

Testing and Monitoring of Heat Pumps at AIT

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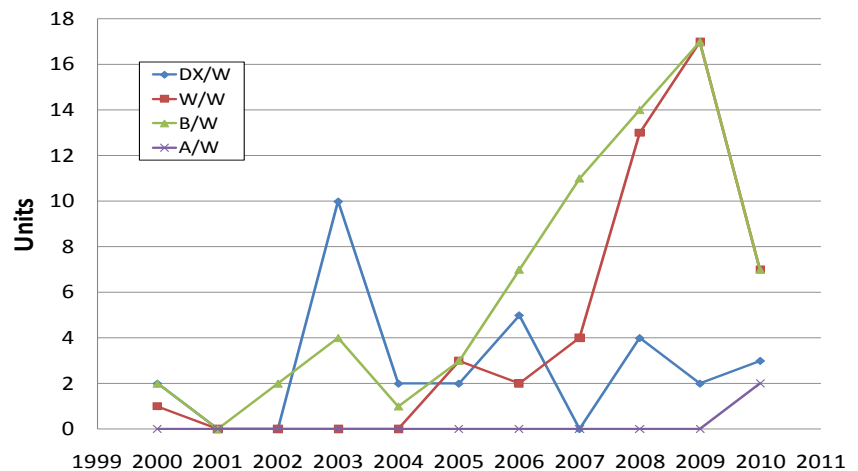
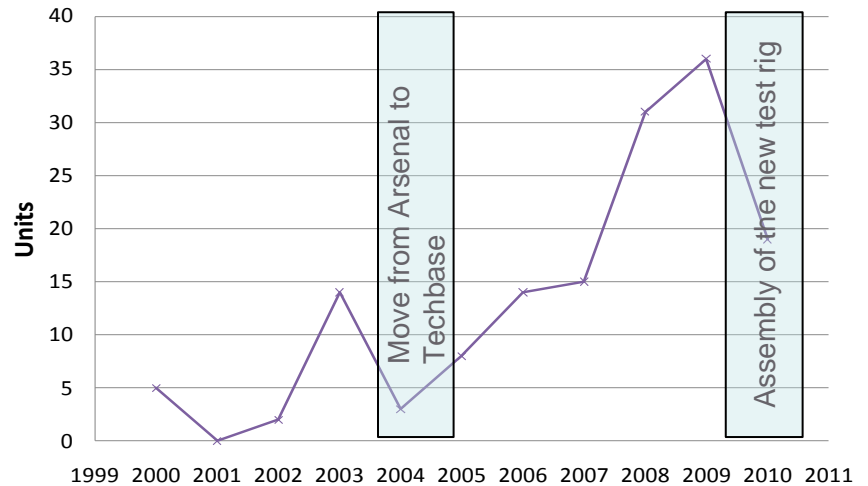
Sustainable Thermal Energy Systems | Energy Department

IEA Workshop on a Technological Vision for the Heat Pump Industry

Vienna, November 9, 2010

Heat Pump Tests at AIT

- 1998/99 design and assembly
- Since 2000:
 - DX/W-HP → 35 Units
 - W/W-HP → 49 Units
 - B/W-HP → 64 Units
- Since 2010:
 - A/W-HP → 2 Units
- Total
 - 150 Heat Pumps are tested



Heat Pump Laboratory - TECHbase

- HP-Systems:
 - DX/W up to 30 kW_{th}
 - W/W up to 100 kW_{th}
 - B/W up to 100 kW_{th}

- Standards/Regulations:
 - EN 14511
 - prEN 15879-1
 - prEN 14825
 - EHPA QL-Regulation
 - NFPac



Heat Pump Laboratory – TECHbase NEW

- HP-Systems:
 - A/W up to 40 kW_{th}
 - GAHP up to 40 kW_{th}
 - DHW-HP

- Standards/Regulations:
 - EN 14511
 - EN 12309
 - EN 255-3; prEN16147
 - prEN 14825
 - EHPA QL-Regulation
 - NFPac



Heat Pump Laboratory - ENERGYbase

- HP-Systems:
 - comfort ventilation units up to 2000 m³/h
 - A/W up to 10 kW_{th}
 - DHW-HP
- Standards/Regulations:
 - EN 13141-7
 - EN 14511
 - EN 255-3; prEN16147
 - EHPA QL-Regulation
 - NFPac

