Learnings from low temperature DH implementations in urban heat recovery

-different ways of collecting surplus heat and main findings

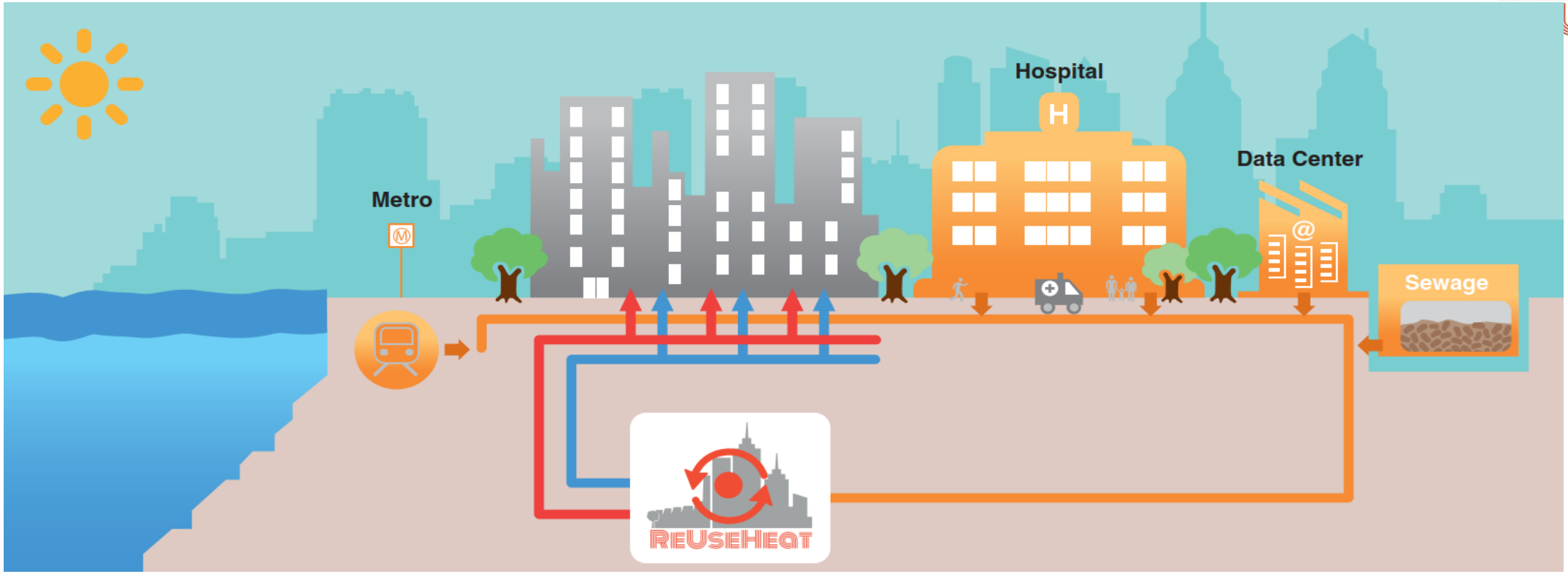
Kristina Lygnerud,
Professor in Energy Sciences: build a bridge between energy and technology
Intrapreneur in district energy: energy planning & financial innovation

Lund University
Swedish Environment Research Institute (IVL)

Agenda

1. The ReUseHeat vision
2. Urban waste heat potential
3. Stakeholder action needed
4. Demonstrators
5. Main learnings
6. After ReUseHeat: helping cities to meet long term goals

The ReUseHeat vision



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant ageement No 767429

Agenda

1. The ReUseHeat vision
2. Urban waste heat potential
3. Stakeholder action needed
4. Demonstrators
5. Main learnings
6. After ReUseHeat: helping cities to meet long term goals

