DTU

Excess Heat as a Sustainable Energy Source for District Heating: A Multi-Stakeholder Perspective.

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Background

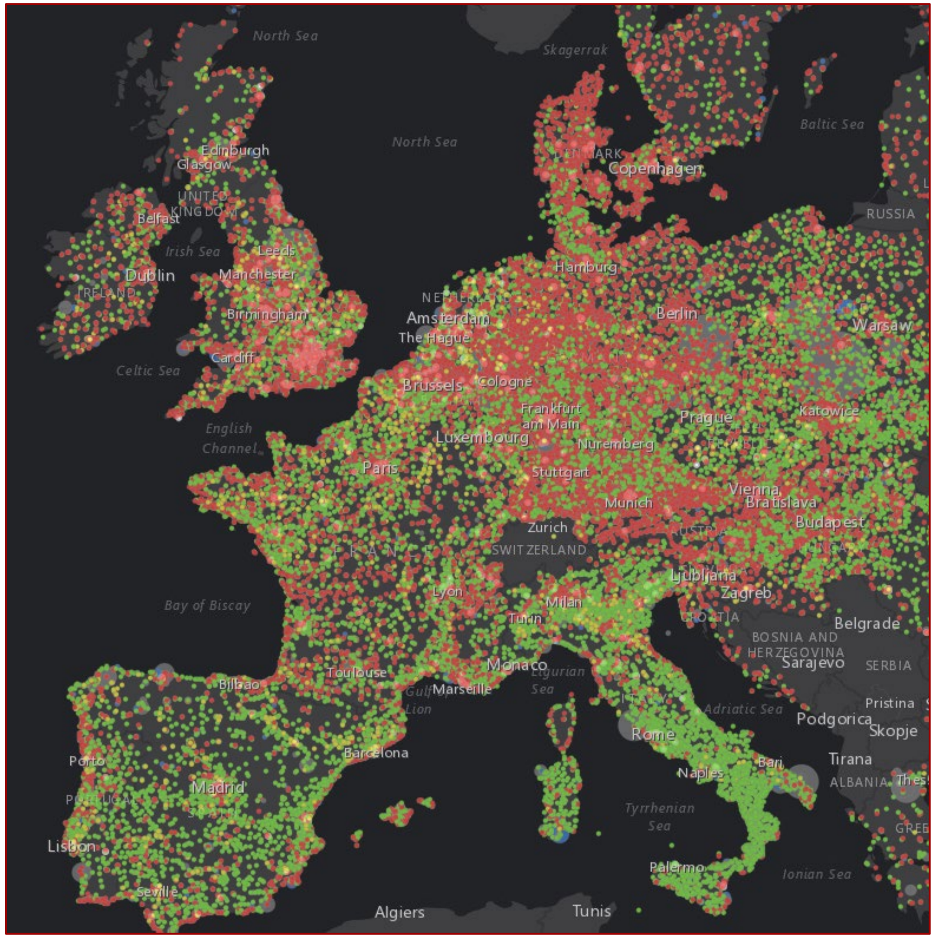
Recapturing excess heat could power most of Europe, say experts

Preventing heat waste largely being ignored as solution to energy crisis, say environmental campaigners

A data centre in France. Such energy-intensive facilities are deemed prime candidates for heat recycling. Photograph: Clement Mahoudeau/AFP/Getty Images

Guardian article:

[Recapturing excess heat could power most of Europe, say experts | Energy efficiency | The Guardian]



Reuse heat project [Waste Heat Map - ReUseHeat]

Background

- Many benefits of excess heat…

- But barriers remains to its wide-scape adaptation. The important ones are:
  a) lack of awareness
  b) complicated negotiations between industry and heating utility; mostly on price of heat, as there are different perception of heat
  c) Who to invest and how much?

- Often ownership structure is referred as public-private partnership (for DH in general)
- Multiple studies mention it but no thorough understanding.