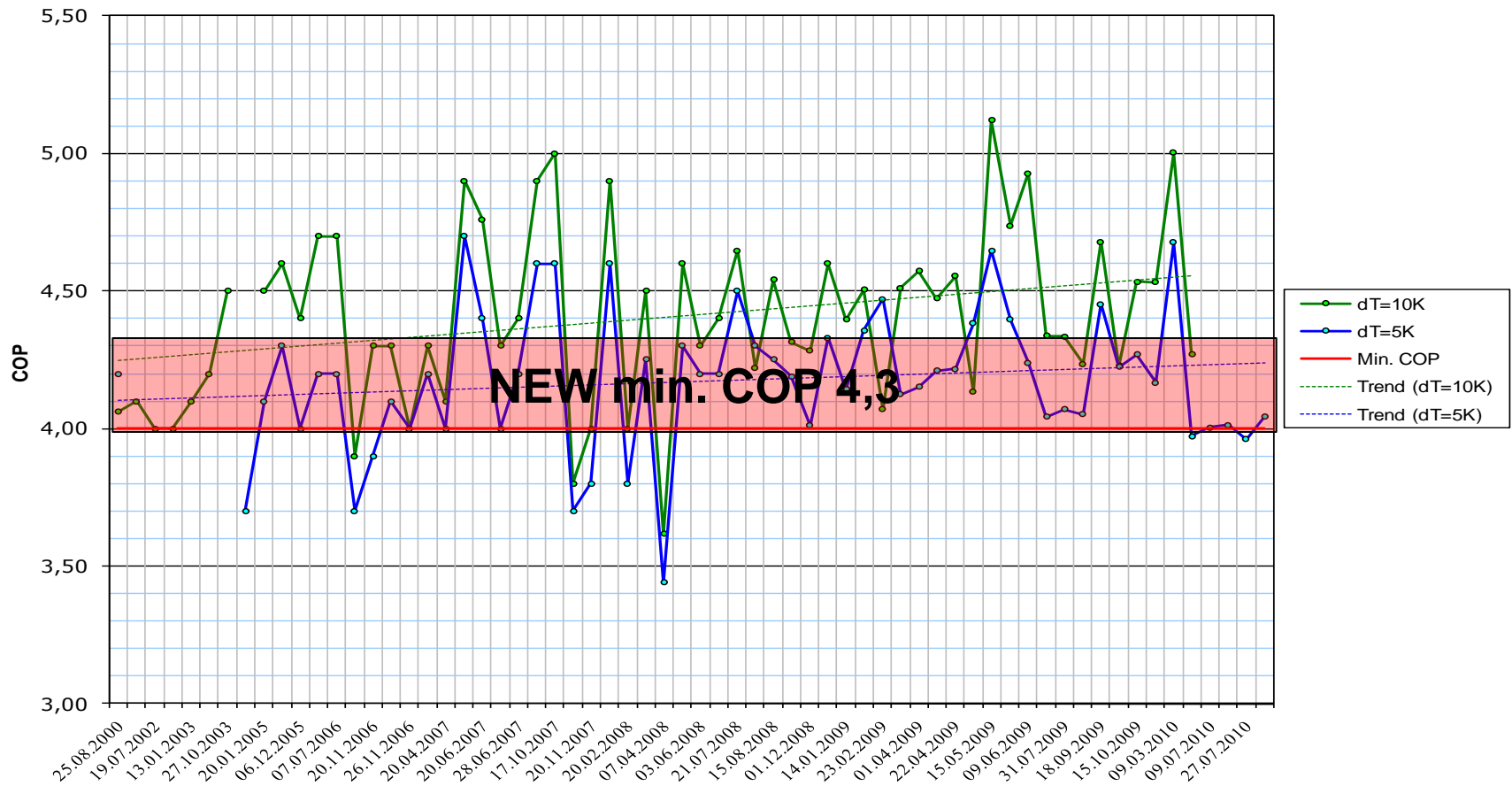


COP Development B/W - HP

COP B0/W35

dT= 10 K → DACH QL Regulation (EN 255)

