



The heat pump case

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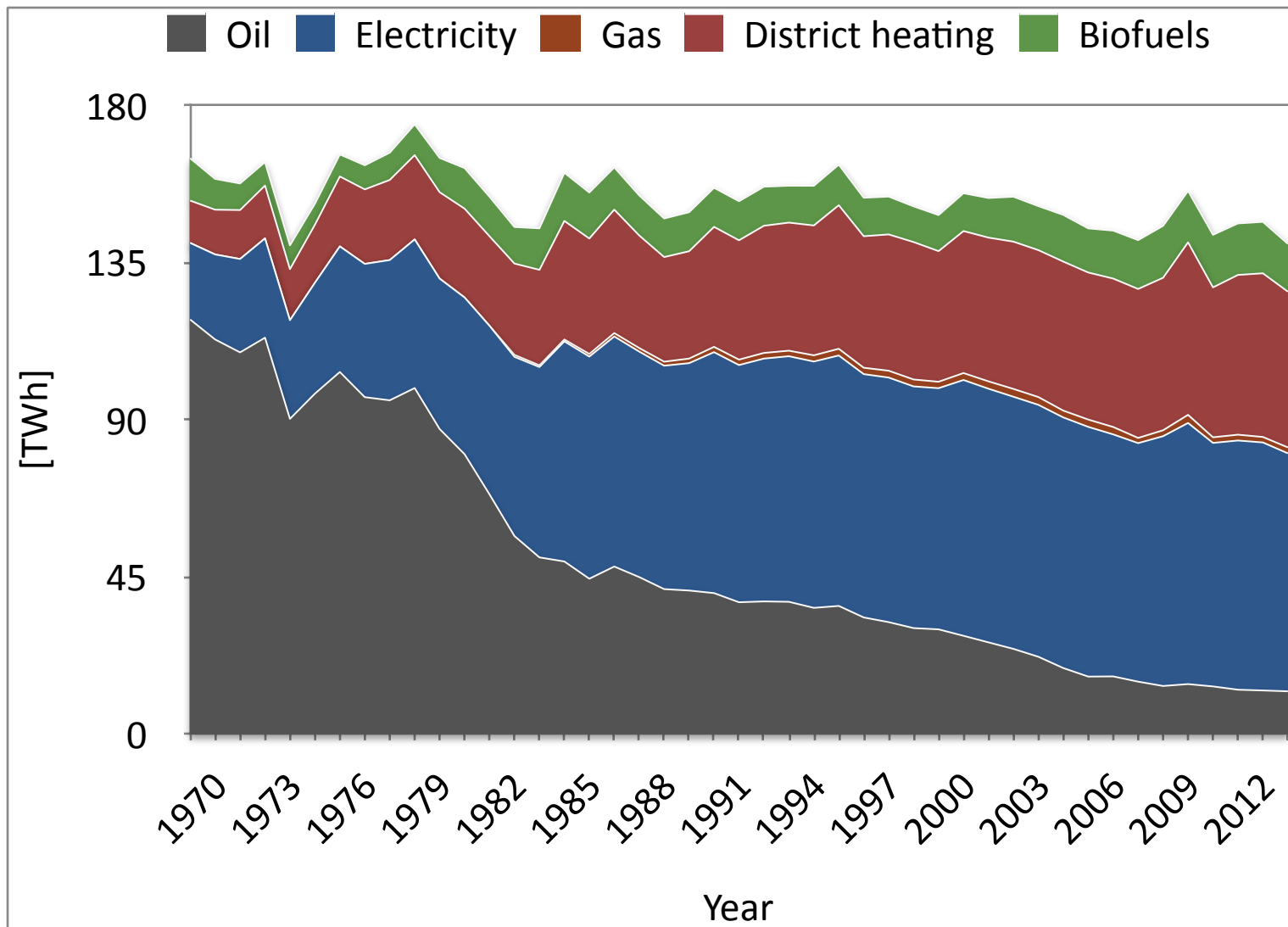
**Buildings account
for 36 % of CO₂
emissions in the EU
(39% in the US)**

