The potential of

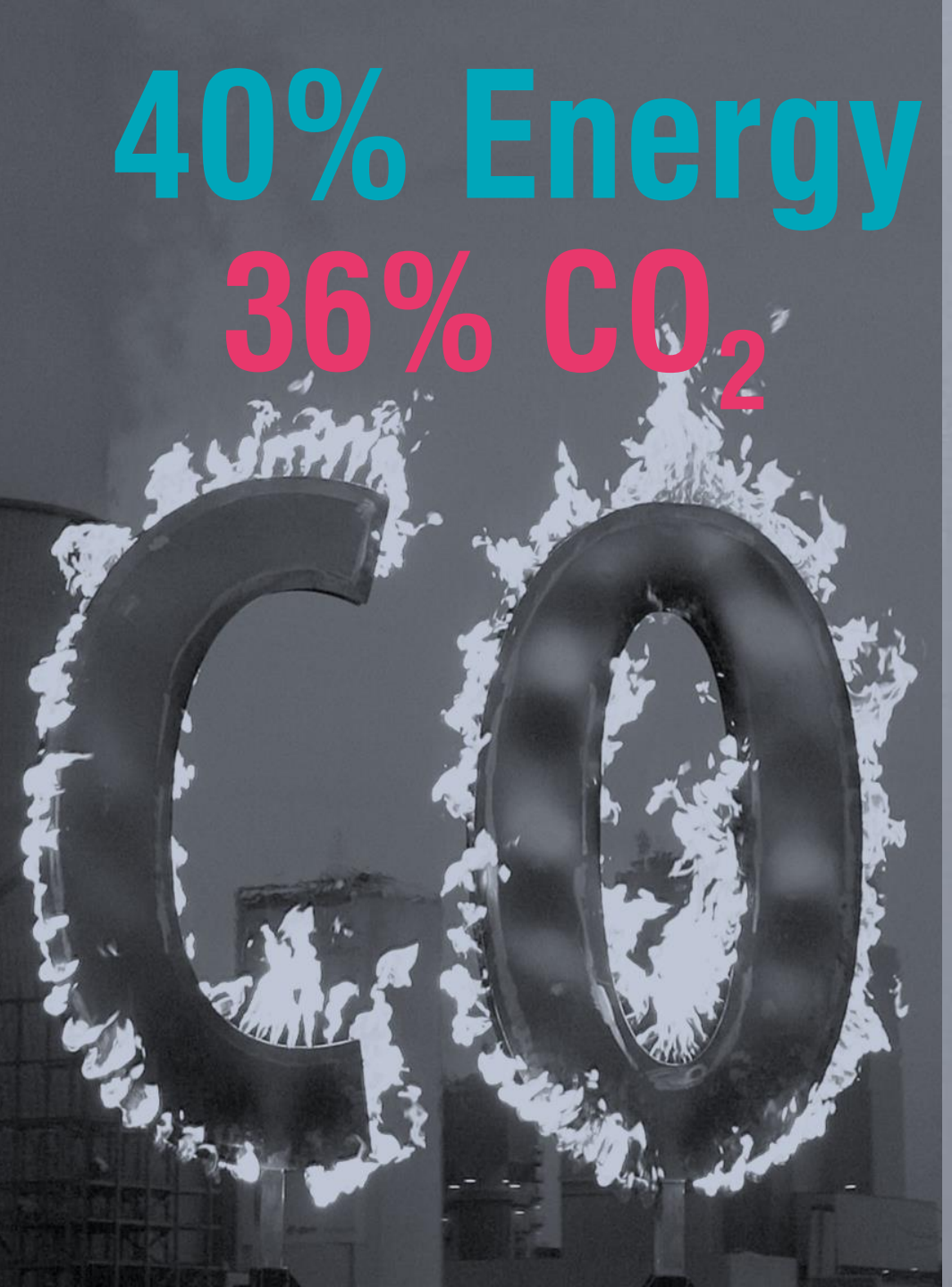
WASTE WATER HEAT RECOVERY (WWHR) SYSTEMS

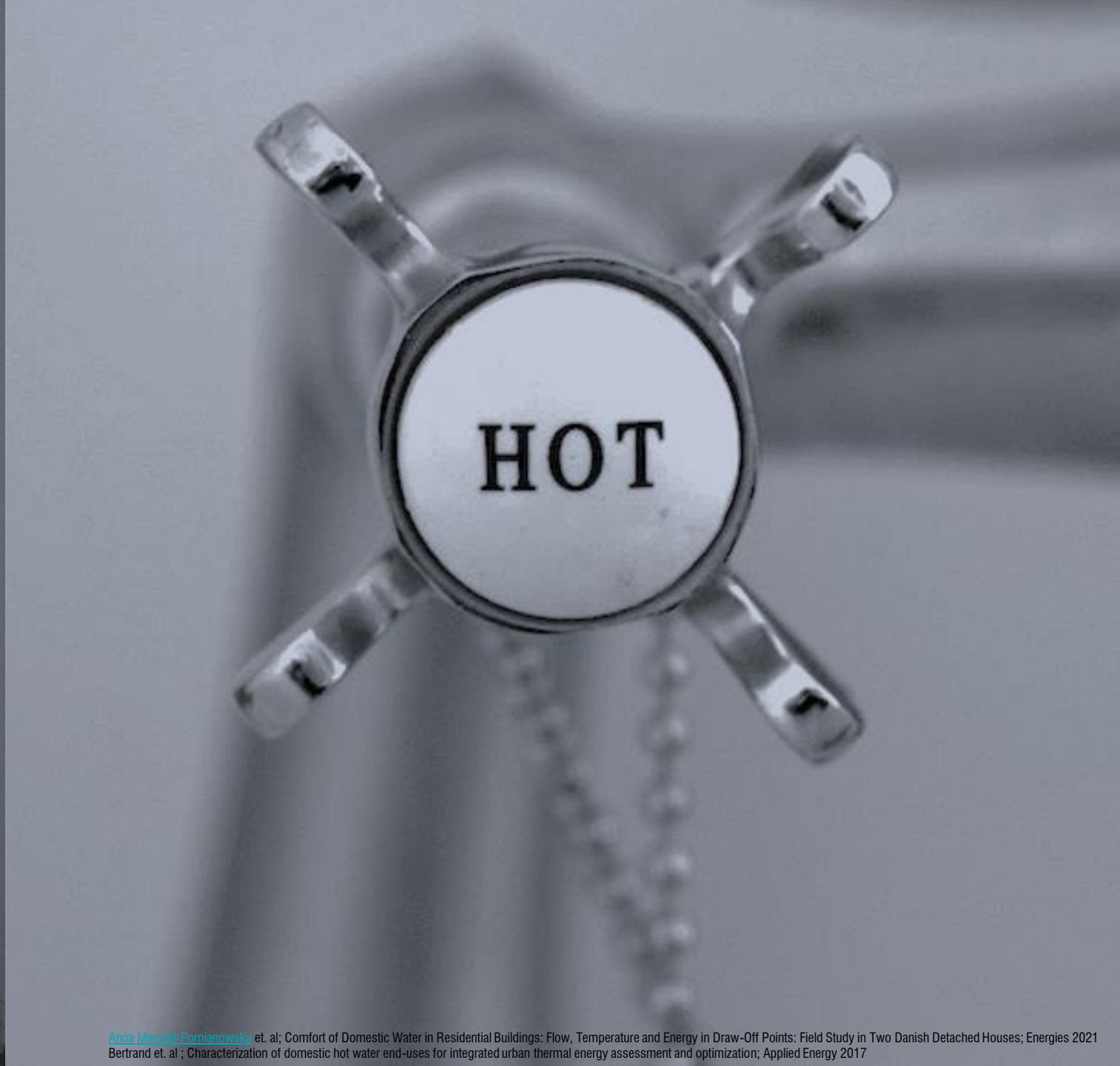
in reducing the energy need for water heating in the EU in a cost-efficient way

Commissioned by ECI

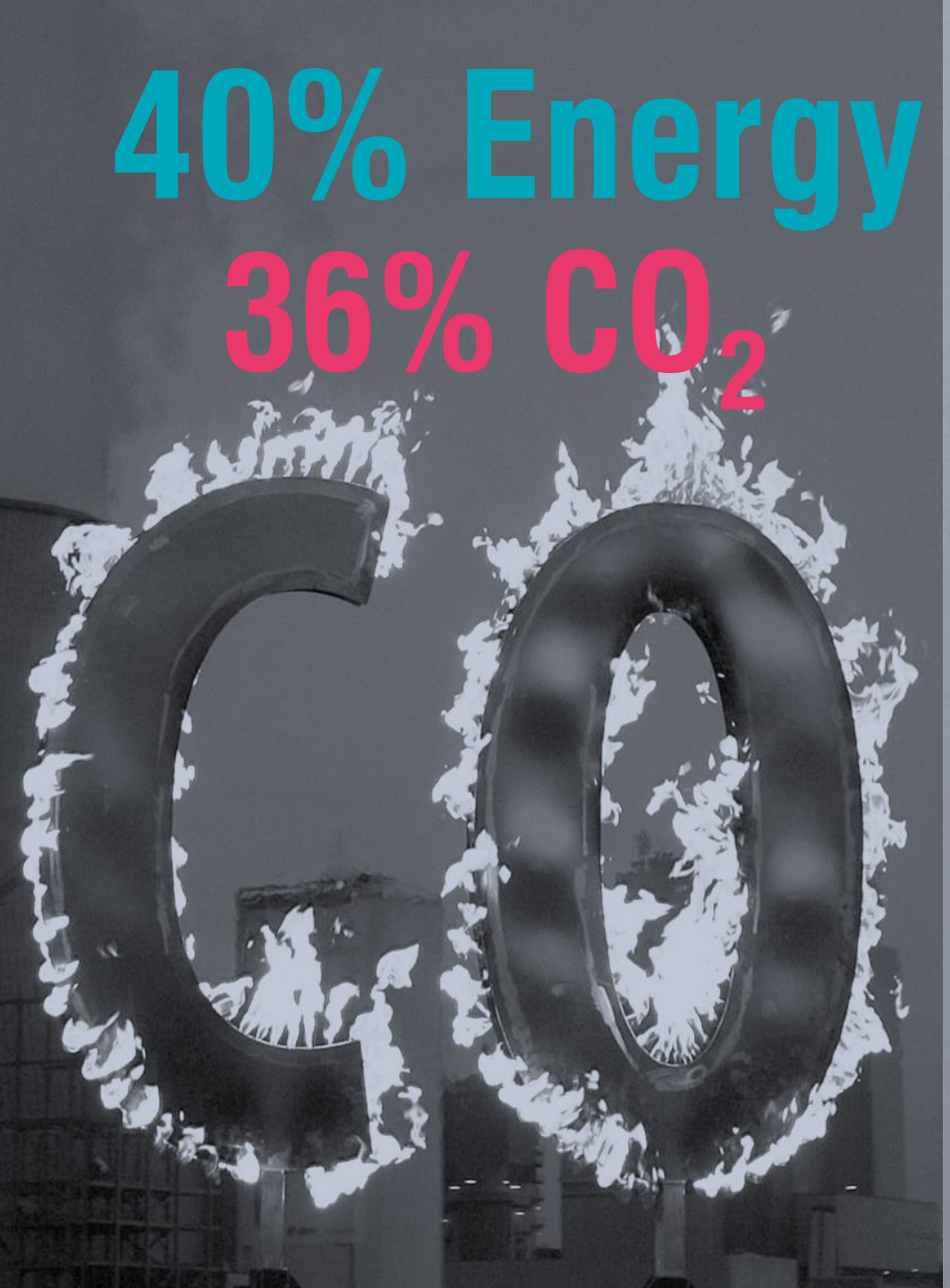
40% Energy

36% CO_2





Anna Marszal-Pomianowska et. al; Comfort of Domestic Water in Residential Buildings: Flow, Temperature and Energy in Draw-Off Points: Field Study in Two Danish Detached Houses; Energies 2021
Bertrand et. al ; Characterization of domestic hot water end-uses for integrated urban thermal energy assessment and optimization; Applied Energy 2017



