arsenal research
Ein Unternehmen der Austrian Research Centers.

ANNEX 28 – Task 1

Country report from Austria

Heinrich Huber, arsenal research

1 Introduction:

The Executive Committee originated in October 2002 the Annex 2002 in the context of the IEA Implementing Agreement on Heat Pumping Technologies (HPP) with the following member states: Germany, France, Great Britain, Japan, Canada, Norway, Sweden, Switzerland, USA and Austria.

The share of the heat demand for the heating of domestic hot water compared to the heat demand for space heating is growing continuously. Decisive for heat pump systems with combined space heating and heating of domestic hot water is the over-all efficiency for both tasks. However the existing test procedures are restricted to the separate space heating (or cooling) and the heating of domestic hot water. This Annex will investigate the testing of the most common combined heat pump systems with heating of domestic hot water.

In the course of this project a test procedure which delivers the data necessary to calculate the over-all seasonal performance factor of heat pump systems with a minimum requirement of testing equipment and testing time should be establish. Further more a simple method to calculate the seasonal performance factor for the heat pump systems will be worked out.

Four tasks are important for the course of the project

Task 1 Systems to be investigated
Task 2 Developing a test procedure
Task 3 Developing a calculation method

The intentions of this project are to establish a comprehensive test procedures for heat pump systems combining space and domestic hot water heating to be used by national and international standardisation institutions and to produce a simple methods to calculate the over-all seasonal performance factor of heat pump systems for the alternative and simultaneous space and domestic hot water heating.

Installers and planners can use this in the run-up of the system to get information about the efficiency. The test standard allows for the first time a comparison of heating pump systems. A further consequence of the comparison can cause higher quality in this sector. Professional articles and the internet assure a spread of information among the utilisation of available resources. An own homepage (www.annex28.net) informs about accomplished activities, deliverables and future development.

2 The analysis of the market should comprise the points:

- ***Which system configurations are commonly used and available on the market (basic data of market share, field of application…)***

The start of the heat pump market is activating from the first oil price shock 1975. The market share from the hot water heat pumps is strong increasing up to the year 1987. From the year 1988 the market is degreasing by the development from solar thermal collectors for hot water production. But in the last years the market is lightly increasing because of better quality of hot water heat pumps and more experience and education of heat pump installers.
The market share of heat pumps for space heating is increasing constantly in the last ten years.

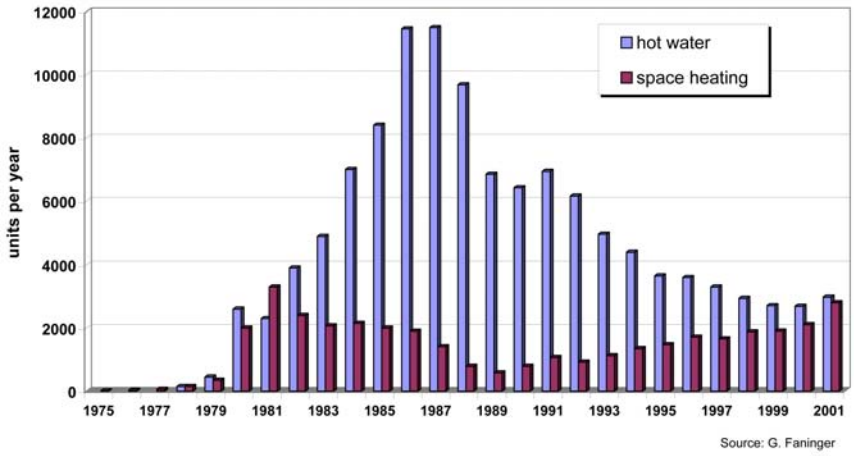

Figure 1: heat pump market in Austria

The division of heat pump systems is dominated by 80% ground coupled heat pumps, 44% are heat pumps with direct expansion.

