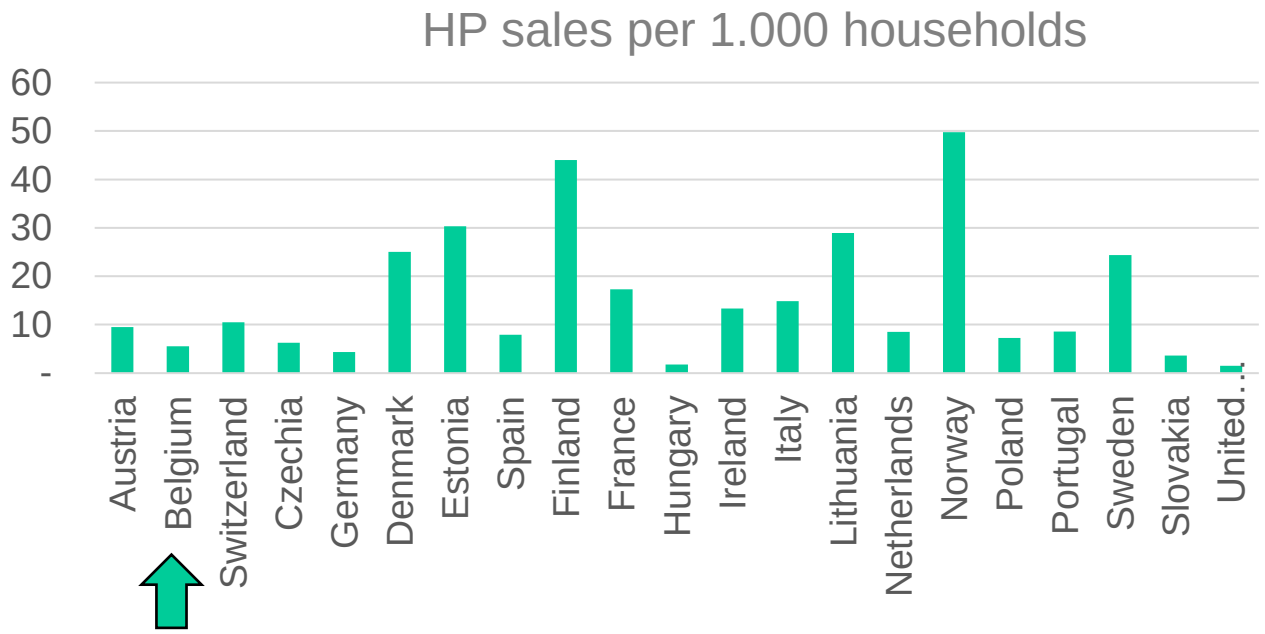
Belgium: country report

Ellen Van Mello (WPP) & Patrick Hendrick (ULB)

