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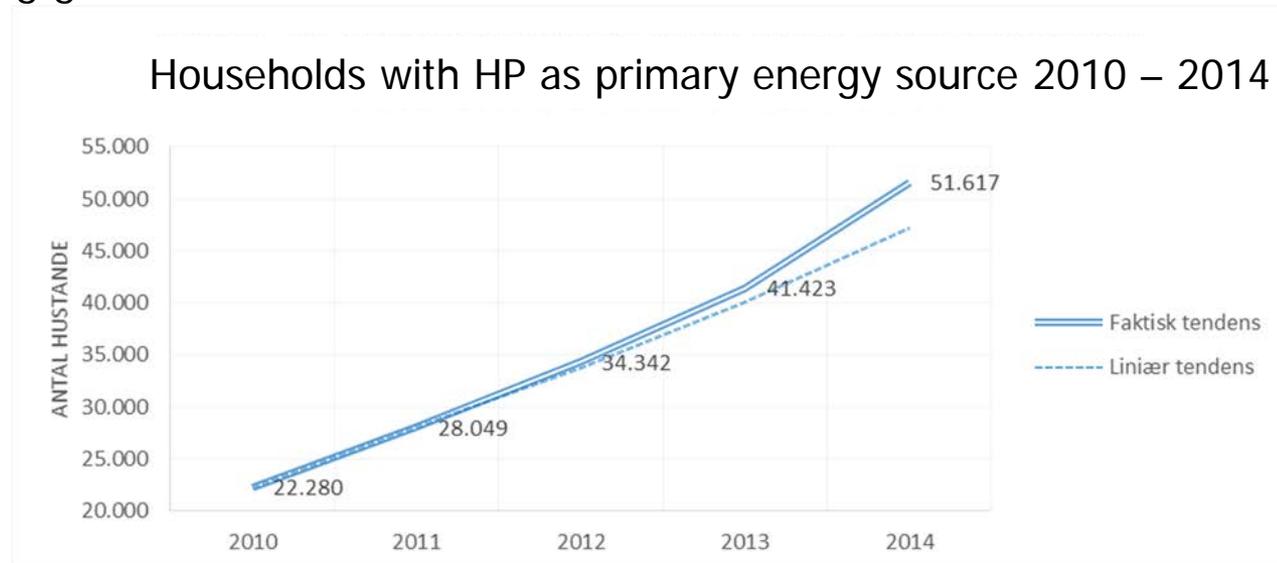
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Demonstration projects regarding Gas hybrid and Booster heat pumps

IEA Workshop Aarhus 4 May 2015
Svend Pedersen

The Government's ambition for the Danish energy future

- Denmark fossil free in 2050
- Heating shall be supplied 100% from Renewable Energy in 2035
- No more oil fired boilers in 2030
- 35 pct. Renewable Energy in 2020 energy consumption
- 50 pct. wind in the Danish electrical consumption
- 2013 No installation of oil and gas fired boilers in new buildings
- 2016 No replacement of oil fired boilers in existing buildings in areas with gas or district heating grid.

