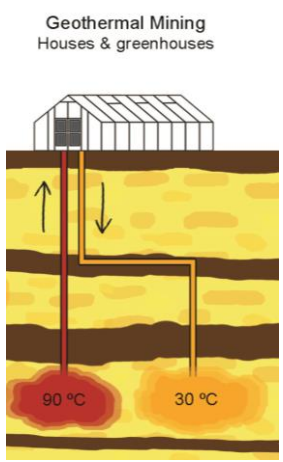

Technical components
Innovating and improving technologies
Sources
Storage
Conversion
Distribution
System integration
Developing heat system configurations for local and regional conditions
System Design
Governance
Monitoring and Control
System Optimization
Decision Framework
Policies and Regulations
Public Participation
Impact Analysis
Societal integration
Planning for a national integrated energy system

Challenges

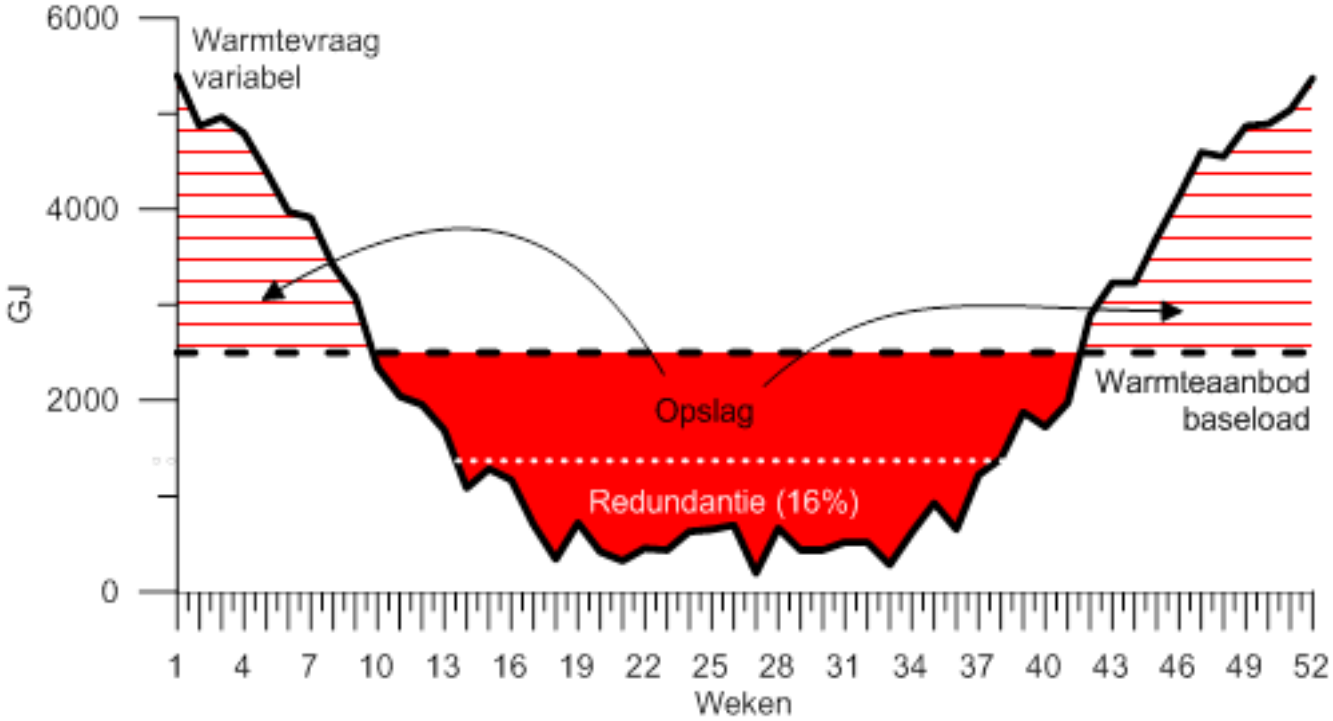
Sources





Challenges

Storage



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Challenges