7/09/2022

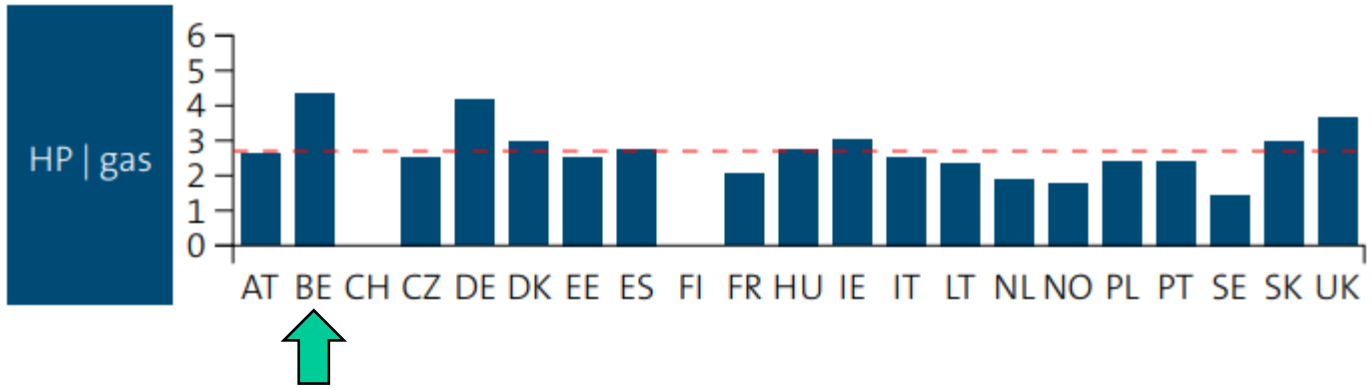

ode
organisatie duurzame energie
bio-e
bio-energieplatform
PV-Vlaanderen
fotovoltaïsche zonne-energie
vwea
Vlaamse windenergie associa
warmtenetwerk
Vlaanderen
wpp
warmtepomp platform

- How we heat buildings:
  - Majority of families heat via fossil fuels (upto 87%)
  - Last year more then 200.000 new fossil fuel boilers (6% oil based)
- Role of heat pumps:



Source: EHPA

- Reasons for slow role out:
  - High density gas grid
  - Higher tax and tariffs on electricity
  - Old building stock



Source: EHPA

- General Belgian Goal 2030 : Reduction of 44% of greenhouse gas emissions
- Renovation goal: renovate all buildings to average lower than 100 kWh/m^2/year by 2050
- Potential of HP by region:
  - Brussels: 43 GWh (now 13 GWh)
  - Flanders: 1455 GWh (now 600 GWh)
  - Wallonia: 1875 GWh HP (now 360 GWh)

Potential of heat pumps Flanders?

BBL (2017): Study by Kelvin Solutions


Kelvin Solutions
energy in progress

Kelvin Solutions bvba
De Populierkens 1, B2350 Vosselaar
BE 0643.981.416 | www.kelvinsolutions.be

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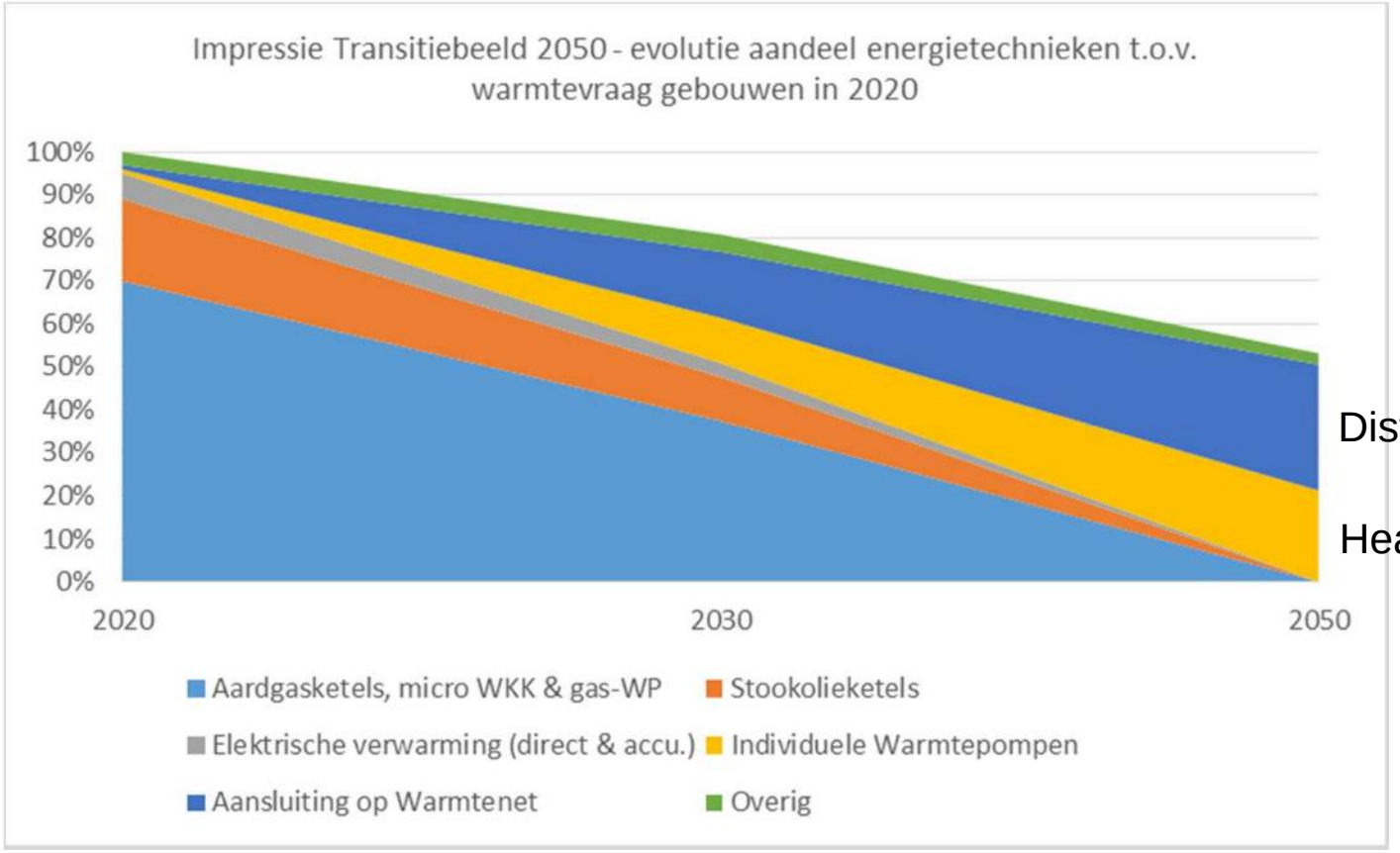
Studieopdracht: naar een vergroening van de warmtevoorziening voor huishoudens in Vlaanderen