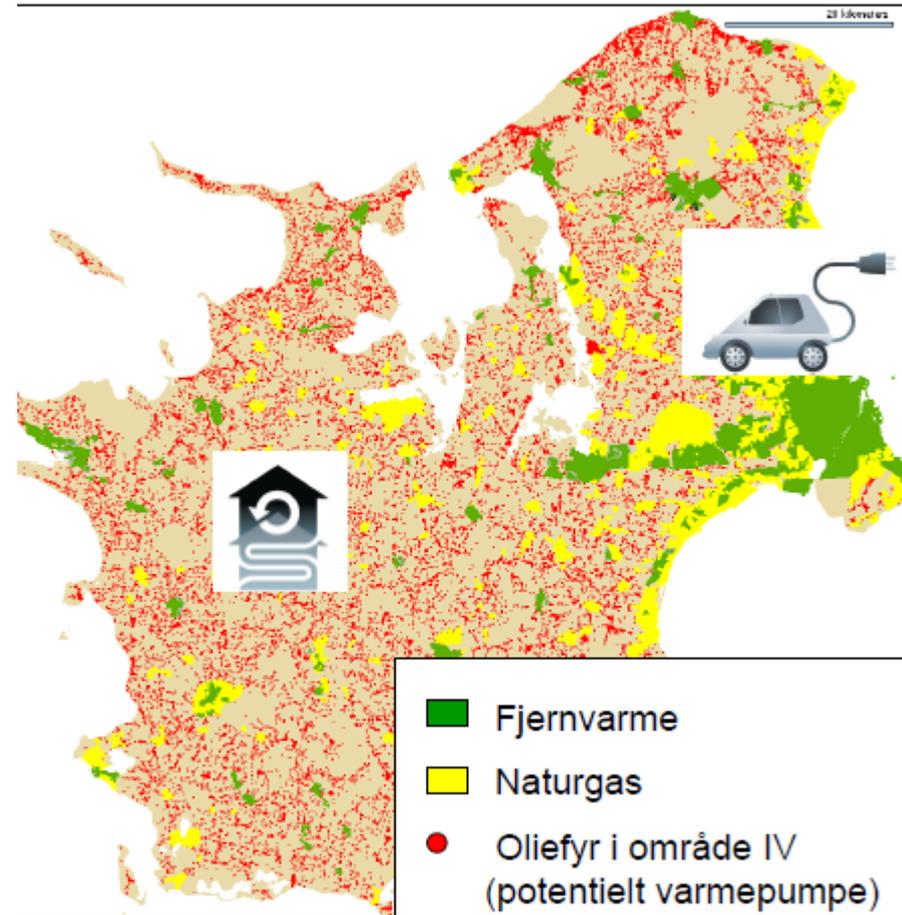


Danish Energy supply

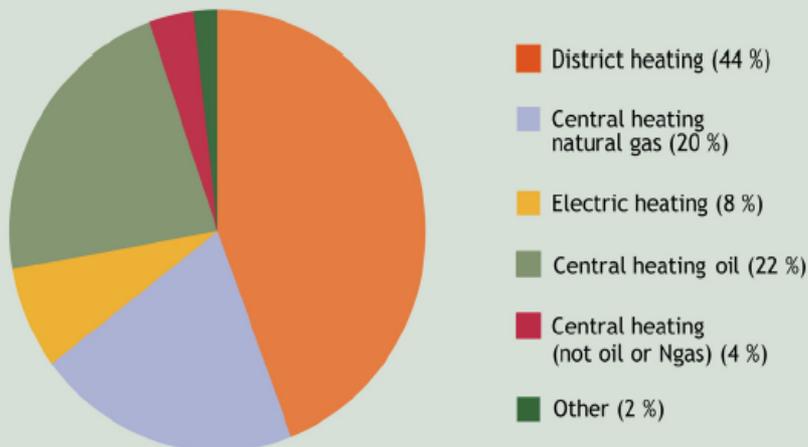
Approximately 2 million households

- District heating app. 1,2 million
- **Gas app. 0,4 million**
- **Oil app. 0,3 million**
- Electricity and heat pumps 0,1 million

Zealand (Sjælland)



Heating sources in Denmark
% of 1.5 million houses



Demonstration project regarding Gas Hybrid Heat Pumps

Partners:

- Danish Energy Agency
- Danish Technological Institute
- Danish Gas Technology Centre DGC
- Bosch
- Viessmann
- Weishaupt

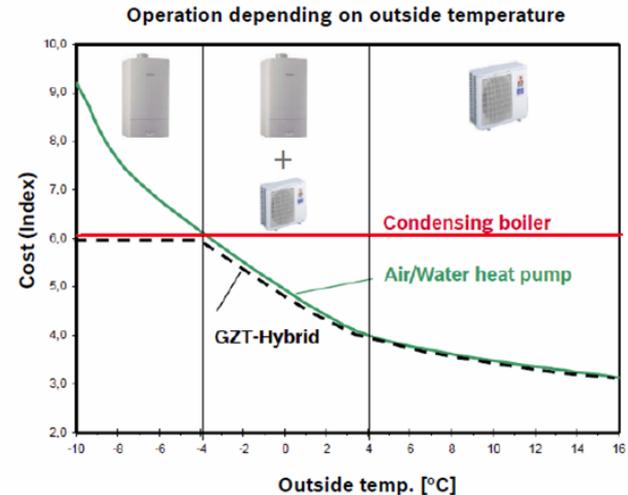


Demonstration project regarding Gas Hybrid Heat Pumps

Why Gas hybrid Heat Pumps ?

