TECHNISCHE UNIVERSITÄT WIEN

DECARBONISATION OF THE SPACE HEATING AND HOT WATER SECTOR: PATHWAYS, CHALLENGES AND REQUIREMENTS FOR SECTOR COUPLING

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Energy Economics Group

Research questions

- What are implications of strong decarbonisation scenarios (compared to e.g. 75% decarbonisation) in the H&C sector?
  - Results EU-28
  - Case study Austria

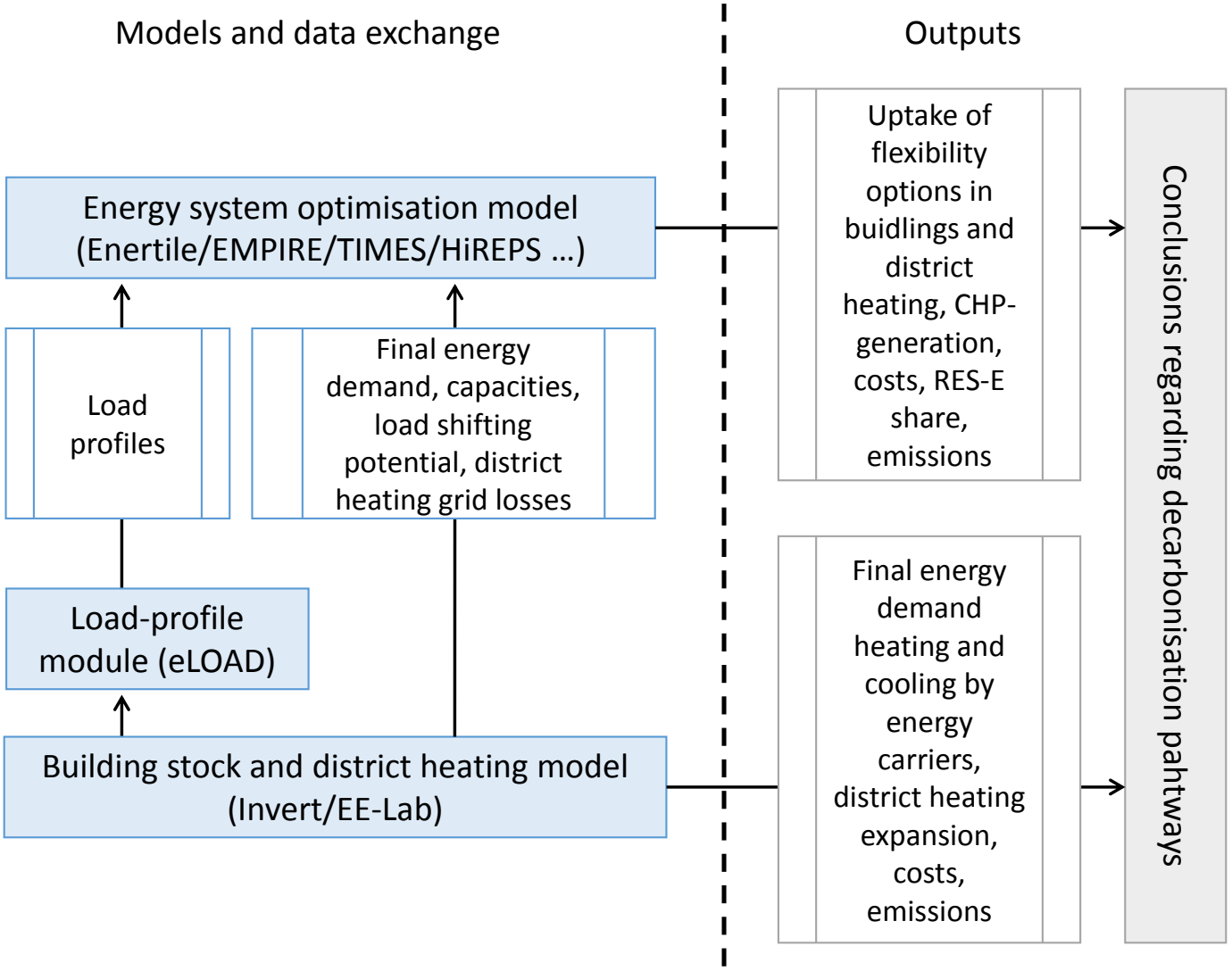
- What is the role of district heating and sector-coupling in strong decarbonisation scenarios?
  - How high are economic district heating potentials considering significant reduction in heat densities?
  - How high are economic P2H-potentials for district heat generation?

Project Background

- H2020 project SET-Nav (Navigating the Roadmap for Clean, Secure and Efficient Energy Innovation, http://www.set-nav.eu/, 2016-2019)
- Heat transition 2050: Pathway for decarbonising heating/cooling in the Austrian building stock (www.eeg.tuwien.ac.at/waermezukunft_2050, completed 2018)
- P2H-Pot: Economic potentials and solutions for Power-to-Heat. Project in the research program “city of tomorrow”, funded by BMVIT and FFG. (www.eeg.tuwien.ac.at/p2h-pot, completed 2017)
- Long term scenarios for the transformation of the German Energy System (completed 2017)
- Hotmaps – The Open Source Mapping and Planning Tool for Heating and Cooling (http://www.hotmaps-project.eu/), 2016-2020

Method

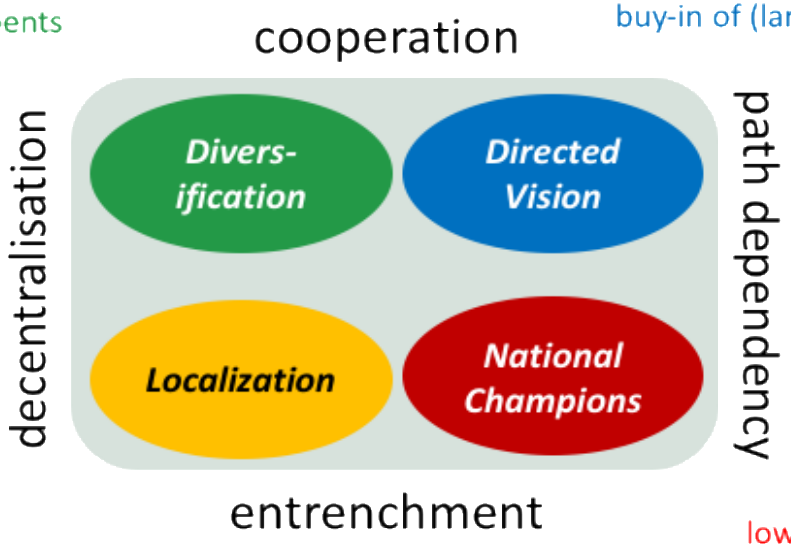
- Hybrid modelling approach of a techno-economic bottom-up building stock model combined with an energy system optimization model