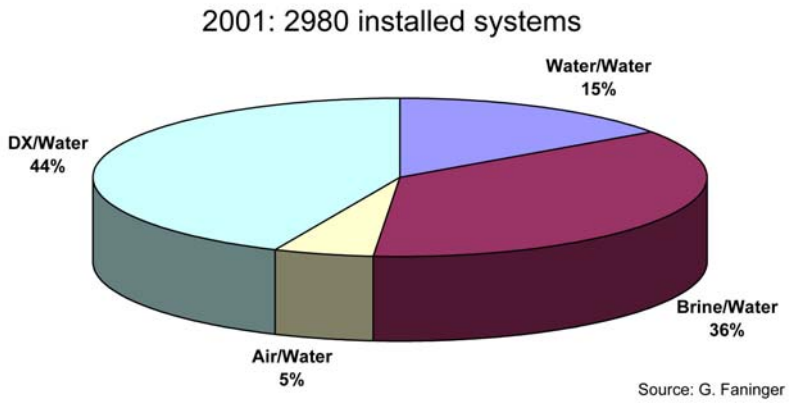

Figure 2: division of heat pump systems

On the Austrian Market the following combined system configurations are available:

1) The standard system (Figure 3): An alternating check valve changes the heat output from the low temperature heating system to the tap water boiler by hot water demand. A heat exchanger heats the tap water in the boiler.

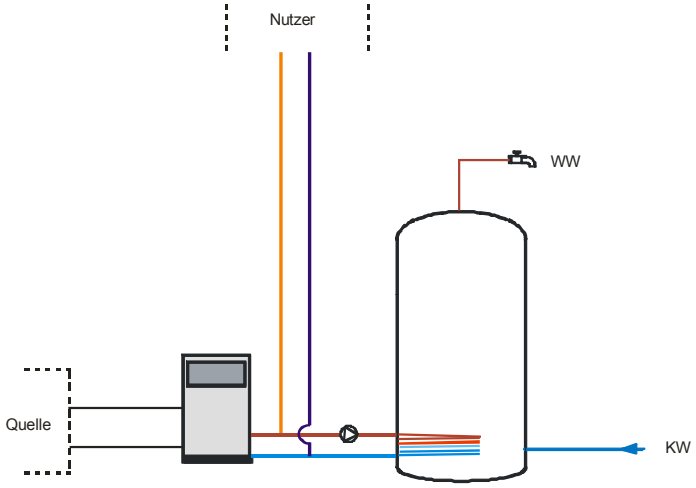

Figure 3: standard storage

2) The “fresh water system” (Figure 4): An alternating check valve changes the heat output from the low temperature heating system to the boiler by hot water demand. The heat transfer medium in the boiler is the same as in the heating system. The hot water is heated by an external heat exchanger at continuous principle.

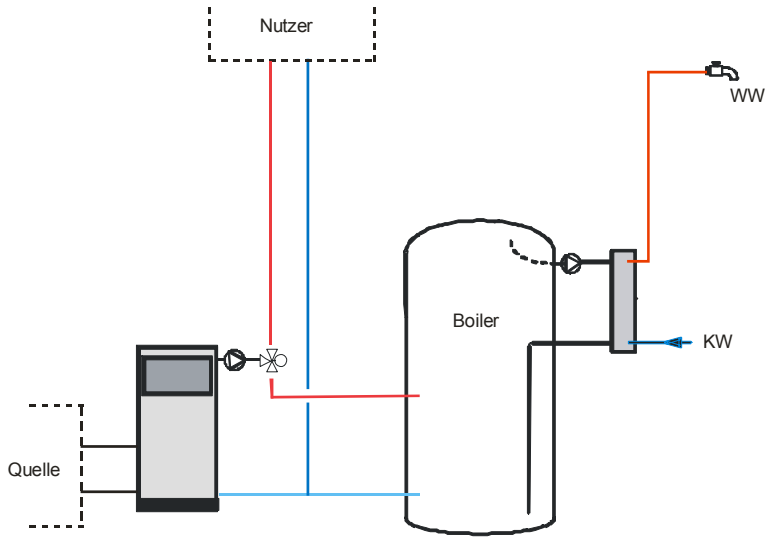

Figure 4: fresh water system

3) The “combined boiler system with desuperheating” (Figure 5): The heat pump operates with a plate heat exchanger for desuperheating and with a second heat exchanger for the heating. The heat of the desuperheating heat exchanger is directly connected to the hot water boiler. The heating outlet of the heat pump is connected with the heating storage of the combined boiler system.