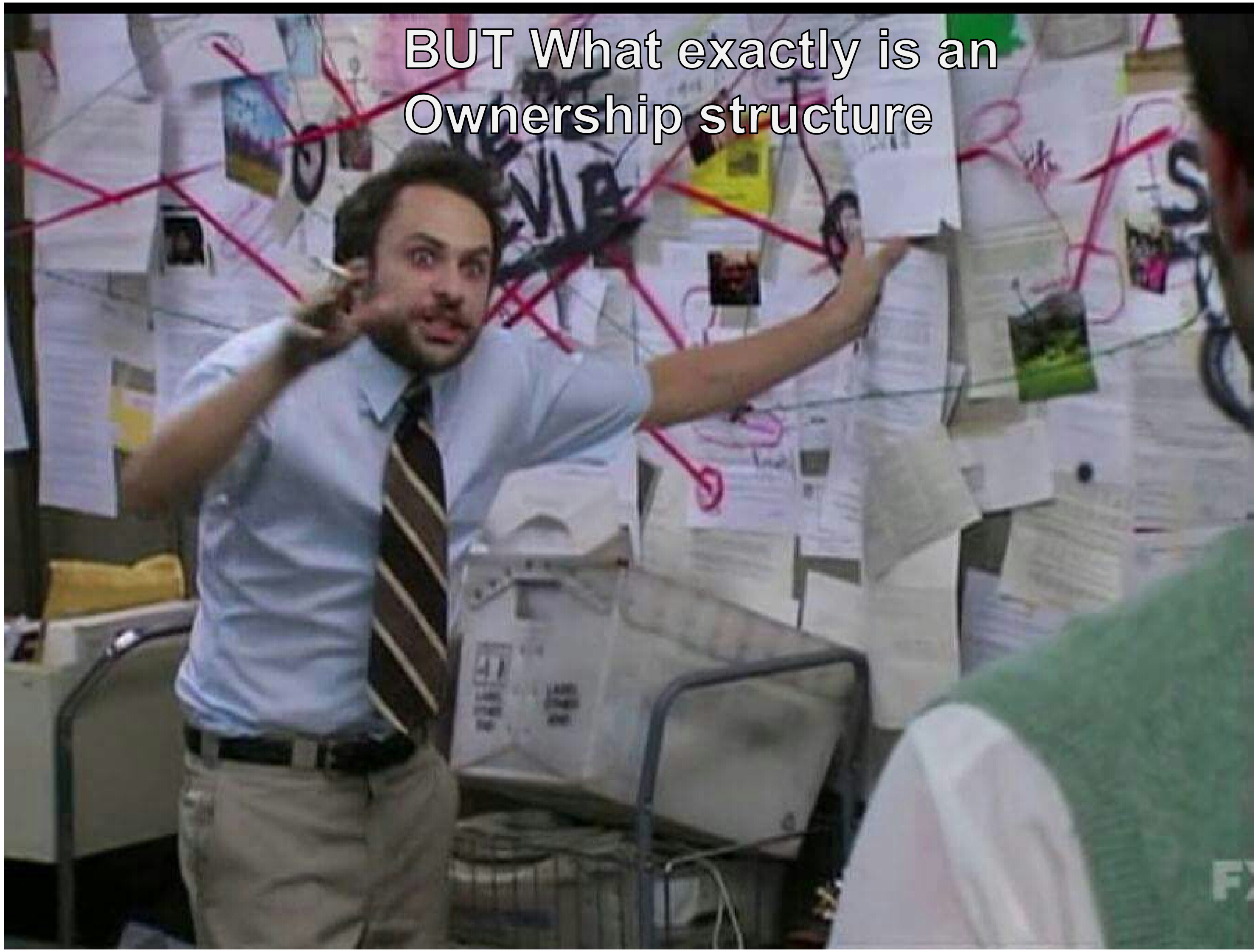
Objective

"To quantify the impact of different ownership structures on the business model of different actors/stakeholders involved in the EH utilization project."

HOW:

We consider a multi-stakeholder perspective by calculating the financial profitability of each stakeholder.

