Annex 37

Technology Collaboration Programme on Heat Pumping Technologies (HPT TCP)

Demonstration of Field Measurements of Heat Pump Systems in Buildings

GOOD EXAMPLES WITH MODERN TECHNOLOGY

Air source heat pump | Ground source heat pump, horizontal ground loop | Ground source heat pump, vertical borehole

This project presents examples of domestic heat pump systems with good performance, and gives guidance on what could be considered good performance. Data from twelve installations in domestic houses (in Europe) were analysed in detail to illustrate the principles of design and installation that ensure good performance.

Success Stories

The results from this project show that:

1 **Heat pumps can reduce CO_2 emissions.** In Sweden and Switzerland, where the carbon content of electricity is low (0.04 kg CO_2/kWh, 2009 figures), using a heat pump resulted in average CO_2 savings of more than 5 tonnes annually as compared to an oil boiler for the evaluated sites. In the UK, the default fuel is gas and the carbon content of electricity is considerably higher (0.49 kg CO_2/kWh), evenso the average saving was still 1.25 tonnes CO_2/year.

2 **Substantial cost savings can be made with heat pumps**, depending on the heat pump efficiency and the relative prices of electricity and alternative fuels, see Figure 1. Annual cost savings were the highest in Sweden (which has cheap electricity and expensive oil) and the lowest in the UK (which has expensive electricity and relatively cheap gas).

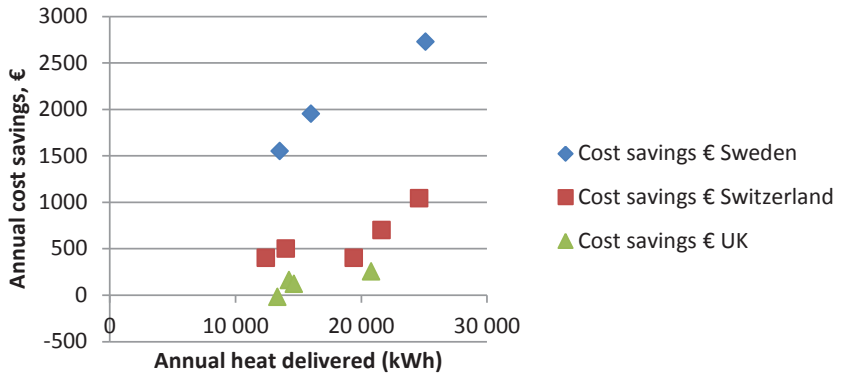
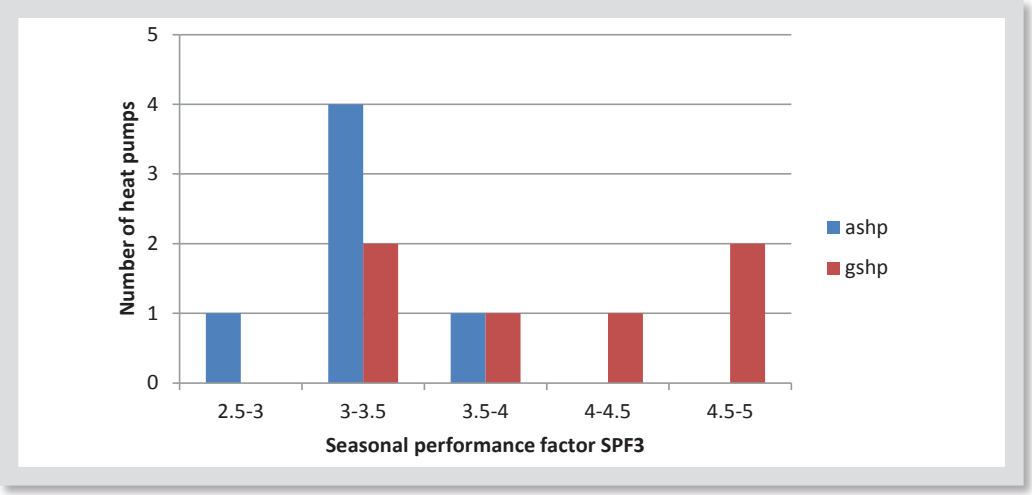


Figure 1. Cost savings versus annual heat delivered based on 2012 figures.

Results

The figure below shows the annual seasonal performance factors, presented as SPF_{H3} according to the SEPEMO-Build definitions for the twelve sites examined, where the heat pumps had been installed during the period 2008 – 2012.

The average performance of the air-source systems is 3.2, while the average performance of the ground-source systems is 4.1.



Conclusions

The conclusions from this project are that air-source systems should be considered as good systems – in real installations in the field – if they have an SPF_{H3} value of 2.8 – 3.2. The corresponding values for ground source systems are SPF3 of 3.3 – 3.9. See Table 1. These conclusions were drawn considering legal requirements from, for instance Energy Label and the Ecodesign regulations for space heaters in Europe, taking into account theoretically achievable levels and the positive effects on energy cost, CO_2 abatement and primary energy reductions.

New houses are here assumed to be equipped with floor heating systems and for retrofit installations radiators heating systems are assumed. Then the figures in Table 1 represent good performance in a real installation in the field. These values concern domestic hot water and space heating. Maximal supply temperatures for floor heating is assumed to be 35 °C and for radiator heating it is assumed to be 55 °C.

Table 1. Threshold values in order for a system to be regarded as a good system.

	ASHP, new	ASHP, retrofit	GSHP, new	GSHP, retrofit
SPF_{H3}	3.2	2.8	3.9	3.3

Methodology

The heat pump systems that were monitored and analysed in this project were located in Switzerland (5 units), the United Kingdom (UK) (4 units) and Sweden (3 units). A range of configurations was covered, as illustrated in Table 2 below.

Table 2. Description of evaluated heat pump systems.

Heat source	Heat sink	Domestic hot water provision	Heating capacity	Annual heat load (space + water)
6 ground source, 6 air-source	Underfloor, underfloor + radiators, and radiators	9 out of 12 systems	5 – 14 kW (average 7.6 kW)	12,400 – 25,100 kWh (average 17,500 kWh)

Further information

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Publications: Final Report of Annex 37 and Executive Summary of Annex 37, available at www.heatpumpingtechnologies.org