40% Energy

36% CO_2

22.000.000 m^3

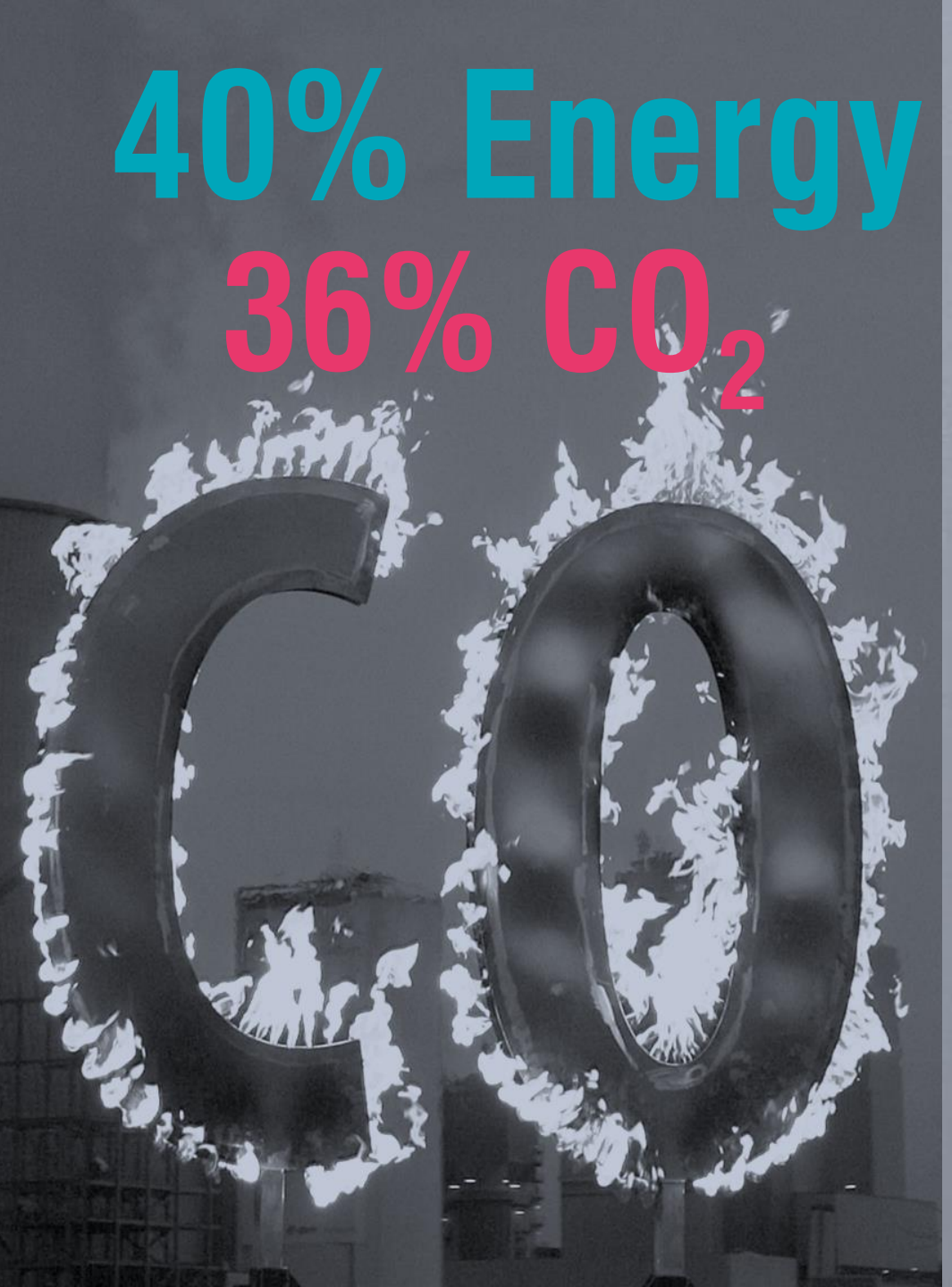
HOT WATER

flows daily into the sewers in the EU

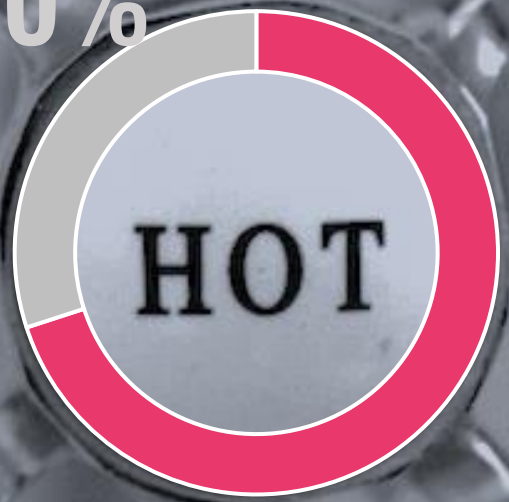
Anna Marszal-Pomianowska et. al; Comfort of Domestic Water in Residential Buildings: Flow, Temperature and Energy in Draw-Off Points: Field Study in Two Danish Detached Houses; Energies 2021
Bertrand et. al ; Characterization of domestic hot water end-uses for integrated urban thermal energy assessment and optimization; Applied Energy 2017

40% Energy

36% CO_2



18-30%



70-82%

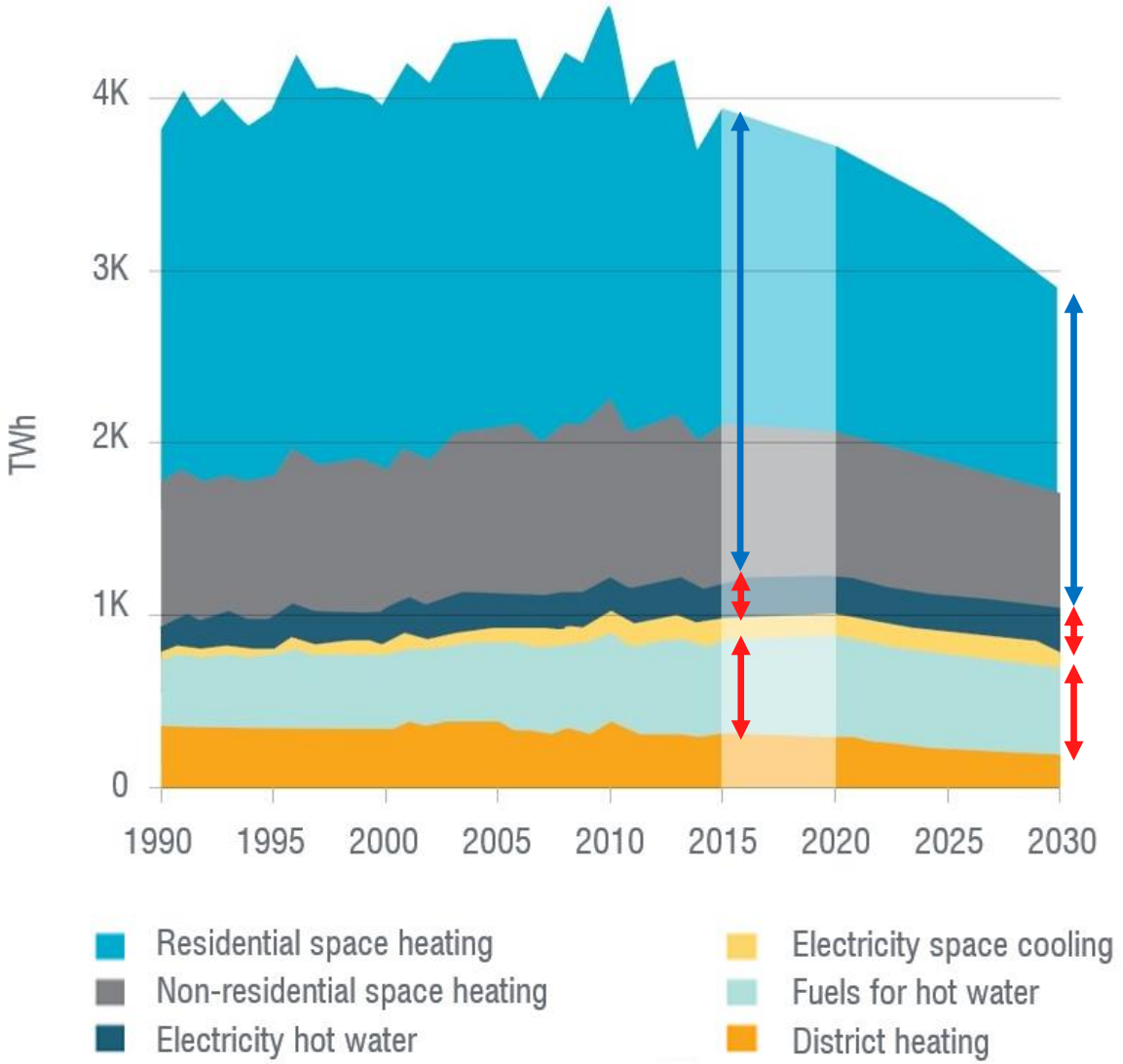
22.000.000 m^3

HOT WATER

flows daily into the sewers in the EU

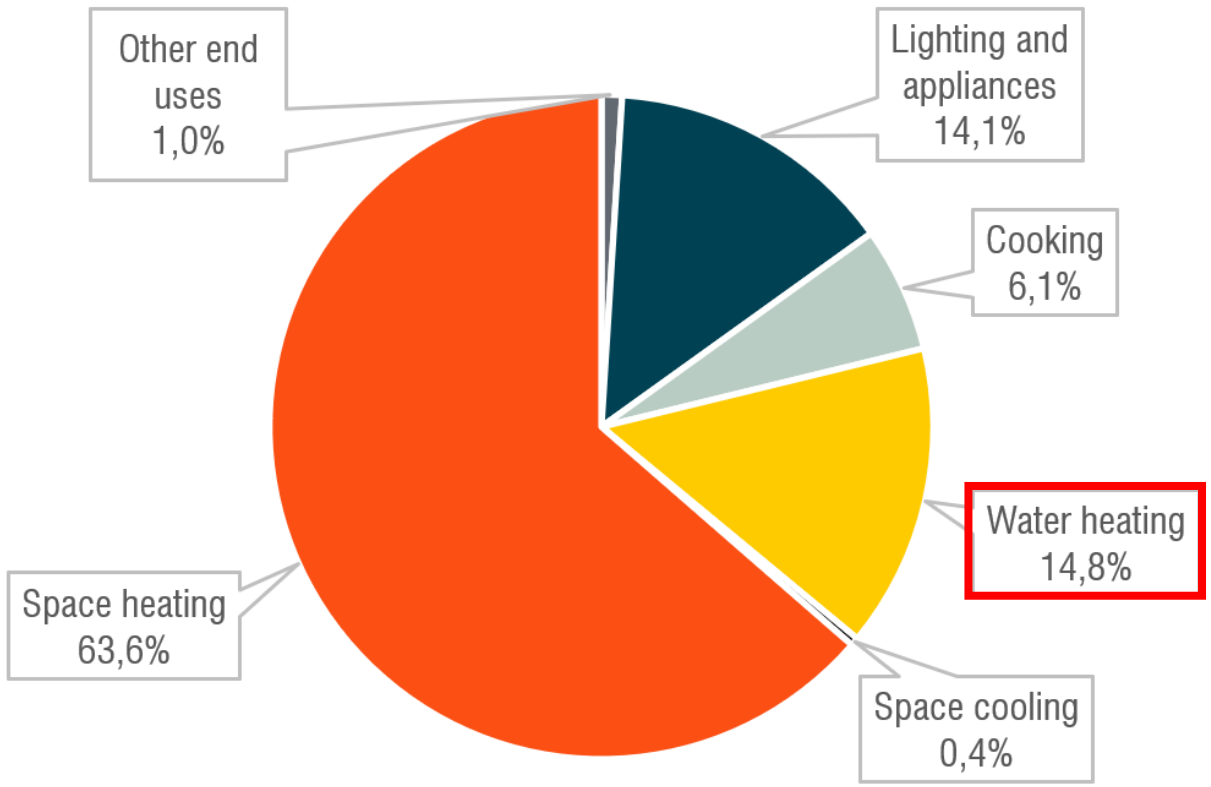
Anna Marszal-Pomianowska et. al; Comfort of Domestic Water in Residential Buildings: Flow, Temperature and Energy in Draw-Off Points: Field Study in Two Danish Detached Houses; Energies 2021
Bertrand et. al ; Characterization of domestic hot water end-uses for integrated urban thermal energy assessment and optimization; Applied Energy 2017