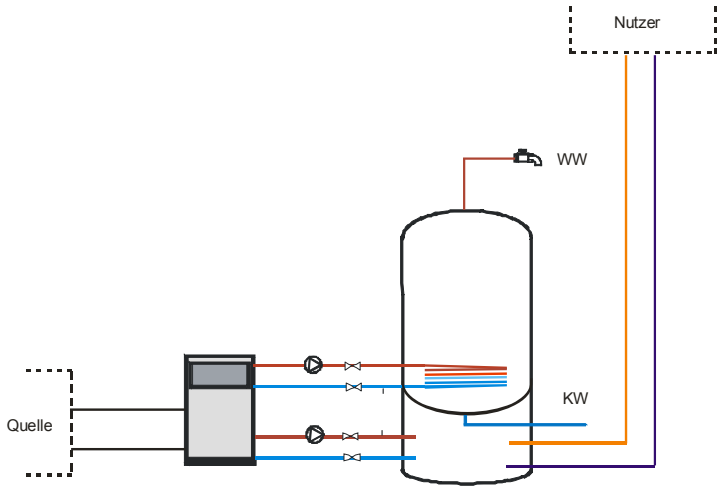

Figure 5: Combined boiler

4) The “combined boiler system with desuperheating - lance” (Figure 6): The boiler is split up into two parts by a separating layer plate. The upper part is used for the hot water storage with the desuperheating lance. The lower part is used for the space heating. In addition to the desuperheating lance the three way valve changes the heating water flow in the upper storage part if the heat pump is operating in hot water preparing mode.

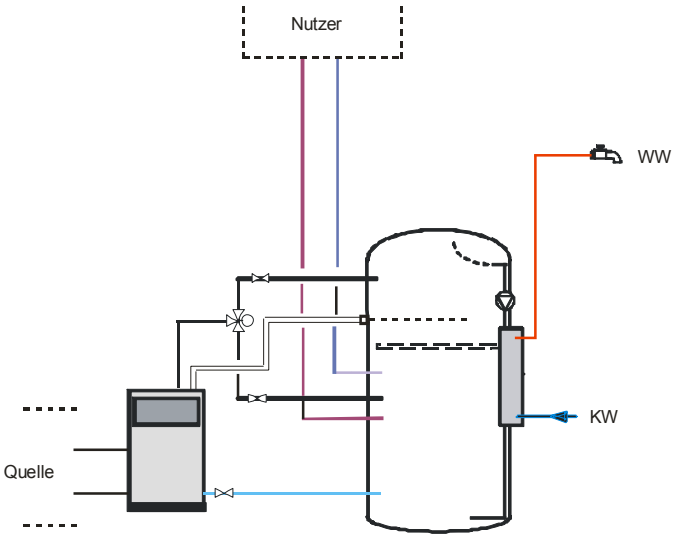

Figure 6: Combined storage with desuperheating (lance)

- ***Which systems are under development***

  Under development are the “fresh water systems”. One of the development potential is the optimisation of the heat transfer medium mass flow in the heat exchanger with RPM-regulated circulation pumps. A second point is the optimisation from the refrigerant desuperheating in the refrigerant circuit.

- ***Which information about the systems are publicly available (testing results, other input data for the calculation)***

  A draft of a test report from the first heat pump test is in the appendix.

- ***Which standard testing and calculation is normally applied for the systems***

  The EN 255-3 is only the test standard in Austria. But normally the systems are not tested in according to this standard.

- ***Are there requirements concerning a minimum efficiency***

  In Austria requirements for a minimum efficiency for hot water production are not available. But some governments of Austria’s federal states are thinking about to prepare requirements to advancement combined heat pumps systems. The advancement is to be dependent on the efficiency.

Concerning **standards** this refers to the following items:
Testing:

- ***Which standards exist for testing and calculation***

  ÖNORM EN 255-3; 1st April 1998; Air conditioners, liquid chilling packages and heat pumps with electrically driven compressors – Heating mode – Part 3:Testing an requirements for marking for sanitary hot water units (includes corrigendum AC: 1997)

- ***Which standards are used, how are the standards implemented (national annexes of common standards (CEN, ASHRAE,…), linked regulations…)***

  ÖNORM EN 255-3; 1st April 1998; Air conditioners, liquid chilling packages and heat pumps with electrically driven compressors – Heating mode – Part 3:Testing an requirements for marking for sanitary hot water units (includes corrigendum AC: 1997)

  ASHRAE 137-1995; June 1995; Methods of testing for efficiency of space-conditioning/ water heating appliances that include a desuperheater water heater

- ***What is missing with regard to combined operation?***

  The standard EN255-3 doesn't make any difference between the different storage systems, which are:

  - Standard storage
  - Storage with fresh water system
  - Combined storage
  - Combined storage with desuperheating (separate storage, storage with separating layer plate)

  The calculated COP according to the EN 255-3 doesn't regard the storage. The storage losses improve the COP of the heat pump. Therefore the efficiency of the whole system isn't evaluated.