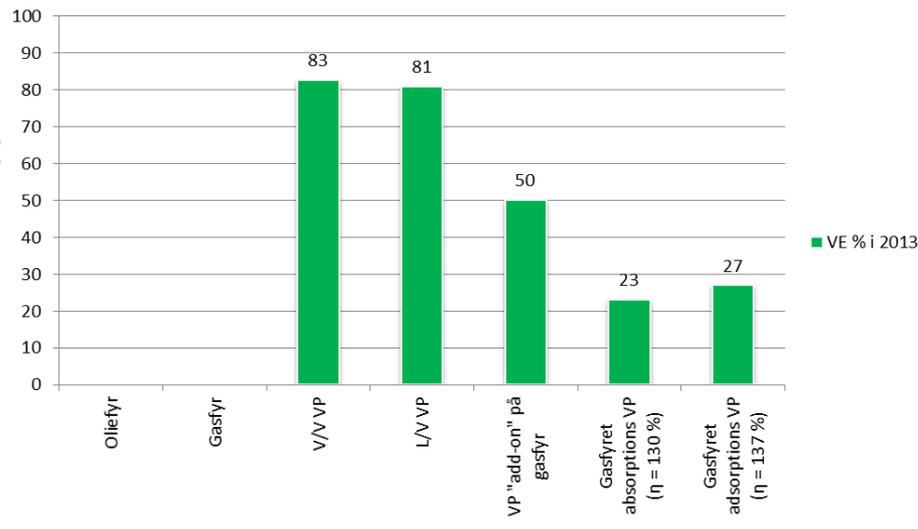
- Danish Gas production will decrease
- Gas Grid Infrastructure from 1980's
- 0.4 Mio Households with gas boiler
- Life time for gas boilers app. 15 years

- High temperature for radiators
- Gas boiler back up
- "Known technology" for Installer/consumer

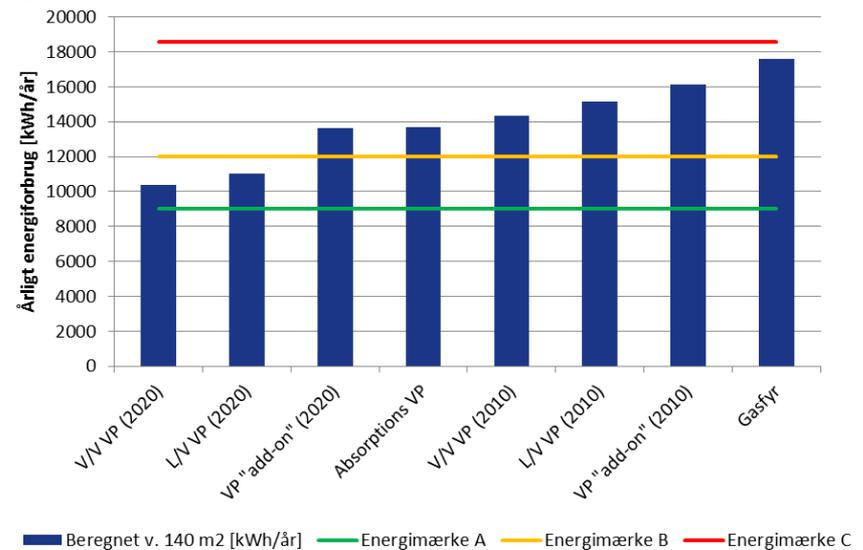


Gas hybrids can phase out fossil fuels, but are the consumers motivated ?

[%] Renewable Energy for different heating sources



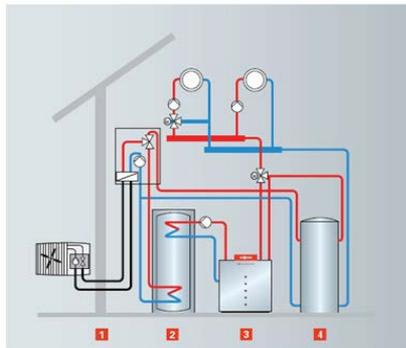
Energy use pr. Year due to the energy labelling of 140 m2 single family house (2010/2020) (2,5/1,8)