dT = 5 K → EHPA QL Regulation and EN 14511

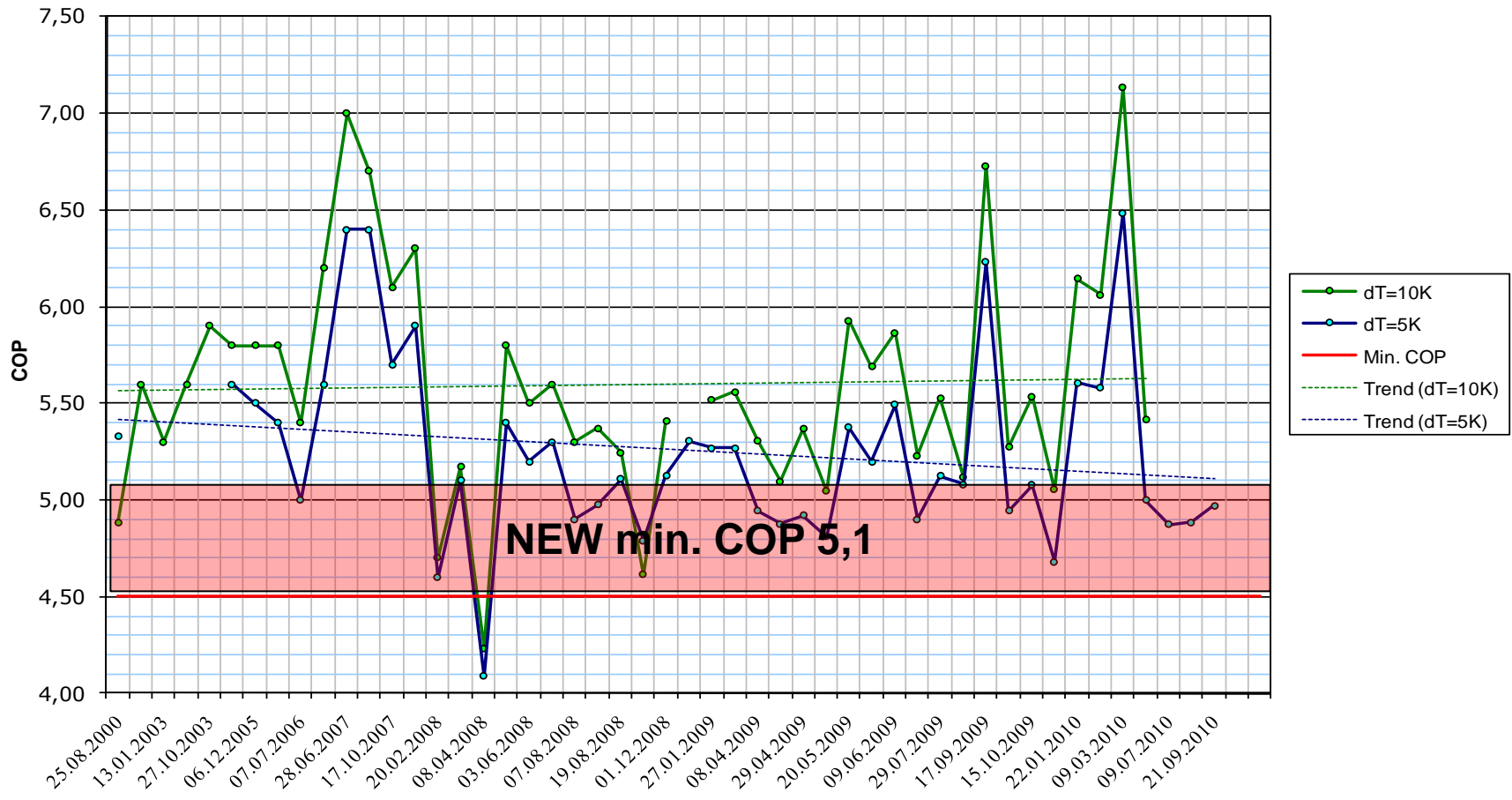


COP Development W/W - HP

COP W10/W35

dT= 10 K → DACH QL Regulation (EN 255)

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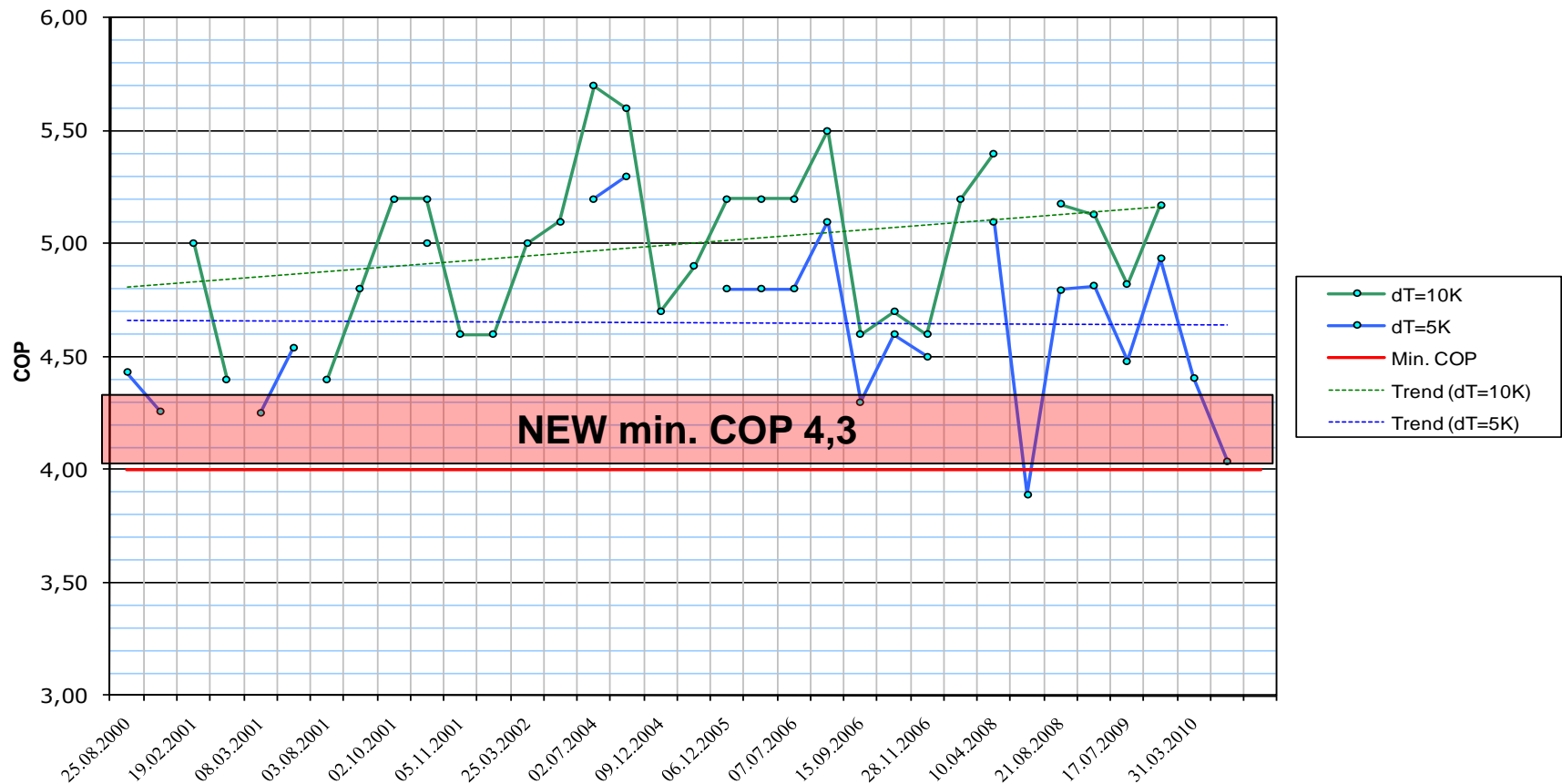