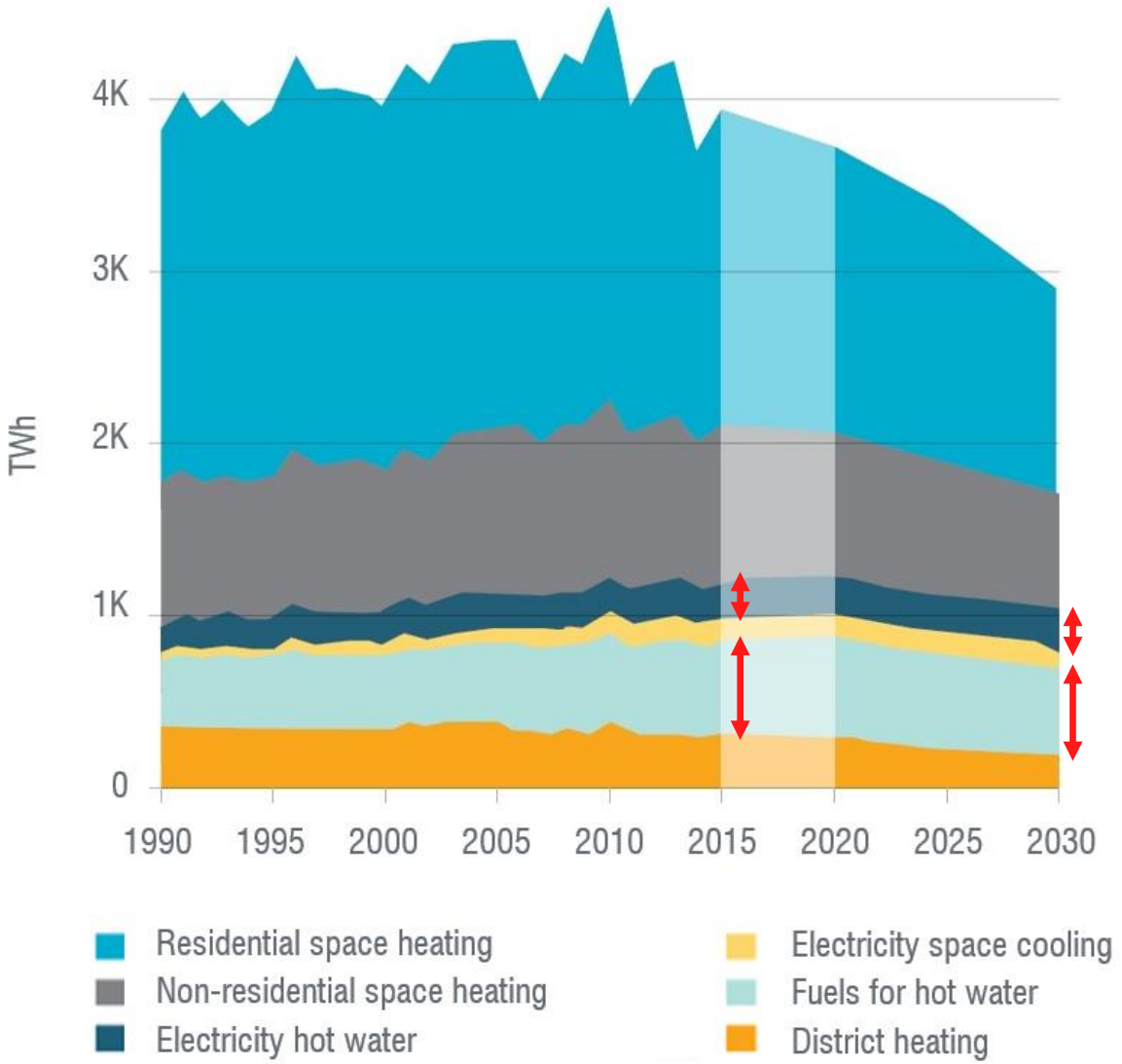
Distribution of final energy demand



Roscini et al.; contributions from the building sector to a strengthened 2030 climate target; BPIE 2020

Distribution of final energy demand



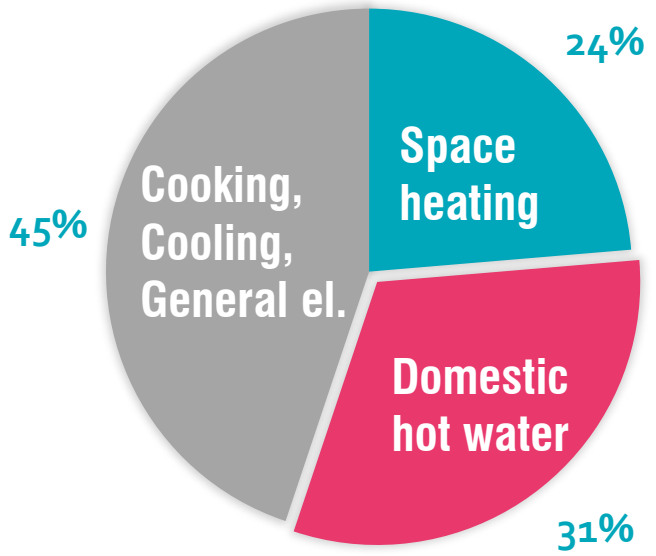


Eurostat database; https://ec.europa.eu/eurostat/de/data/database

Roscini et al.; contributions from the building sector to a strengthened 2030 climate target; BPIE 2020

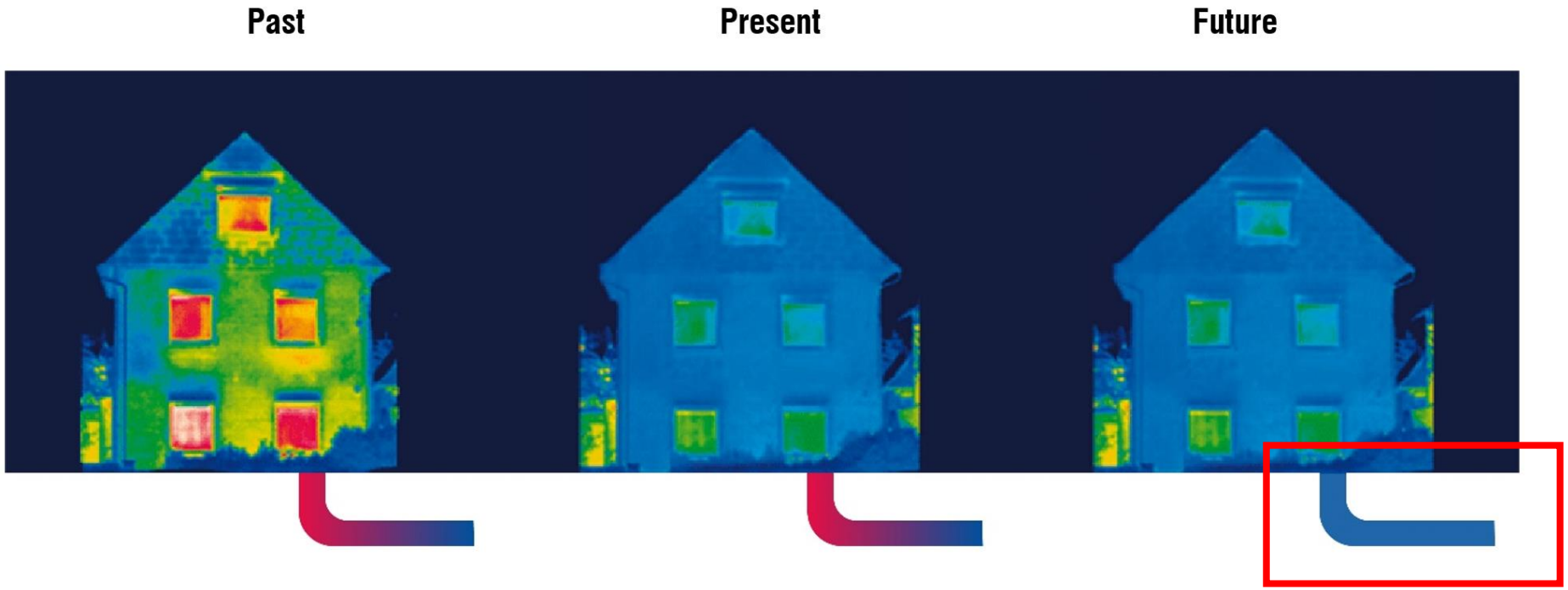
Distribution of final energy demand

MULTI-FAMILY BUILDING 2010 INNSBRUCK, AT (PASSIVE-HOUSE)

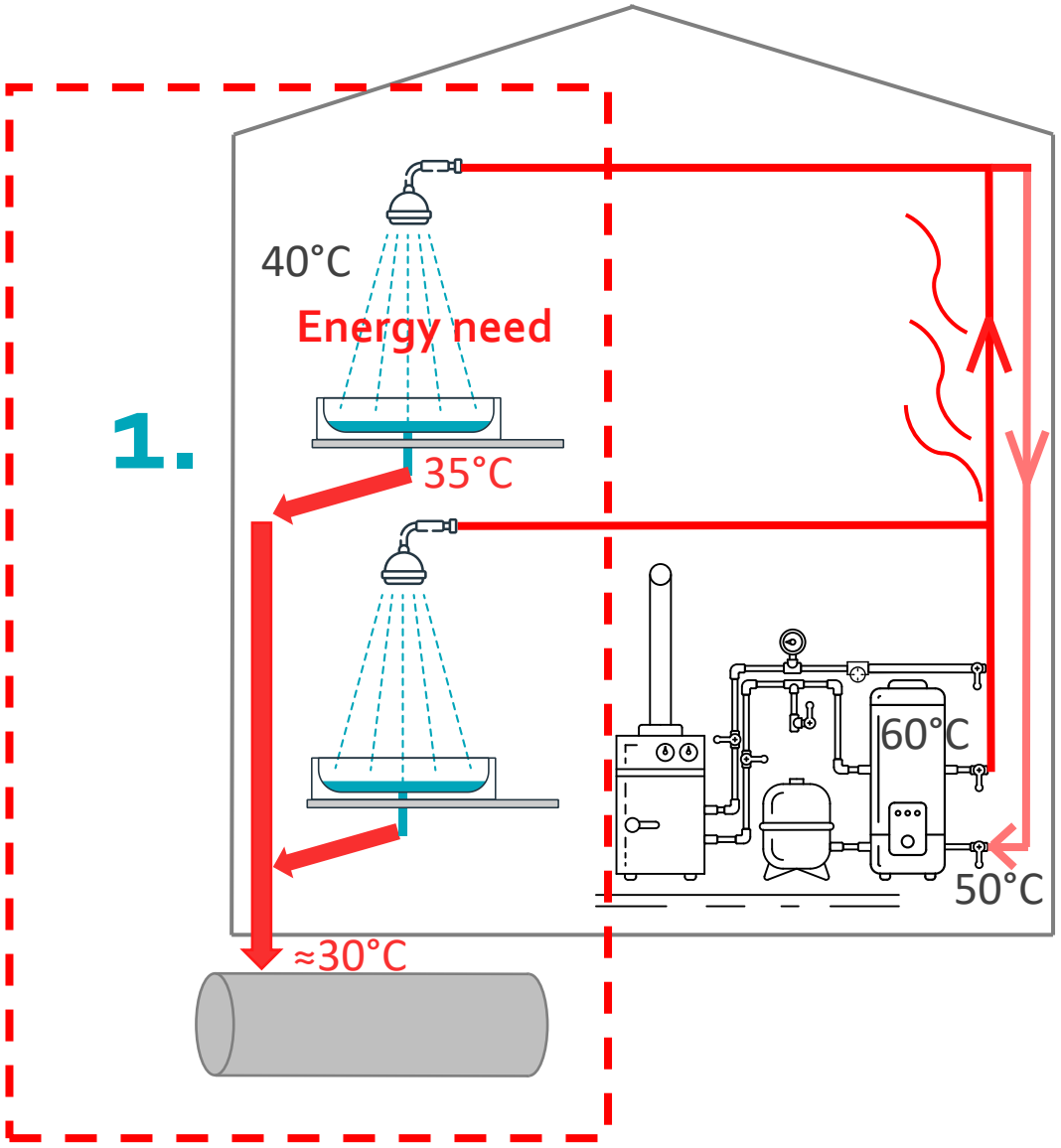


Energiebilanz im Passivhaus und berechnete Anteile aus einer Messung am Lodenareal in Innsbruck (Passivhaus Insititut, 2017)