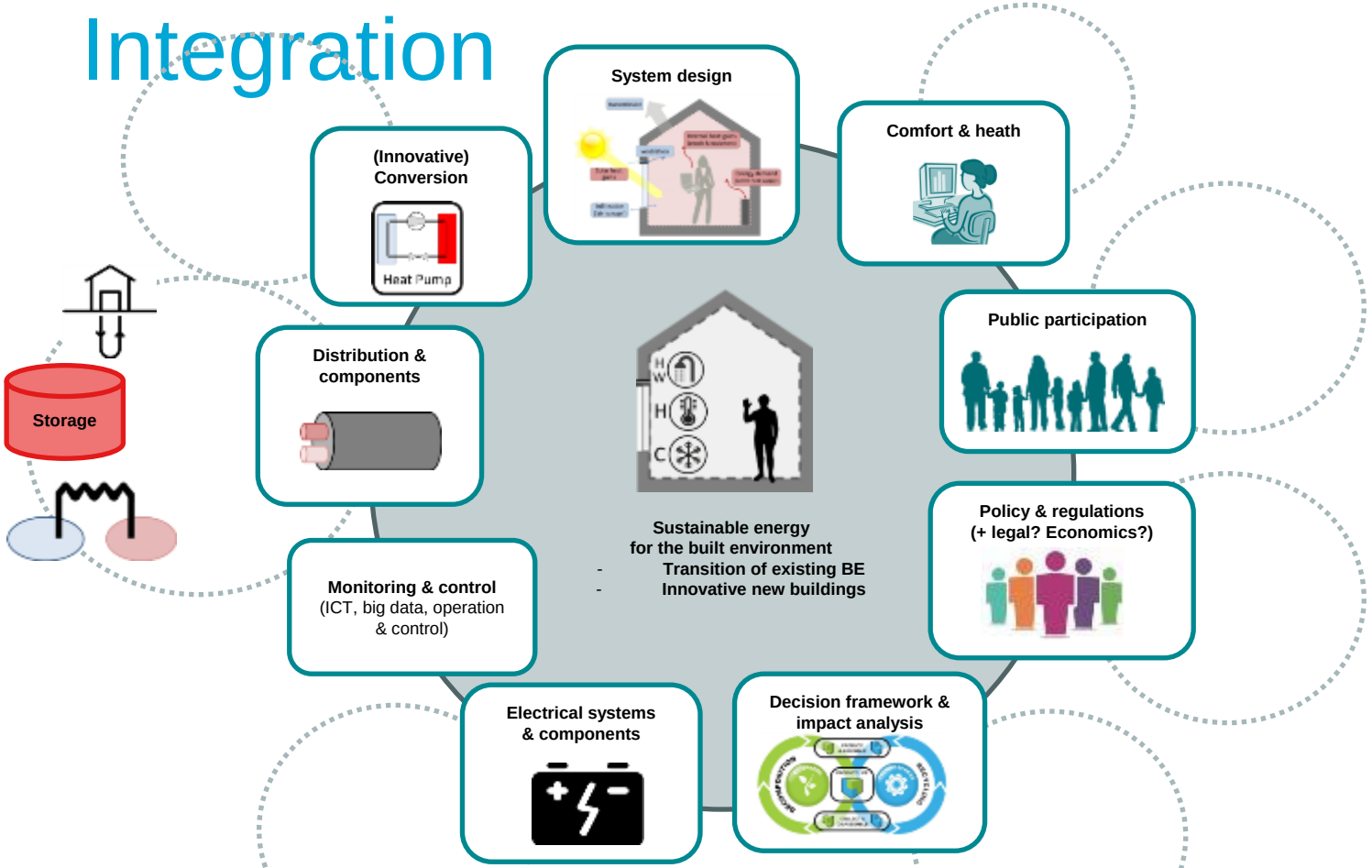
Conversion

Challenges

Distribution

Challenges

Integration



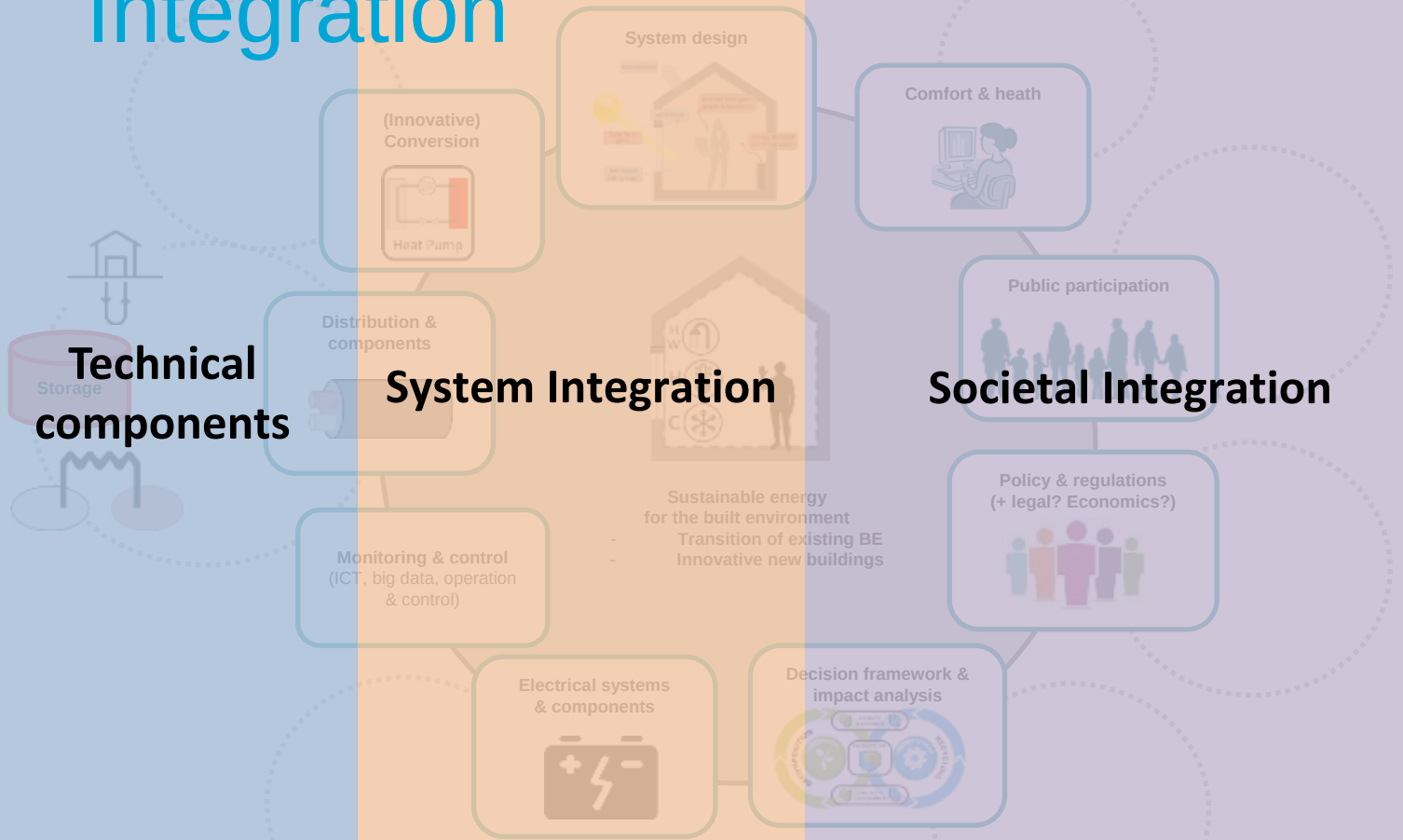
Challenges

Integration

Technical components

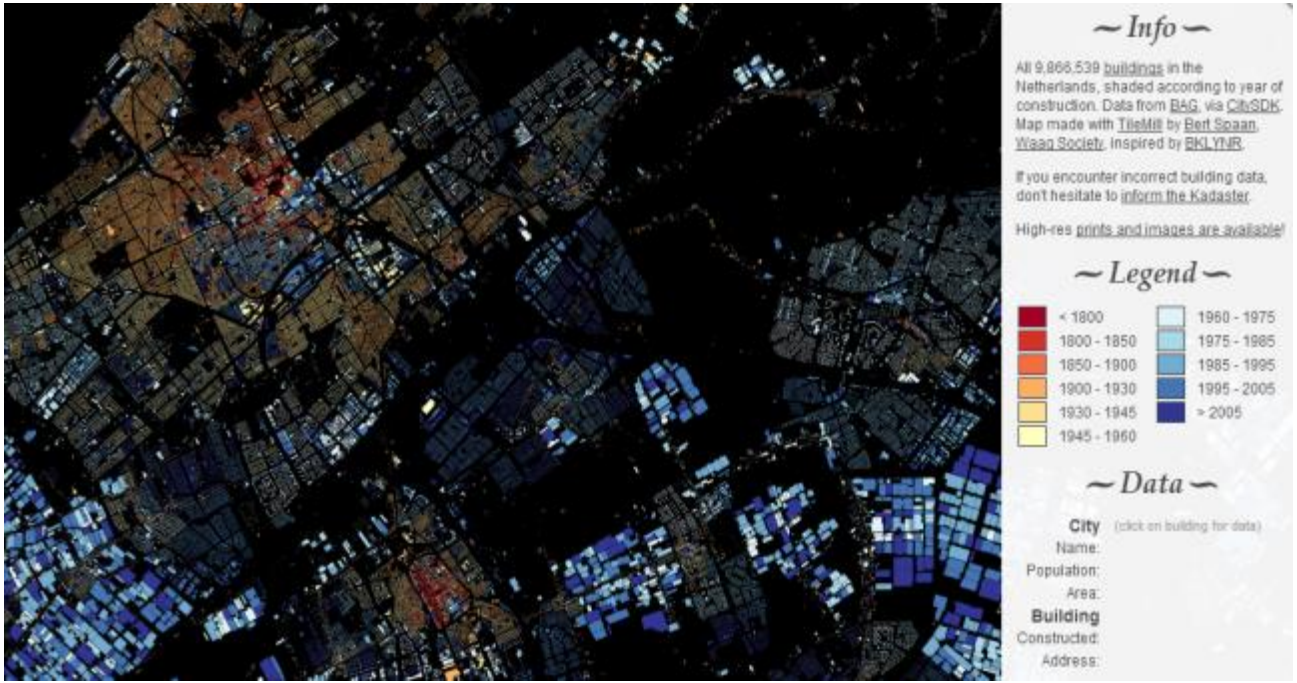
System Integration

Societal Integration



Challenges

Integration



http://dev.citysdk.waag.org/buildings/#52.0524,4.4172,12

Challenges

Uncertainty

- We need to better predict energy systems
  - Monitoring
  - Simulation
  - Changing in time
- Then we can design them better
- And use them better: multi-scale planning