COP Development DX/W - HP

COP E4/W35

dT= 10 K → DACH QL Regulation (EN 255)

dT = 5 K → EHPA QL Regulation and EN 14511



Monitoring @ AIT

- Standardized Monitoring since 2002
 - System information through measurement data and questionnaire
- Data bank
 - analysis of collected data
- Analysis
 - SPF
 - temperature trends
 - electrical Input, thermal Output
 - TEWI
 - emissions



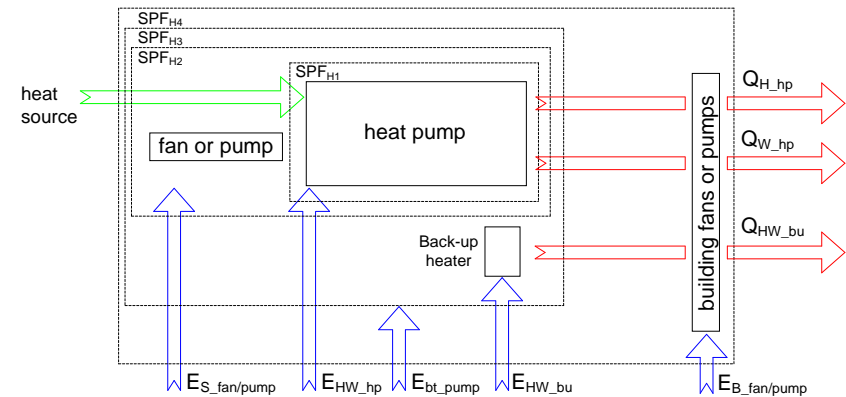
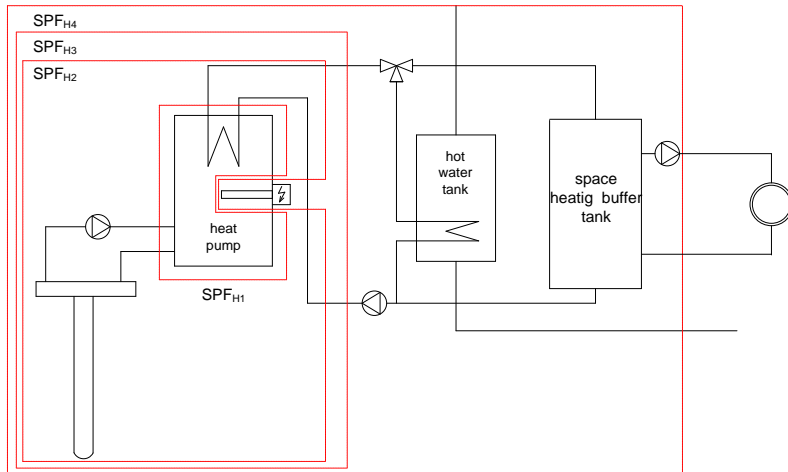
Monitoring @ AIT

- up to now 34 systems have been measured
 - A/W: 7
 - B/W: 7
 - DX/W: 19
 - W/W: 1
- running systems at the moment
total 10 (4 A/W, 6 B/W)
- planned systems
total 10 (3 A/W, 5 B/W, 2 DX/W)



