ENGINEERING
TOMORROW

Heat Recovery in Supermarkets and Industry

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Excess heat feeding into the district heating network

The calculation methodoligies are used on a Supermarket case and a Brickyard

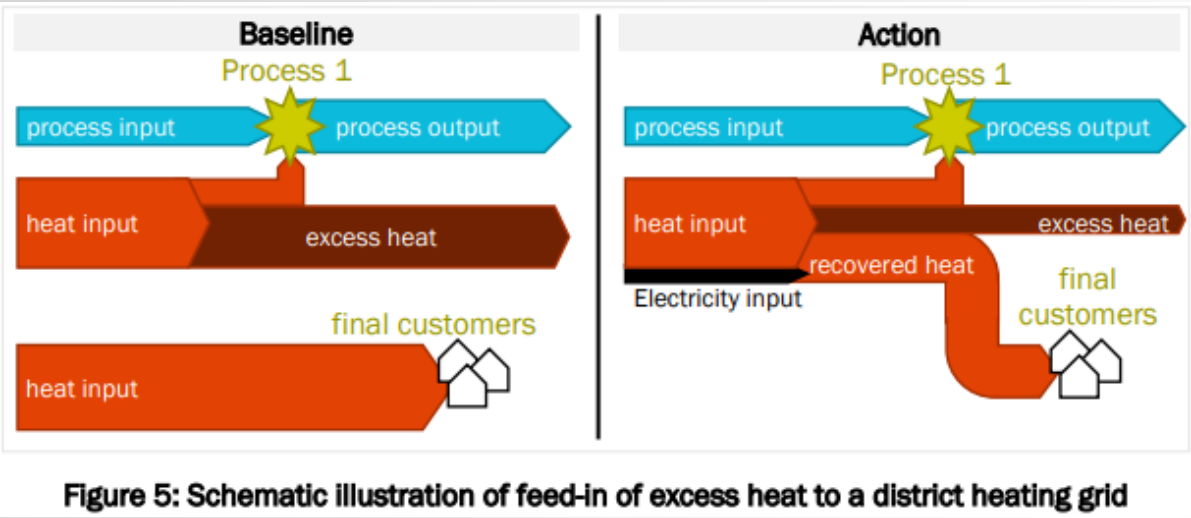


Figure 5: Schematic illustration of feed-in of excess heat to a district heating grid

Final energy savings at end customers:

$$TFES = Q_{EH} \cdot (1 - HL_{DHG}) \cdot \left(\frac{1}{eff_{Baseline}} - \frac{1}{eff_{Action}}\right) \cdot (1 - f_{ei}) \cdot (1 - f_{BEH})$$

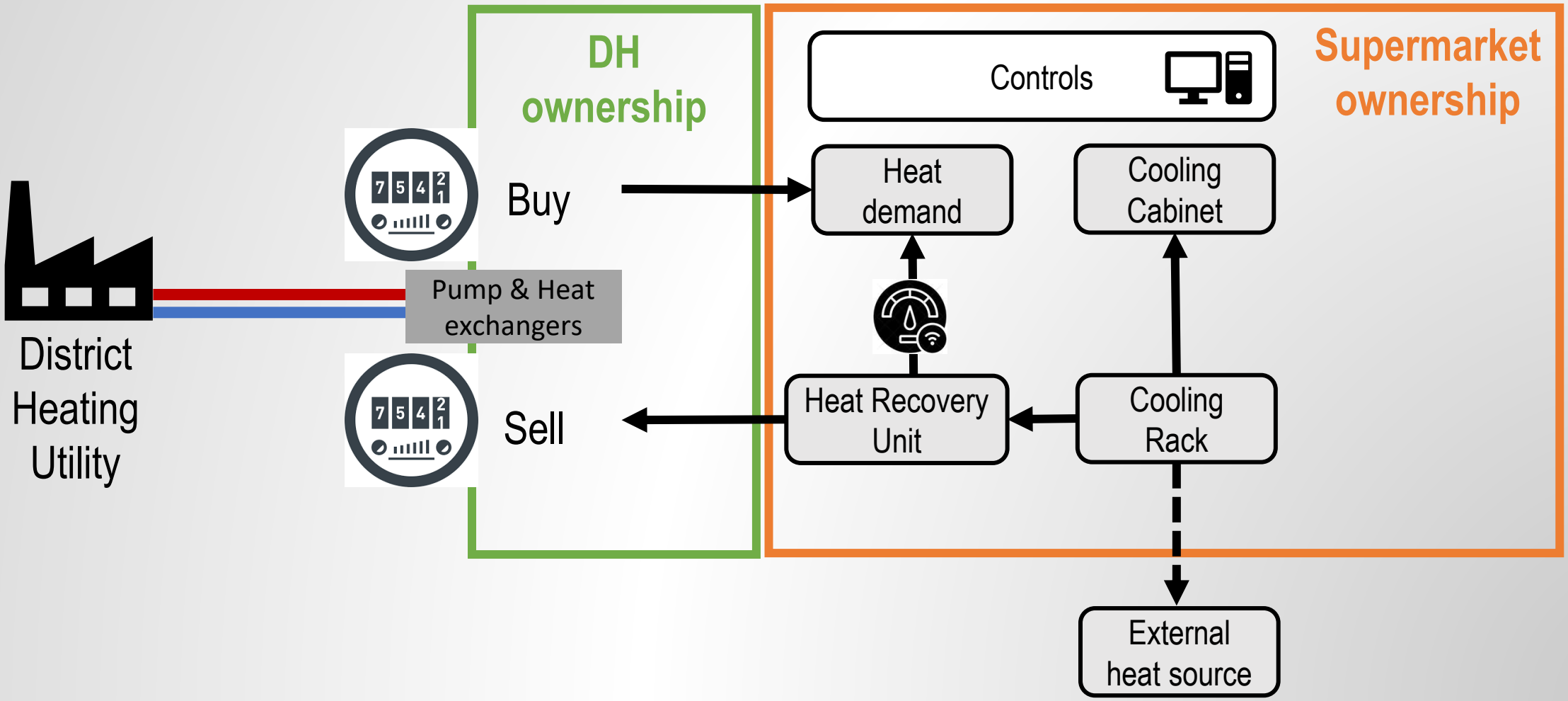
TFES	Total final energy savings [kWh/a]
Q_{EH}	Excess heat fed into the district heating grid [kWh/a]
HL_{DHG}	Heat losses in the district heating grid [dmnl]
$eff_{Baseline}$	Conversion efficiency of the reference heating systems [dmnl]
eff_{Action}	Conversion efficiency of the district heat consuming heating systems [dmnl]
f_{ei}	Factor to calculate extrinsic incentives [dmnl]
f_{BEH}	Factor to calculate rebound effects [dmnl]