  The standard should include the test point in the heating mode and a test procedure for the summer/winter season with regard to the source temperatures.

  In the Standard EN 255-3 is also missing a test procedure for the Cooling mode from brine systems.

3 Calculation:

- ***Dependency on energy requirements, regulations, energy labels (e.g. impact of building standard, legionella for DHW temperature)***

  At the moment the calculation doesn't depend on any regulations or standards.

- ***Which physical effects are considered in the methods (e.g. changing source and sink temperature, part load operation, bivalent operation etc.)***

  The heat source temperature, refrigerating capacity, specific heat capacity and the annually temperature profile should be included in the calculation method.

- ***How the calculation is performed (default values of SPF, standard testing COPs corrected with factors, more detailed calculation of physical effect…)***

  The basis should be COPs from standard testing EN 255-3, whereby shall be try to include the different storage systems during the tests. Acting on the tests would be tried to develop a calculation method with the physical parameters. The first evaluation is carried out with the simulating program WP-OPT. The second evaluation agreed with the results from the monitoring of heat pump systems. During this evaluation the hand calculate method shall be reduced and optimised in an easy calculation method.

  VDI 4650; draft, Nov. 2000; Calculation of heat pumps, short procedure for the calculation of the seasonal performance factor (SPF) of heat pumps, electric heat pump for room heating

o Meteorological data:

- ***are there standardised meteorological data sets used for the calculation of energy systems in the different countries (e.g. test reference years)***

  We will use the metrological data (Klimadaten von Österreich) from the ZAMG.

- ***what information or calculation methods exist for the heat source (e.g. ground, water)***

  The ground temperature is used from the “Atlas of Geothermal Resources”, GGA-Institute, Hanover.

o Demand:

- ***which building standards exist, what are limits prescribed by the local authorities, do building labels exist***

  Austria has nine provinces with separate building regulations and different building advancement. Therefore different standards exist in Austria. The new EU directive of buildings is to lead over in national right in Austria by the end of 2006.

- ***which are the usual domestic hot water temperatures used***

  The usual domestic hot water temperature is for personal hygiene 34 °C up to 38 °C and for washing up approximate 45°C.

- ***what kind of standard tapping profiles exist in standards or regulations***

  In Austrian standards or regulations inclouding water tapping profiles do not exist.

- ***Are there regulation concerning legionella***

  - BGBl 304/2001 Trinkwasserverordnung - Austria

  - Worksheets DVGW W551, W552, W553 - Germany

4 Electricity supply

- ***What tariffs exist in connection with heat pumps***

  The tariffs of energy supply are in the province of Austria very different. In some energy supply companies deliver electricity during all day to the same tariff, but with a right to interrupt the supply from heat pumps for one or two hours. Other energy supply companies deliver electricity to a lower price during the night.

- ***Is there interrupted supply (cut-off time) of the heat pump (remote control for heat pump electricity supply)***

  The energy supply companies interrupt the electricity supply for heat pumps via remote control signal.

- ***What are the consequence for the heat pump operation and design***

  Heat pump systems in supply area of interrupt electricity supply are designed with storage tanks for the heating demand covering during the cut-off time.

- ***Standard system design:***

  How systems are normally used in the country (e.g. common system design heat pumps system: heat pump systems for bivalent operation, monovalent systems, as far as it is possible to generalise that)

  The most heat pump systems are monovalente systems (95% are ground source systems) only 5% are air to water systems thus bivalent systems. For hot water preparing different systems are used. On the one hand heat pumps only for hot water preparing, these systems use air or direct expansion systems as heat source, and on the other hand heat pumps for space heating in alternative operating for hot water preparing.

5 Refrigerants

- ***Are certain refrigerants prohibited or are to be prohibited in the near future and what are the consequences for the system design***

  The Austrian government it was decided and to enact an ordinance for prohibition of F-gases at December 2002. This ordinance should replace the F-gases through natural refrigerants, e.g. CO2, propane or ammoniac, in heat pumps and chillers. The time frame for the realising this ordinance is the end of 2007 for new installed systems. 2005 is provided to make a review for an adaptation the ordinance. The Austrian heat pump industry makes a monitoring of heat pump systems in order to demonstrate the efficiently and leak tightness of heat pumps and the potential to reduce the green house emissions.