System boundaries – IEE SEPEMO Build

- AIT measurements have been set up according to system boundary SPF H3



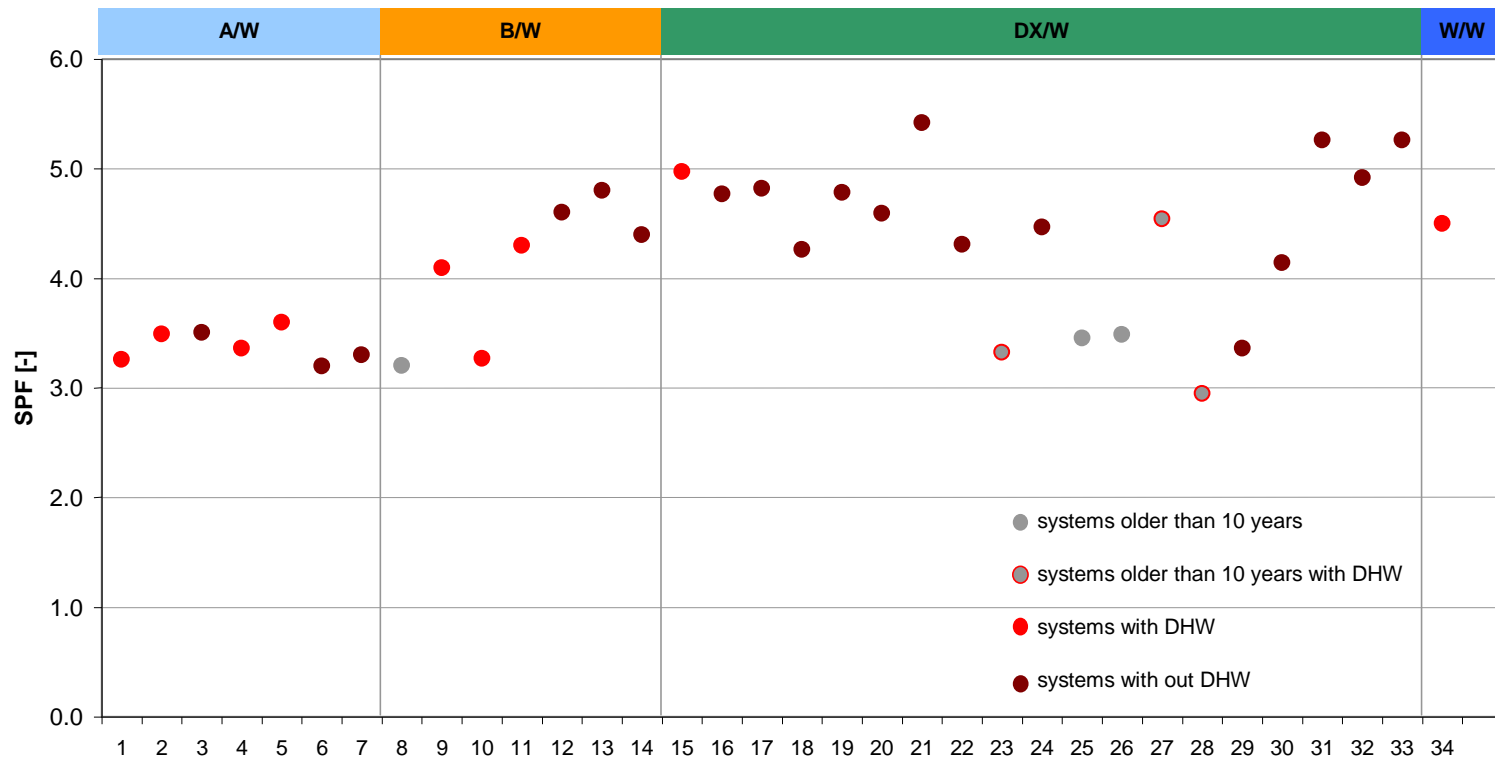
SPFH2:

This system contains of the heat pump unit and the equipment to make the source energy available for the heat pump. SPFH2 evaluate the performance of the HP operation, and this level of system boundary responds to SCOPNET in prEN 14825 and the RES-Directive requirements.

SPFH3:

This system contains of the heat pump unit, the equipment to make the source energy available and the back up heater. SPFH3 represents the heat pump system and thereby it can be used for comparison to conventional heating systems (e.g. oil, gas,...). This system boundary is similar to the SPF in VDI 4650 1, EN 15316-4-2 and the SCOPON in prEN 14825.

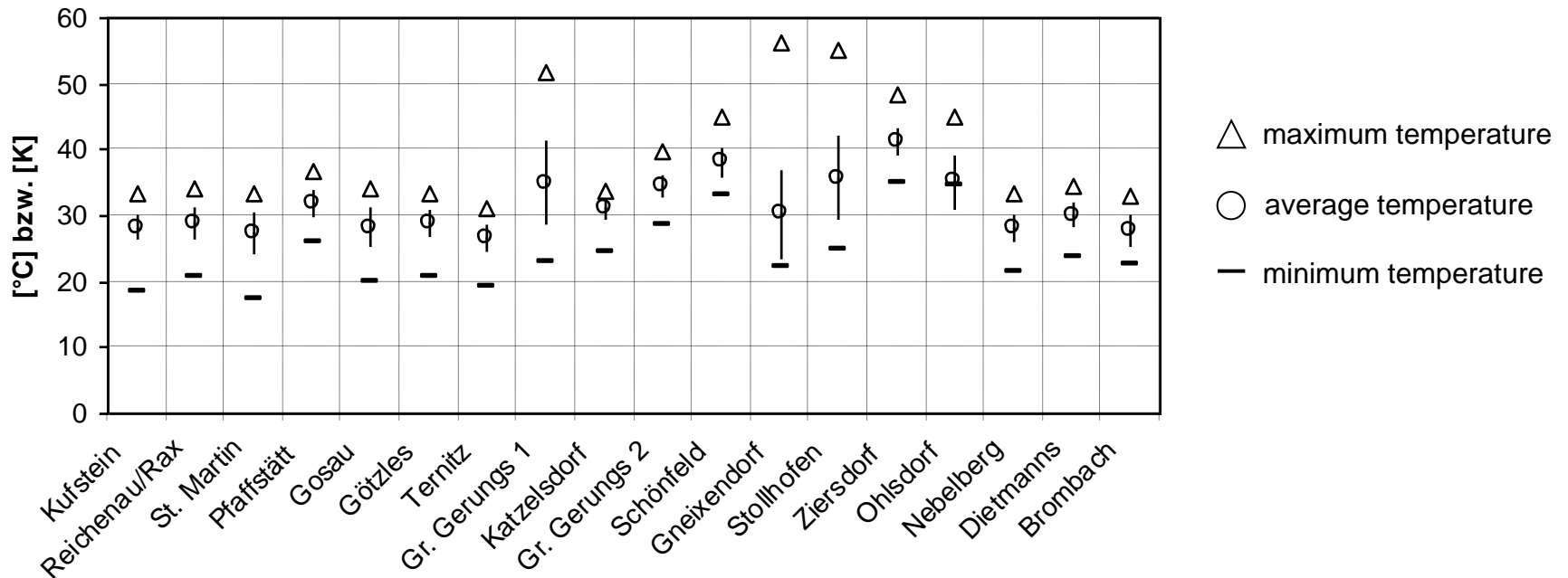
Measured Seasonal Performance Factor of different heat pump systems