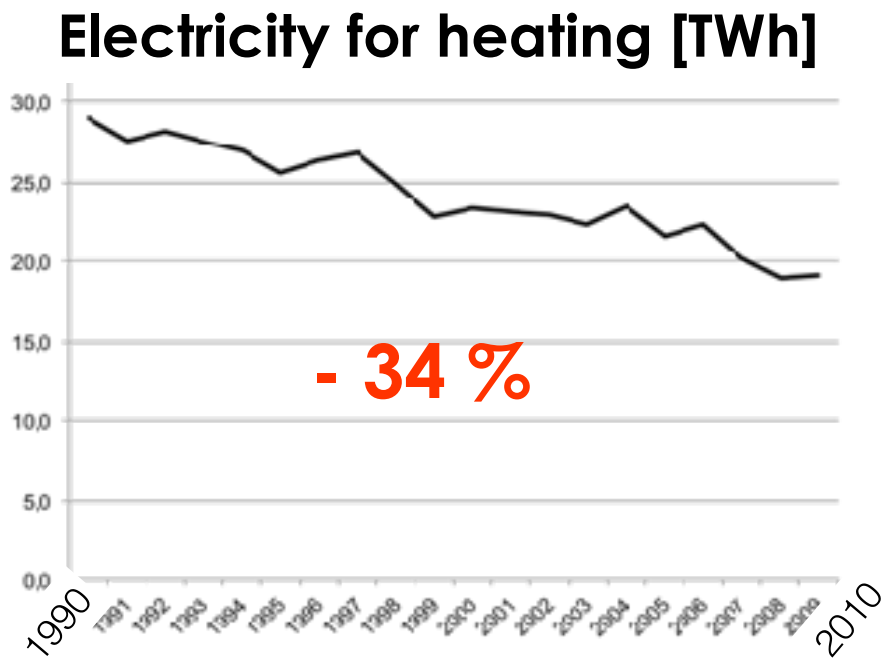
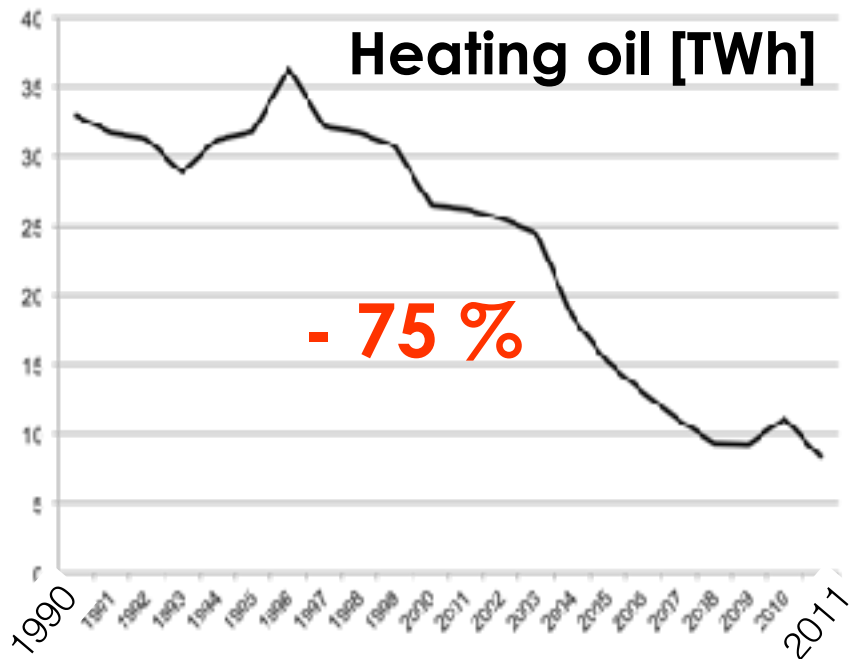
"Renewable energy's next frontier: heat"

"...unlike power or transportation, heat remains widely under-served by renewable sources of energy."

