Market and energy saving potential with Industrial HPs

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Agenda

- Heat Pumping Technology
- Market: Energy Demand and Saving Potential
- Industrial Application
- Research and Development
- Conclusion

Background and sources

- **IEA- International Energy Agency**
  The IEA Heat Pump Programme HPP

  „Application of Industrial Heat Pumps“ (R&D project)

  Cooperation between

  IEA Industrial Energy Systems and Technologies Annex 13

  IEA Heat Pump Programme Annex 35

  IZW → operating agent ANNEX 35-13

- **IHP-> Purdue conference July 2010**
- **Workshop Industrial Heat Pump IHP** **Chillventa Congressing 2010**
- **Workshop IHP- Symposium**
  European Heat Pump Summit 2011

Annex 35-13

ongoing

Application of Industrial Heat Pumps

- Reduce the use of energy and emissions of greenhouse gases by the increased implementation of heat pumps in the industry.

- Arranging the information on heat pumping technologies for industry that will lead to better understanding the opportunities and using these in order to reduce the use of primary energy consumption and the CO_2-emissions as well as energy costs.

Operating Agent: Germany

www.heatpumpcentre.org

Application of Heat Pumping Technology

Residential

Commercial

Industrial

District cooling and heating

Application: Residential HPs

Space Heating + Cooling

Tumble dryer

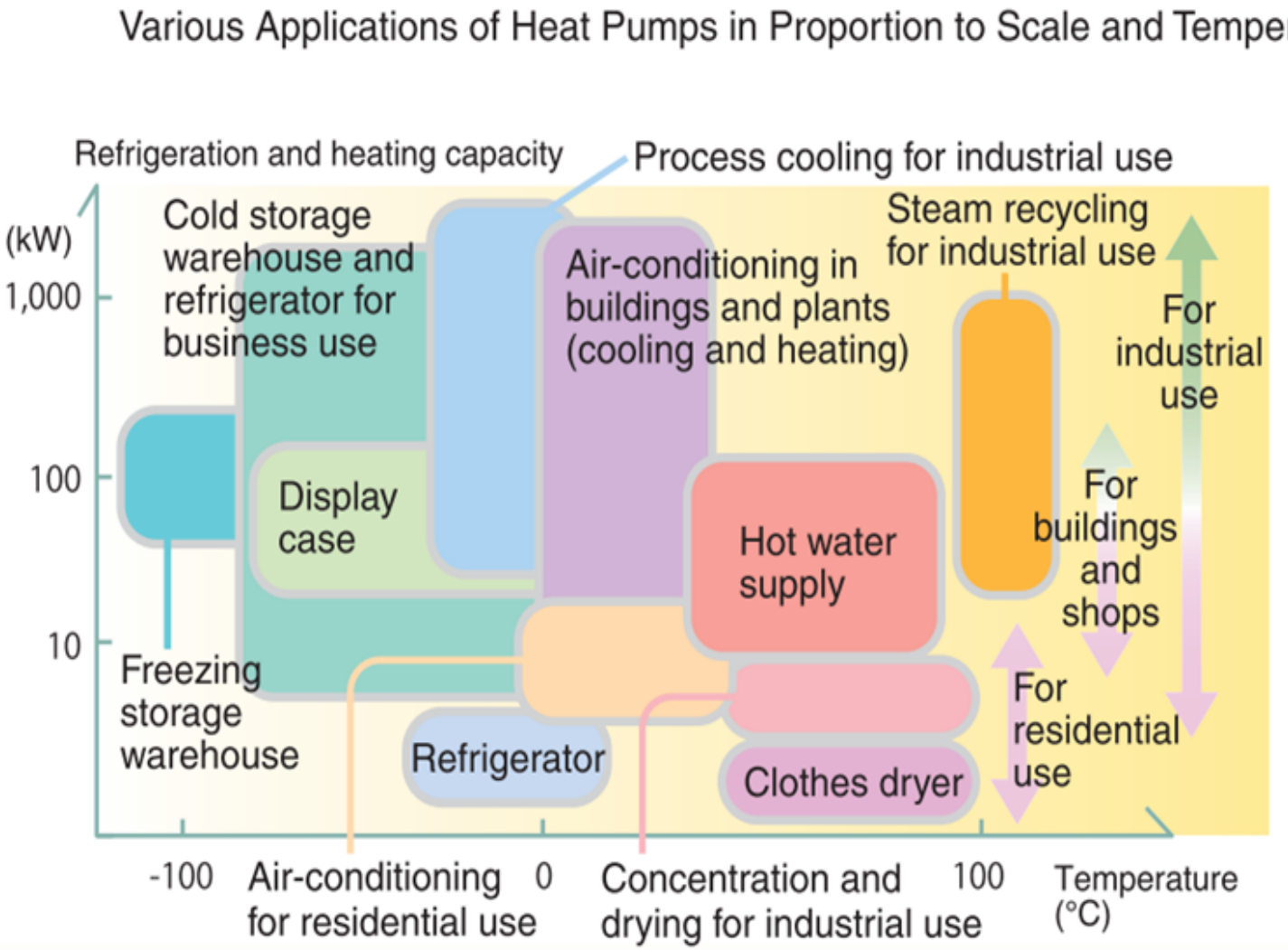
Domestic Hot Water

Refrigerator

Freezer

Use of aero-geo-+hydrothermal renewable energy sources

Application of Heat Pumping Technology



Source from Japan: **www.hptcj.or.jp/e/index.html**

Final Energy Consumption -EU 27-

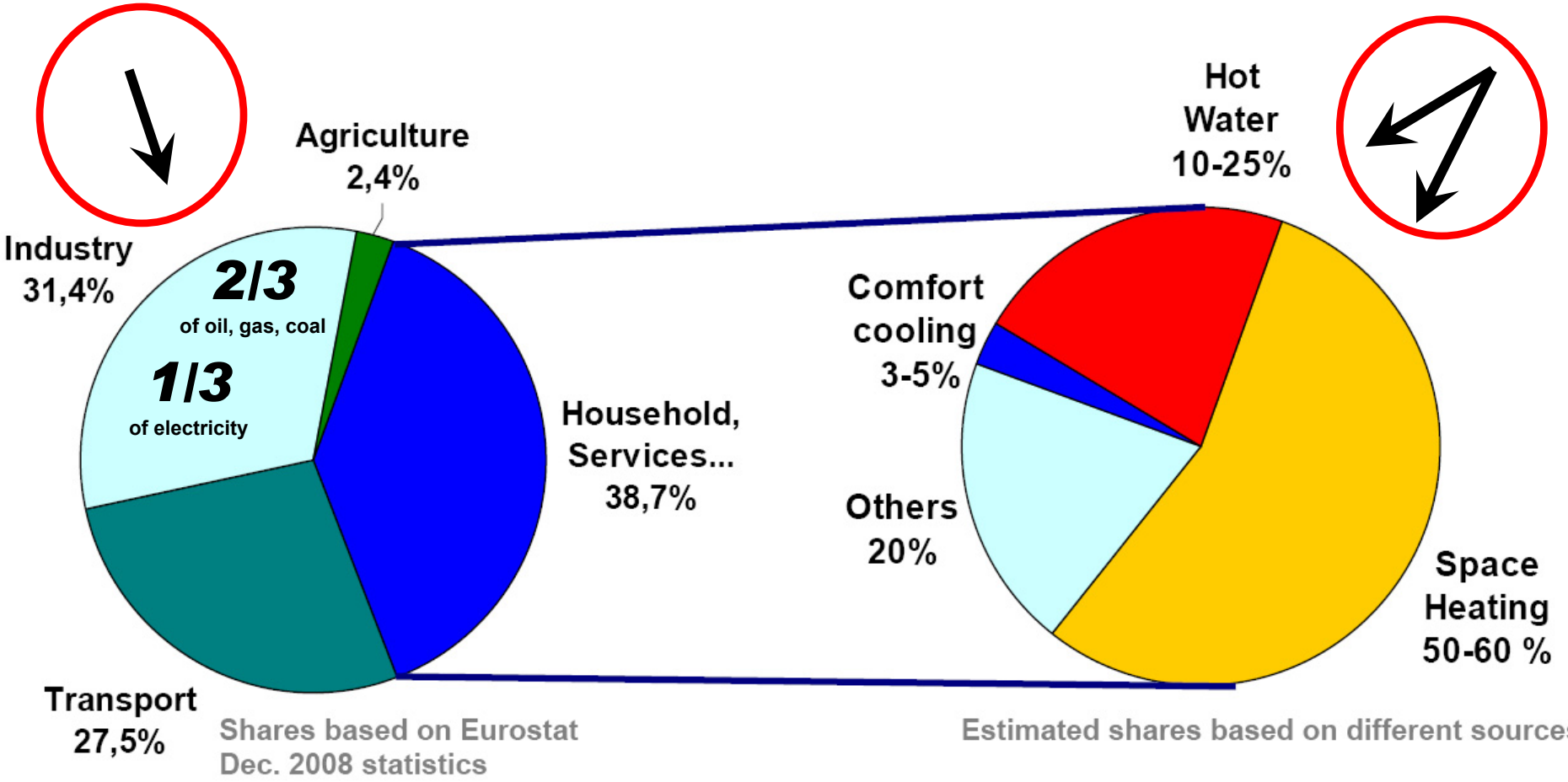


Chart produced by IZW e. V.