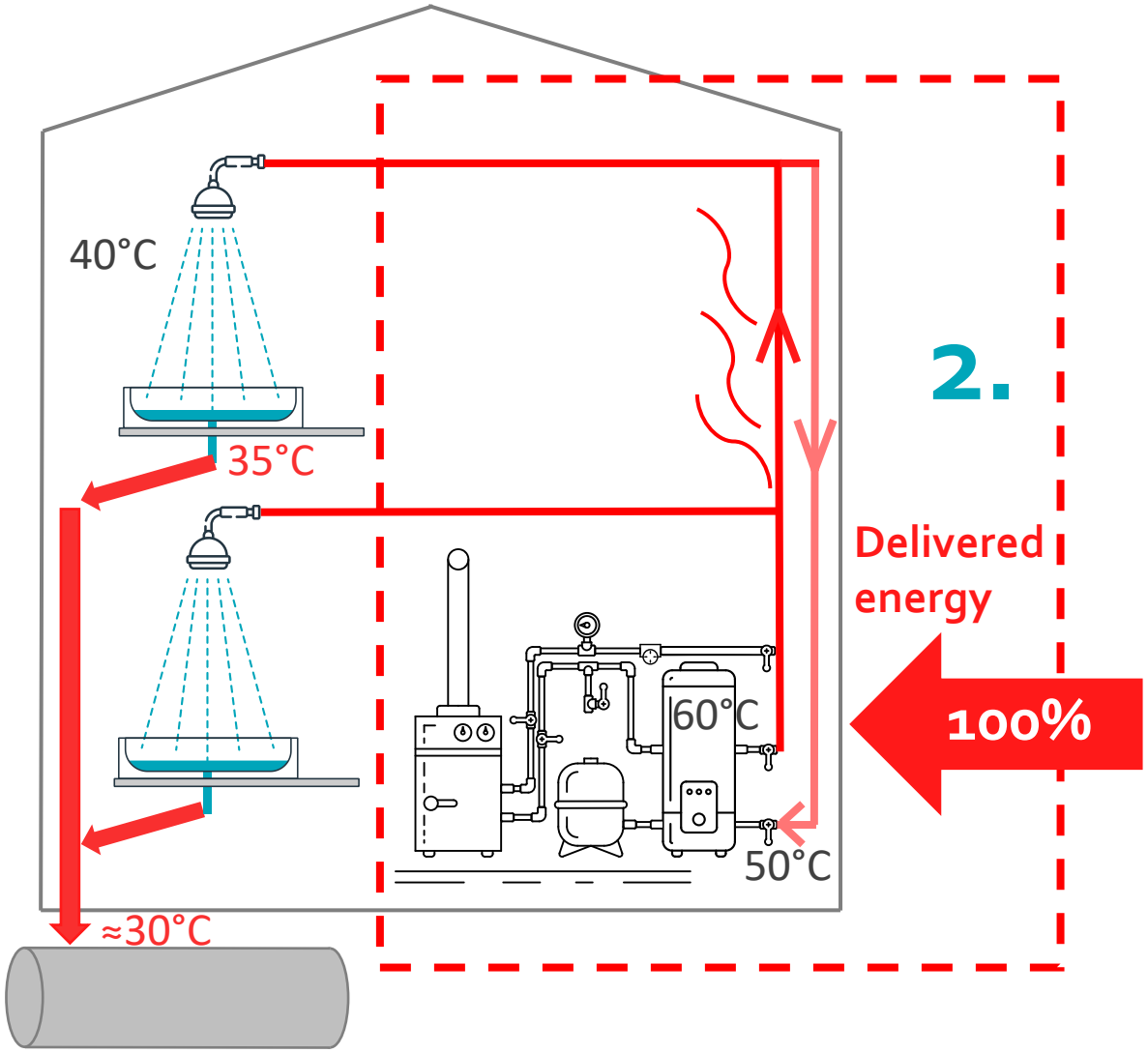
Drain water, the last systematic thermal bridge?



Energy need vs. delivered energy

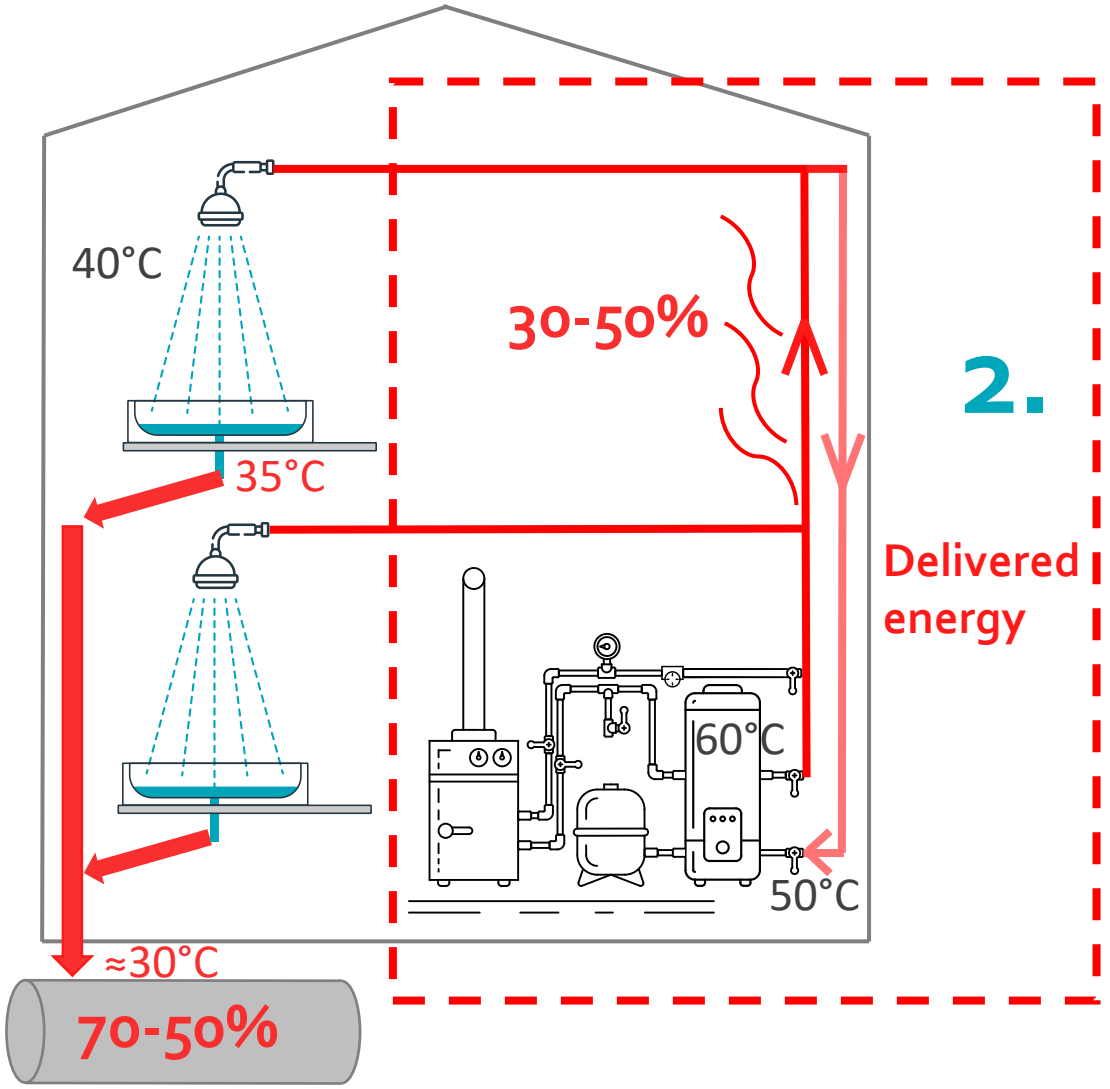


Energy need vs. delivered energy



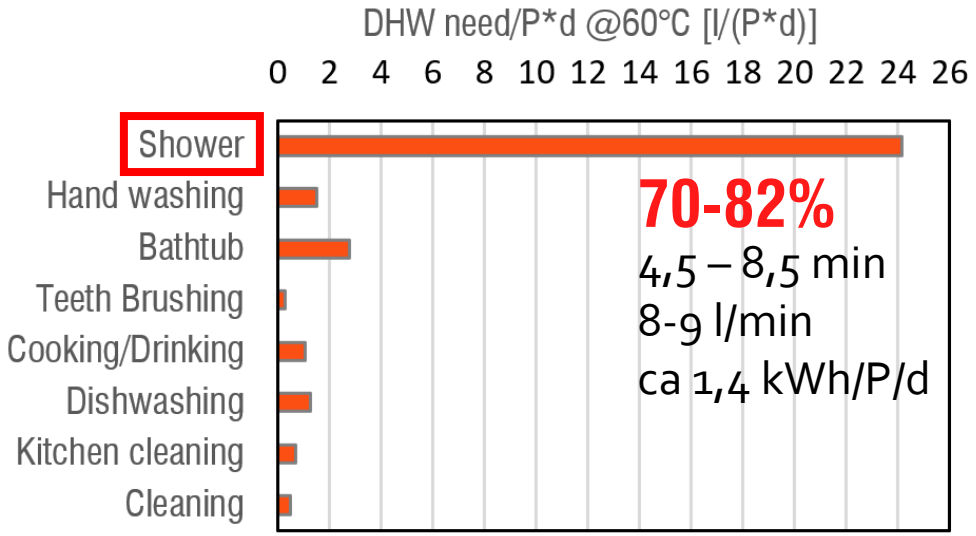
Source: European commission; Towards a smart, efficient, and sustainable heating and cooling; Brussels 2016; https://ec.europa.eu/commission/presscorner/detail/it/MEMO_16_311