DX/W-Systems

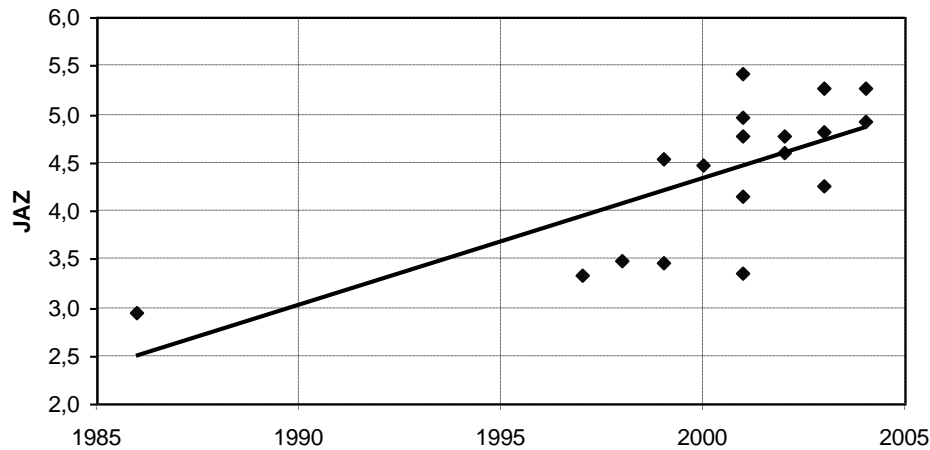
- Single family houses
- Average heated areas ~200 m²
- year of commissioning between 1986 and 2001
- year of monitoring between 2003 and 2005
- Average SPF 4,4
 - Lowest SPF 2,9 (oldest site 1986)
 - Highest SPF 5,4 (2001)

Supply temperature of the heat sink system during heat pump operation

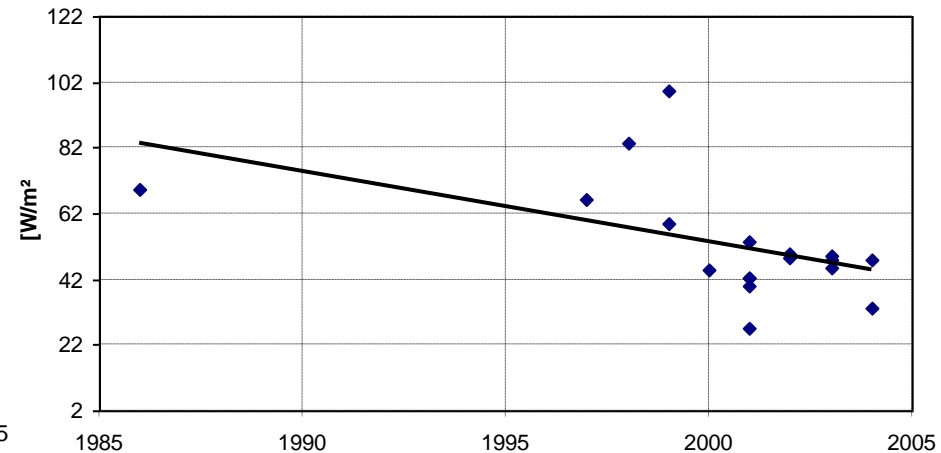


DX/W-Systems

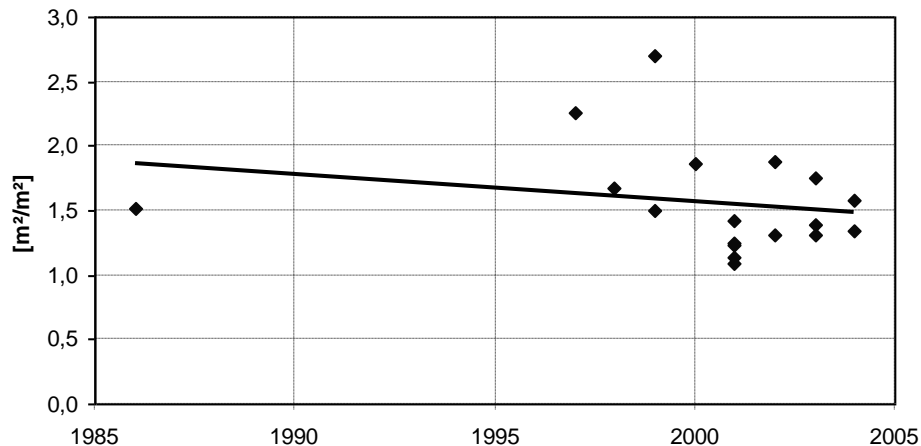
development of SPF



development of spec. heat load



ratio between horizontal collector area
and heated area



- increasing efficiencies
more renewable energy is used
- Increasing building standard
Steady ratio between horizontal collector area and heated area