Energy consumption in the industries

Potentiale

1/3

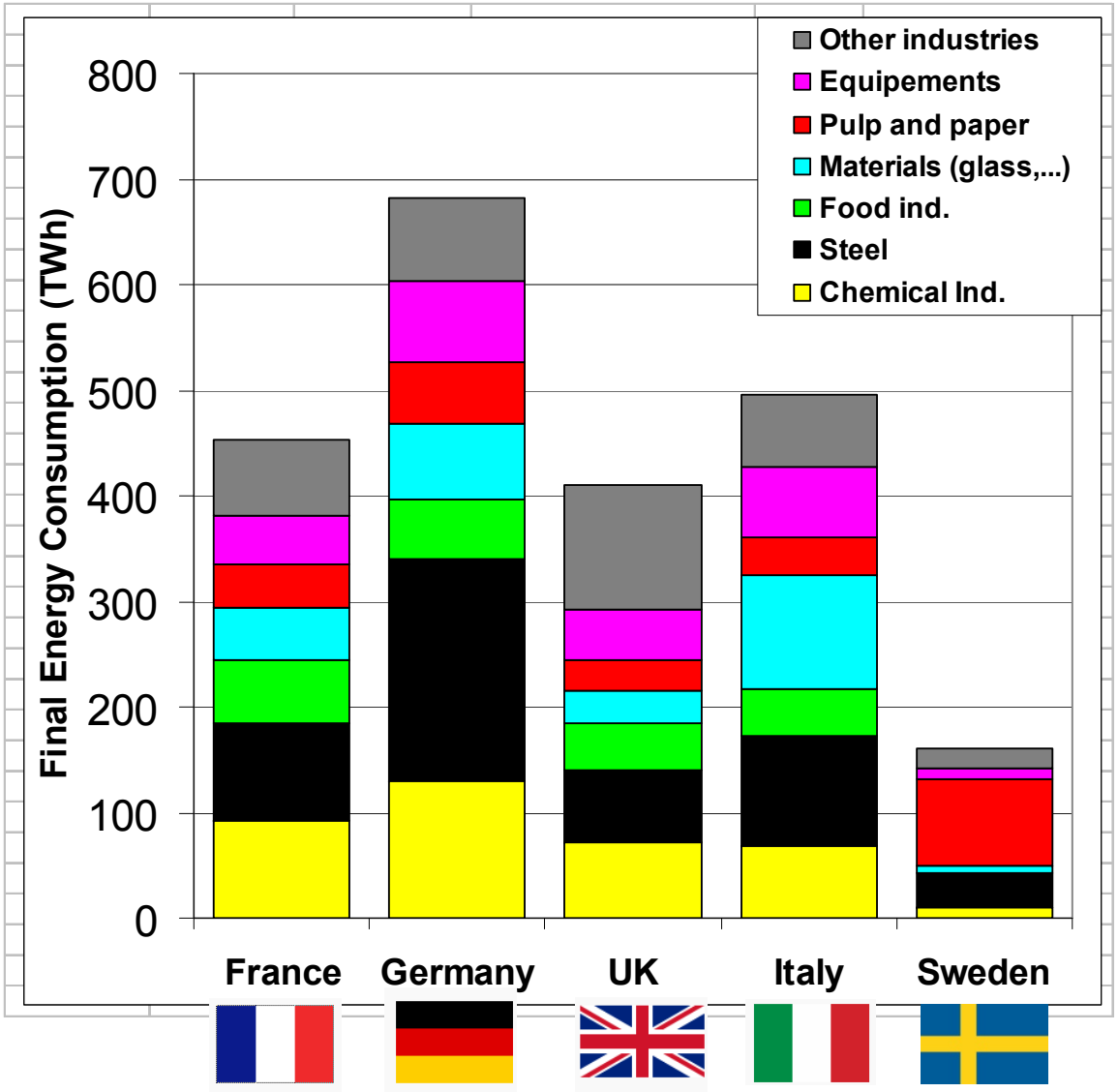
of electricity

2/3

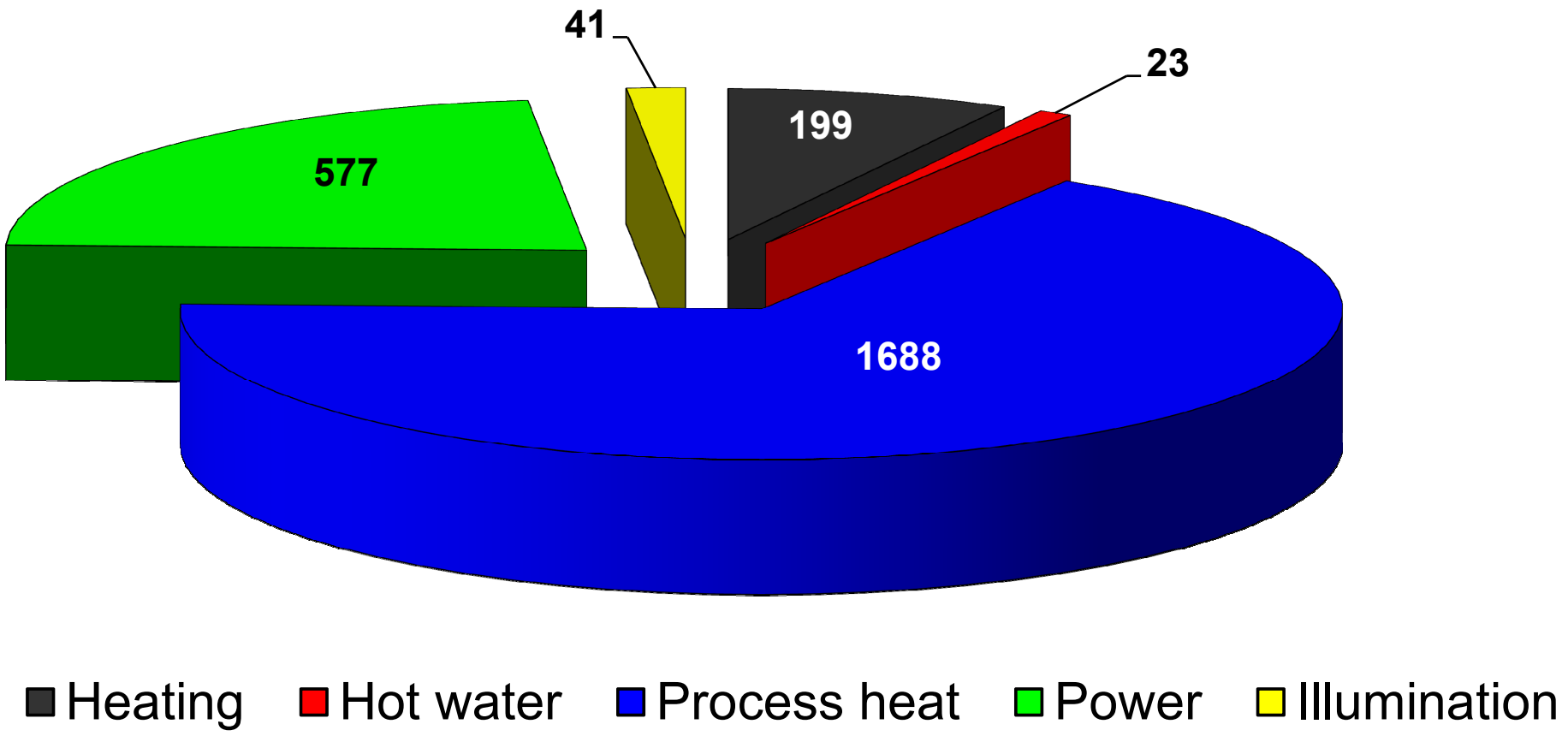
of oil, gas, coal

Food, steel and chemical industry are the main consumers

Source: EDF



Final energy demand in Industry for different applications in 2008 in PJ Germany



Source: Annex 35-13 Report

Heat demand in German Industry

[PJ]	Hot water	Heating			Process heat		
		≤ 70 °C	≤ 80 °C	≤ 100 °C	70 °C	80 °C	100 °C
Food	6.15	17.96	17.96	18.90	7.32	15.43	30.01
Textile	0.28	4.59	4.59	5.10	1.98	2.21	3.67
Wood	0.14	1.31	1.31	1.31	5.41	5.41	5.41
Pulp and paper	0.38	8.03	8.03	8.92	3.85	3.85	112.57
Chemical	1.37	17.80	17.80	19.78	7.38	9.59	20.89
Plastics	0.38	6.57	6.57	6.92	14.86	14.86	14.86
Metal	0.88	15.77	15.77	16.60	6.91	6.91	6.91
Automobile	1.37	21.69	21.69	24.09	7.15	7.15	7.15
Other	3.62	67.67	67.67	71.60	0.28	0.28	0.28
summ	14.56	161.37	161.37	173.22	55.13	65.69	201.75