In opdracht van:

Project	17_06_BBL	Datum:	12/09/2017
Documentnummer:	17_06_03	Versie:	C
Auteur:	Wouter Cyx	Interne Review:	Hartwin Leen



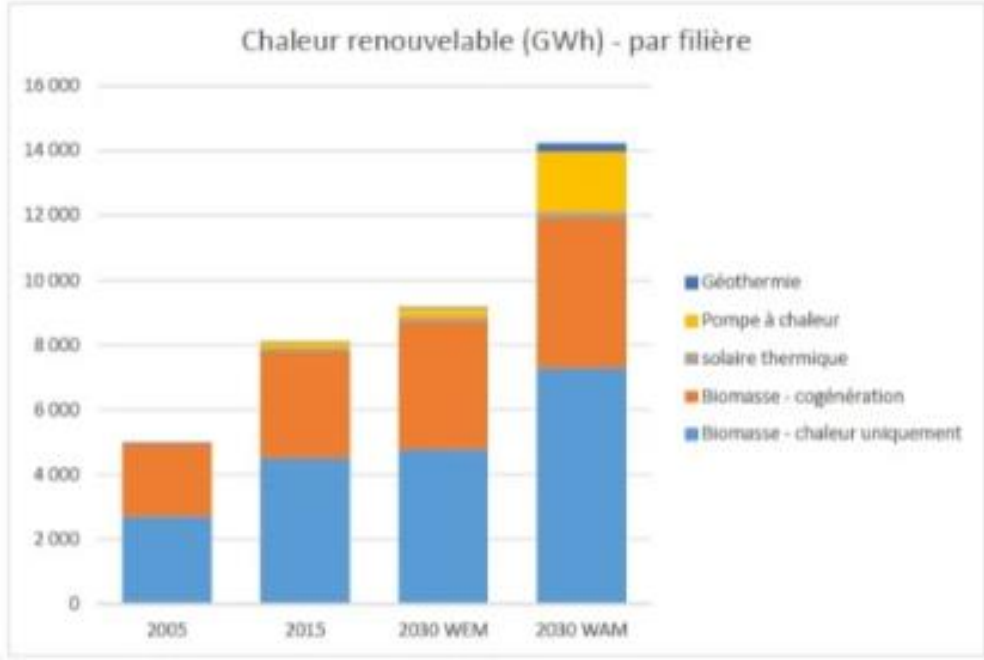
District heating

Heat pumps

Potential of renewable heat Wallonia:

Chaleur renouvelable - WAM	2030
Biomasse - chaleur uniquement	7 281
Biomasse - cogénération	4 645
solaire thermique	181
Pompe à chaleur	1 875
Géothermie	251
TOTAL - WAM	**14 233**

Source: PACE 2030, SPW



Decisions residential buildings:

=> Flanders: first bans on fossil fuel

- 2021: ban on connection to gas grid for new appartment buildings (15 units) and new allotment or new collective housing projects
- 2022: ban on new oil boiler (in new and existing buildings)
- 2025: ban on connection to the gaz grid for new residential buildings

=> Brussels: High subsidies

- Subsidies upto 4750 euro

=> Wallonia:

- Subsidies from 1000 to 6000 euro

Belgian participation in recent annexes of IEA HPT:

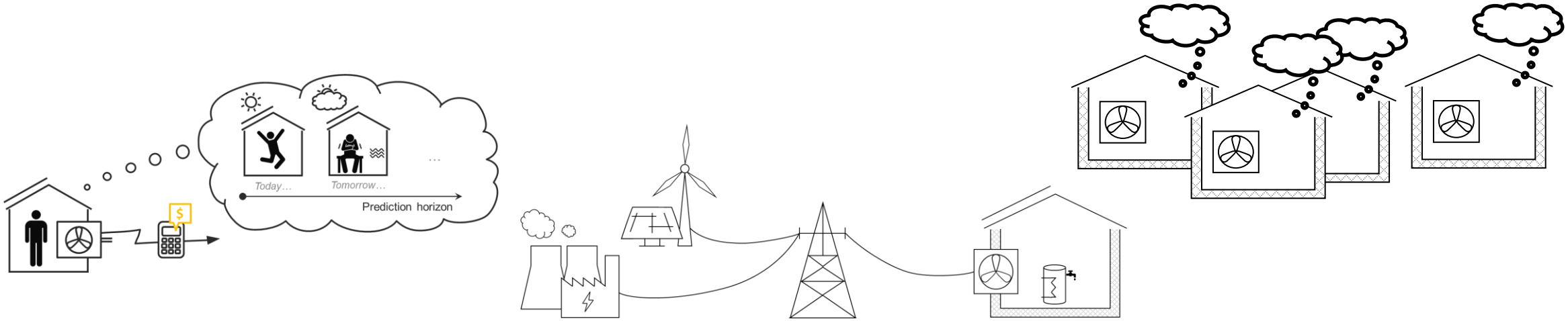
- Annex 49: Design and integration of heat pumps for nZEB:
  https://heatpumpingtechnologies.org/annex49/
- Annex 58: High Temperature heat pumps
  => partner: UGent
  https://heatpumpingtechnologies.org/annex58/
- Annex 61: Heat pumps in Positive Energy Districts *Participation procedure ongoing*
  => partners: KU Leuven (prof. Helsen), Boydens Engineering part of Sweco (prof. Boydens), VITO, ULB (prof Hendrick)
  https://heatpumpingtechnologies.org/annex61/

List of projects (running and finalized)