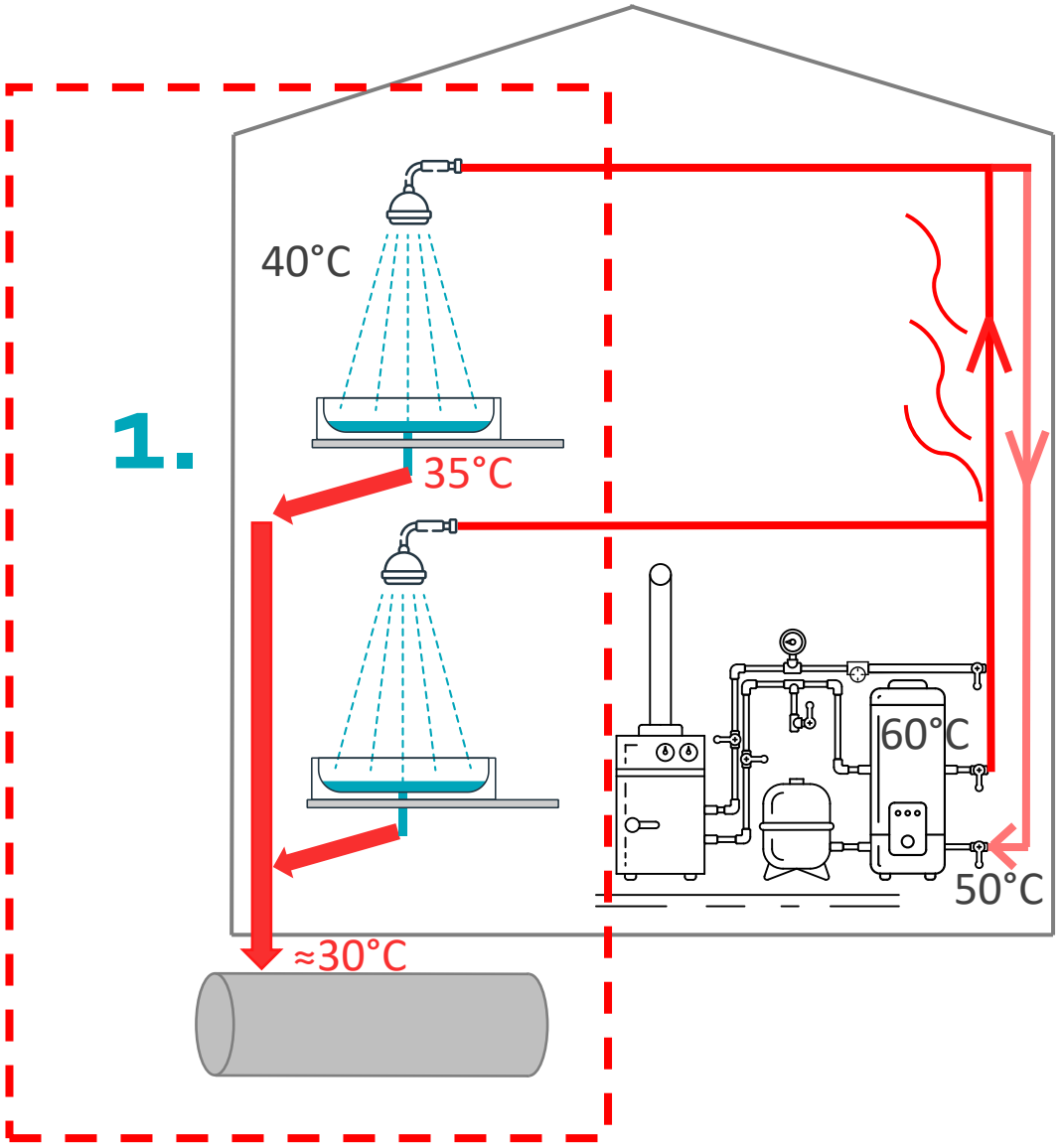
Energy need vs. delivered energy



Source: European commission; Towards a smart, efficient, and sustainable heating and cooling; Brussels 2016; https://ec.europa.eu/commission/presscorner/detail/it/MEMO_16_311

Energy need vs. delivered energy



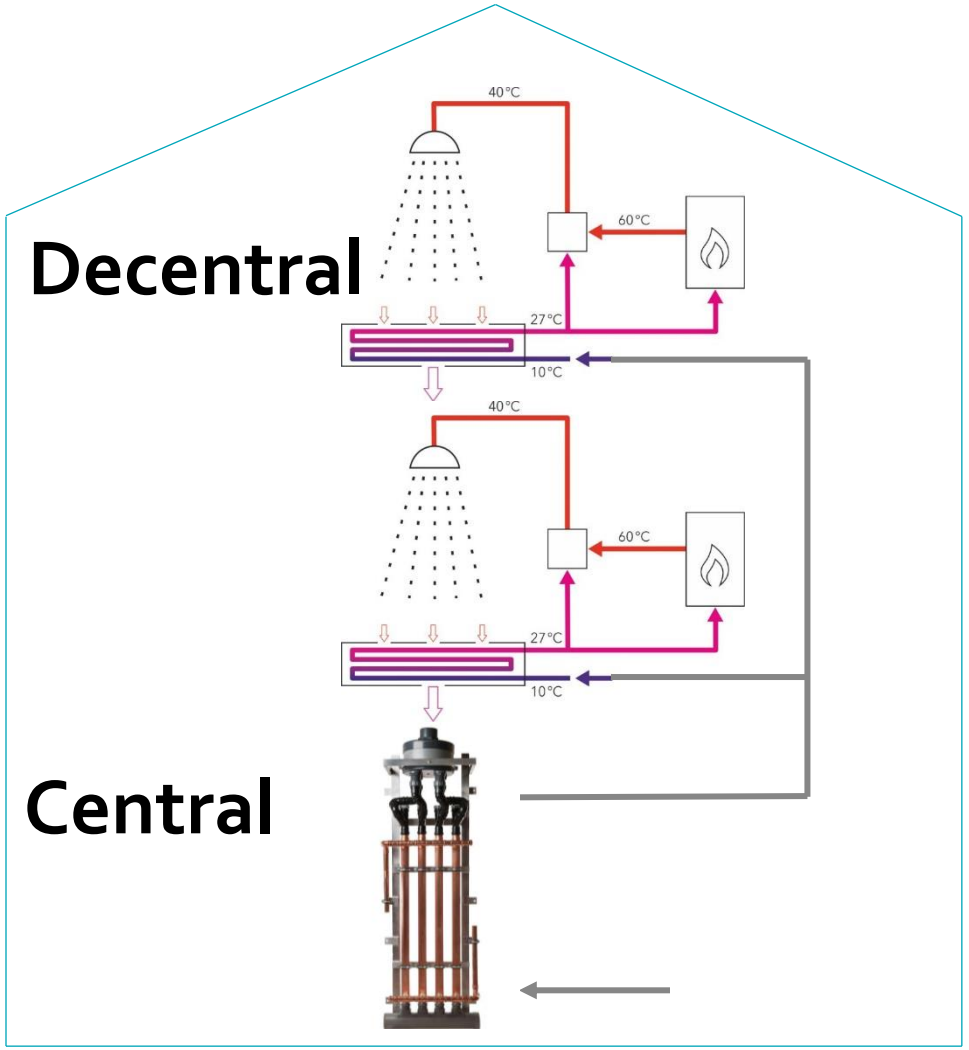


Source: Passive House Planning Package (PHPP) https://passivehouse.com/04_phpp/04_phpp.htm

Types of WWHR

City-level

Decentral

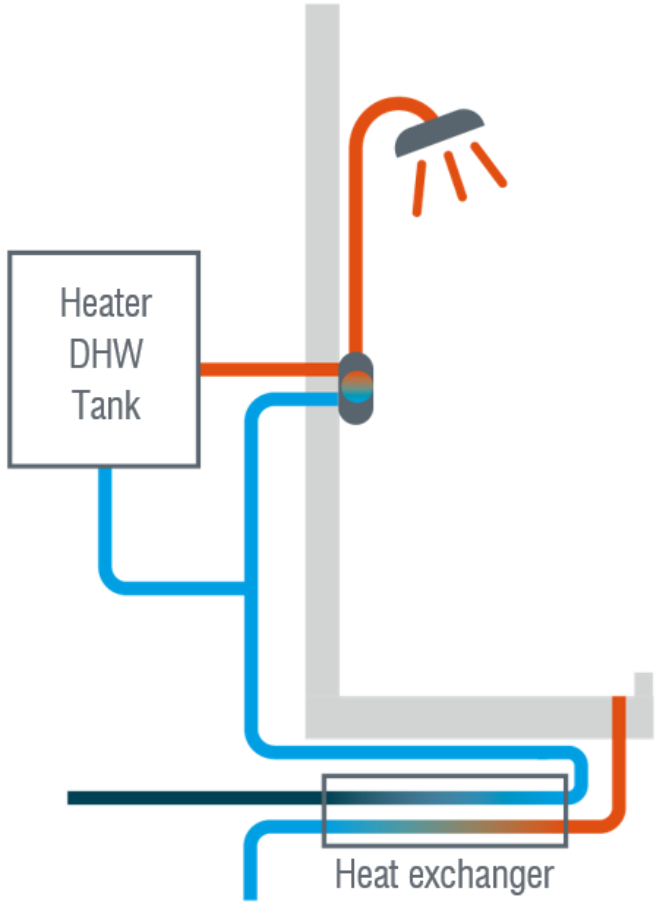


Source: Wagner Solar GmbH, BERDING BETON GmbH; Q-Blue b.v.

Decentral WWHR

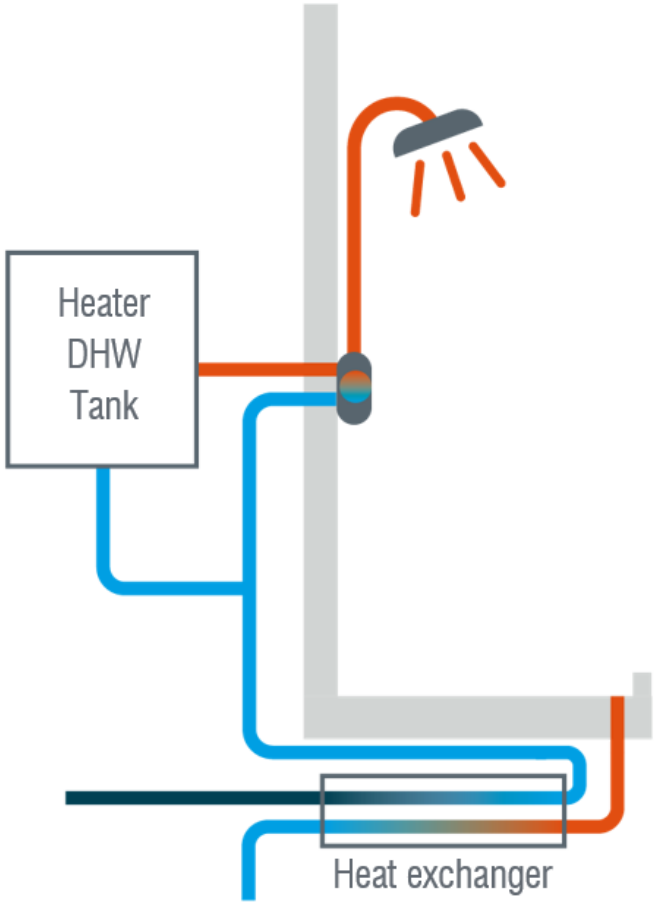
Counter Flow Products B.V., Joulia ltd., Hamwells Nederland B.V.