SET-Nav Storyline Set-Up of Decarbonisation Pathways

- many new entrant
- heterogeneous actors
- active consumers
- coordination, digitalisation, open platforms
- regulatory opening
- challenges to incumbents

clear shared vision -
EU in guiding role -
strong coordination between member states -
durable and stable policy framework -
buy-in of (large) stakeholders -

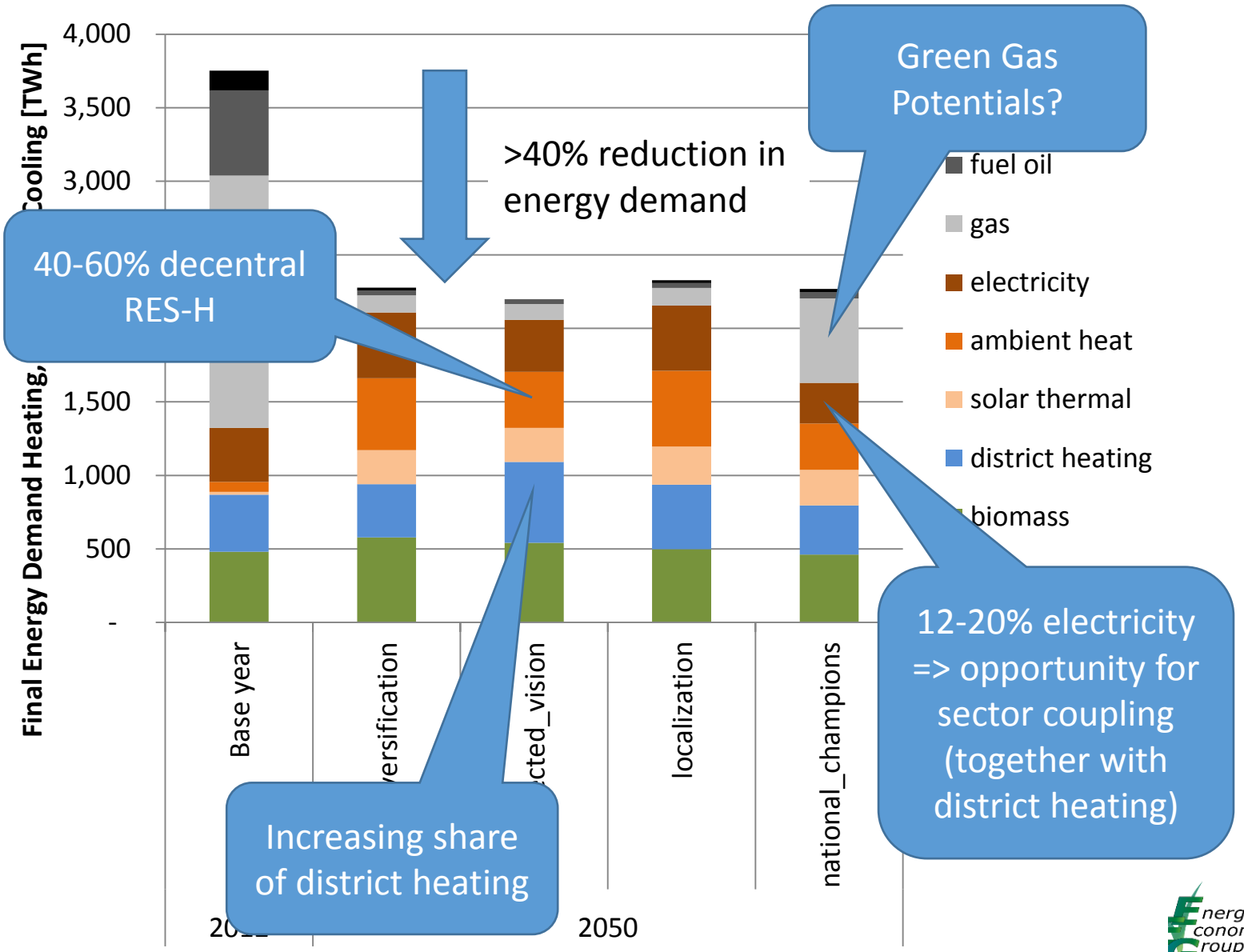


- local resources
- national differentiation
- resistance to big infrastructure
- experimentation & diversity (but weak spillovers)
- winner-takes-all digitalisation

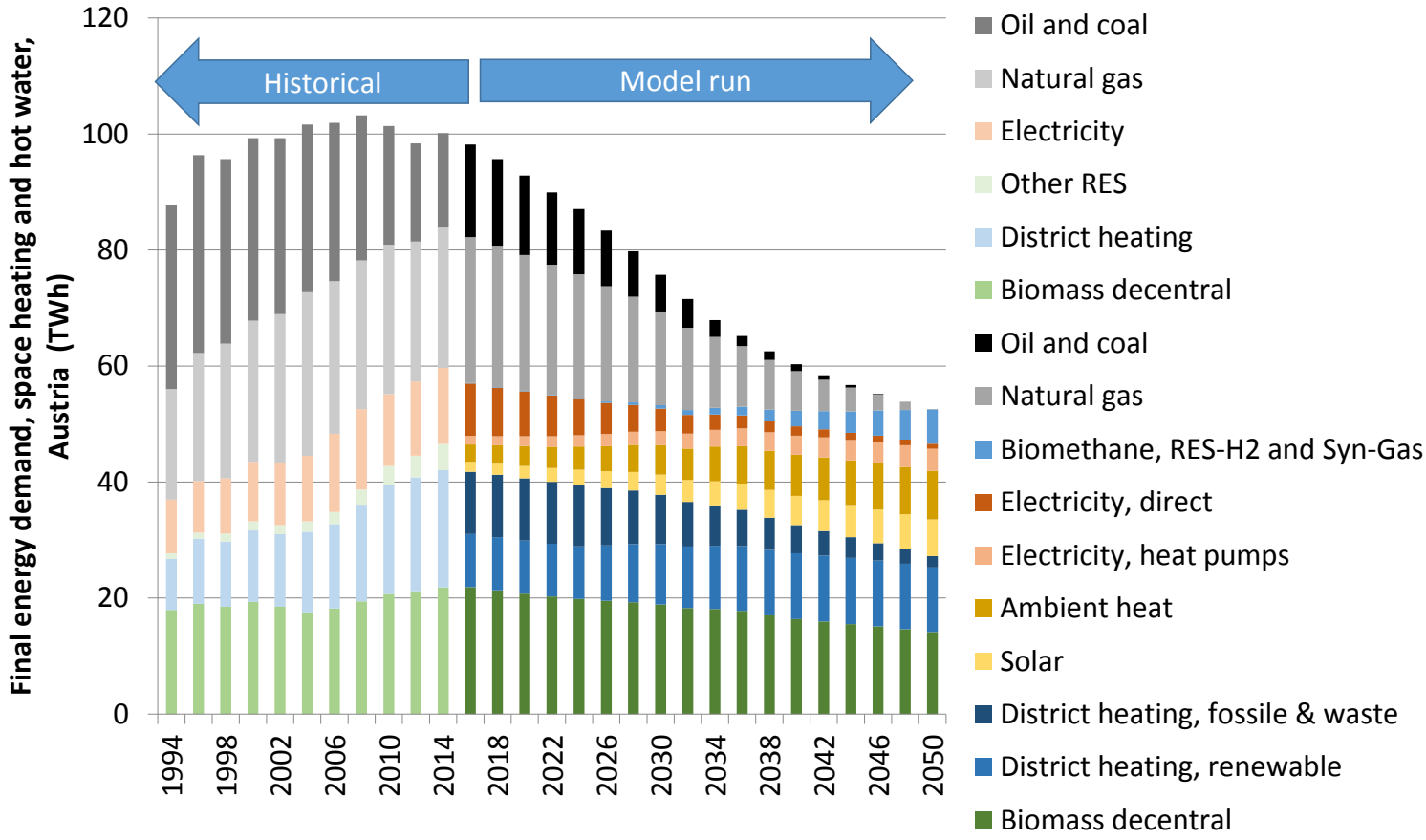
low transitional risks -
strong role for incumbents -
regulatory capture -
large-scale projects & balance sheets -