- Net present value - NPV
- Internal rate of return - IRR
- Payback period
- Levelized cost of heat - LCOH


BUT What exactly is an
Ownership structure

Ownership structures

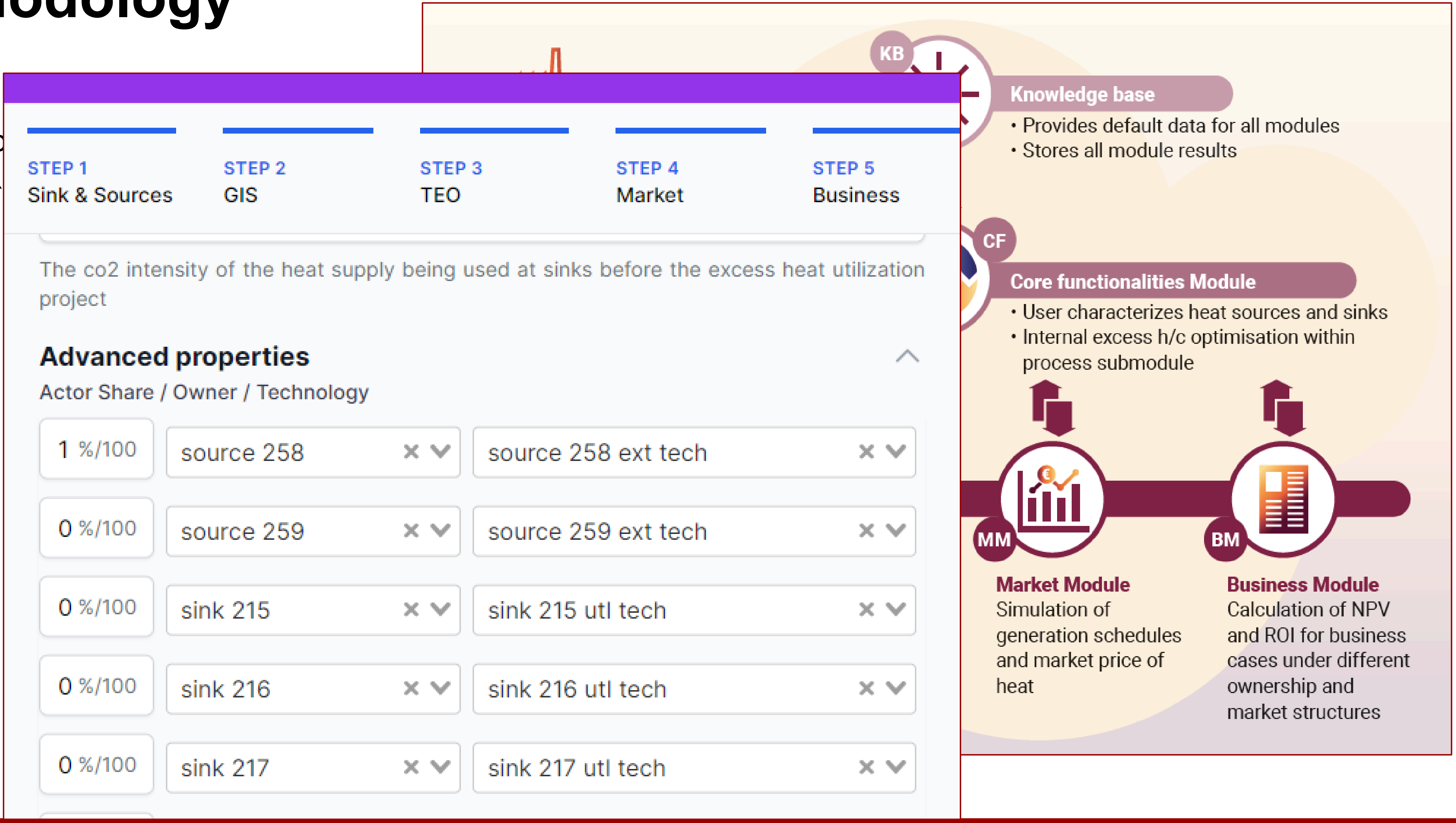
- ❑Technology ownership structure
  - Who will own the technologies needed for excess heat utilization?
    - » Investment in CAPEX and OPEX
    - » Optimal technologies from TEO output

- ❑Grid ownership structure
  - Who will own or invest in heat distribution grid?
    - » Also, possible to invest in certain share of grid
    - » GIS output

These will have an impact on the finances of the stakeholders involved.