B/W-Systems with bore hole heat exchanger



B/W-Systems

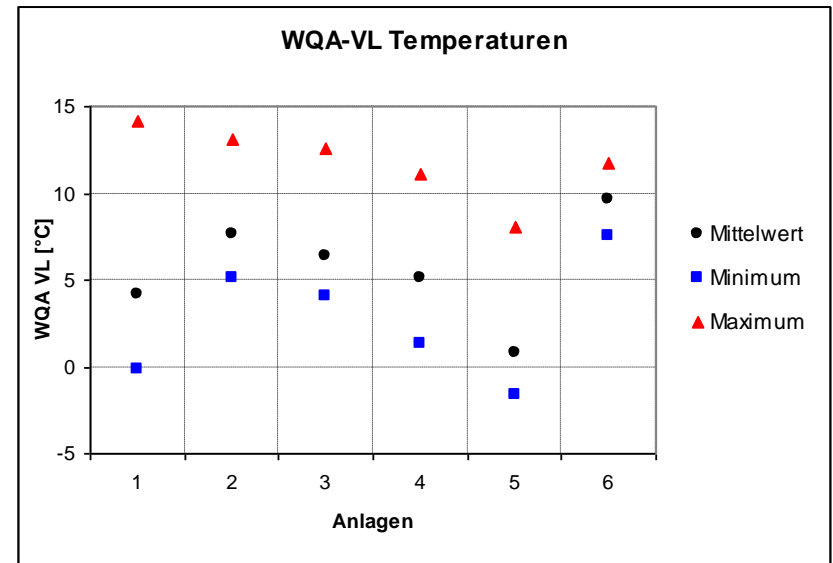
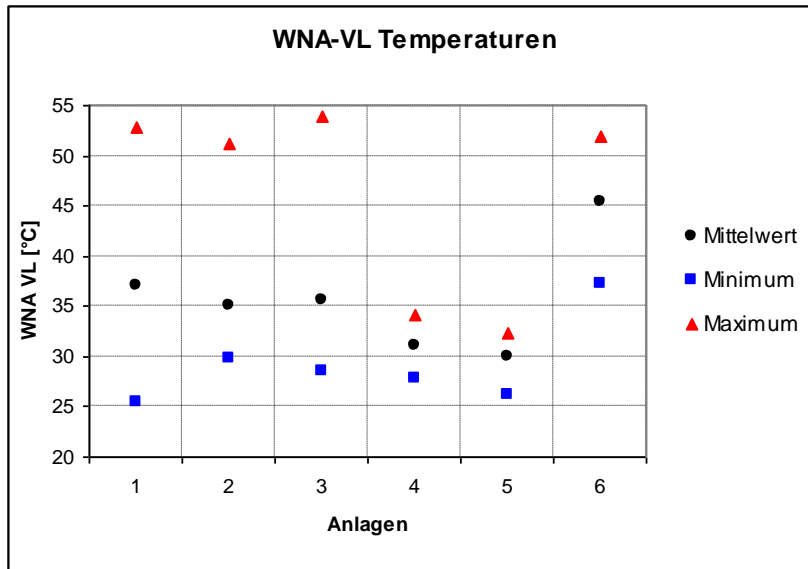
heat sink- and heat source temperatures

Supply temperature - heat sink system

During heat pump operation

Outlet temperature - bore hole heat exchanger

During heat pump operation



● average temperature

■ minimum temperature

▲ maximum temperature

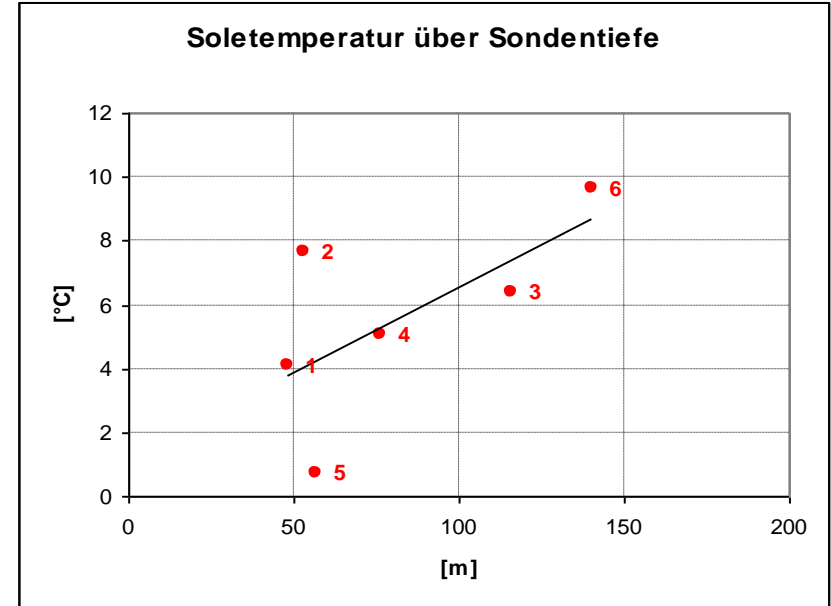
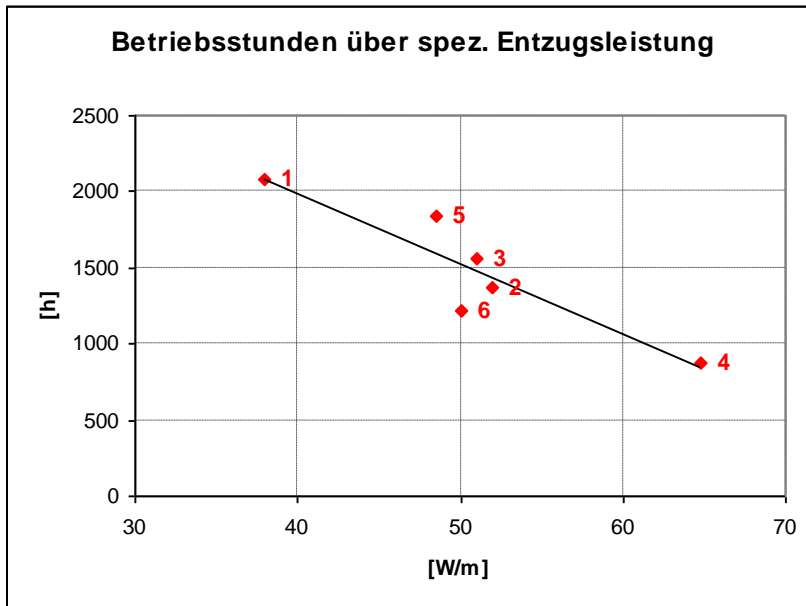
B/W-Systems