Source: Crespo del Granado et al., 2018

Final energy demand and energy carrier mix, H&C, EU-28

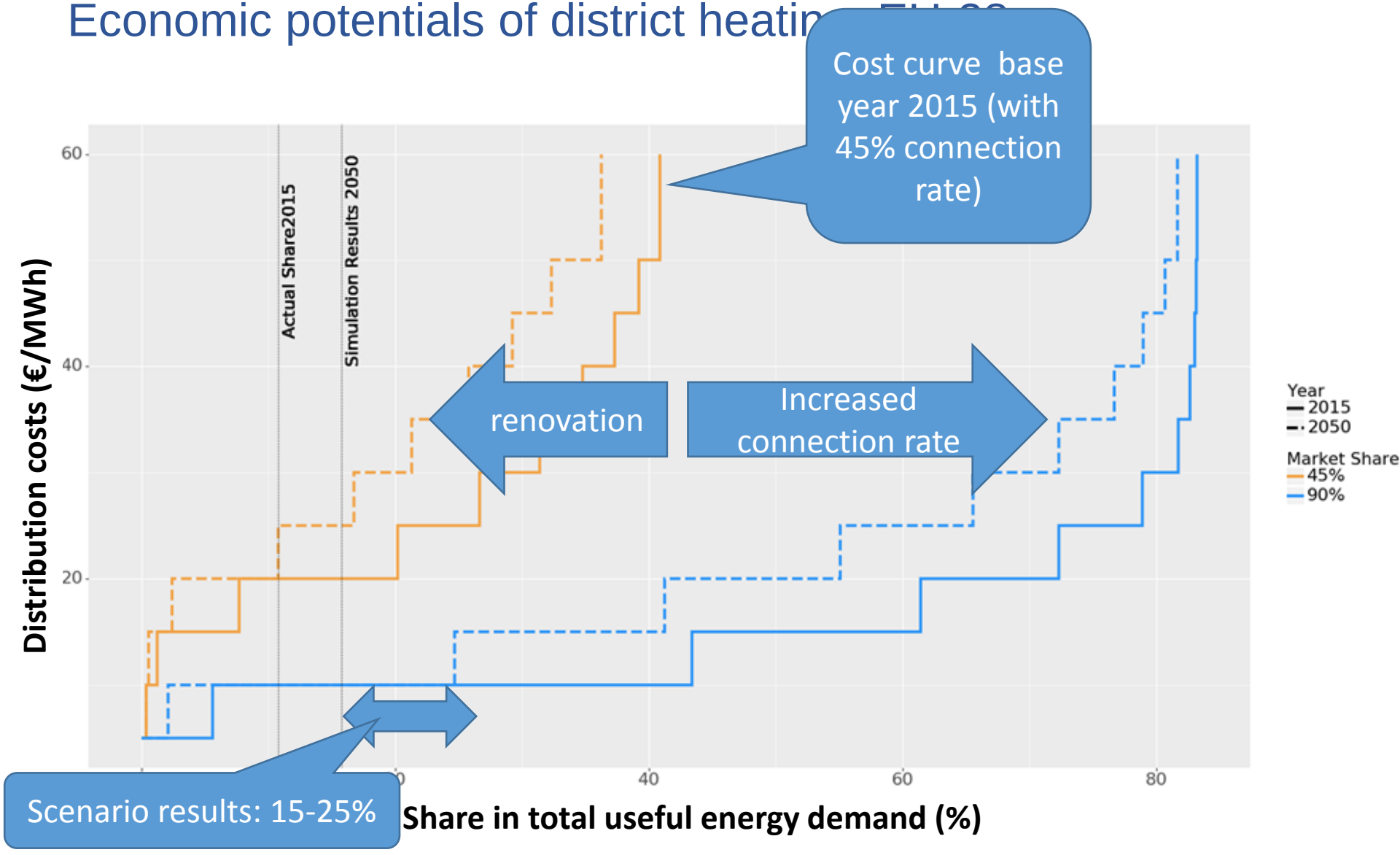


The case of Austria:
Scenario 100% renewable heating/cooling 2050



District heating: How high are economic potentials considering significant reduction in heat densities?