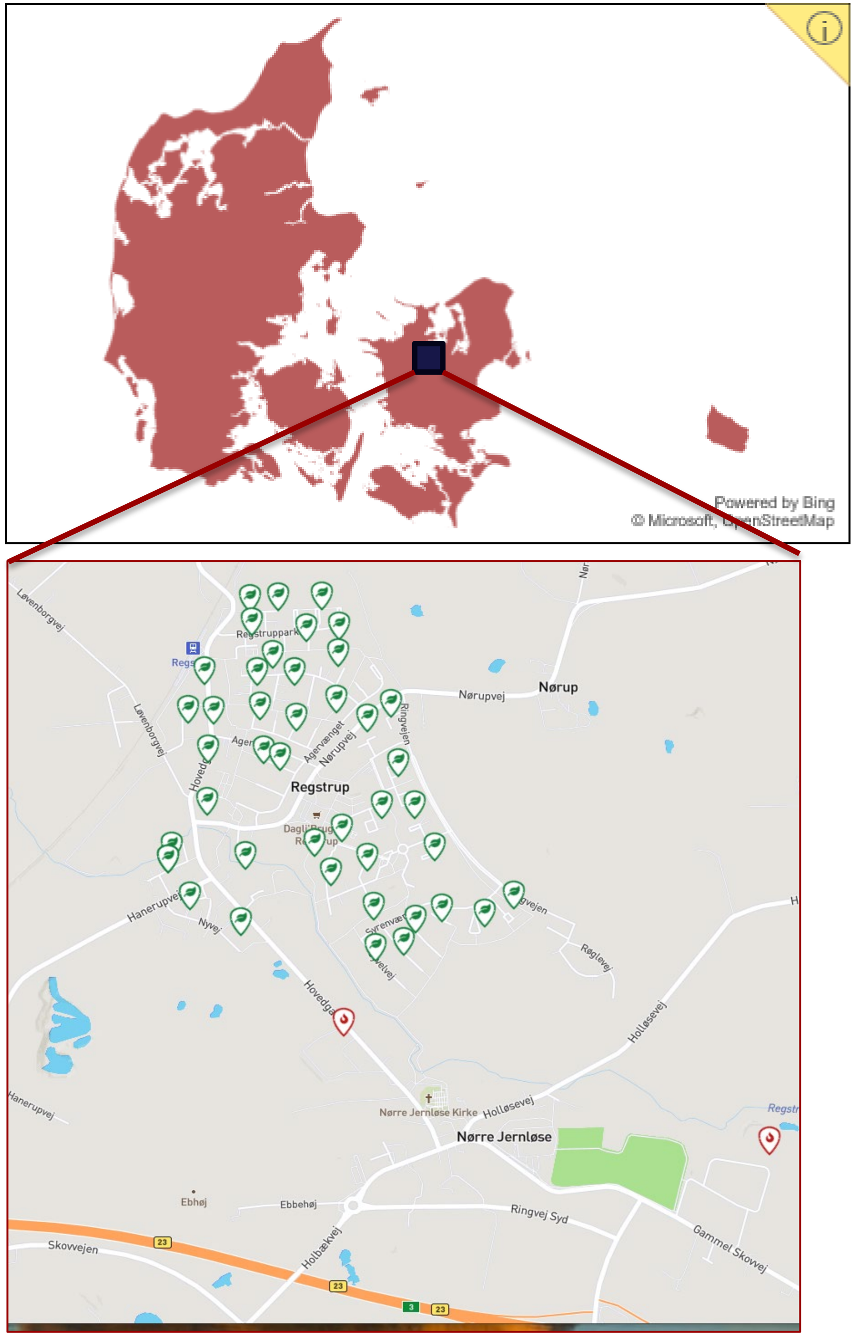
Methodology

Leverage the power c
framework of EMB3R



Case Study

- Regstrup Town in Holbæk Kommune, Denmark
- Population: 2000 inhabitants
- Annual heat demand: 23 GWh (estimated)
- About 500 houses
- Mostly natural gas based Individual heating
  - – present crisis has forced them to look for alternative
- Two excess heat sources
  - – 1) Schoeller Plast
  - – 2) Super frost