The ReUseHeat project- urban heat

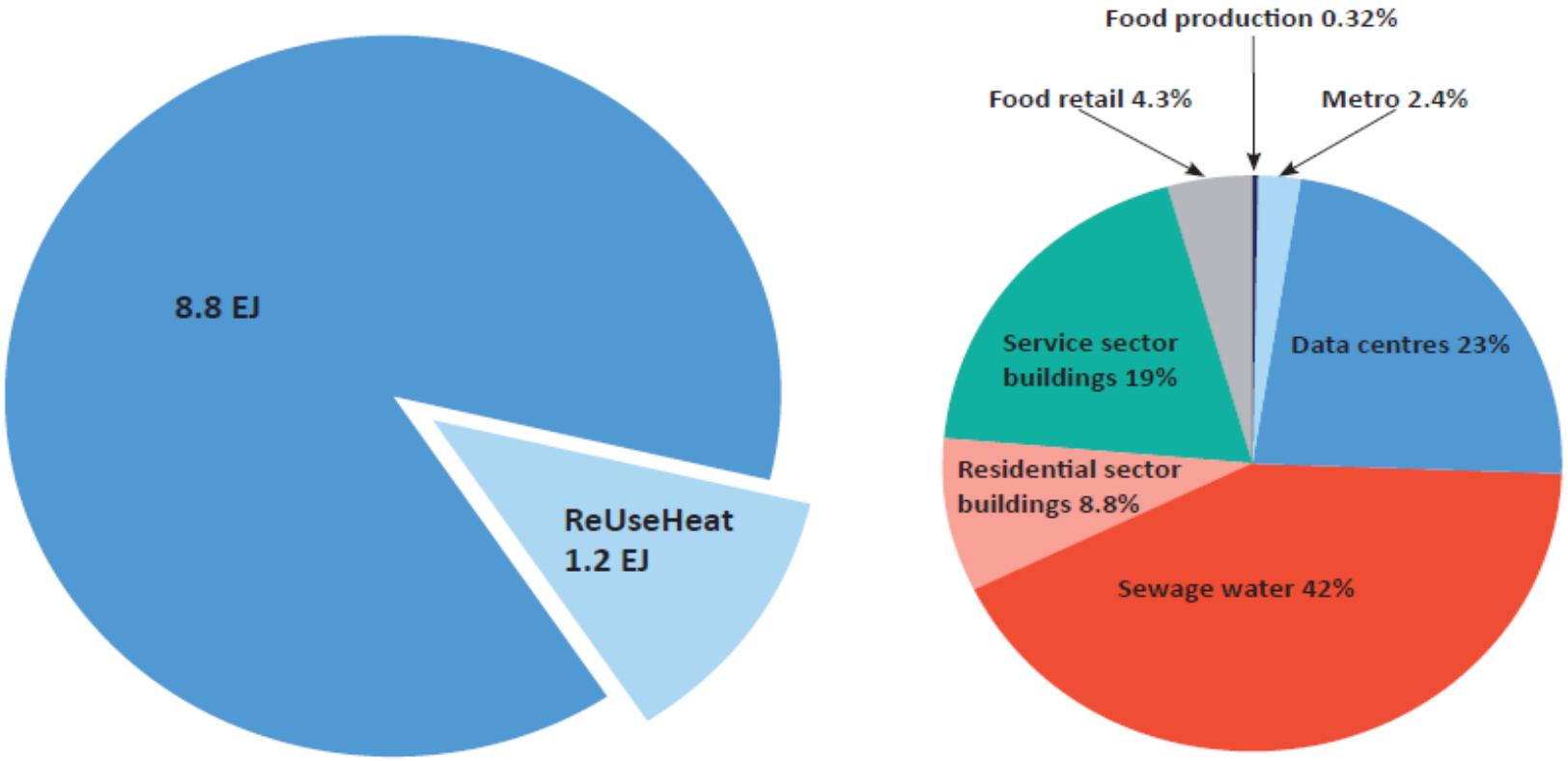


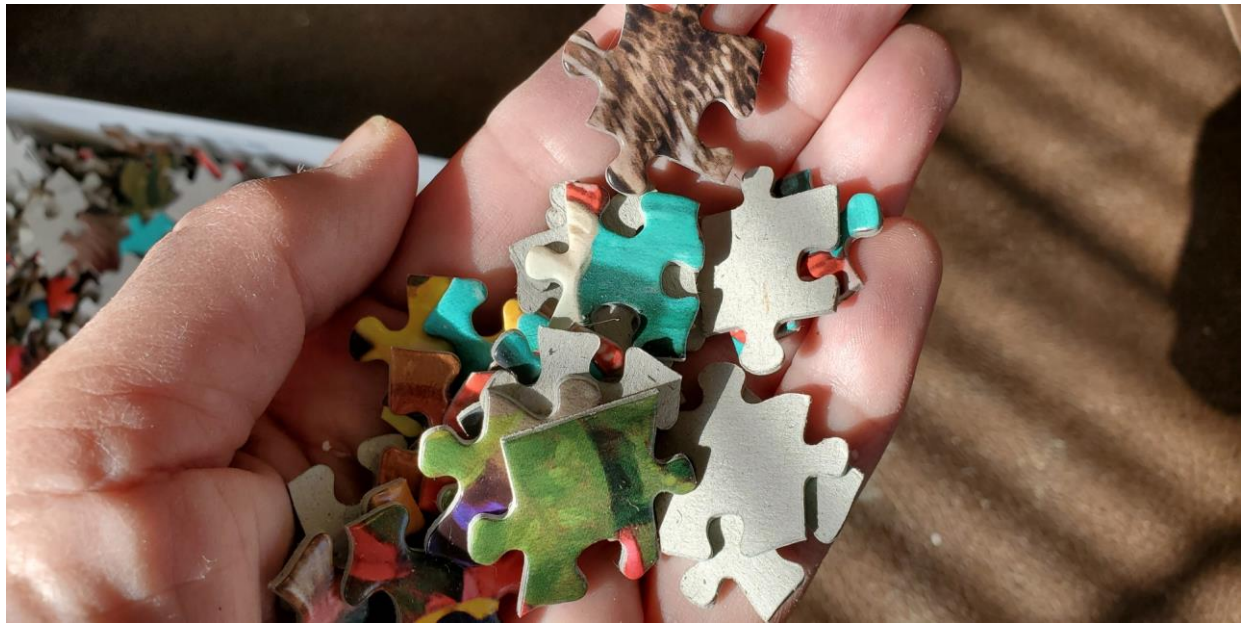
Figure 1. Low Temperature heat sources studied in ReUseHeat as a part of the European heat demand for buildings (left), further split to show the share of each low temperature source (right).