Economic potentials of district heatin

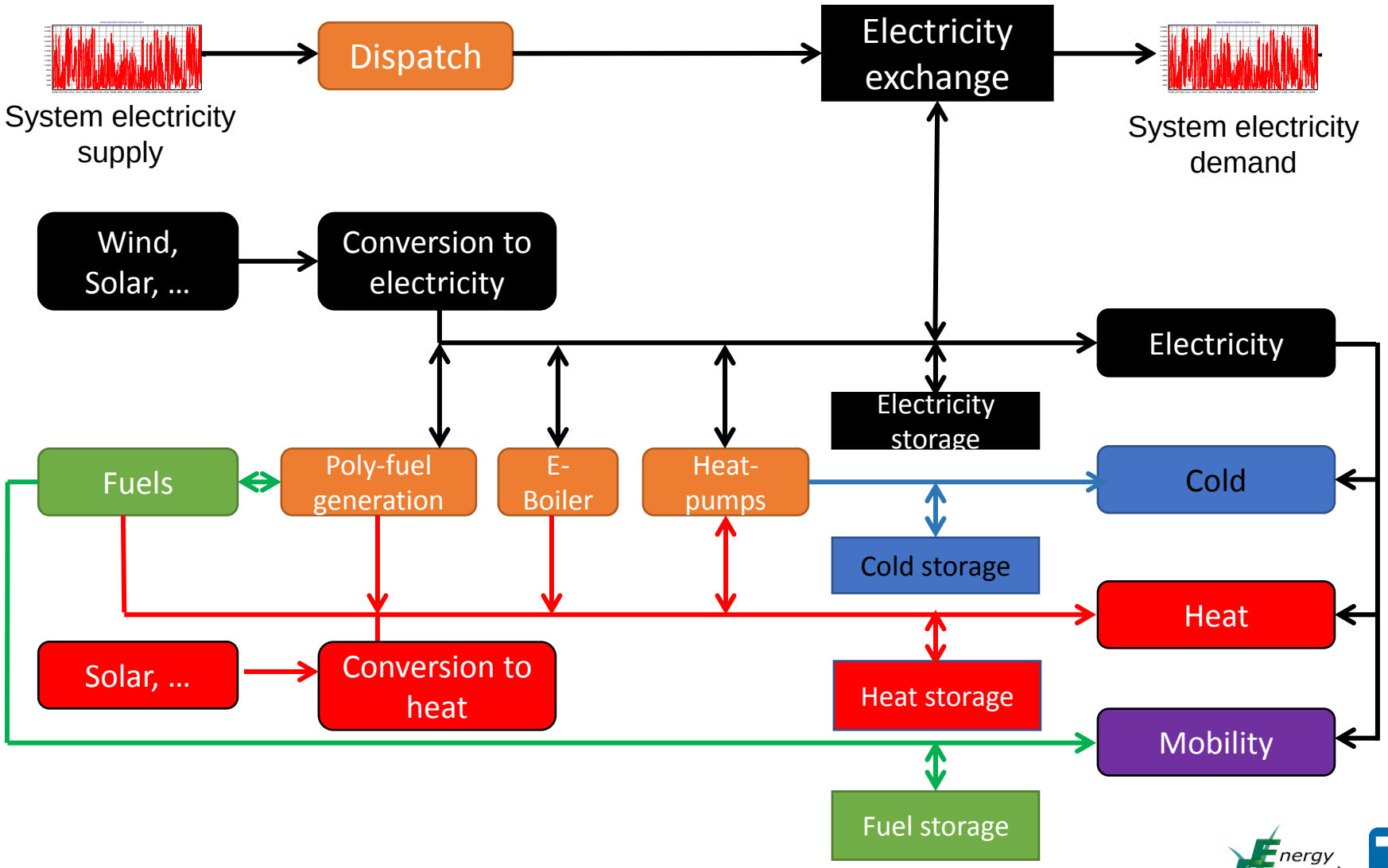


Source: Invert/EE-Lab model results in Hartner et al, 2018, http://set-nav.eu/

How high are economic P2H-potentials for district heat generation?

Exemplary case studies from Austria

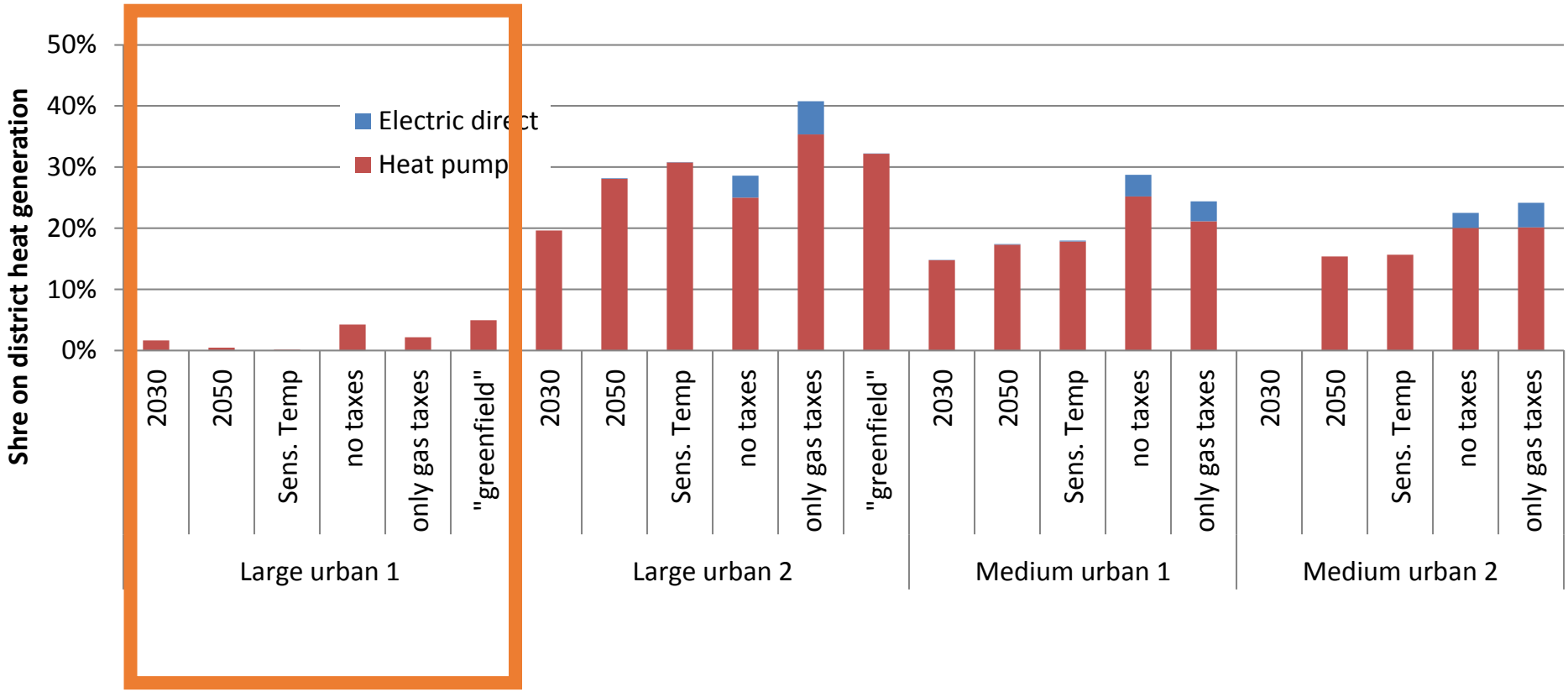
Integrated energy systems and power-to-heat as flexibility option