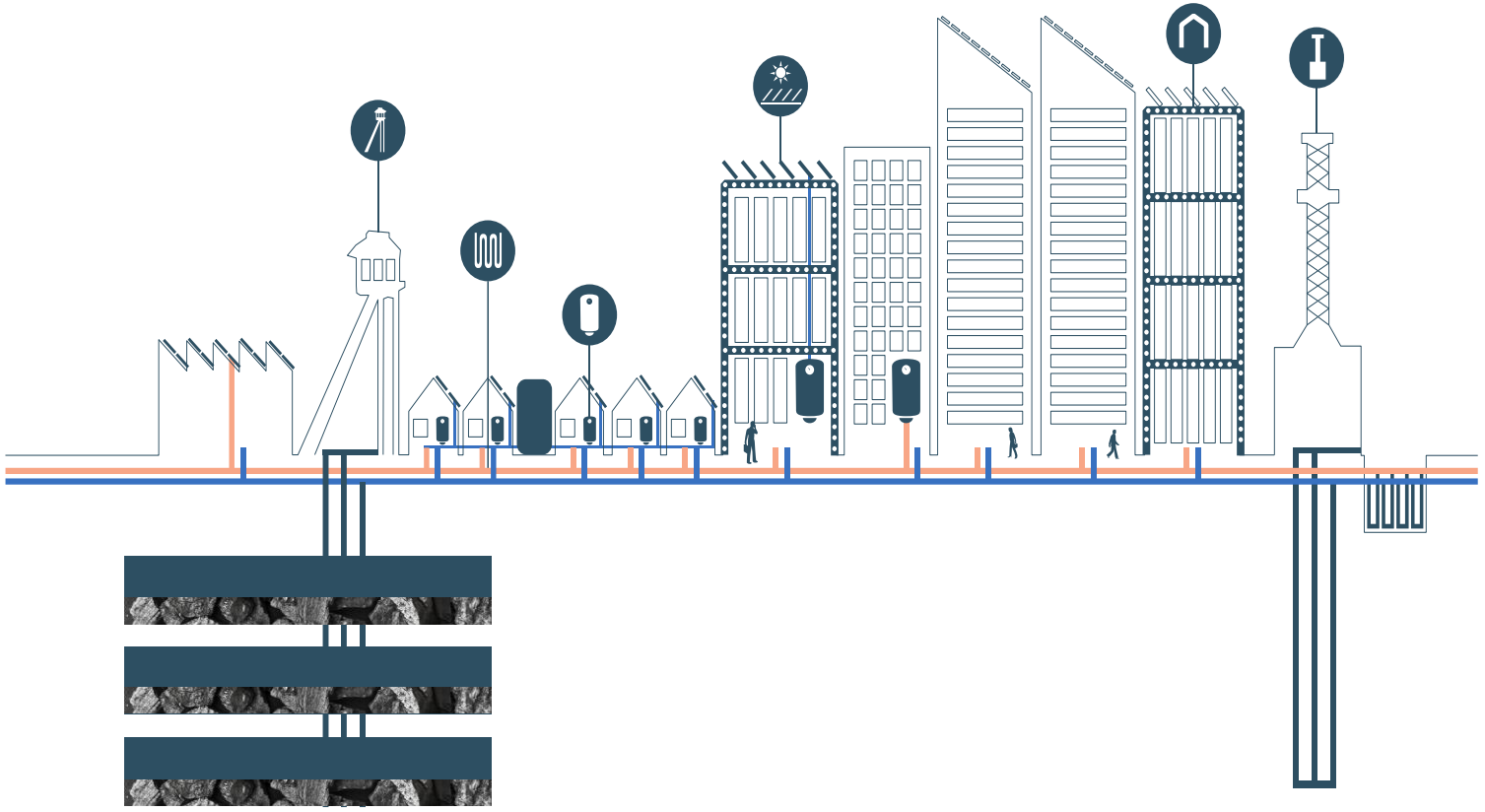
Projects - Thermal Systems Simulation (The SySi's) (kuleuven.be)

List of PhD's (running and finalized)

PhDs & Awards - Thermal Systems Simulation (The SySi's) (kuleuven.be)



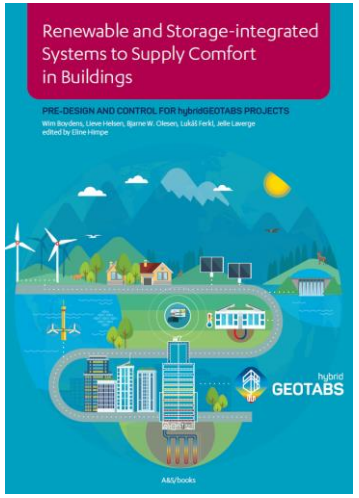
Towards low-carbon energy services in a multi-vector and multi-sectorial system