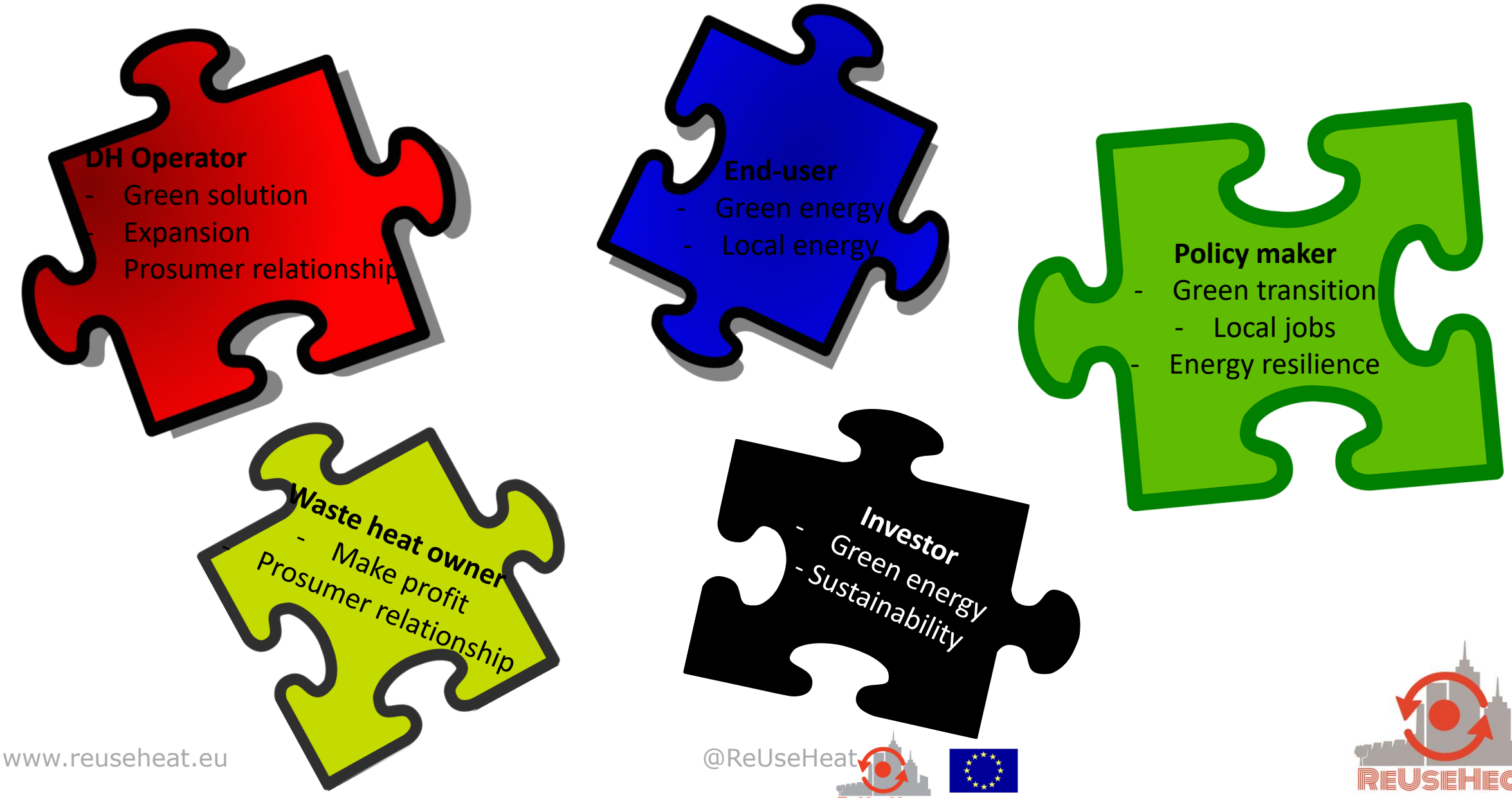
Agenda

1. The ReUseHeat vision
2. Urban waste heat potential
3. Stakeholder action needed
4. Demonstrators
5. Main learnings
6. After ReUseHeat: helping cities to meet long term goals

