A pathway to emission free district heating in a world driven by data and electricity. Case: data center waste heat utilization.

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> 25 SEPTEMBER 2019 COWI COMPANY PRESENTATION



Evolution of household heating

- 1. Individual room heating the more chimneys the better
- 2. Central heating in houses
- 3. District heating



District Heating Denmark - just recently

> From "waste" to district heating





Why: Surplus heat?

- > Ambitious target for CO₂ emissions
- > Energy is available around the corner and is currently wasted
- > Lower electricity prices in Denmark has triggered a boost for heat pumps
- > The future of district heating (DH) is moving toward low temperature heat
- > DH and low temperature surplus heat is a perfect match
- Use the DH infrastructure to distribute, accumulate and balance supply and demand
- Use the DH infrastructure to balance the power grid (stop when power prices are high – produce when power prices are low)



District Heating Denmark from now on





Tal fra Energidataservice . www.energidataservice.dk

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How: Waste heat?

Rethink the way we plan

Make it attractive for industries to settle down in area where waste heat can be utilised:

- > Laws and regulations should be supportive
- > Community should assist with infrastructure (power & heat)
- > Make it easy and worthwhile to integrate industries and communities

Result:

- > Overall energy cost is reduces both for industry and for community
- > Carbon footprint of industrial production decreased
- > Industry and community are in "sync" -> increasing tolerance and understanding



Quality of energy – is it waste or surplus?

Universal fact -> Energy and mass balance

Energy can be used more than once

Quality of energy is easy to understand and is prices (based on "usability")



Quality of energy – an example





Process integration – a way to reuse and minimize













You have to ask yourself:

- 1. Why burn fuels in order to produce "warm water" for district heating?
- 2. Why reuse energy until it cannot be used for district heating anymore?



optimal local solution is not necessarily the same as optimal "global" solution



From local industry to local community - merging energy systems - <u>www.cooldh.eu</u>



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Examples of waste heat utilisation

- 1. DH is coming to town and 10 MW of waste heat is able to be utilised from 70 year old industrial plant. Energy that has been wasted for decades.
- 2. Large international company want to modernise and turn their heat supply into renewable energy. Only financial viable by "integrating" the industrial plant into the DH-network (delivers today 80% of the demand).
- New industrial plant is going to be build a redesign is made that increased the energy consumption on the plant with 10% but makes the surplus heat directly available for the DH-network.



Data centers





Data centers – a growing industry



Source: IDC's Data Age 2025 study, sponsored by Seagate, April 2017





Data centers in Denmark

- > Estimated energy consumption 2025
 - > 400 MW electricity
 - > 3600 TWh/year
- Data centers are estimated to use 17% of the Danish electricity consumption in 2030.
- Waste heat utilisation today is almost zero (facebook in Odense an exception – is prepareing)
- The big data centers (hyper scale) are all placed close to electrical substations in order to get the electricity to lowest possible price.



Utilisation of low temperature surplus heat





Use of electricity for heating



electricity twice as expensive as natural gas

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Use of electricity + surplus heat for district heating

Electricity is twice as expensive as natural gas (or biomass)

TTT

Using only 25% electricity for 100% heat production

Cutting energy cost in half and reducing local emissions to zero



Potential heat recovery from data centers



Fjernvarmesystem	Transformer- station	Afstand [km]	Varme- behov, maks. [MW]	Varmebehov [MWh]
Aarhus Fjernvarme	Trige og Malling	10	980	3.323.000
Odense Fjernvarme	Fraugde	5	780	2.646.000
Aalborg Fjernvarme	Vester Hassing	4	563	1.910.000
TVIS	Landerupgård	10	518	1.756.000
Esbjerg-Varde Fjern- varme	Endrup	16	344	1.167.000
Holstebro-Struer Fjern- varme	Idomlund	4	159	538.000
Viborg Fjernvarme	Tjele	10	97	329.000
Aabenraa - Rødekro - Hjordkær Fjernvarme	Kassø	9	84	284.000
Bjerringbro Fjernvarme	Tjele	14	27	91.000
Hinnerup Fjernvarme	Trige	5	25	86.000
Hadsten Fjernvarme	Trige	8	22	74.000
Ringe Fjernvarme	Fraugde	8	19	64.000
Hjallerup Fjernvarme	Vester Hassing	12	13	44.000



Recommendations

- > Make it worth while to do the right thing
- > Make it easy to do the right thing cutting red tape / bureaucracy
- Let primary responsibility for making it possible be on public shoulders (lawmakers, regulators, and local authorities)
- Turn challenges into opportunities and attracting energy intensive companies to area with energy integration possibilities

Make sure to use energy more than once