Hydraulic connections of WWHR

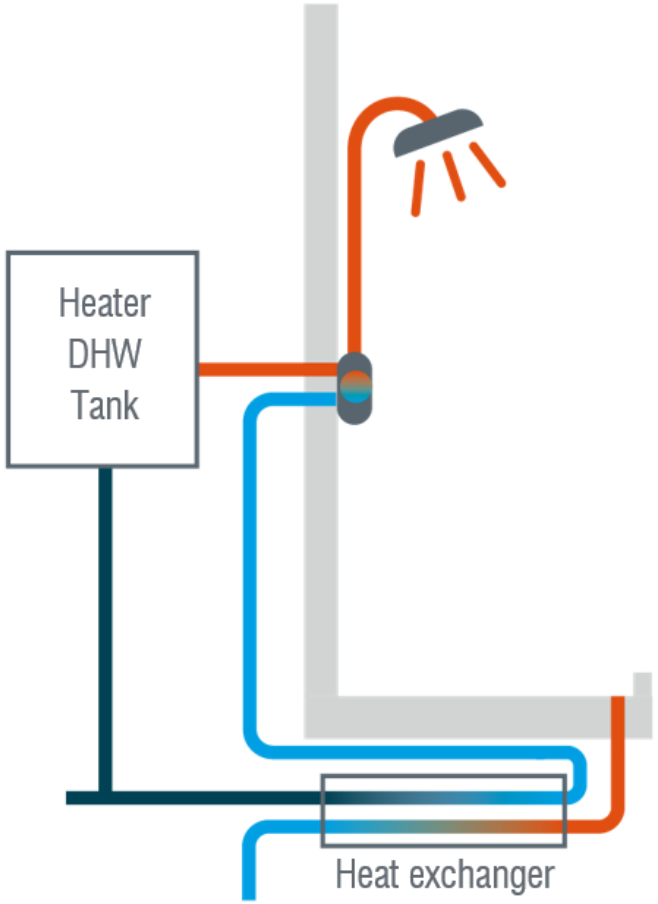


A) **Preheating** for "**cold** and **warm**" water
(balanced volume flow-rate)

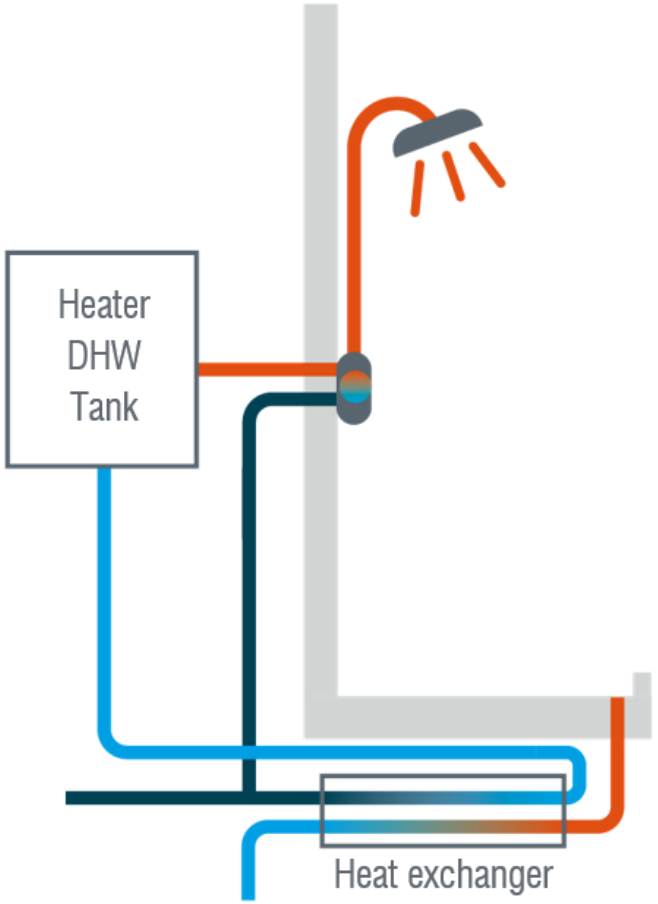
Hydraulic connections of WWHR



A) **Preheating** for "**cold** and **warm**" water
(balanced volume flow-rate)

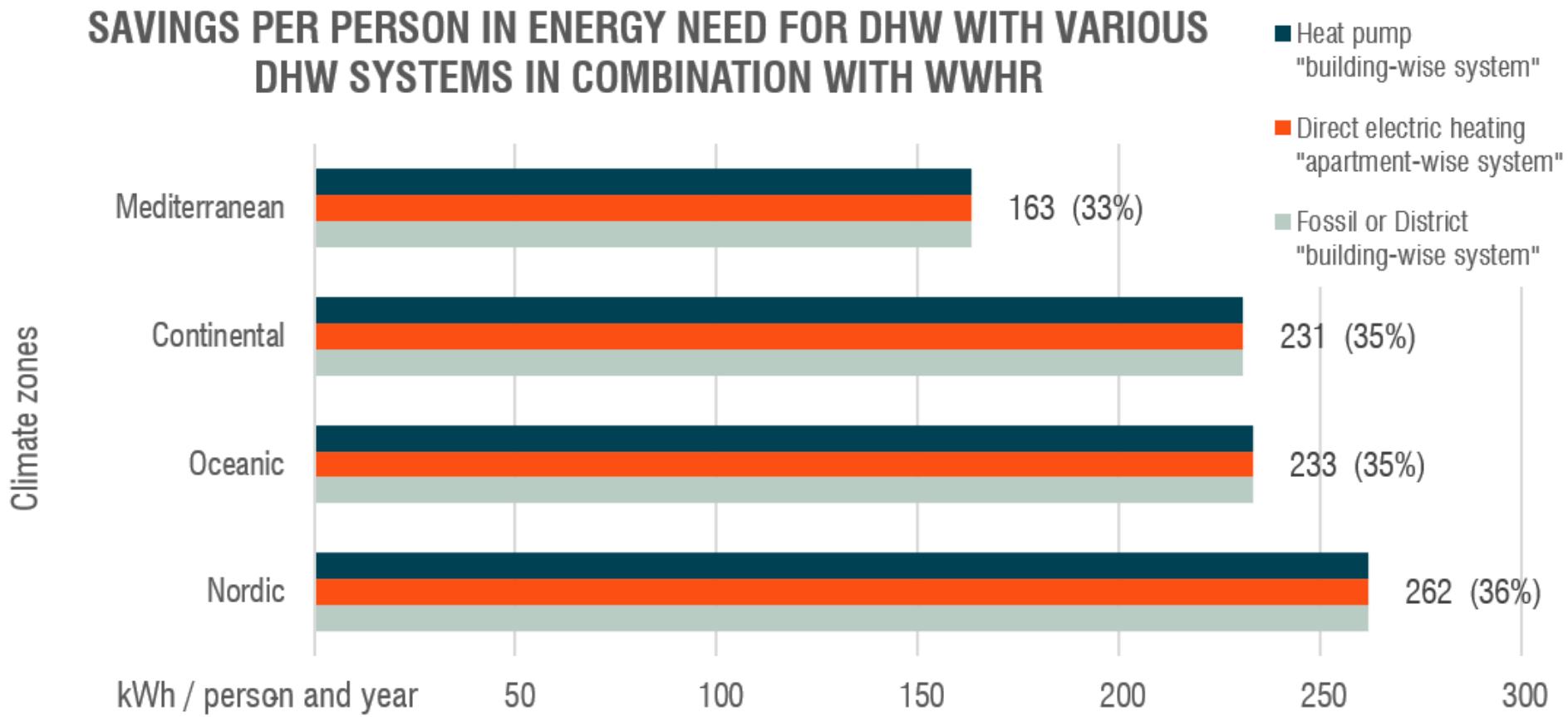


B) **Preheating** for "**cold** water"
(dis-balanced volume flow-rate)

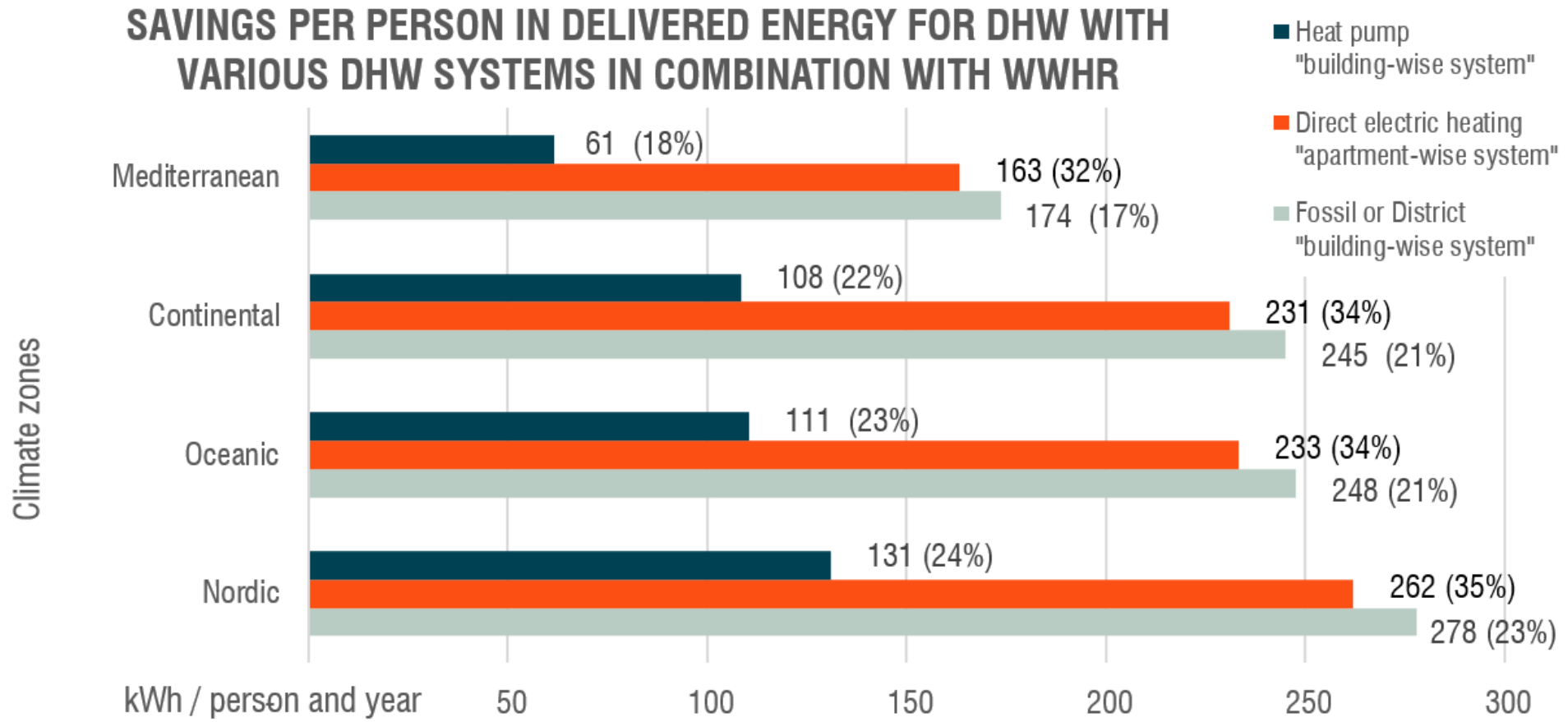


C) **Preheating** for "**warm** water"
(dis-balanced volume flow-rate)