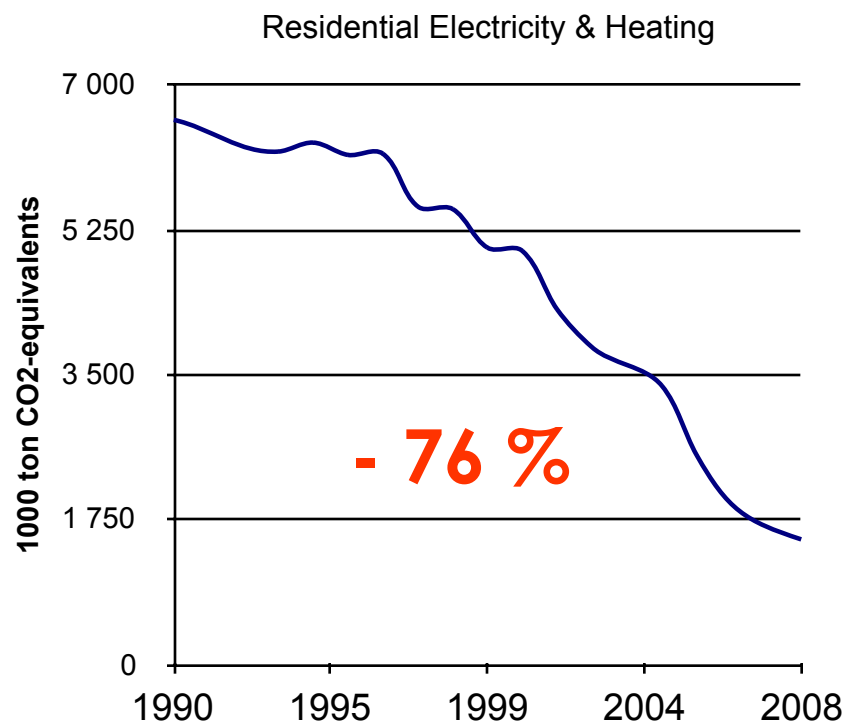
– IEA, 2016

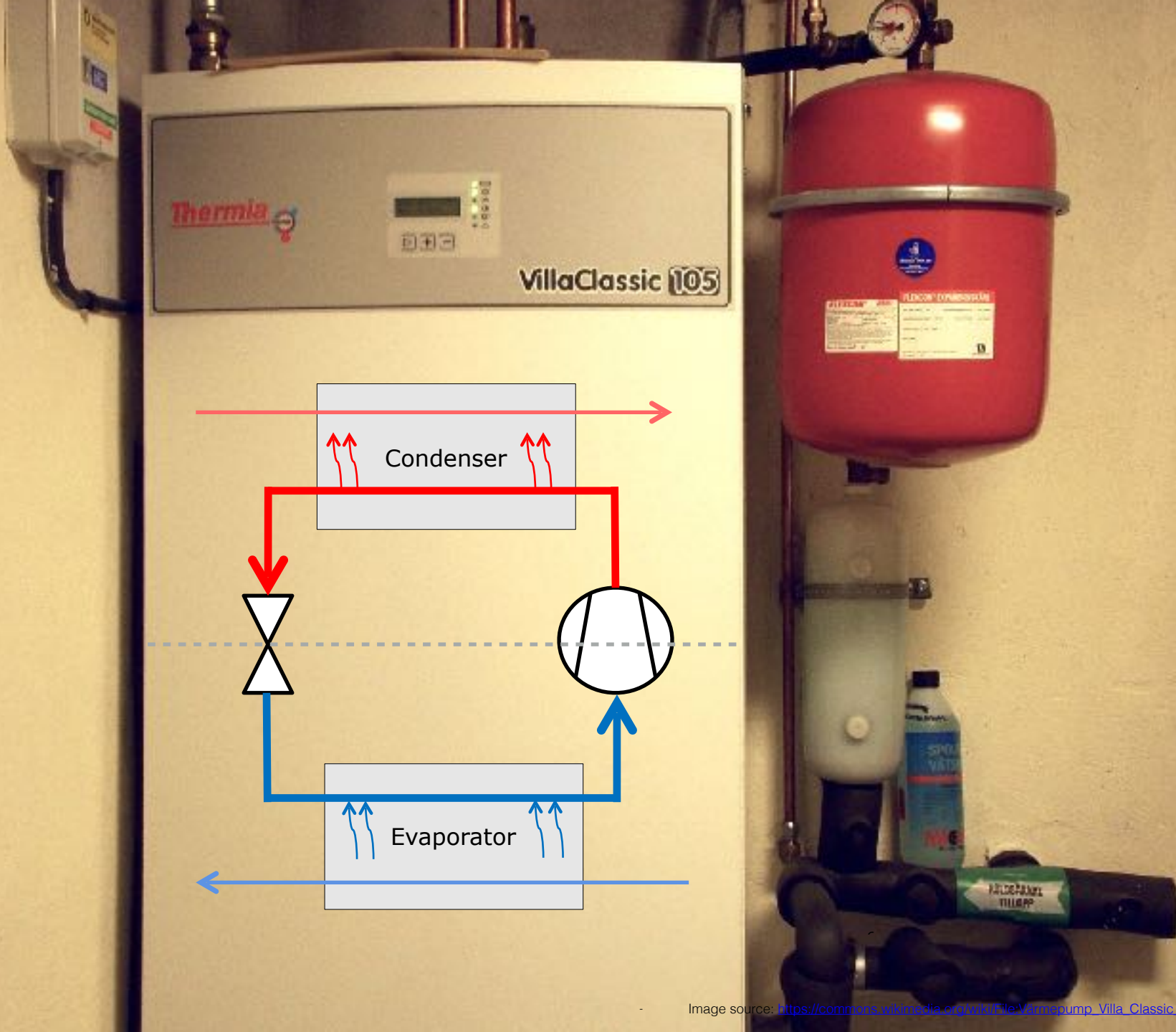
Final energy usage in housing and service sector, per energy carrier, from 1970 to 2014 [TWh]