Stakeholders

- DH grid operators
- Owners of waste heat
- End-customers
- Policy makers
- Investors




DH Operator
- Green solution
- Expansion
- Prosumer relationship
End-user
- Green energy
- Local energy
Policy maker
- Green transition
- Local jobs
- Energy resilience
Waste heat owner
- Make profit
- Prosumer relationship
Investor
- Green energy
- Sustainability

Stakeholders

Interviews in 8 EU countries (76 respondents)- there are barriers

- Absence of legal framework for urban waste heat recovery
- Incentives for RES and CHP
- Absence of standardized contracts
- Diverging views on the value of heat
- Long payback periods
- Low technical maturity of existing solutions
- Low awareness about low temperature heat recovery

Stakeholders –and action needed

Interviews in 8 EU countries (76 respondents)- there are barriers

- Absence of legal framework for urban waste heat recovery
- Incentives for RES and CHP

Policy upgrades needed!

- Absence of standardized contracts
- Diverging views on the value of heat
- Long payback periods
- Low technical maturity of existing solutions
- Low awareness about the possibilty

Demonstration needed!

DH operator

Waste heat owner

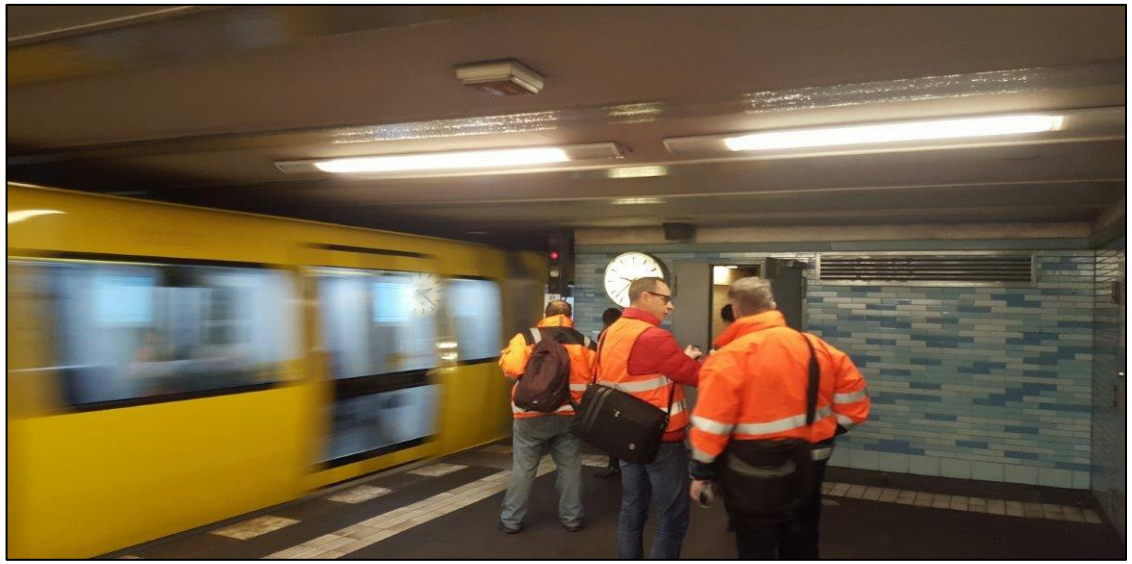
Investor

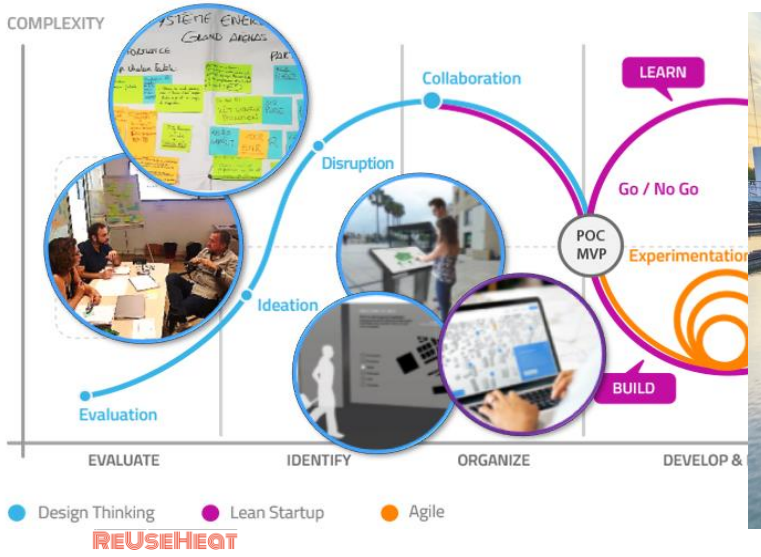
…to eventually trigger end-users

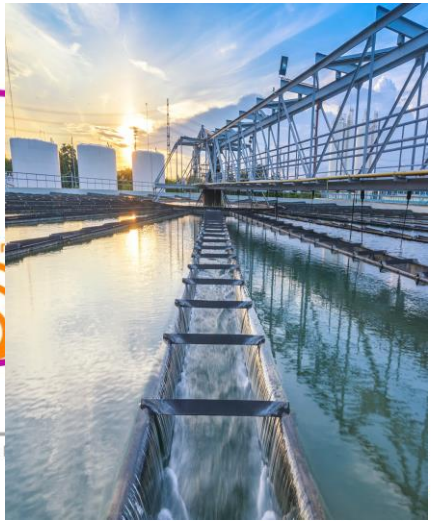
Agenda

1. The ReUseHeat vision
2. Urban waste heat potential
3. Stakeholder action needed
4. Demonstrators
5. Main learnings
6. After ReUseHeat: Helping cities to meet long term goals