Source: according to Blarke et al, 2013

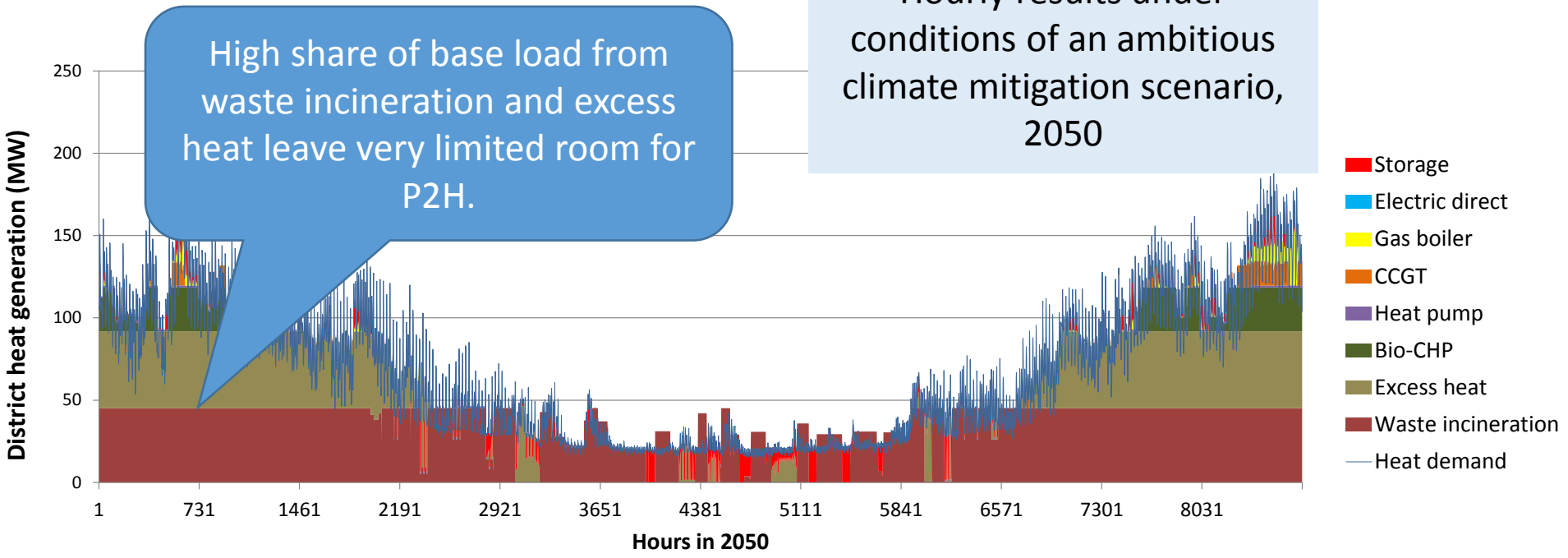
Optimum share of P2H in district heating under various settings of 2050 decarbonisation scenarios

- Depends on economic and political side conditions
- Depending on grid type and existing heat supply <5% to 40% of heat supply (under favourable conditions) may be covered by P2H



Source: HiREPS-Model-Results from the project P2H-Pot, Totschnig et al, 2017, www.eeg.tuwien.ac.at/P2H-Pot

Results (1): Large urban district heating with waste incineration, industrial excess heat potential, biomass CHP and CCGT plant



- In different scenarios, the share of P2H varies between 0.1% and 5%.

Source: HiREPS-Model-Results from the project P2H-Pot, Totschnig et al, 2017, www.eeg.tuwien.ac.at/P2H-Pot