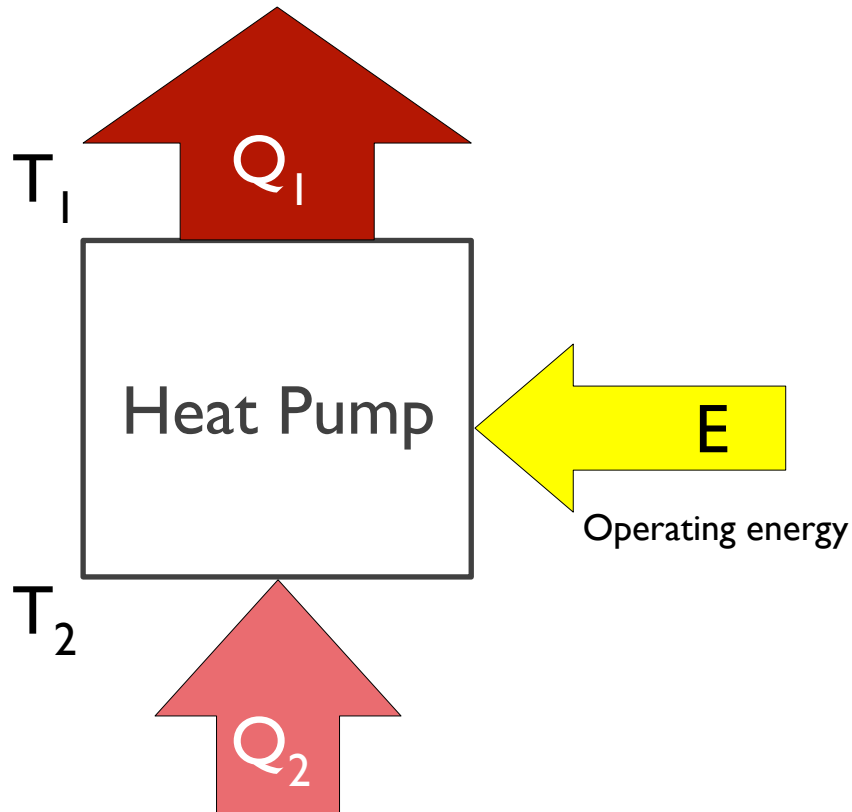
Greenhouse gas emissions from buildings





Heat pump – the technology

High temperature
to heat sink



$$Q_1 = Q_2 + E$$

$$\text{COP} = Q_1 / E$$

Heat pump heat sources

Air