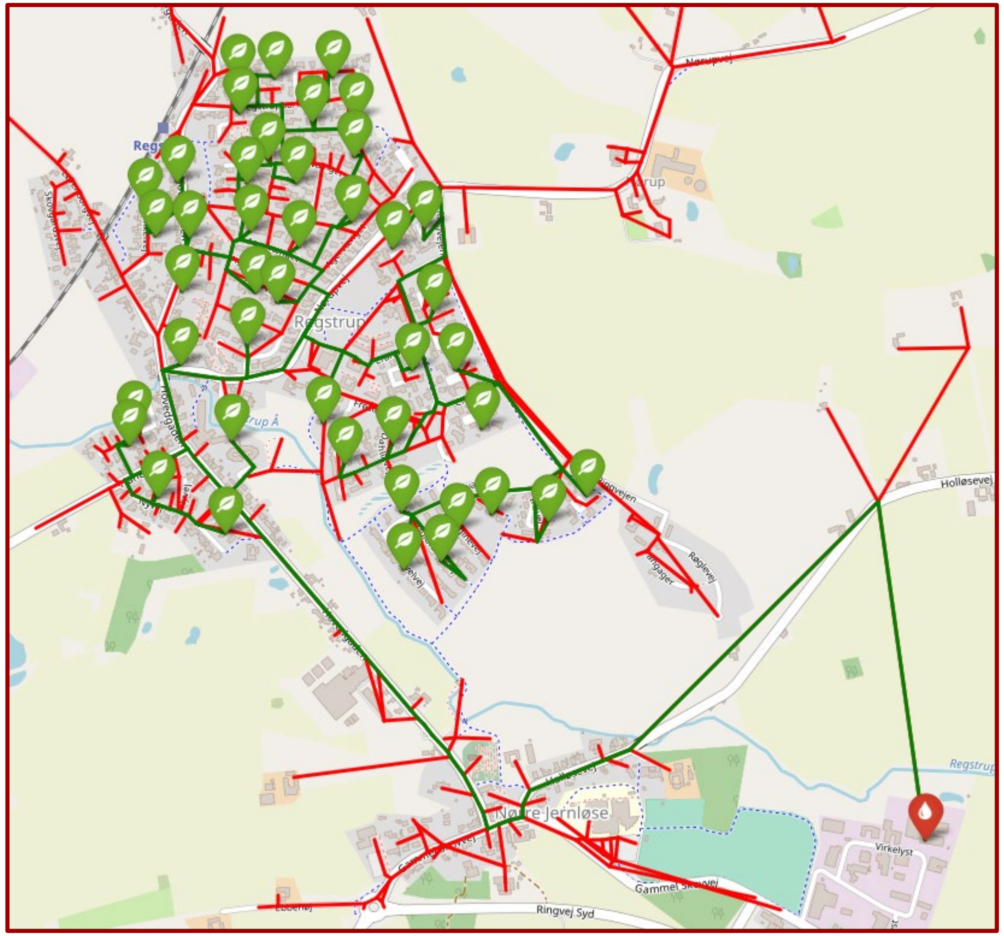
Scenarios for ownership structure

- Three ownership structures are evaluated:

Scenario Name	Technologies	Heating Gird
1. Source	Source	Source
2. Sinks	Sinks	Sinks
3. Shared*	Each source & sink own their technology	Equally shared among all sources & sinks

- Note: Source is a commercial entity (industry with excess heat) & Sinks represent end consumers.
- * Overall, sinks take on more burden of the grid as there are 43 sinks.

Results – Grid & Optimal technologies



TECHNOLOGY	Installed capacity (MW)	CAPEX (Million €)	Annual heat generation (GWh)	Length (km)	Total thermal loss (MW)
Grid	2.7	16.5		31.32	0.5
Super Frost Heat Pump	0.08	0.02	0.032	--	--
Super Frost Natural Gas Heat Recovery Boiler	2.6	1.36	22.1	--	--

Grid has significant cost

Results – Overall project finances

IRR - with grid cost (%)	IRR - without grid cost (%)	Payback period (years) - with grid cost	Payback period (years) - without grid cost
8	310	9.4	0.3

9.4 years payback could be quite acceptable for public entity but may not be the case for a commercial entity.