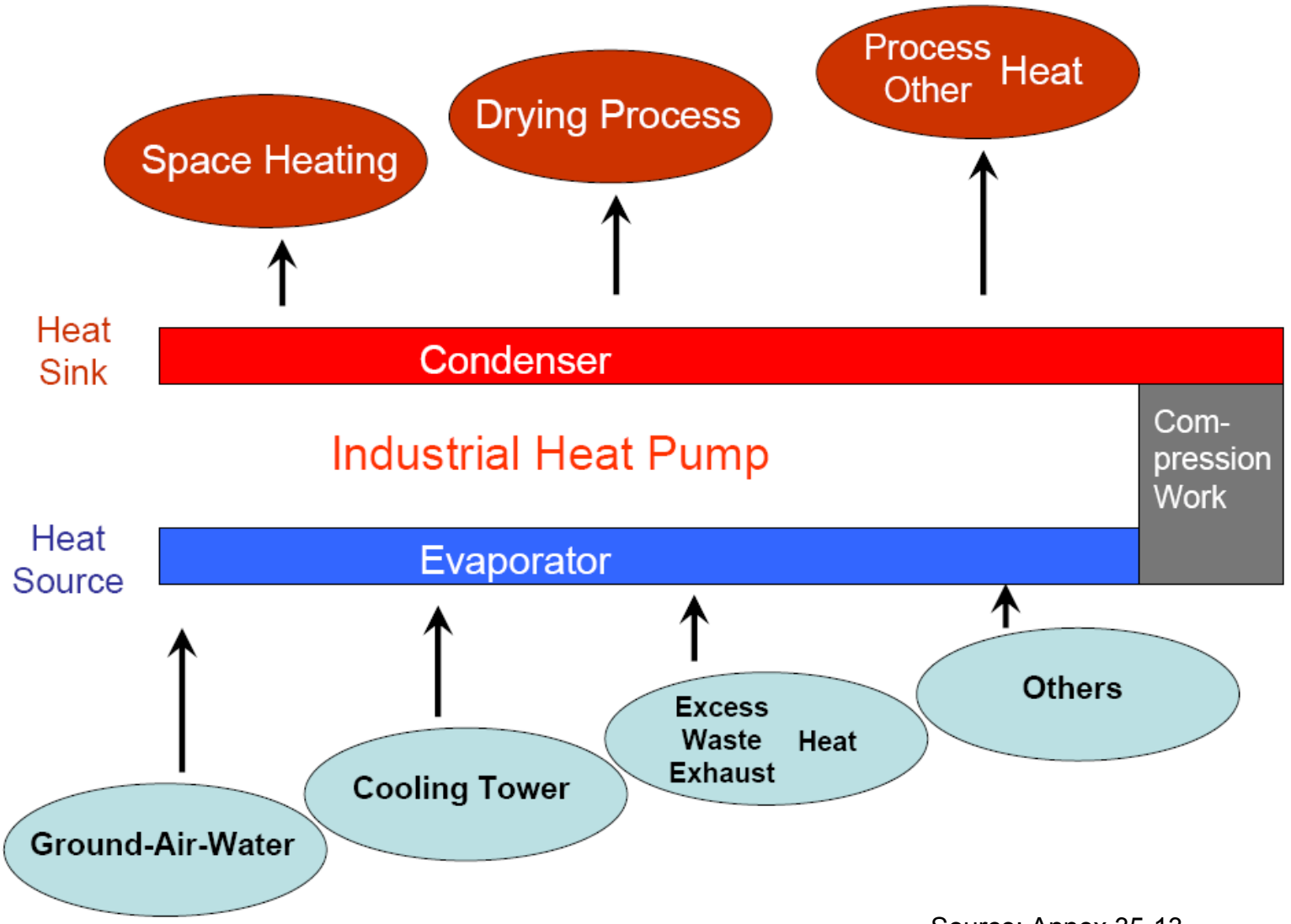
Source: Annex 35-13 Report

Process specific examples for HP applications

Industry	Branch	Process	Temperature [°C]	Specific heat demand [MJ/t]
Food	Brewery	Mash	78	61
	Brewery	bottle wash-up	80	54
	Brewery	Barrel wash-up	80	25
Pulp and Paper	Paper	Recovered paper recycling	45	252
	Paper	Drying processes	100	3,960-6,840
	Paper	Finish	60	29
Chemical	Basic material production	Chlorine production	100	270 / 1620
	Plastics production	PVC production	100	18
	Plastics production	Polyproplyene generation	50	43
Building material	Brick production	Homogenise	80	14
Wood	Wood	Drying	70-105	900
Metal processing	Automobile	Washing	60	4,460
	Automobile	Scouring	60	5231