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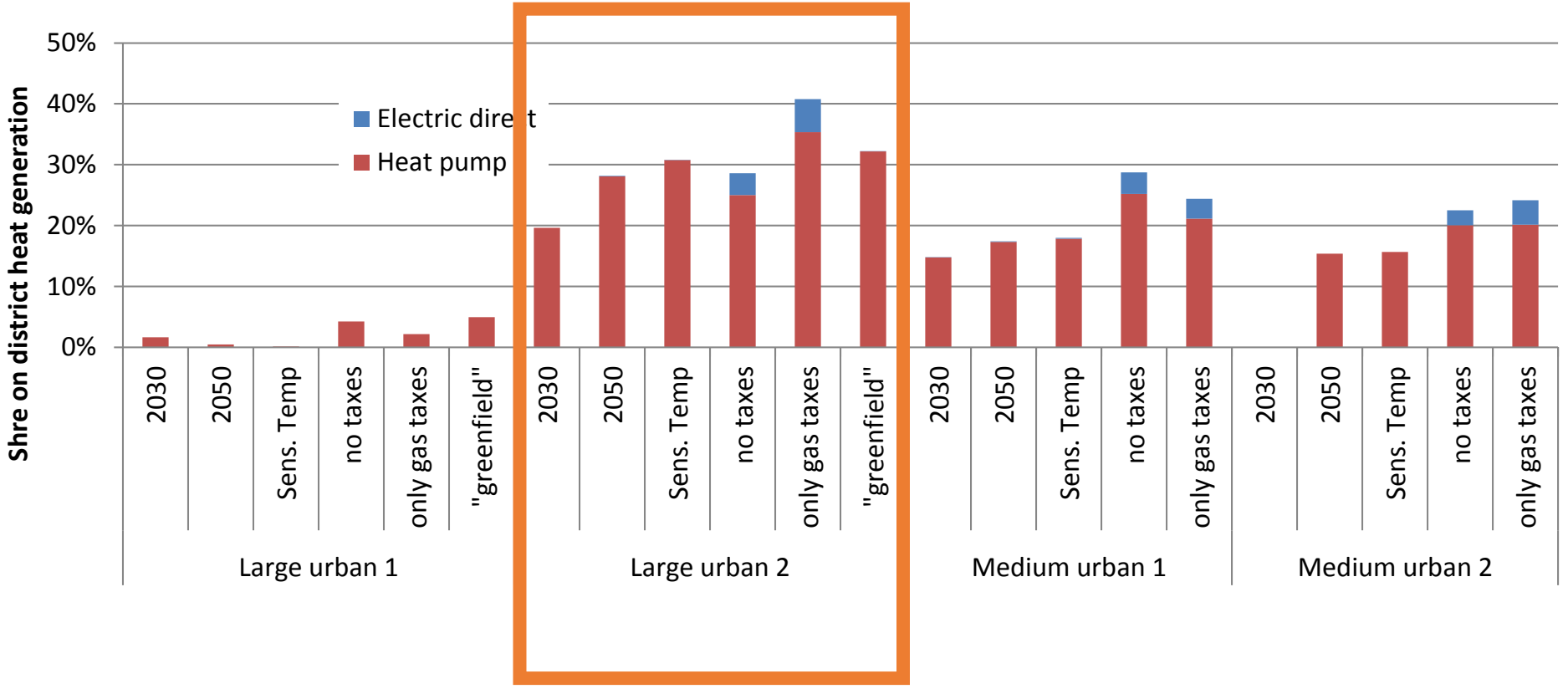
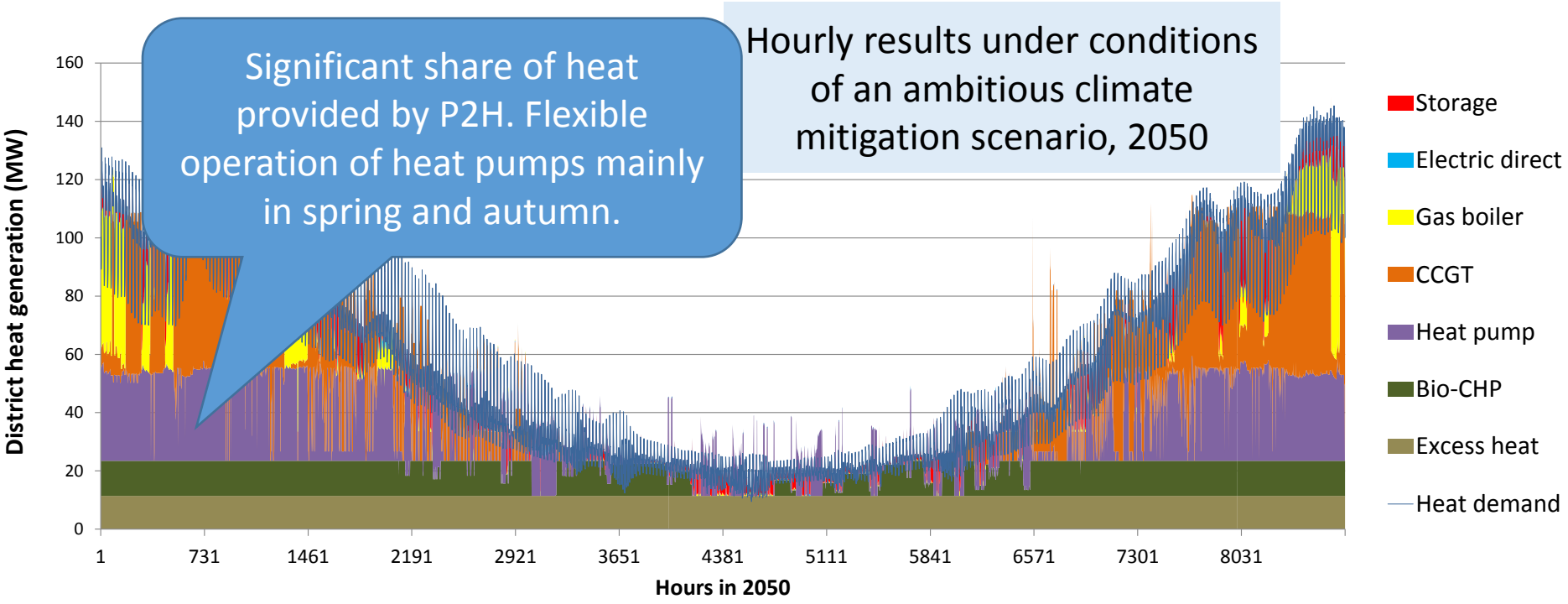


Source: HiREPS-Model-Results from the project P2H-Pot, Totschnig et al, 2017, www.eeg.tuwien.ac.at/P2H-Pot

Results (2): Large urban district heating based on waste incineration, biomass CHP and CCGT plant



- In different scenarios, the share of heat pump varies between 20% and 35%.

Source: HiREPS-Model-Results from the project P2H-Pot, Totschnig et al, 2017, www.eeg.tuwien.ac.at/P2H-Pot

Optimum share of P2H in district heating under various settings of 2050 decarbonisation scenarios