Renewable and storage integrated systems for optimal comfort supply

- 2016-2021 EU-H2020 hybridGEOTABS (www.hybridgeotabs.eu)
  Model Predictive Control and Innovative System Integration of GEOTABS in Hybrid Low Grade Thermal Energy Systems
- 2017-2022 IBPSA Project 1 (ibpsa.github.io/project1)
  BIM/GIS and Modelica Framework for building and community energy system design and operation
- 2019-2022 VLAIO Spin-off Fellowship & KU Leuven C3 project
  Energy efficient optimal control of buildings and their energy systems
- 2020-2022 VLAIO O&O iCOSY2
  Intelligent Connected Comfort System
- 2022 start up of Spin-off Builtwins
  Sustainable Buildings Control



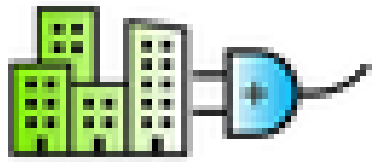



The Heat Pump as a crucial component in thermal networks

- 2014-2021 IWT/VLAIO Proeftuin De Schipjes (Living Lab 'De Schipjes')
  Woningrenovatie: innovatie bij energiezuinig verbouwen' De Schipjes - Samengaan van gebouwzorg en energieoptimalisatie in historische woonerven
- 2015-2019 VITO PhD Fellowship Bram van der Heijde
  Optimized integration of thermal energy storage and conversion in fourth generation thermal networks
- 2017-2020 VITO PhD Fellowship Annelies Vandermeulen
  Control of thermal networks to unlock flexibility
- 2020-2024 FWO PhD Fellowship Jelger Jansen
  Model Predictive Control of Fourth Generation District Heating Networks

Low-carbon energy services in a multi-vector and multi-sectorial system

- 2021-2025 VLAIO Baekeland PhD Fellowship Wouter Peere @ boydens engineering – part of Sweco
  The development of future-oriented fossil-free energy concepts for clusters in various (Flemish) settings and environments
- 2021-2025 KU Leuven C2 project PED (PhD Fellowship Lucas Verleyen)
  Positive Energy Districts - Identifying technically-feasible and effective solutions towards decarbonization under existing boundary conditions
- 2022-2026 FWO (to be approved) PhD Fellowship Louis Hermans
  Integrated optimal control and design of low-carbon multi-energy vector districts, including difficult-to-decarbonize buildings
- Starting in 2022 KU Leuven IOF Program REINFORCE
  Energy System Integration for Low-carbon Energy Services



Heat Pumps in a demand response context

- 2016-2019 EU-H2020 FHP
  Flexible Heat and Power, Connecting heat and power networks by harnessing the complexity in distributed thermal flexibility
- 2016-2021 KU Leuven C2 Project
  Energy Storage as a Disruptive Technology in the Energy System of the Future
- 2018-2021 VITO PhD Fellowship Javier Arroyo
  Synergy of mathematical and AI techniques for novel methods of building energy management
- 2020-2025 VLAIO Moonshot
  InduFlexControl I & InduFlexControl II
  Control algorithms for flexibility in power-to-X and industrial processes.

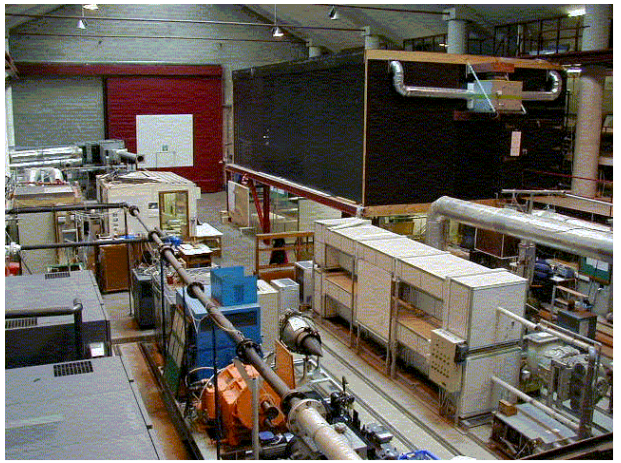
RESEARCH @ UGent

- Prof Depaepe, Prof Lecompte: focus on component performance
  - participation in annex 61 high temperature heat pumps
  - Contact: Steven.Lecompte@UGent.be