Source: Annex 35-13 Report

Heat Source and Heat Sink in Industrial Heat Pump application



Source: Annex 35-13

Heat pumps in industrial washing applications

DANISH TECHNOLOGICAL INSTITUTE

EUROPEAN HEAT PUMP SUMMIT 2011
Powered by Chillventa

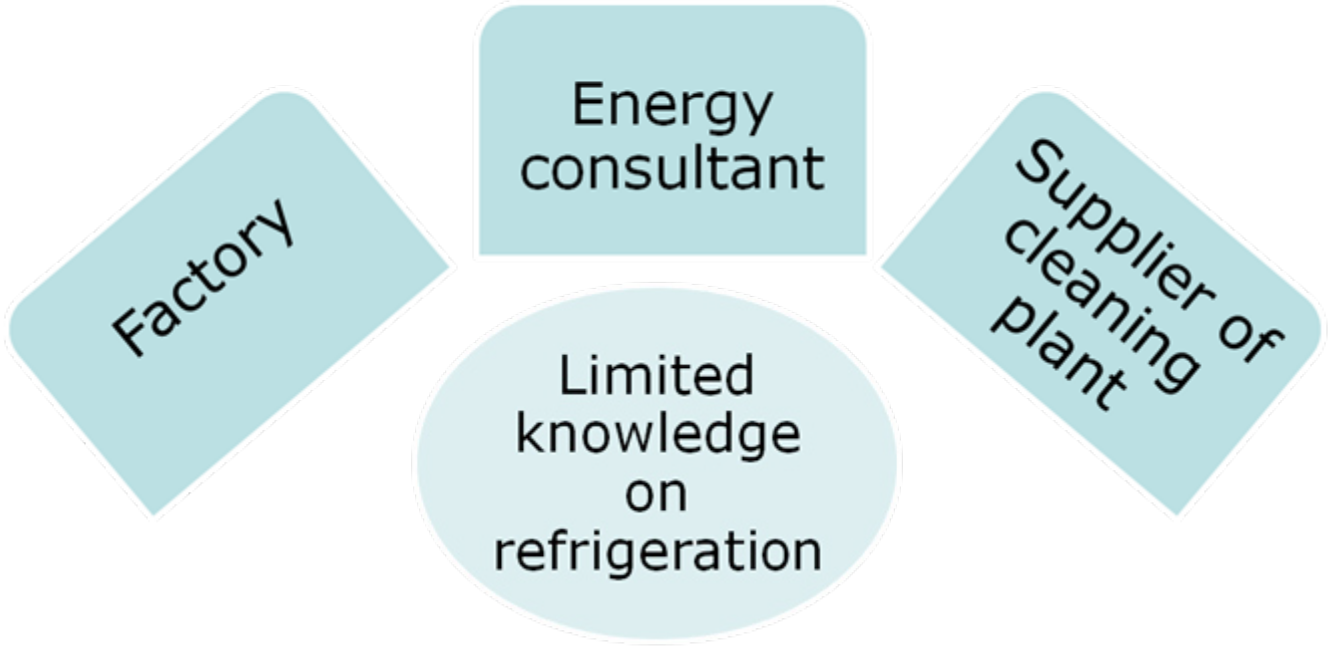
European Heat Pump Summit 2011 - Nürnberg

September 2011

Bjarke Paaske, bjpa@dti.dk, phone: +45 7220 2037, Energy and Climate Division

Heat pumps in industrial washing applications

Washing plants for metal items are energy consuming
Plants are often heated by electricity



No standard heat pump units available

Heat pumps in industrial washing applications

Demonstration of custom built heat pump

Component	Max power [kW]	Average power [kW]	Average power HP [kW]
Heaters – soapy water	24	7.6	2.2
Heaters – clean water	18	16.7	4.7
Pump – soapy water	1.5	1.5	1.5
Pump – clean water	0.75	0.75	0.75
Blower – drying air	2.2	2.2	2.2
Heater – drying air	6	3.5	3.5
Motor	0.18	0.18	0.18
Filter mist	1.5	1.5	1.5
Total	**54.1**	**33.9**	**16.5**