Water

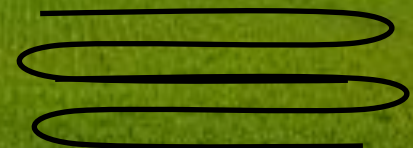


Ground

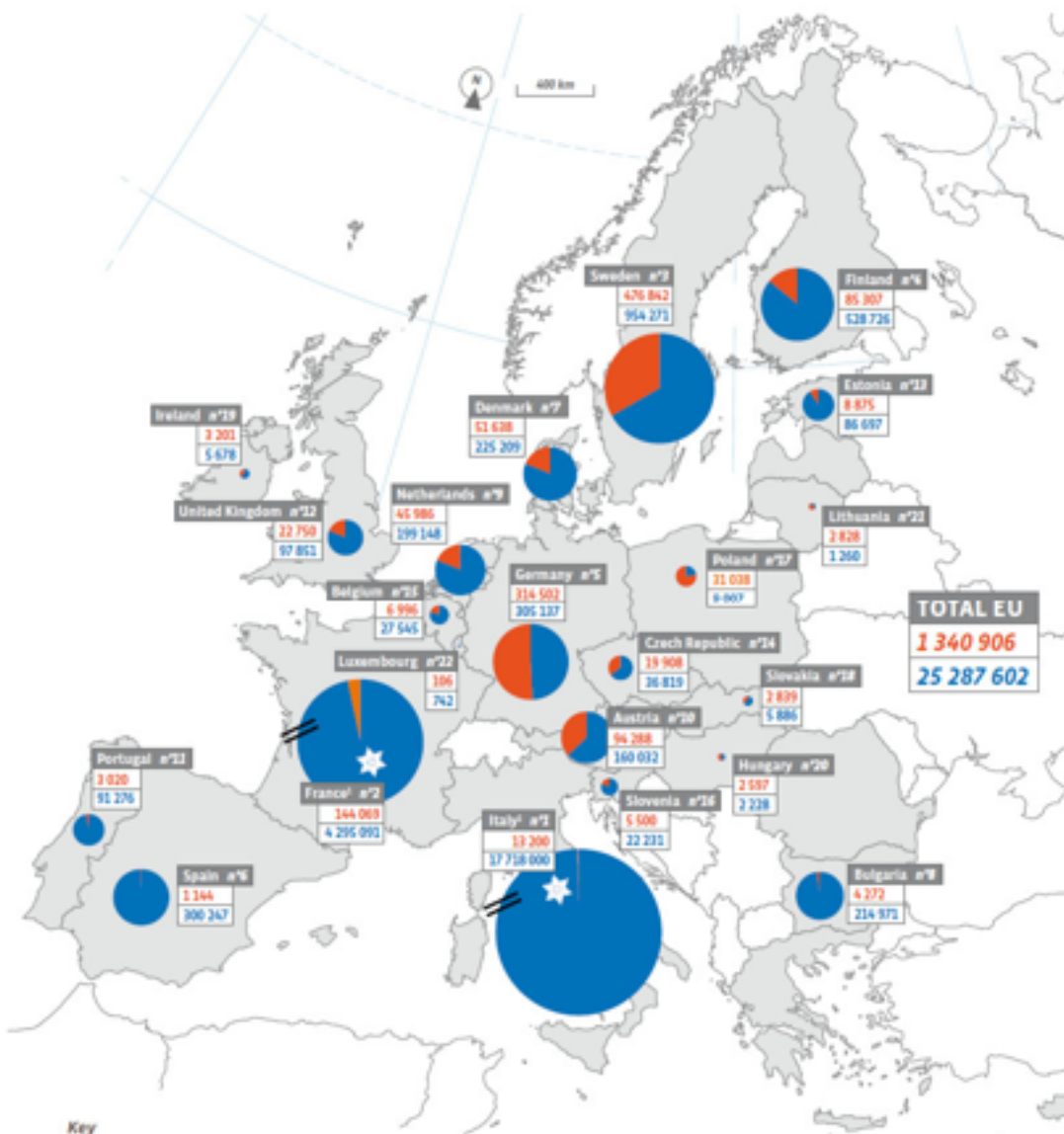
- Vertical



- Horizontal



Aerothermal and geothermal heat pump park in function in European Union in 2014 (installed units).