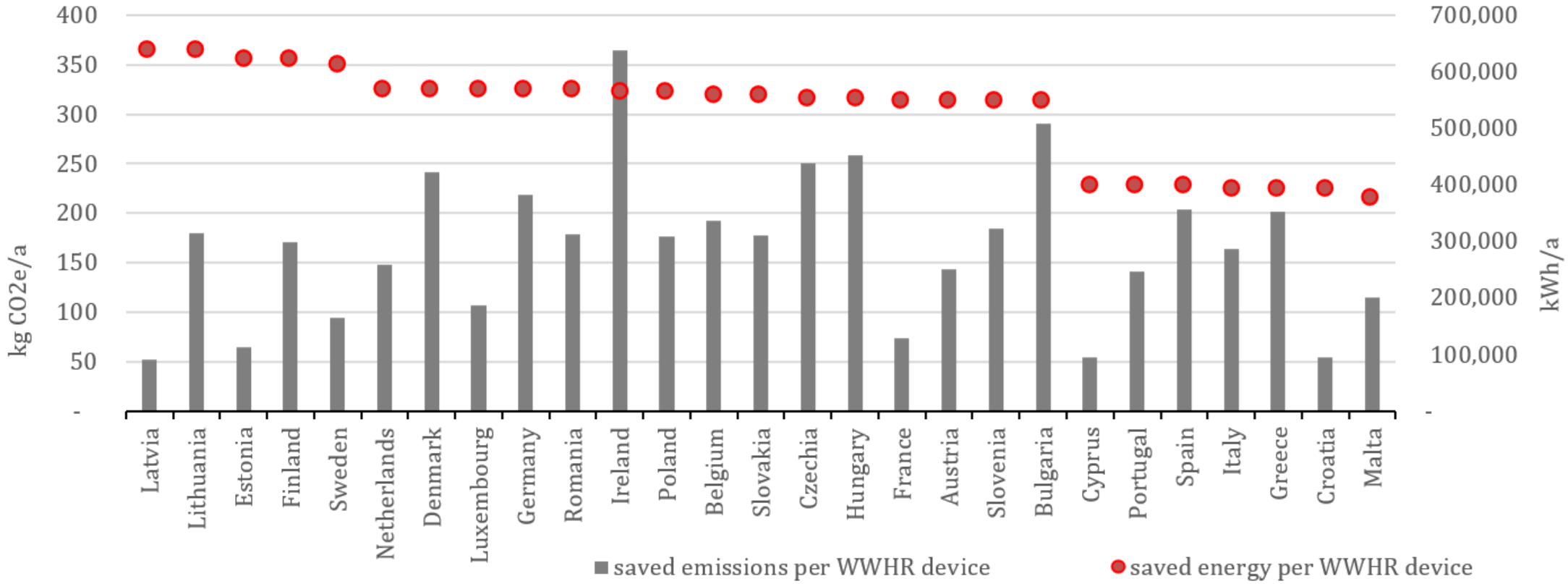
Savings of energy need in combination with various hot water systems (per person)



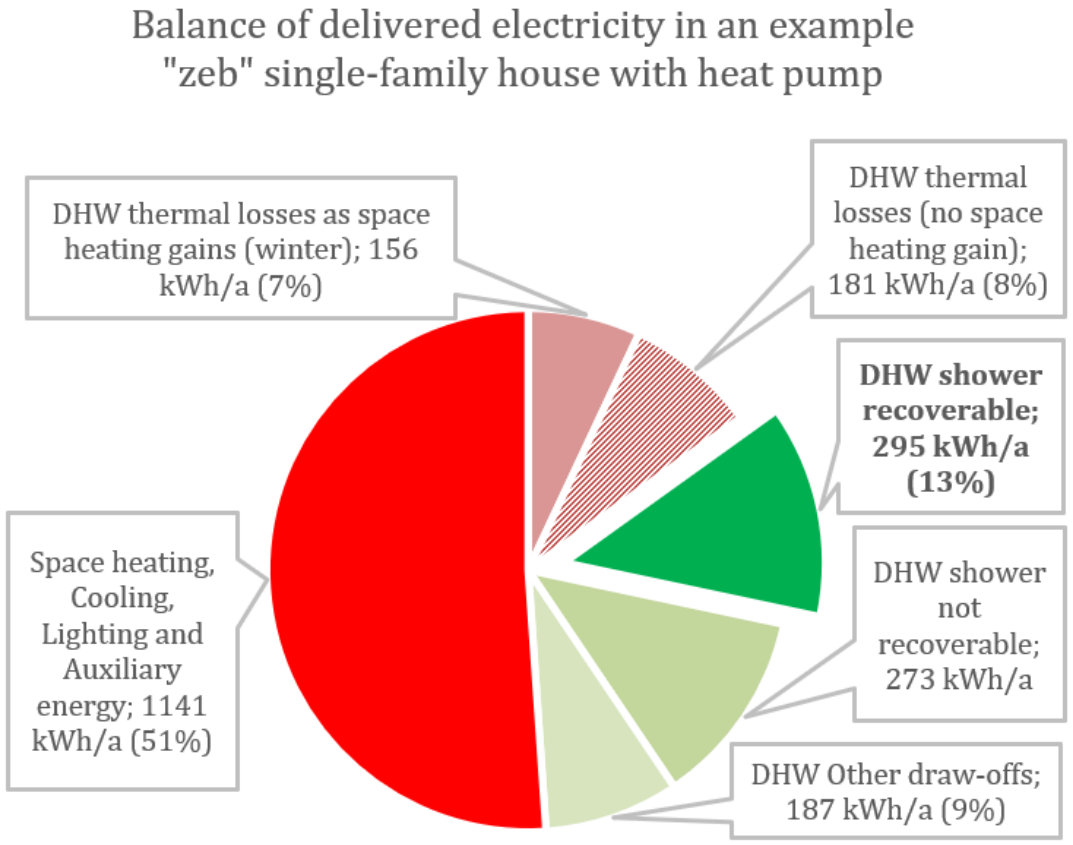
Savings of delivered energy in combination with various hot water systems (per person)

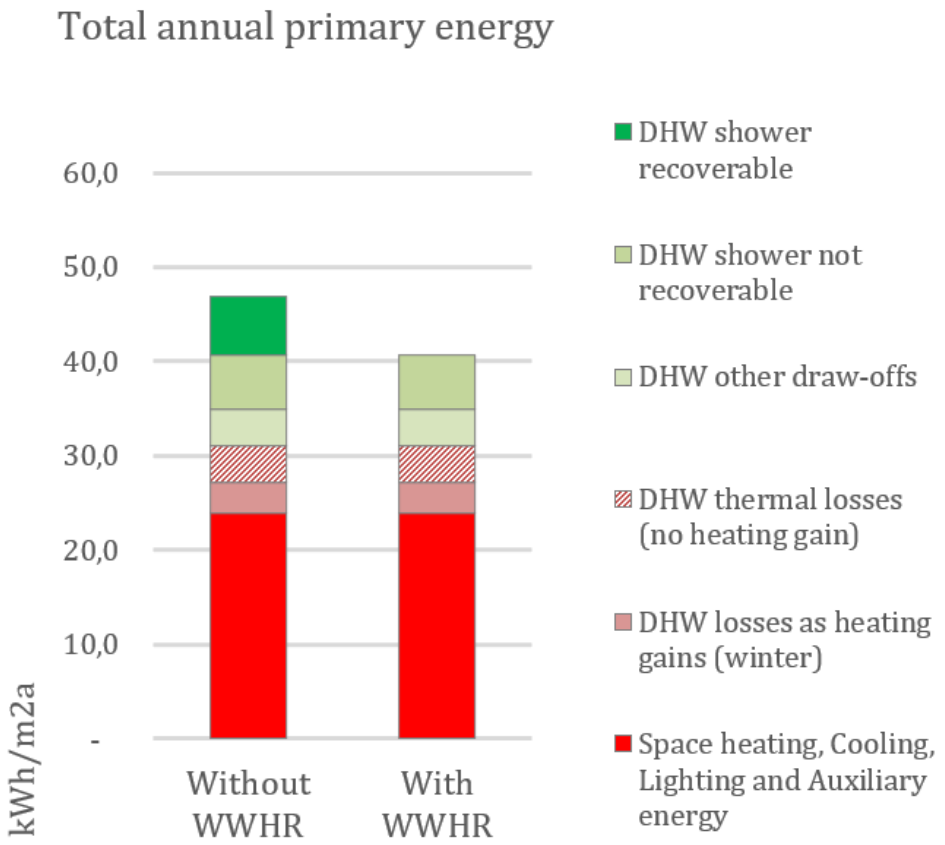


Annual energy and emission savings per WWHR device per country



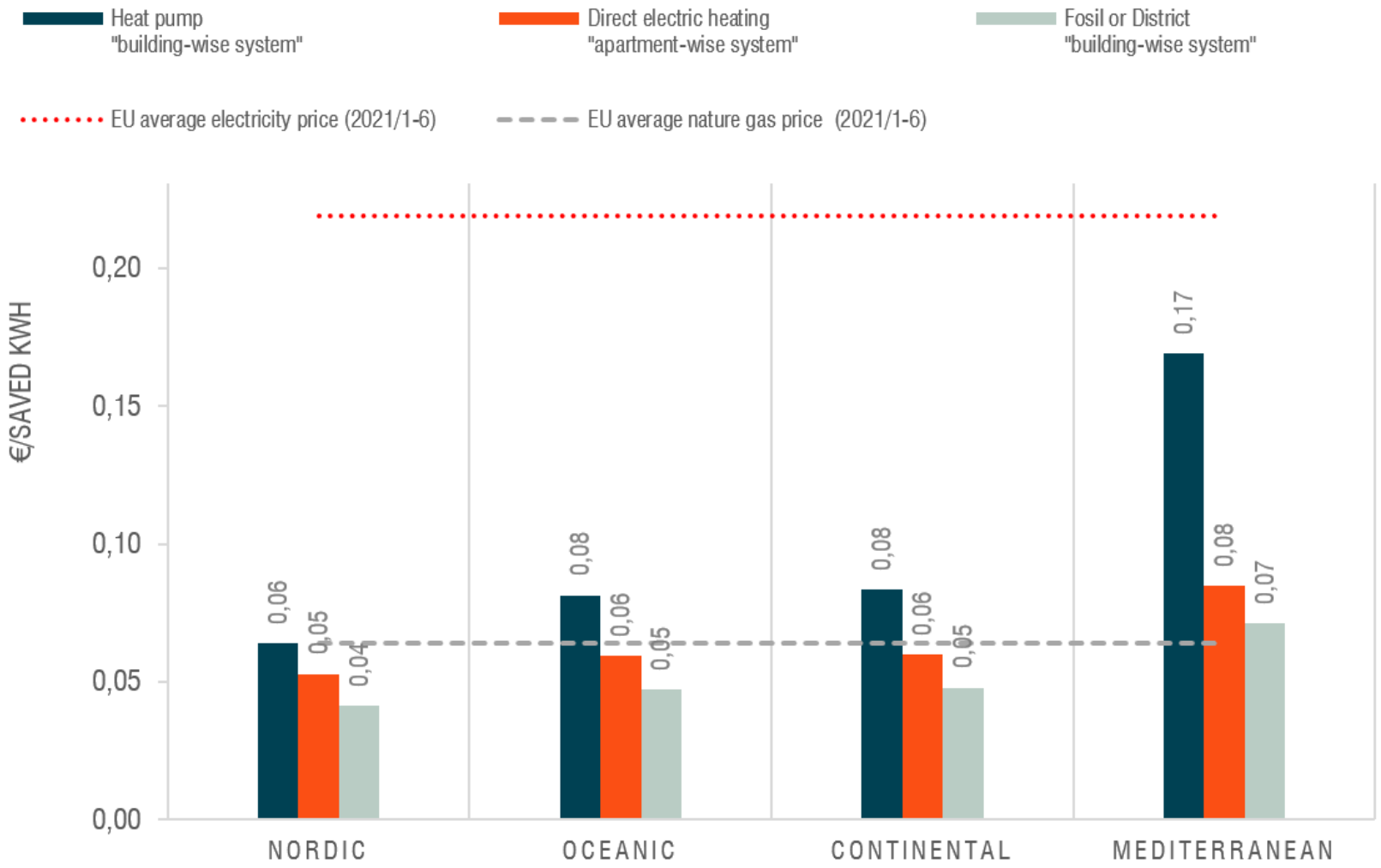
With WWHR, recoverable share of delivered energy in a "ZEB "* single-family house