- Depends on economic and political side conditions
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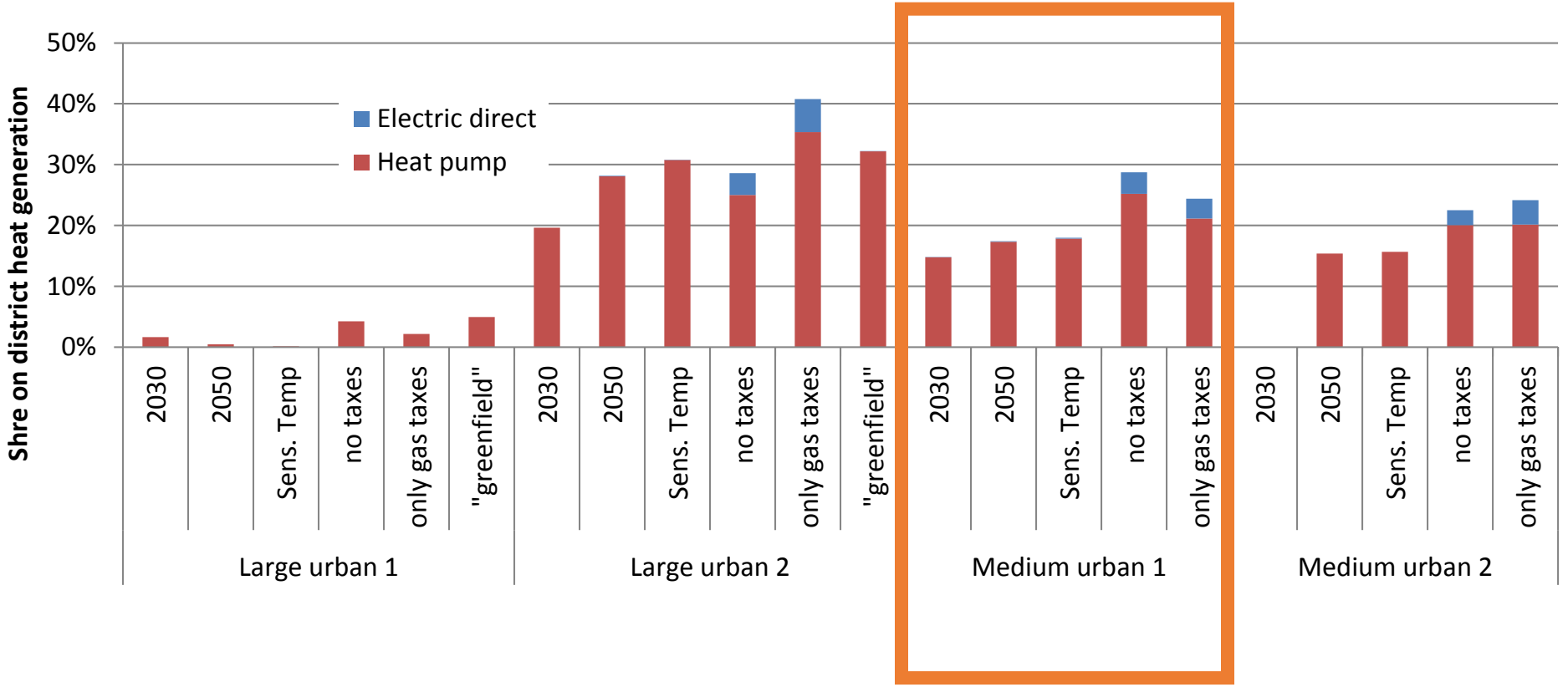
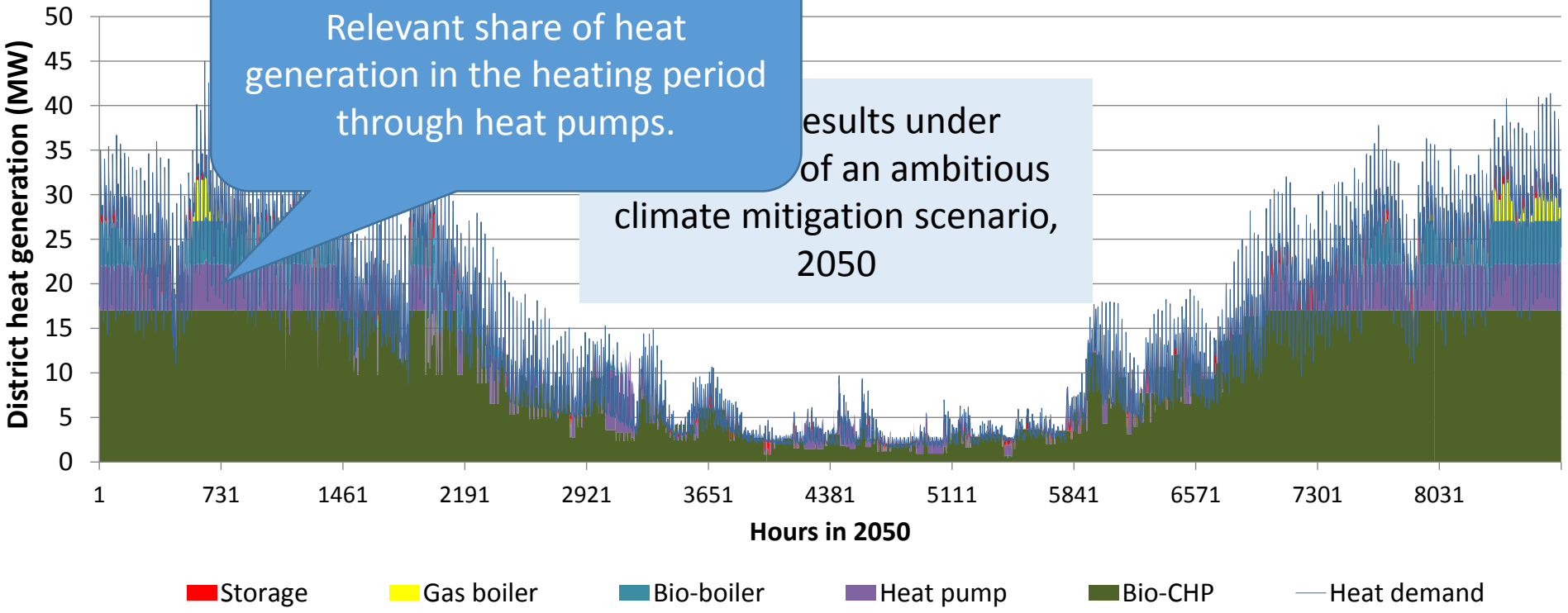


Source: HiREPS-Model-Results from the project P2H-Pot, Totschnig et al, 2017, www.eeg.tuwien.ac.at/P2H-Pot

Results (3): Medium scale urban district heating based on biomas



- In different scenarios, the share of heat pump varies between 15% and 25%.

Source: HiREPS-Model-Results from the project P2H-Pot, Totschnig et al, 2017, www.eeg.tuwien.ac.at/P2H-Pot

Optimum share of P2H in district heating under various settings of 2050 decarbonisation scenarios