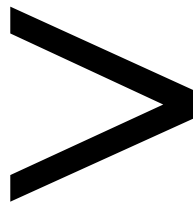


Note: The pie charts are proportioned to the total number of units installed and not to the total capacity installed. Source: Eurobarometer 2015.

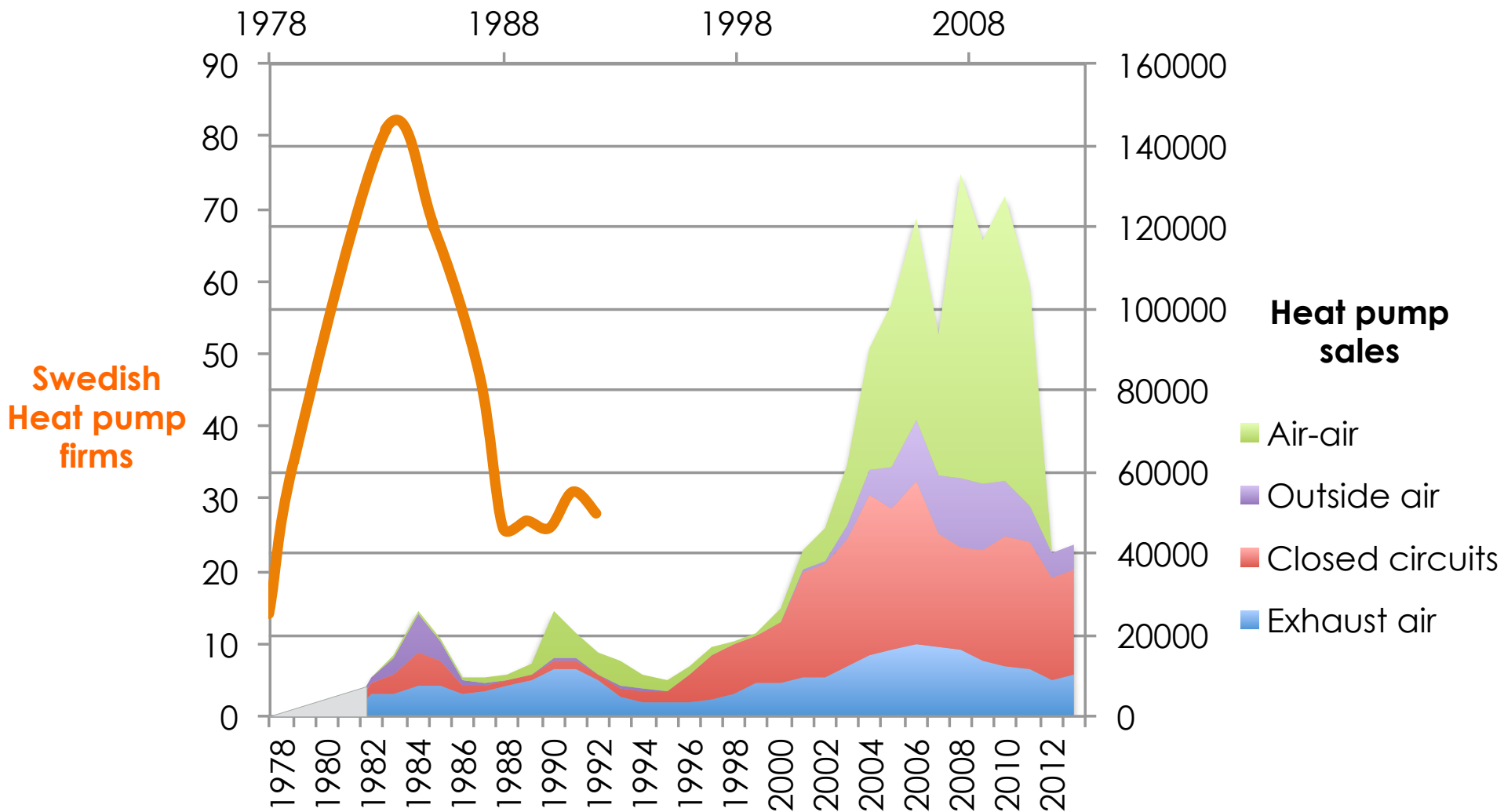
<http://www.sunwindenergy.com/sites/default/files/field/image/eurobarometer-2015-map-aerothermal-and-geothermal-heat-pump-park.jpg>