- Prof Laverge, focus on building interaction
  - Coordinator of hybridGEOTABS horizon 2020 project (cfr projects slide prof Helsen)

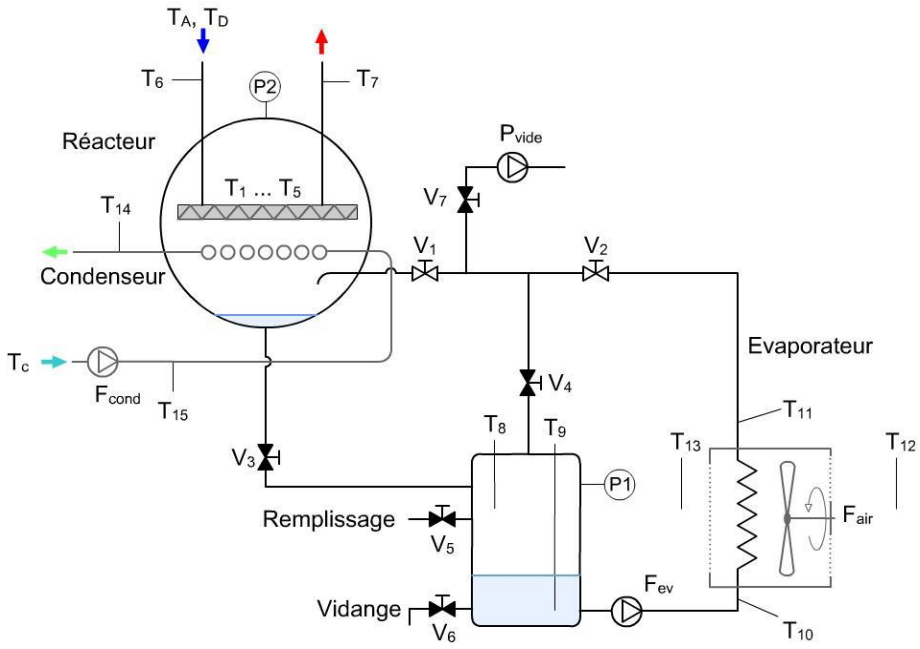
- **Buildings**
  - ✓ Exhaust air heat pumps (ventilation) for residential buildings: E/N
  - ✓ Heat pumps for both heating/cooling coupled to passive cooling techniques: N
  - ✓ Innovative vapor compression cycles with 2-phase compression/expansion for heating, cooling and power production: E/N
  - ✓ Reversible heat pump/ORC systems for Carnot batteries: E/N
- **Vehicles**
  - ✓ R1234yf heat pumps for passenger cars: E
- **Industry**
  - ✓ Very high temperature heat pumps (>180°C) for industrial processes: N
  - ✓ CO_2 commercial refrigeration with waste heat recovery: E/N

E: experimental; N: numerical



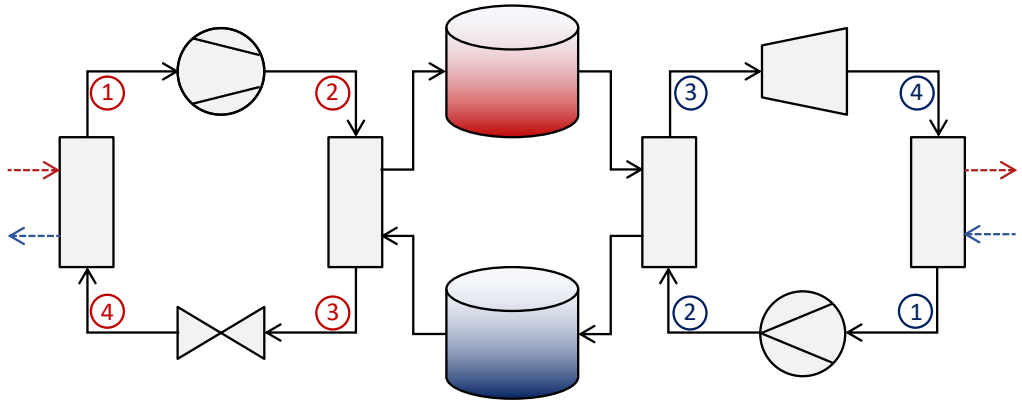
Test bench for testing two-phase scroll compressors (H2020 Regen-by-2 project)