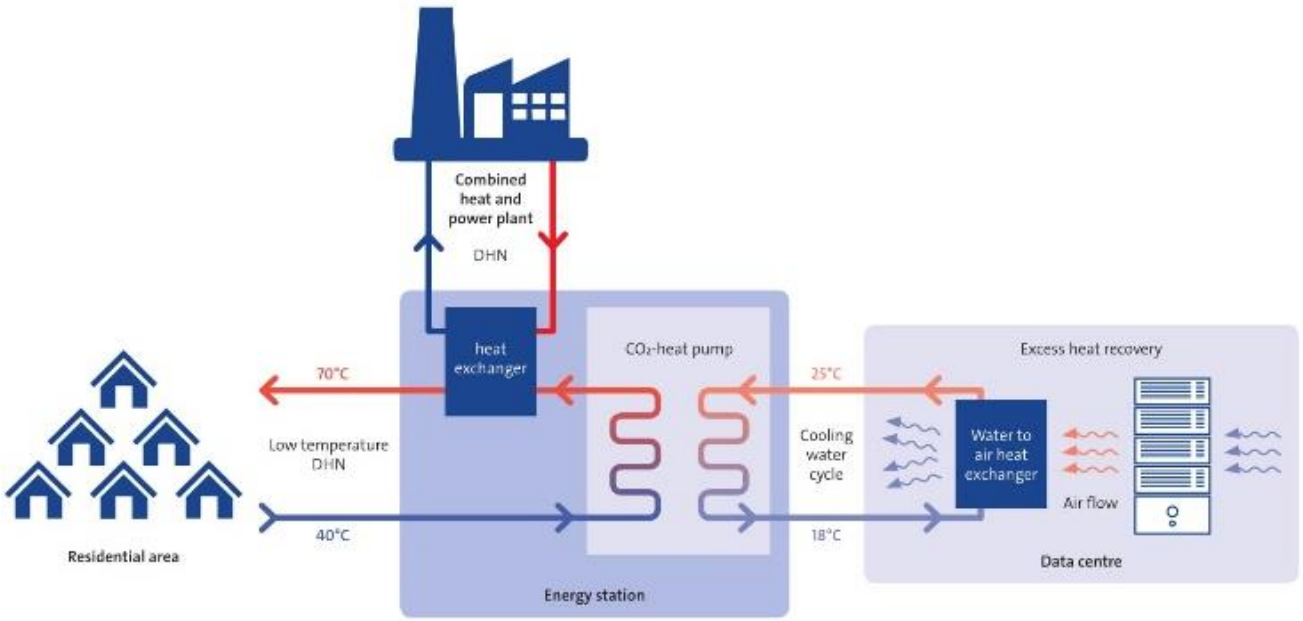
ReUseHeat- demonstration sites

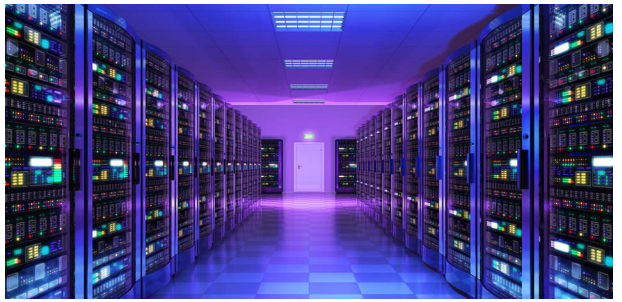






Different ways of collecting surplus heat





Datacenter

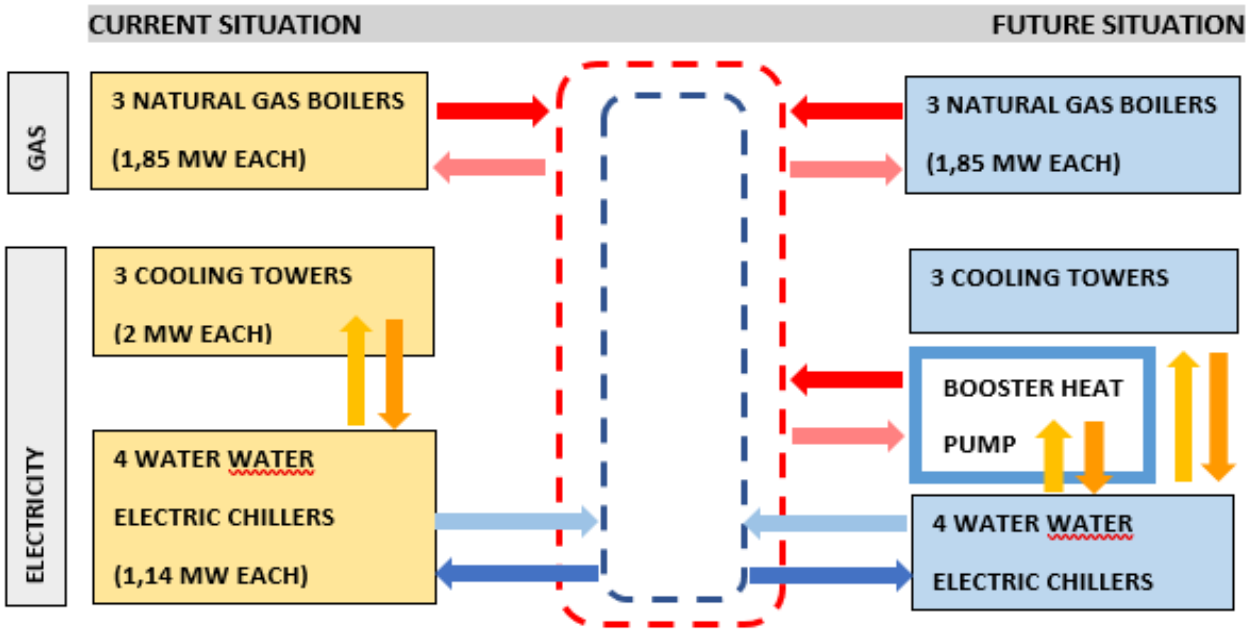
Heat source 25
Heat pump used to raise temperature to 70˚C
Heat and hot water to 400 new buildings (residential and shopping mall)
Link to existing DHN (high temperature) for mitigating risk

Different ways of collecting surplus heat

Performance (from handbook at www.reuseheat.eu)

Demonstration case	Impact	Intended Result	Achieved based on real monitoring period	Estimated values for a complete year
Data centre in Brunswick (Germany)	Heat supply [MWh/yr]	2, 300	345	Partial load: 903 Full load: 2 451
	Waste heat recovered [MWh/yr]	1 750	239	Partial load: 603 Full load: 1 660
	Electrical consumption according to moniotired data [MWh/yr]	580	106	Partial load: 300 Full load: 791
	Primary energy saved [MWh/yr]	1, 284	379	Partial load: 939 Full load: 2 602
	CO_2 emissions saved [tonnes/yr]	304	60	Partial load: 147 Full load: 412
	Simplified payback period [Years]	8	Not possible to be calculated	Partial load: 9.16 Full load: 3.05

Different ways of collecting surplus heat



Hospital

The demonstrator recovers low-temperature heat from the condensation circuit of the water-water electric chillers: 25-35˚C
Heat pump to raise the temperature to 50-55˚C

Different ways of collecting surplus heat

Performance (from handbook at www.reuseheat.eu)

Demonstration case	Impact	Intended Result	Achieved based on real monitoring period	Estimated values for a complete year
Hospital in Madrid (Spain)	Heat supply [MWh/yr]	770	1 888	2 704
	Waste heat recovered [MWh/yr]	532	1 227	1 751
	Electrical consumption [MWh/yr]	238	537	789
	Primary energy saved [MWh/yr]	554	3 213	3 768
	CO_2 emissions saved [tonnes/yr]	154	601	721
	Simplified payback period [Years]	15	Not possible to be calculated	1.87

Different ways of collecting surplus heat

2 concepts derived

Ernst Reuter Platz (Technical University)

+ proximity heat source and user

+ convenient placement of heat pump

Metro

Frankfurter Allée (Metro building)