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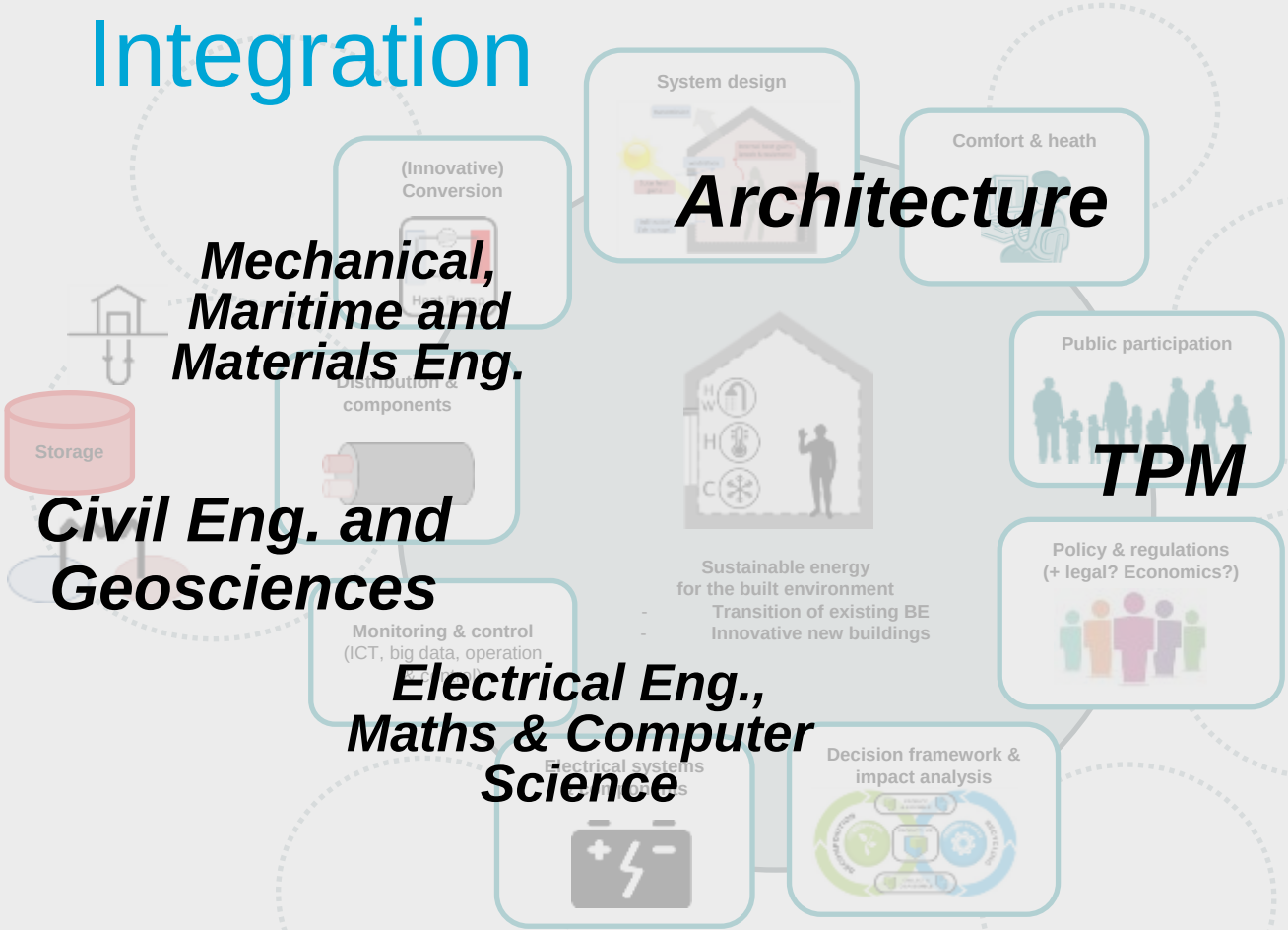
Activities

Integration



Architecture

Mechanical, Maritime and Materials Eng.