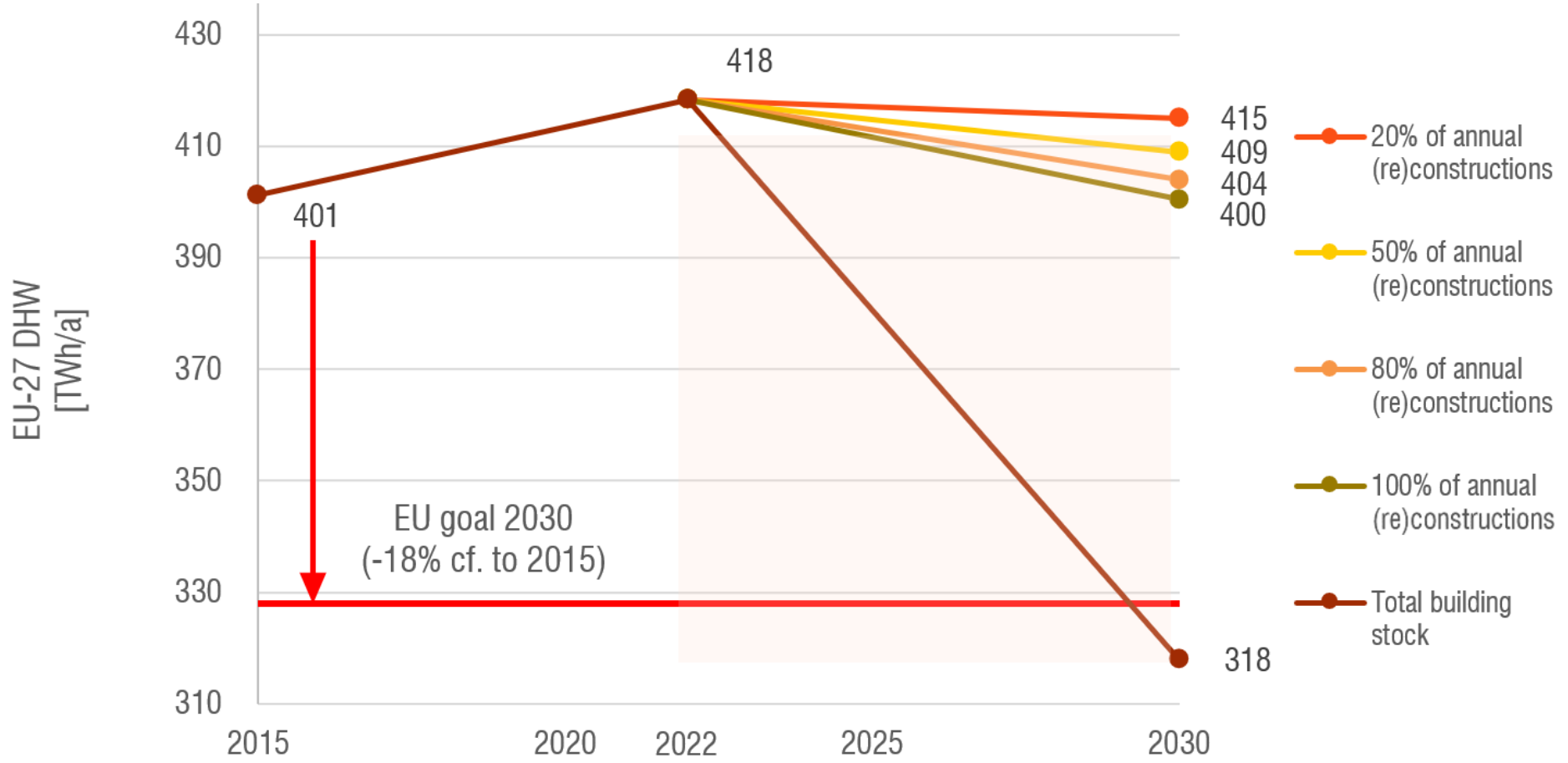


*near-zero energy buildings" (nZEB), which will be replaced by the "zero emission building" (ZEB) standard in 2030

Cost of the saved energy with WWHR [€/kWh]



EU-27 (Fit for 55) Energy demand for DHW in 2030* depending on application rate of WWHR



*total of 35 million renovated and 15 million newly built buildings between 2022 and 2030

Conclusion

- **"As a passive system with no moving parts and no maintenance, and with a lifespan as long as the water pipe system itself, this is a unique feature for an energy-saving technology without loss of comfort."** (Dr.-Phys. Jürgen Schnieders)

- **40% of of delivered energy can be** saved by DHW system with optimized distribution, storage and circulation losses.

- **The economy** is particularly good in **sport facilities, businesses and hotels (more than a 100 €/a per family)** & **climates with colder ground water.**

- **Ecological footprint** is balanced already during the **first year of its operation.**
  WWHR has a **high level of recyclability**; the **life-cycle of WWHR devices (>20 years)**

Conclusion

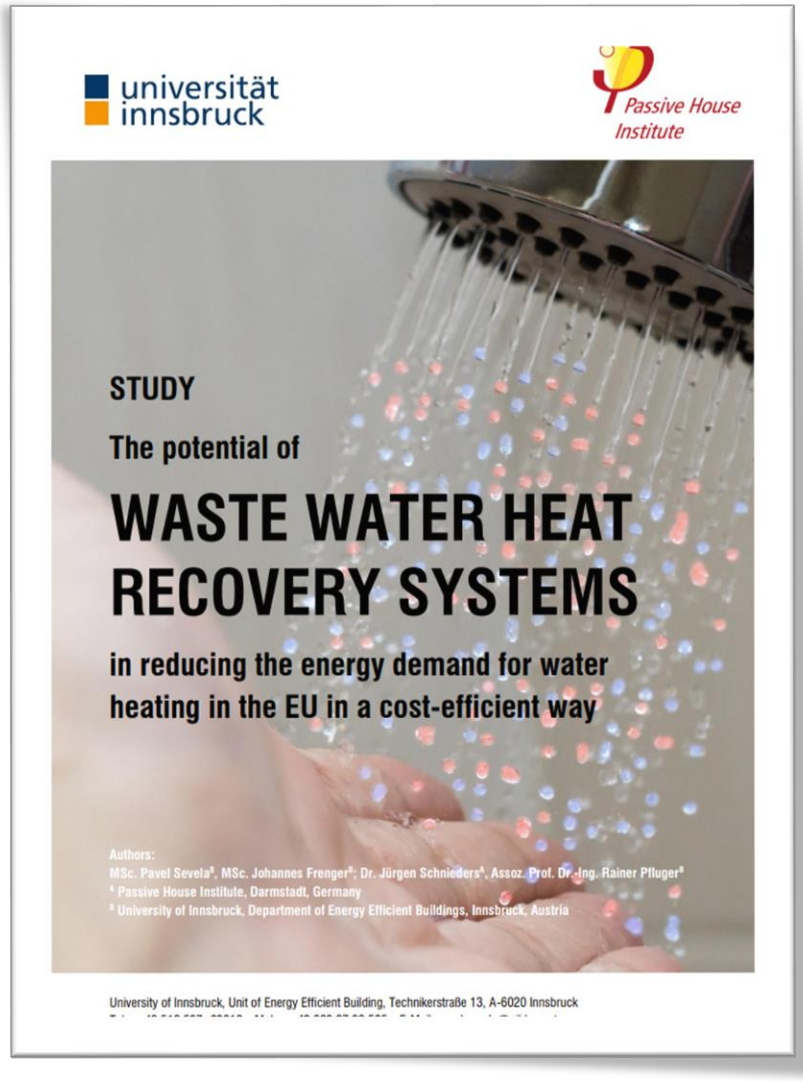
- **HVAC** has a renovation rate about **three times higher than the building stock** (currently below 1%* in the EU). With **WWHR, decarbonisation** can thus be achieved **more rapidly than with regular energy-saving** measures such as insulation of the building envelope.
- **WWHR can exceed the EC targets (by 24 % & 100 TWh/a) for reducing energy consumption for water heating at European level.**
- **Missing European norms & Eco-design Directive for WWHR.**
- **WWHR may be included in the EU's toolbox**
- **Training of professionals is needed**

*European Comission; EPBD-Facts and figures; https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficient-buildings/energy-performancebuildings-directive_en

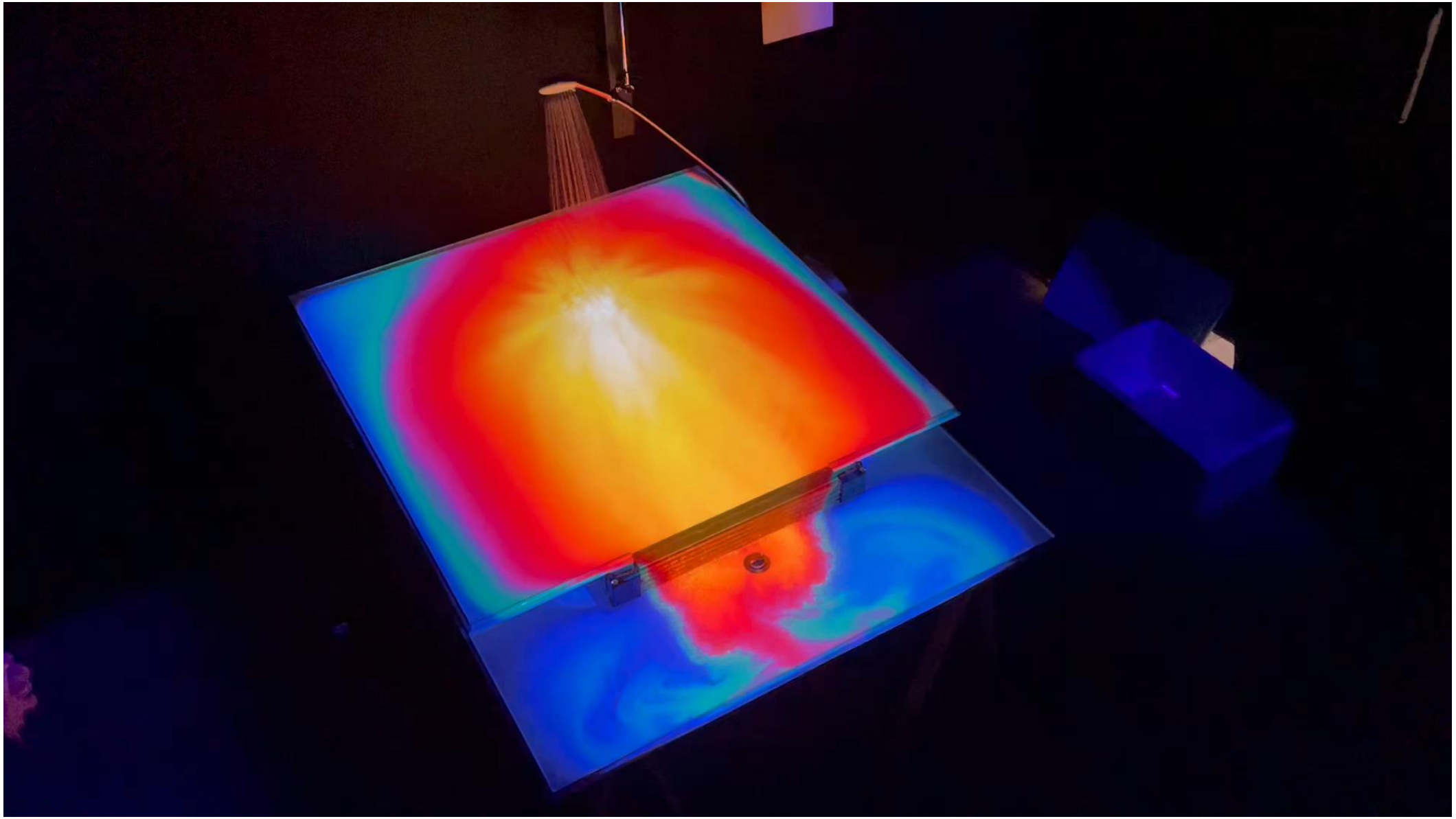
More content

- Full study: https://diglib.uibk.ac.at/7640369

- Short paper: https://proceedings.open.tudelft.nl/clima2022/article/view/439/419



universität innsbruck



Joulia ltd.