- transmission pipeline needed source/ use

- heat pump between tracks

Different ways of collecting surplus heat

Lessons learned (from handbook at www.reuseheat.eu)

- The distance between the heat source and the heat user is an important barrier to the economic viability of waste heat recovery from the metro
- The permits needed for waste heat recovery can be time-consuming to acquire when waste heat recovery experience is limited.
- Waste heat recovery is not the top priority of metro organisations nor of large energy companies, which makes the decision-making process difficult and slow
- Defining the limits of the waste heat recovery system takes time and knowledge and, to be efficient, several stakeholders need to work simultaneously to understand the limitations.
- Recovering heat from the tunnel can be difficult if it needs to account for the safety regulations of the metro operation
- Recovering heat from a metro tunnel necessitates the management of metal dust in the air.
- The ReUseHeat solution has the advantage of being highly modular and scalable. In a system where one ReUseHeat recovery unit is installed, it should be easy to scale up the number of heat recovery units.
- The surrounding soil conditions of a metro system will affect how warm the system is during Winter and Summer and its need for heating and cooling.
- The best stage to consider metro heat recovery is most likely when designing new tracks or stations so it can be a built-in

Different ways of collecting surplus heat

How can awareness be created?

- Cities inform the citizens (ReUseHeat)
- Waste heat recovery is made standard
  - requested in building processes
  - make standard in public procurement
  - define what urban waste heat recovery is (=RES)

Water- Awareness

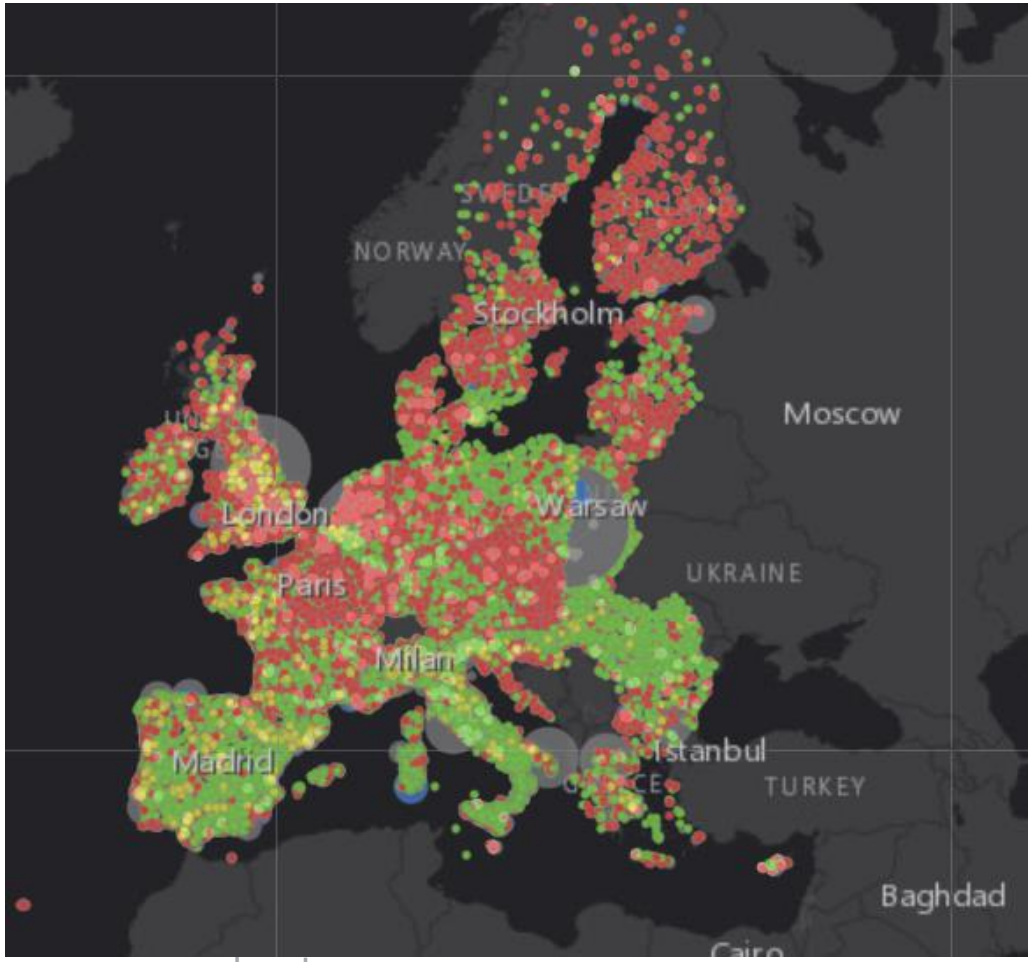
…demand will increase (end-user), construction companies, energy companies

Different ways of collecting surplus heat

Lessons learned (from handbook at www.reuseheat.eu)

