Dutch industrial waste heat in district heating: Wasted effort?

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We provide an inventory of potentials and costs for waste heat utilization in the Netherlands for low-temperature application in households, services and greenhouse horticulture towards 2020.

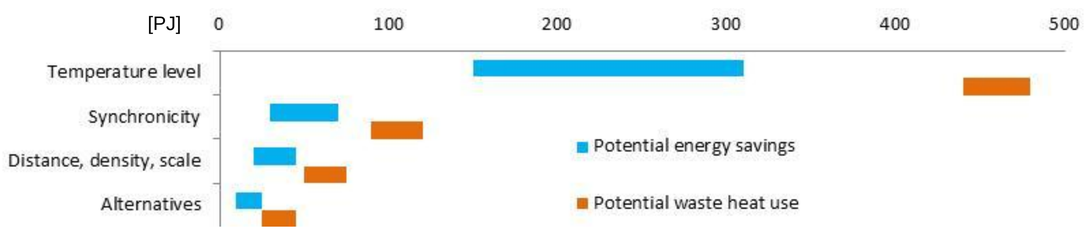
Characteristics

Scale	>10 MW_{th}	1-10 MW_{th}	100 kW_{th}-1 MW_{th}	<100 kW_{th}
Sectors	Industry, power generation	Greenhouse horticulture, small industry, services	Services, dwellings	Dwellings
Temperature levels	High-low	Low	Low	Low
Alternatives: demand reduction	Efficiency, proces integration	Efficiency, insulation	Insulation	Insulation, passive houses
Alternatives	CCS (heat application) CHP, boiler, process heat (sources)	CHP, geothermal, heat-cold storage	Geothermal, boilers, CHP biomass, heat-cold storage	Geothermal, heat-cold storage, (micro)CHP, biomass, HE-boiler, heat pump, solar
Heat losses in distribution	Very small	Very small	Small	Medium- large
Fuel energ taxes	Low, CHP/Powerplants: none	Low, CHP: none	Medium/High, CHP: none	High
Emissions trading system	Usually (>20 MW)	Seldom	No	No

Indicative savings and emission reductions

Destination for heat		Primary energy savings		CO_2 effect		CO_2 non-ETS
	Heat source	GJ/GJ_{th} demand	%	$tonne/GJ_{th}$ demand	%	$tonne/GJ_{th}$ demand
New residential						
	Waste heat industry	0.75	69%	-0.04	67%	-0.06
	Power plant/waste incineration	0.66	61%	-0.03	54%	-0.06
Existing residential						
	Waste heat industry	0.73	70%	-0.04	69%	-0.06
	Power plant/waste incineration	0.65	63%	-0.03	56%	-0.06
Non-residential						
	Waste heat industry	0.82	74%	-0.05	73%	-0.06
	Power plant/waste incineration	0.75	68%	-0.04	62%	-0.06
Greenhouse horticulture						
	Waste heat industry	0.08	21%	0.03	-24%	-0.11
	Power plant/waste incineration	0.01	2%	0.04	-31%	-0.11

Matching supply and demand

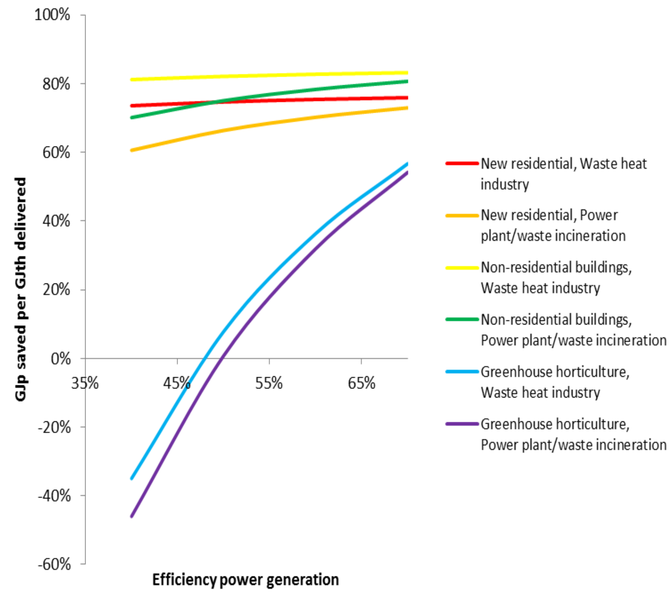


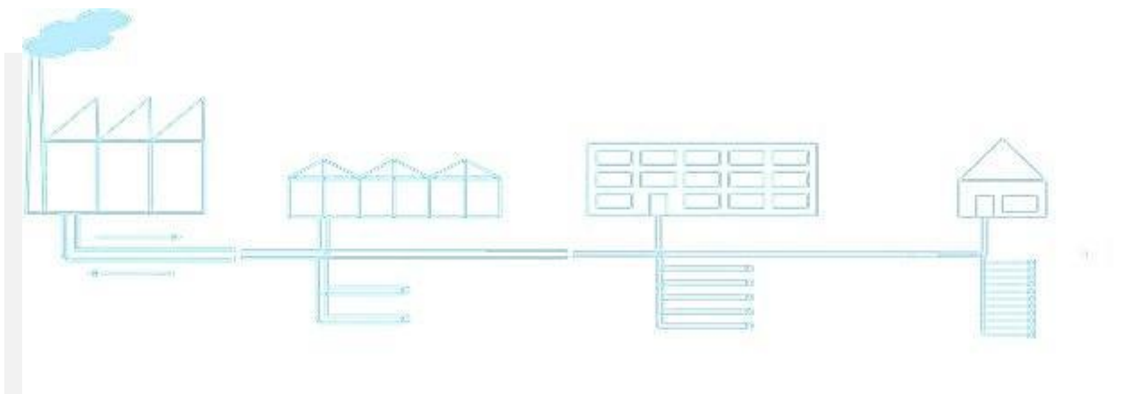
- Temperature level: 80-120 ^{o}C
- Synchronicity I: +7000 full load hours heat availability, 1000-2000 full load hours demand. With heat buffers and auxiliary boilers 30%-45% of available heat usable
- Synchronicity II: Required lifetime of heat source: 30-40 years
- Synchronicity III: No peak power plants
- Distance density and scale: local match required of sufficient scale

Determining factors for energy savings

In cases that waste heat distribution performs well, alternatives generally do well, too

- Energy inputs for tapping the heat and pumping energy
- Loss of electricity output when tapping heat from power generation
- Distribution losses
- Auxiliary boilers
- Reference heat source
- Power generation efficiency





Conclusion

Despite large amounts of available waste heat, the amount that makes sense to be used in heat distribution is relatively limited. The main cause for this is the poor match between supply and demand. Moreover, alternatives for deployment of waste heat on the supply side and alternative heat sources on the demand side may be more attractive.

Acknowledgements

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