Results – Ownership structures impact on Source

Ownership structure	IRR - with grid (%)	IRR - without grid (&)	Payback - with grid	Payback - without grid
Source	-1	132	22.16	0.759
Sinks	inf	inf	--	--
Shared	81	133	1.237	0.751

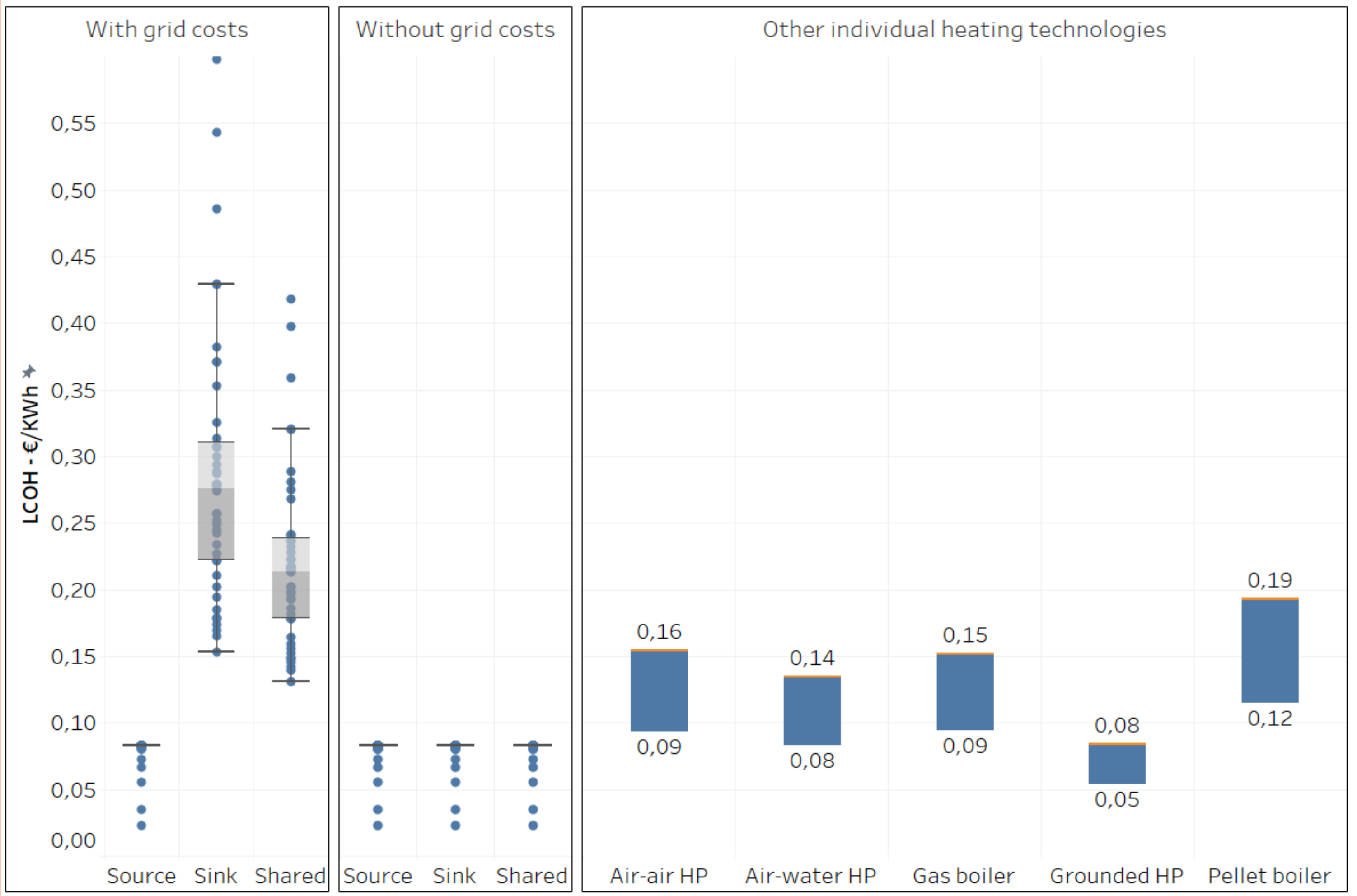
Source: Not so good for source to invest in all the technologies. However, if grid cost is excluded there is a strong business case.

Sinks: No investment by source, but sells excess heat - best case scenario

Shared: Also, a very good business case for the source.

Results – Ownership structures impact on Sinks

- When grid cost is not bear by the sinks, their LCOH is the lowest.
- Physically not quite possible for each house to install its own ground sourced HP.
- Shared ownership structure could be further investigated by allocating more cost to the source.



Conclusion

- Shred ownership structure can be modified to allocate more cost to the source.
- Grid has significant cost – Thus, public financing are quite important.
- Overall project finances shows a potential for profitable business case.
- More cost allocation to source or public funding of the grid cost.

Thanks