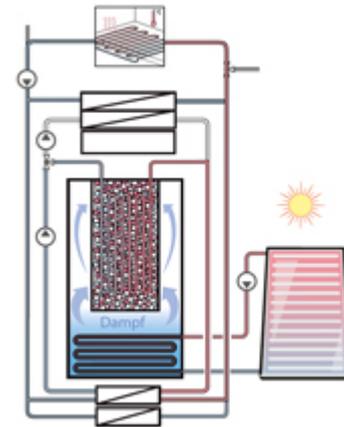
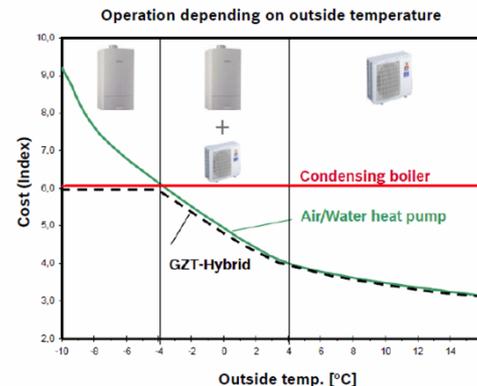
Parameter	Unit	Alternative 1	Alternative 2	Alternative 3	Alternative 4		Alternative 5	
Heating system		Gasboiler	B/W HP	A/W HP	Gashybrid HP (Complete new instal.)		HP add-on on existing gasboiler	
Energi input		Naturgas	Elec	Elec	Gas (40 %)	Elec (60 %)	Gas (40 %)	Elec (60 %)
Netto heating demand	[kWh/year]	16.800	16.800	16.800	16.800		16.800	
Innstation costs m. m.								
Unit and installation incl. VAT	[€]	5.000	18.000	14.000	10.724		5.362	
- labour costs	[€]	2.750	5.400	2.100	3.351		1.005	
Labour cost deduction	[€]	900	1.300	700	1.100		300	
Energy saving incentive (0,25 kr/kWh)	[€]	-	400	400	200		200	
Total instal. cost	[€]	4.100	16.300	12.900	9.424		4.862	
Depreciation	[€/year]	186	815	645	471		243	
Interest rate	[%]	3,5%	3,5%	3,5%	3,5%		3,5%	
Interest avg. Gross	[€/year]	83	366	285	192		99	
Interest avg. Net	[€/year]	55	246	191	129		66	
Life time, efficiency, energyprice etc.								
Expected	[year]	22	20	20	20		20	
Efficiency of system	[%]	102	330	300	102	350	102	350
Fuel cost	[€/l], [€/m ³]	1,2			1,2		1,2	
Lower calorific value	[kWh/l], [kWh/m ³]	11			11		11	
Energy price	[€/kWh]	0,11	0,23	0,23	0,11	0,23	0,11	0,23
Electricity price (Auxiliary energy)	[€/kWh]	0,29	-	-	0,29	-	0,29	-
Operation Costs								
Gross Heating demand	[kWh/år]	16.471	5.091	5.600	6.588	2.880	6.588	2.880
Auxiliary energy	[kWh/år]	75	-	-	25	-	25	-
Fees (District heating)	[€/år]	-	-	-	-	-	-	-
Energy Costs	[€/år]	1.788	1.146	1.261	714	649	714	649
Maintenance costs								
Service and maintenance	[€/år]	300	300	200	300		300	
Total annual costs	[€/år]	2.330	2.507	2.297	2.262		1.972	
Index	[-]	1,00	1,08	0,99	0,97		0,85	

Types of gas hybrid heat pumps

- 1: Electrical HP and gas boiler sold as a package solution
- 2: Electrical HP sold as an add-on to an existing gas boiler
- 3: Gas fired adsorption HP (Zeolite)
- 4: Gas fired absorption HP



Vitocal 200-S und Öl-Gas-Heizkessel für den bivalenten Betrieb bei der Modernisierung [1 = Vitocal 200-S Außen- und Inneneinheit] [2 = Warmwasserspeicher] [3 = Heizkessel] [4 = Heizwasser-Pufferspeicher]



Field Measurements

- 6 stk. Bosch Compress Hybrid 5000 AWS and 30 kW Condens 5000 WT (Type 1)
- 1 pcs. Bosch Compress Hybrid 5000 AWS and 14 kW Europur gas boiler (Type 1)
- 1 pcs. Reb2B Atlantic Alfea Hybrid Duo Gas 14 kW (Type 1)
- 1 pcs. Viessmann Vitocaldens 222-F (Type 1)
- 3 pcs. Weishaupt 25 kW A/W HP and 40 kW gas boiler (Type 2)
- 1 pcs. MHG Thermiair 16 kW and older oil boiler 20 kW (Type 2)
- 1 stk. Bosch 17 kW Compress 6000 AW and older oil boiler (Type 2)

Challenges

- Slow start of the sale of hybrid heat pumps
- Few products on the Danish market
- Expensive products
- The technology is hard to explain for installers
- Needs expert knowledge and backup of installers
- Compability problems between products
- Decreasing oil and gas prices



District Heating Micro Booster HP



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Partners:

Danish Energy Agency



Grontmij as project leader



**Waste and Heating Aarhus as
host/supplier**



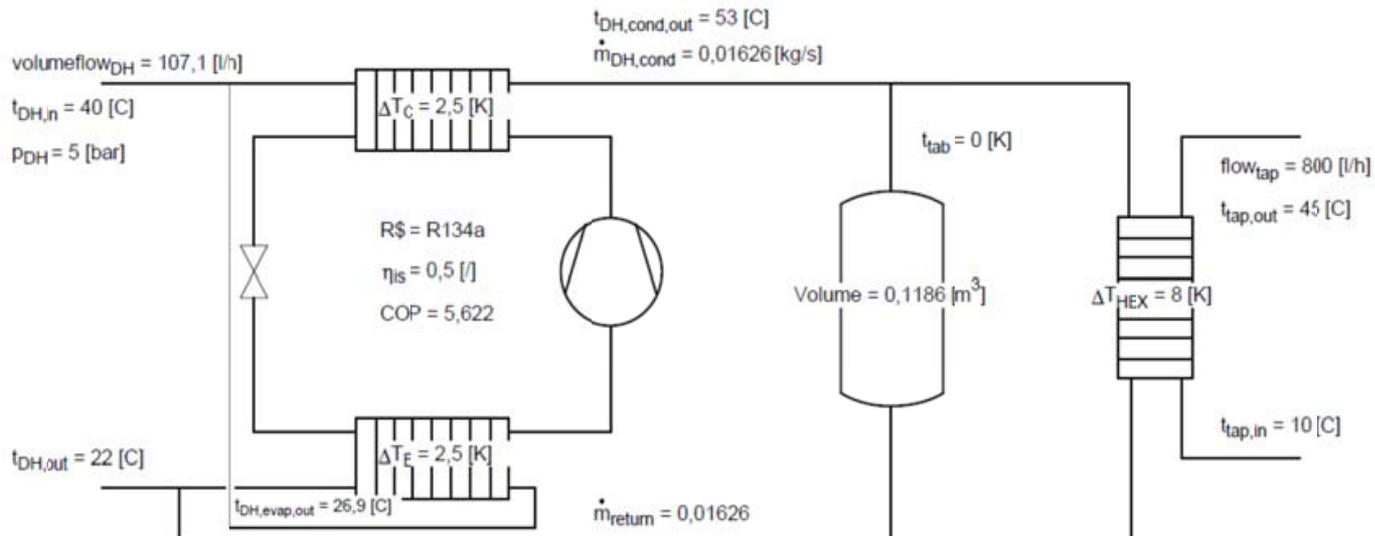
Danfoss as supplier of LTVF-units



Concept

- Low temperature district heating with 40°C outlet
- HP (micro booster) for hot tap Water

→ Space Heating



Benefits of Low temperature District Heating

- Reduction of heat loss in the grid
- Lower grid costs
- Increased possibilities to use Renewable Energy sources (sun, geothermal, excess heat)
- Reduction of return temperature
- Use of return heat from existing systems as source to new District Heating areas.

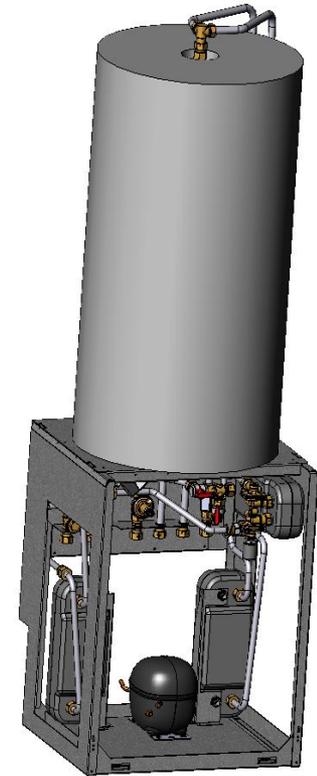
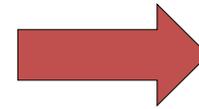
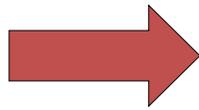


Barriers

- Micro booster LTDH unit is more expensive than normal
- The houses shall have low temp. heating system
(New build)
- Micro booster LTDH unit shall down



Design





Field test – Geding

- 25 (23+1+1) households – all participating
- Second generation of the unit is designed, produced and implemented
- Field test is running now – started Dec. 2014
- Visitors from German MVV Energie Mannheim - show case