- Depends on economic and political side conditions
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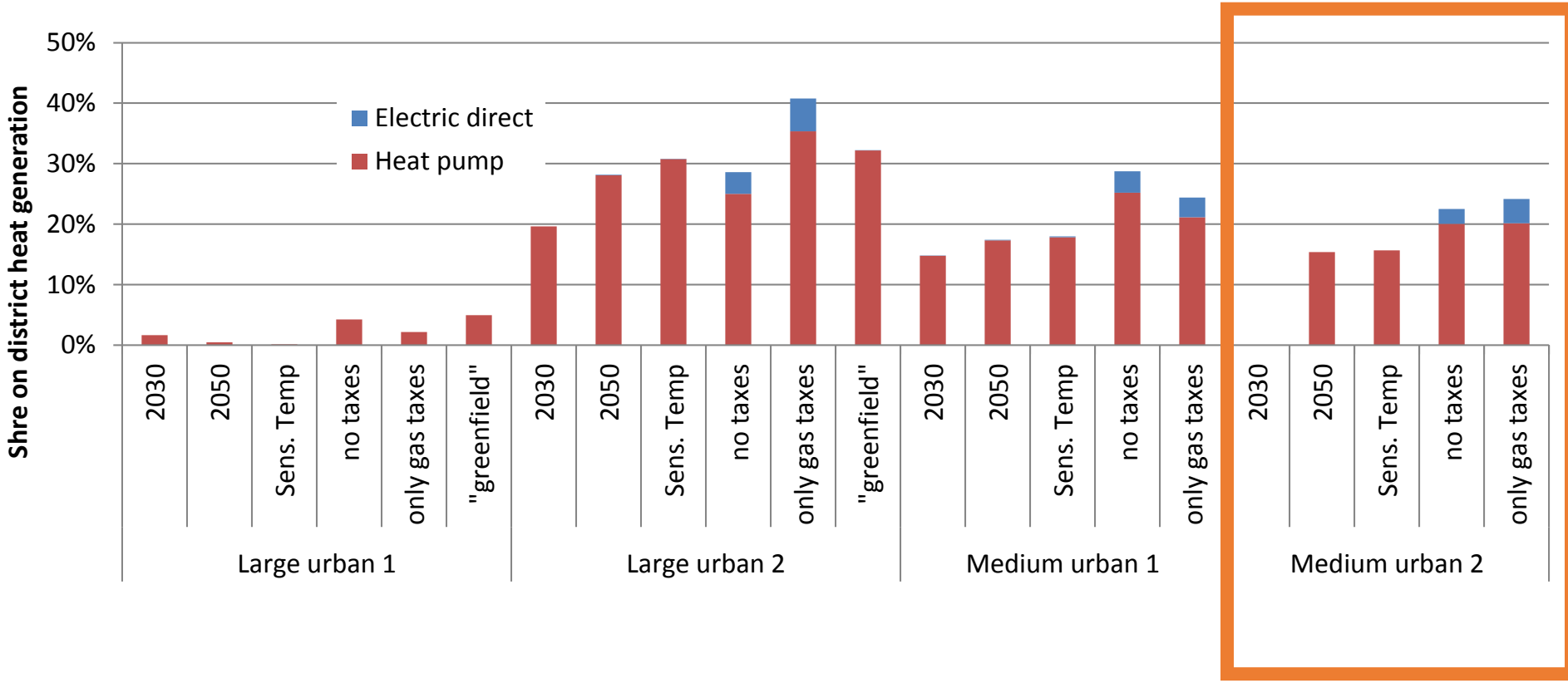
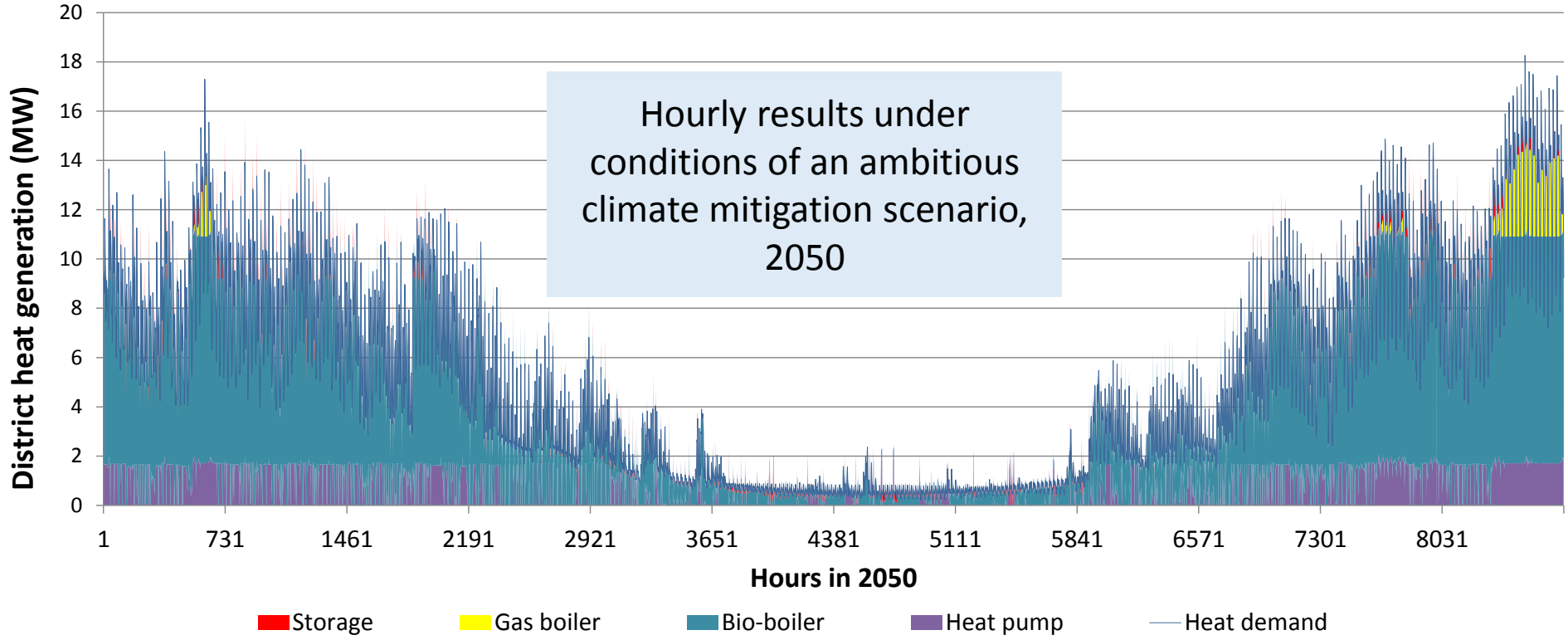


Source: HiREPS-Model-Results from the project P2H-Pot, Totschnig et al, 2017, www.eeg.tuwien.ac.at/P2H-Pot

Results (4): Medium scale urban biomass district heating



- In different scenarios, the share of heat pump varies between 0% and 21%.

Source: HiREPS-Model-Results from the project P2H-Pot, Totschnig et al, 2017, www.eeg.tuwien.ac.at/P2H-Pot

Decarbonisation is an opportunitiy and a challenge. ALL components of H/C decarbonisation will be required:

- Building refurbishment and efficiency improvements
  (>40% reduction of heat demand 2012-2050, EU-28)
- Decentral renewables: Biomass, Heat pumps, Solar
  40%-60% of H/C demand in 2050, EU-28
- Smart solutions, sector coupling and making use of the heating sector as a flexibility option for an increasingly volatile RES-E generation
- Decarbonisation of electricity generation
  ~12%-20% of H/C sector covered by electricity
- District heating:
  - Expansion and high connection rates
    ~15%-40% of H/C demand, EU-28
  - Sector coupling via heat pumps can be economical with shares up to 40%
    Highest flexibility potentials in spring and autumn
    Strong differences between different district heating systems
  - Transition to 4th generation district heating
- Local, regional, national heat planning and mapping

Thank you!

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www.set-nav.eu

www.hotmaps-project.eu

www.e-think.ac.at

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