50 % reduction in
energy consumption is expected

Heat pumps in industrial washing applications

Looking at 10 washing plants at the factory

Type	Power cons. [kW]	Saving potential [%]	Operation Time [%]	Annual energy cons. [kWh]	Annual savings using HP [kWh]	Annual CO2 reductions [tons]	Simple payback period
Tinofix	33	50	79	228.373	114.187	48,6	2,9
Tinofix	50	55	70	306.600	168.630	71,8	2,0
Tinofix	50	55	75	328.500	180.675	77,0	1,8
KSN T5000	32	50	52	145.766	72.883	31,0	3,9
KSN 2xT5000	56	55	52	255.091	140.300	59,8	2,4
KSN T3500	32	50	52	145.766	72.883	31,0	3,9
KSN T5000	42	55	52	191.318	105.225	44,8	2,7
KSN T3500	32	50	52	145.766	72.883	31,0	3,9
KSN T3500	34	50	52	154.877	77.438	33,0	3,6
KSN T3500	32	50	52	145.766	72.883	31,0	3,9
Total	**393**			**2.047.825**	**1.077.988**	**459**	**2,8**

Simple payback time of all 10 heat pumps is 2,8 years

Experimental results of a heat pump using R-245fa as working fluid

Presented by D.BOBELIN

SUMMARY:

- Research on HP at EDF R&D
- High Temperature HP market
- Test bench
- Test campaign
- Conclusion

EDF R&D main projects on industrial HP field:

Project Alter ECO

Rhodia, Arkema, Danfoss, CIAT,…

HT/VHT HP
140°C – 250 kW

Integrated by CLAUGER

Realization 2011

Technical partnership:

EDF / Johnson-Control

HT HP
100°C – 700 kW

Integrated by JCI

made in 2010

Project ANR

Jonhson-Control, France Évaporation, SRM, AgroParistech…

Water VHT HP

140°C – 700 kW

Integrated by F-Évaporation

Realization 2011 - 2012

Heat pump:

- A double screw oil injected industrial compressor with variable volume ratio and variable speed electric motor (including oil separation and oil cooling).
- A shell and tube condenser with integrated sub cooler.
- A dry expansion shell and tube evaporator
- An electronic expansion valve
- Super-heating heat exchanger placed between the evaporator and the compressor

Conclusion

➔Big potential for the heat pump especially on high temperature

➔ Thanks to its thermodynamic, safety and economic properties, R-245fa was chosen as refrigerant

➔Our prototype provided by JCI demonstrates the possibility of using R-245fa at industrial scale

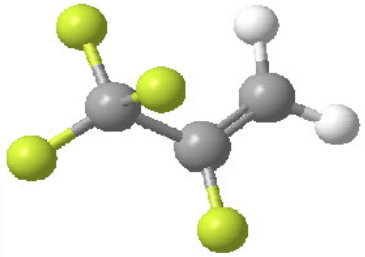
➔ Reliability of the heat pump is demonstrated

➔ Prototype can theoretically reach a temperature of 120°C and offer a promising field for more industrial applications

➔A research phase on HFO refrigerant must be carried on for the future

Low GWP Working Fluids for High Temperature Heat Pumps

HFOs



Nürnberg, 28. – 29.9.2011

EUROPEAN HEAT PUMP SUMMIT 2011

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Kostas Kontomaris, Ph.D.
DuPont Fluorochemicals R&D

A Low Pressure Candidate: DR-2

	HCFC-123	DR-2
Safety Class	B1	**A1** (expected)
Atmospheric life time [yrs]	1.3	**0.0658** (24 days)
ODP	0.02	**None**
$GWP_{100\ YR\ ITH}$	77	**<10**
Critical Temperature [°C]	183.7	**171.3**
Critical Pressure [MPa]	3.7	**2.9**
Normal Boiling Point [°C]	27.9	**33.4**
Thermal Stability	Lower	**Higher**

Very Low GWP AND Non-Flammable

Conclusion

Energy Saving Potential IHP

Industrial heat pumps can significantly reduce fossil fuel consumption and greenhouse gas emissions in

drying, washing, evaporation and distillation processes in a variety of applications
as well as
heating and cooling of industrial buildings.

Industries which can benefit from this technology include food and beverage processing, forest products, textiles, and chemicals .....

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Heat Pump

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Thank you for your attention

Heat Pump **M I S S I O N** is

LOW

or

NO E M I S S I O N