- To create awareness information must be focused on making the technology understandable and to explain its advantages in the simplest way possible, in terms of language and form of used media
- Data are not valuable if not contextualized via graphics or other contextual elements that users can relate to
- The Design Thinking approach for building a suitable MVP, based on a Wireframe model, tested via an Agile method end-user' feedback, and finally build the products and undergo the measuring and qualification of the products under real conditions, has been validated as an efficient methodology
- The development of a dashboard system, necessitates a review of data management and availability of, for example the DHCN
- Through the exchanges in ReUseHeat, a cross fertilization has taken place, where faults in data were detected and removed

Further awareness creation: map



https://aau.maps.arcgis.com/apps/webappviewer/index.html?id=789b7faef30148bda20d320de9455919

Agenda

1. The ReUseHeat vision
2. Urban waste heat potential
3. Stakeholder action needed
4. Demonstrators
5. Main learnings
6. After ReUseHeat: Helping cities to meet long term goals

Main learnings

Technology is not the main stopper of urban waste heat recovery. Rather, it is the low level of maturity amongst necessary stakeholders to realize the opportunity, to identify who to collaborate with and how.

Main learnings

Urban waste heat recovery investments have features that will be standard in the future energy system.

They, for example, make use of locally available heat sources without any combustion.

Main learnings

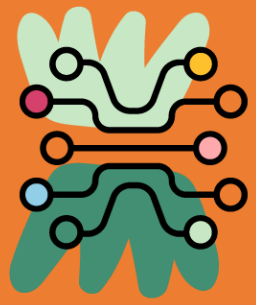
Waste heat is mentioned and encouraged but important pieces of regulation are missing for derisking the investments and for creating a demand of waste heat recovery solutions as early as in the construction phase of buildings.

The problem is there for waste heat recovery in general but even more pronounced for urban waste heat since it is a largely unknown possibility.

Agenda

1. The ReUseHeat vision
2. Urban waste heat potential
3. Stakeholder action needed
4. Demonstrators
5. Main learnings
6. After ReUseHeat: Helping cities to meet long term goals

USEK KNOWLEDGE TO MAKE EFFICIENT DECISIONS



We find the optimal technol-economic solutions to reach your goals.

Model

The city is modelled in close collaboration with the costumer.

RESEACH

Validate goal achievement

We ensure an efficient economic plan and can help establish contact to investors.

Taxonomy Green Deal

You get a full implementation plan and can start roll out sustainable district heating and cooling.

TEN21®

Input data

Current infrastructure such as commercial and residential buildings, transmission grid...

Heating and cooling resources

Climate targets, taxes & subsidies

Technology catalogue

THE MODEL

Finding an optimal path to a green future...

Results

per year, sector and area

The mix of heating and cooling technology

Generation and storage capacities

Energy use per sector

Costs: Total system cost, running cost, and investment costs

Greenhouse gas emissions

Assumptions

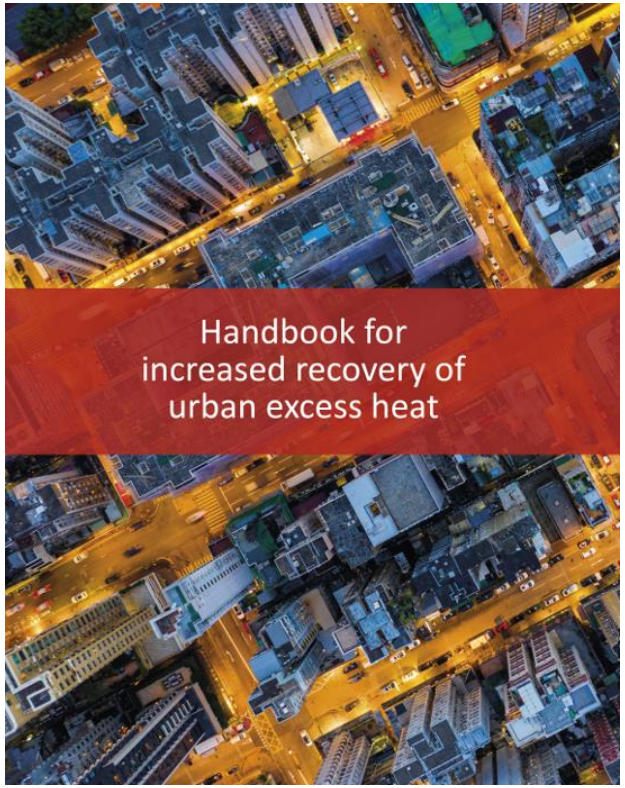
Heating and cooling demand projections

Energy price projections

Environmental assumptions

TEN21

Thank you for listening!



Handbook avaliable online
www.reuseheat.eu

Decision support avaliable at
www.ten21.eu