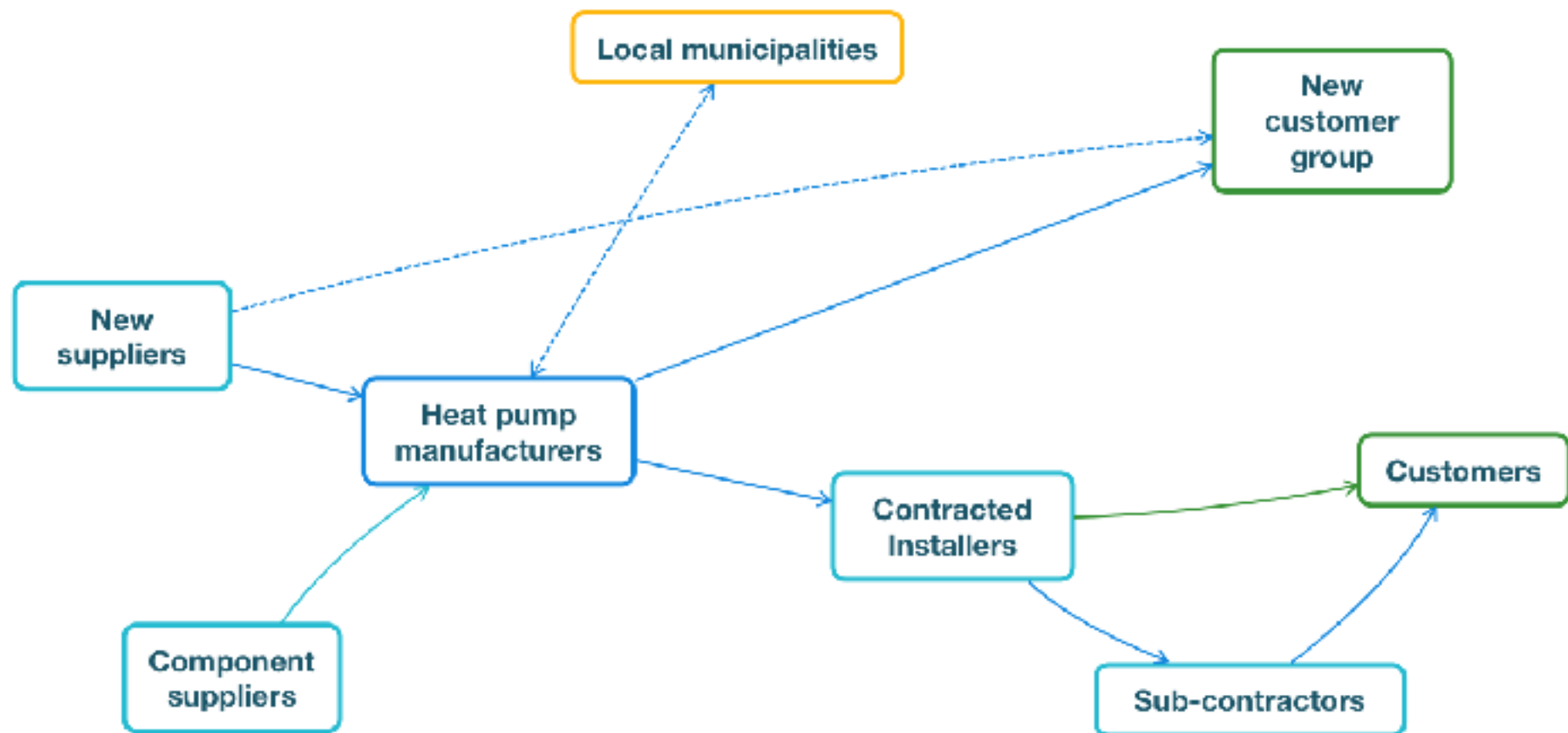
$\sim 30 \text{ TWh}_{\text{heat}}$



$16,6 \text{ TWh}_{\text{el}}$ (in 2015)







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