bore hole heat exchanger

Operating hours and specific abstraction capacity of the bore hole heat exchanger

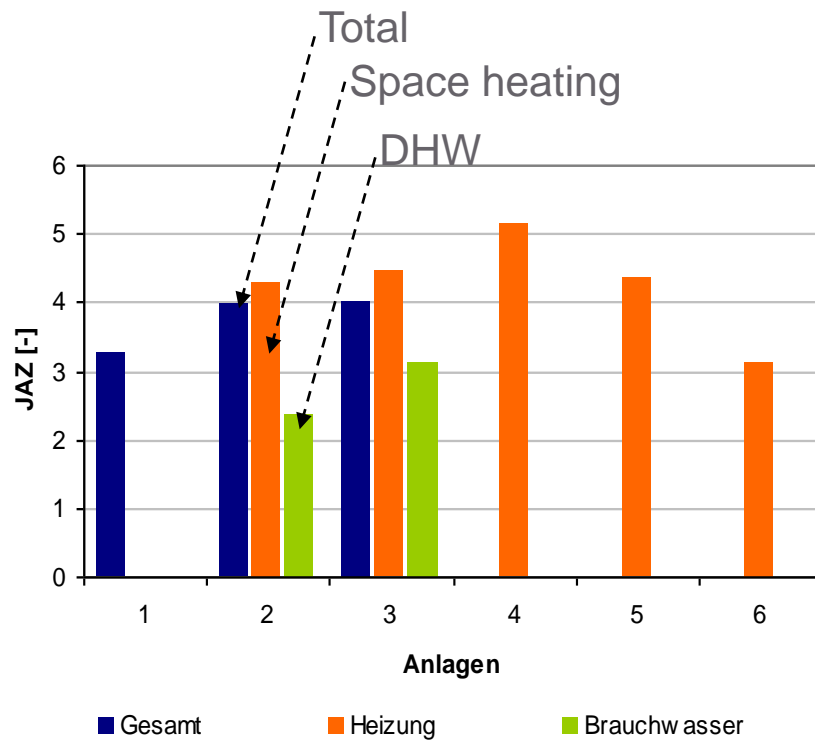
Outlet temperature - bore hole heat exchanger

Depended on the single bore hole heat exchanger length

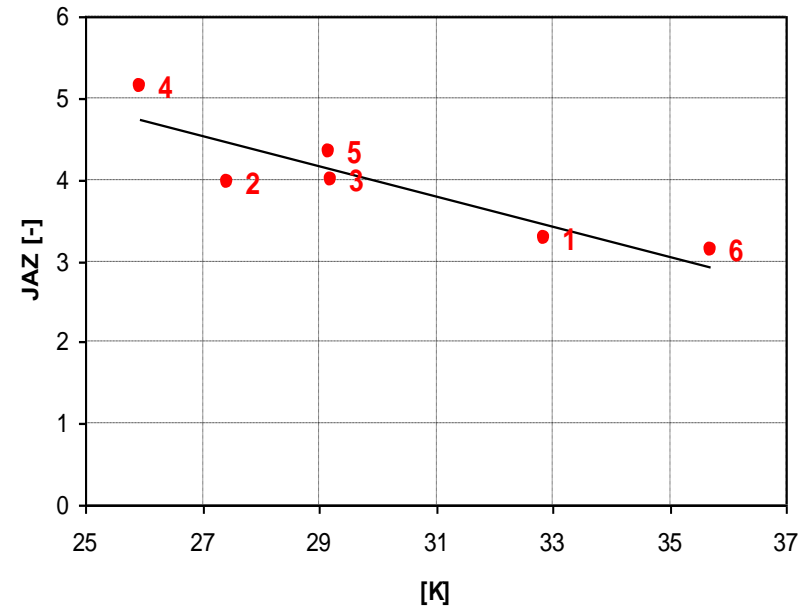


B/W-Systems

Seasonal Performance Factor



SPF dependent on the average temperature difference between heat sink and heat source



Conclusion

- Independent third party tests are important for quality assurance
- Higher min. COP will force the manufacturer to increase the efficiency of the units
- Proper system design and installation have most impact on the efficiency of the system
- Ground coupled systems
 $\text{SPF} > 4$
- Air to water heat pump systems
 $\text{SPF} > 3$

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