Effect on primary energy consumption at end customers:

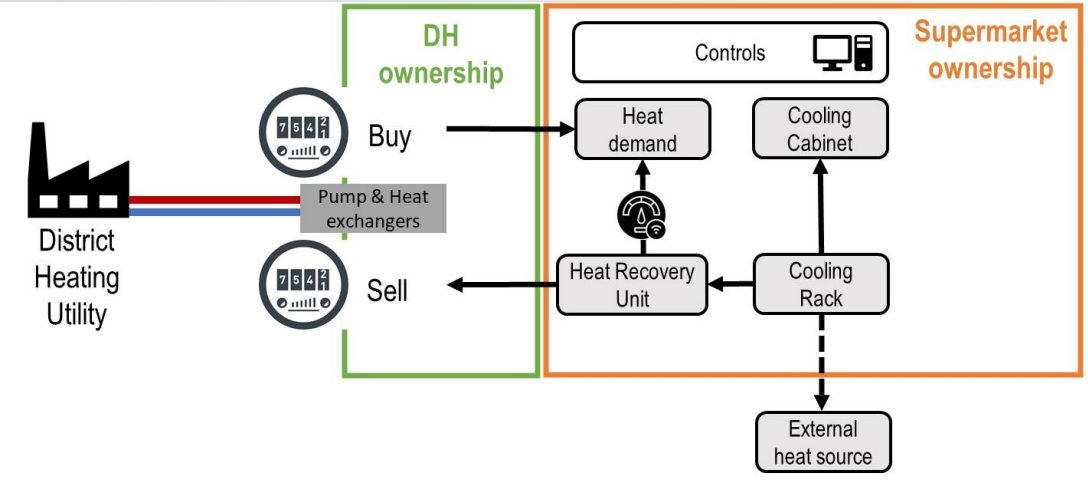
$$EPEC = Q_{EH} \cdot (1 - HL_{DHG}) \cdot f_{PE}$$

EPEC	Effect on primary energy consumption [kWh/a]
Q_{EH}	Excess heat fed into the district heating grid [kWh/a]
HL_{DHG}	Heat losses in the district heating grid [dmnl]
f_{PE}	Primary energy factor of the reference heating system [dmnl]

The outline of a ‘prosumer’ supermarket in Denmark



The EU perspective of aggregating Supermarkets



Technologies are developed and ROI is always below 3 years:

In operation : 150 supermarkets

12 month outlook : 200 new installations

Number of supermarkets in the EU : 230.000

Basic Excess Heat generation : 30 TWH/a

TFES = 0,11*30 = 3,3 TWH/a
EPEC = 0,90*30 = 27 TWH/a

Potential Heat Pump operation : 70 TWH/a

$EPEC = EPEC_{gas} - EPEC_{el} = 10$ TWH/a

$EPEC_{gas} = (1\text{-}DHL)*PEF_{gas}*Q_{EH} = 0,90*70 = 63$ TWH/a (gas)
$EPEC_{el} = PEF_{el}*Q_{EH}/COP = 2,28*70/3 = 53$ TWH/a

Local PEF for Wind based elecricity can reduce $EPEC_{el}$

Specific state of the art Case

SuperBrugsen in city of Augustenborg:

- **All** internal heating demands are covered and the heating bill reduced from 13.500 to 1.350 €/a

- 15 family dwellings are additionally heated by DH with heat from the supermarket

Brickyards are obvious sources of Excess Heat

- Situated in Graasten Denmark
- MW of (gas fired) heat consumed for owens and to dry the bricks
- District Heating will be connected to the facility in 2024
- DH feed of heat usage from flue gas and air compressors
- Most recovered heat needs upgrading from heat pumps

Heat recovery from this brickyard is equivalent to the potential of 20 supermakets

Principles for heat recovery