- Strategies for integrating HPs in complex energy systems at the city district level:
  - Guidelines for defining energy system architectures.
  - Guidelines for components sizing.
  - Energy performance evaluation of complex energy systems.
- Hybrid HP and boiler systems for existing buildings:
  - Guidelines for integrating HPs in existing buildings.
- Sorption heat pumps:
  - New Adsorbent Materials development with enhanced sorption performances.
  - HP Prototyping and tests.
- Integration of HPs in industrial processes: feasability studies



Currently one project using heat pumps for energy storage: *"Carnot batteries as effective sector-coupling systems for heat and power: techno-economic analysis and robust optimisation"*

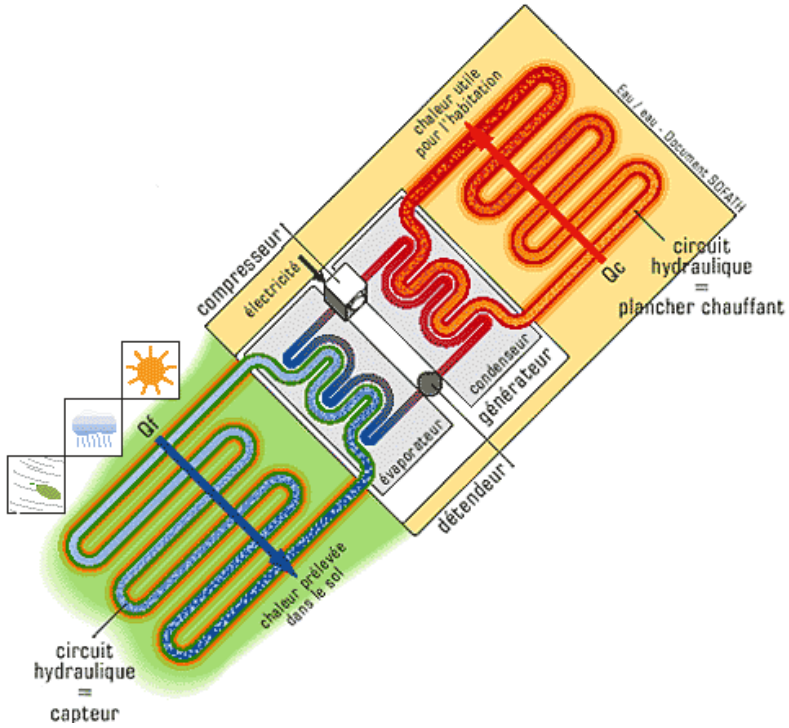
- Use of heat pump to charge a sensible heat thermal storage (water tanks).
- The storage can be discharged either directly to deliver heat, either through an organic Rankine cycle to produce electricity.
- The heat pump can recover waste heat and boost the Carnot battery efficiency.
- Goals of the projet: optimisation of the design of different Carnot battery concepts under techno-economic uncertainties and identification of attractive integration scenarios for each concept.
- Joint thesis with ULiège (already one prototype and one demonstrator under development for coupling with DHN).
- Contact: antoine.laterre@uclouvain.be



heat pump thermal storage heat engine

Energy recuperation from the sewer (sewage water) for NZEB (Riothermy)

An example in Brussels (with water DSO)



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https://warmtepomp.ode.be/nl/

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technologieplatform van ode organisatie duurzame energie





VWEA PVVL BEP WPP WNVL