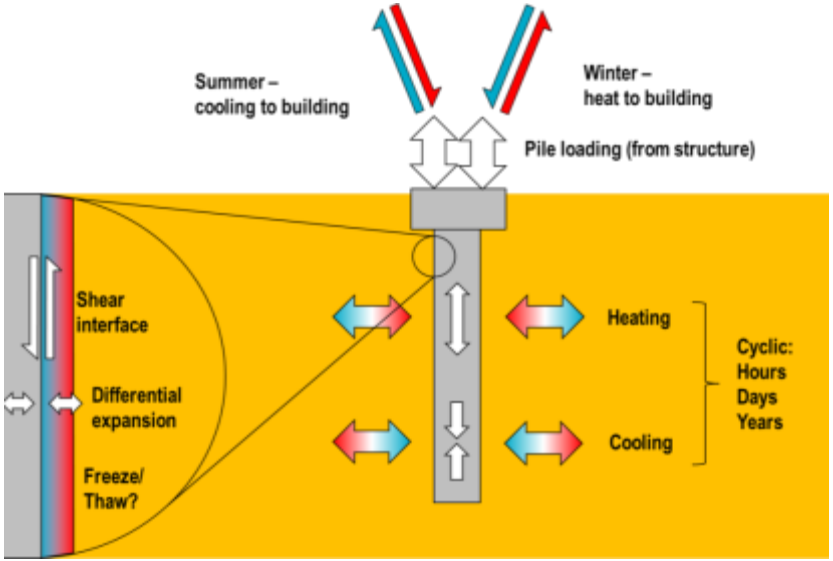
TPM

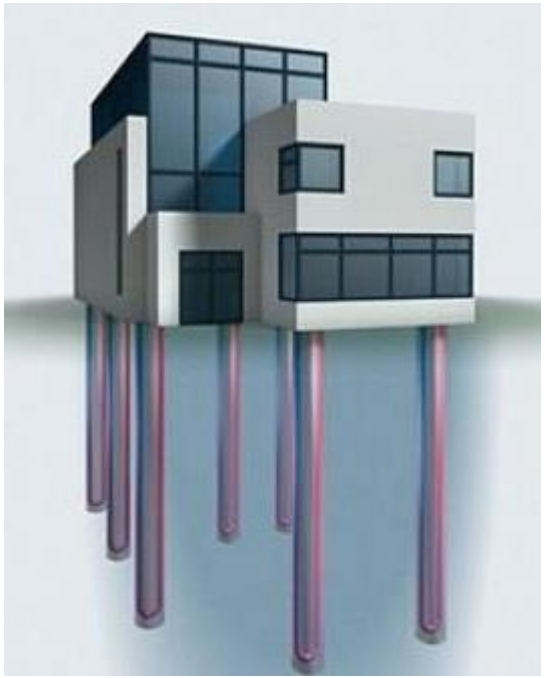
Civil Eng. and Geosciences

Electrical Eng., Maths & Computer Science

Activities

Campus projects – Energy Pile

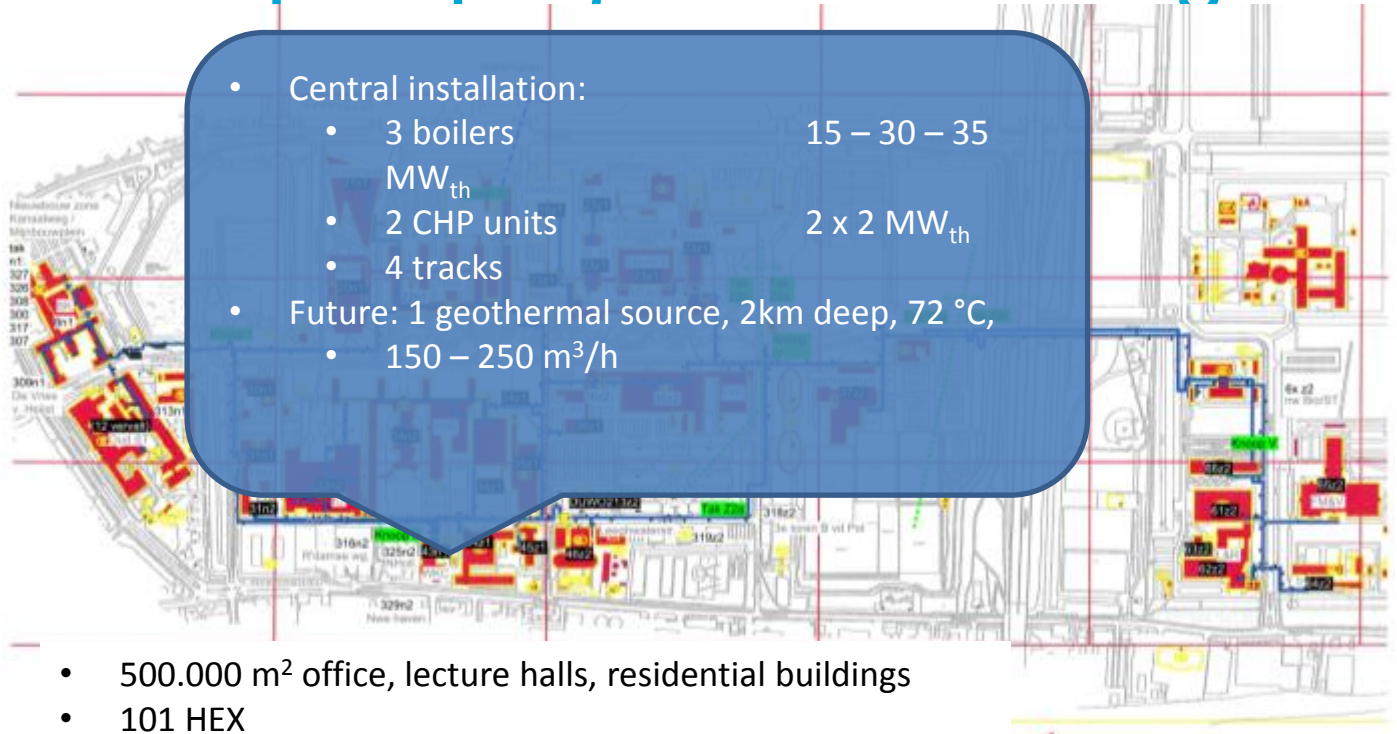




Sustainable | local | predictions | integrated

Activities

Campus projects – Smart grid



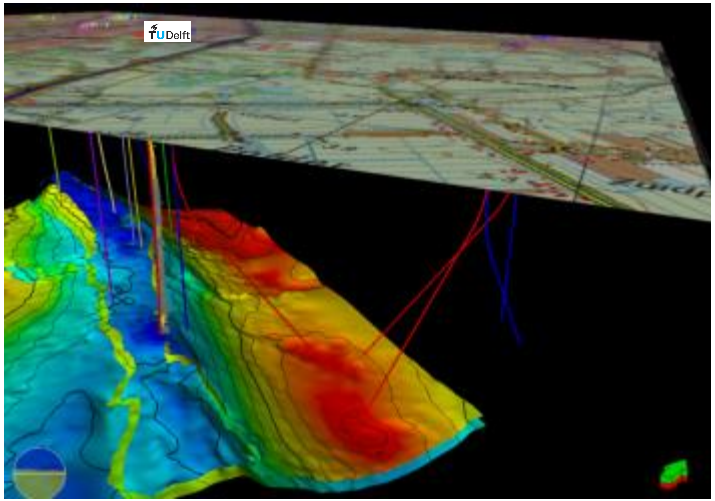
- Central installation:
  - 3 boilers 15 – 30 – 35 MW_{th}
  - 2 CHP units 2 x 2 MW_{th}
  - 4 tracks
- Future: 1 geothermal source, 2km deep, 72 °C,
  - 150 – 250 m^3/h

- 500.000 m^2 office, lecture halls, residential buildings
- 101 HEX
- Heat demand ~ 125.000 GJ

efficiency | local | planning | integrated

Activities

Campus projects – DAPwell



Image/data courtesy of Douglas Gilding / DAP / NAM

Geology: cores >500m

Monitoring: geophysics, fibre optics, best monitored well

Materials: new casing material

Integrated: to campus, urban

Simulations / reducing uncertainty

Sustainable | uncertainties | hardware | integrated

New technologies

Efficiency

New materials

'The right heat in the right place at the right time'

Society-business-technology

Integrated

Reduce uncertainties

Retrofit

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Martin Bloemendal – ATES
Sabine Jansen – Built environment
David Bruhn – Deep Geothermal
Jan Peter van den Hoek – Thermal energy from water
Rene Pecnik – Solar thermal
Alex Daniilidis – geothermal field development
Rafid al Khoury – BTES
Chris Kleijn – Heat transport

Smart fields – Jan Dirk Jansen
Seasonal storage – Hadi Hajibeygi
Heat pumps / thermodynamics – Carlos Infante Ferreira
Exergy analysis – Lydia Stougie
Monitoring and control – Laure Itard
Smart heat grids – Tamas Keviczky
Agent based models – Igor Nikolic
Impact assessment – Eelco de Groot
Social innovation – Gerdien de Vries
Cost benefit analysis –Niek Mouter / Matthew Pentecost

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