Quality of heat pump systems through high-quality training schedules

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Abstract

During the last 20 years heat pump technology was slowly but constantly driven further. Better components, new refrigerants, experiences in designing systems, quality labels and training schedules, combined with national incentive policies and other changes in the framework conditions supported a stable market development, which is just now starting to grow significantly in some countries.
A crucial point in developing heat pump markets tumed out to be the quality of the planning and installing the heat pump systems to raise the confidence of the consumer. Therefore training courses where started in many countries, the Austrian Certified Heat Pump Installer is one very effective example. The next step could be a joint European vocational training and certification system to continue the positive market development of the heat pump technology. We received an official statement by the City of Vienna that our project "Renewable Energy Western Hungary" has been in the INTERREG III/A programme assessed positive.
We are planning the development of geothermal energy during this programme.

1. Introduction

The heat pump market in Europe did not have an easy start during the 80ies compared to the markets in the US and in Japan. The predominance of water type central heating systems and the very low degree of development of air conditioning in Europe meant that the conditions for replacing old systems by heat pumps were technically much more difficult and that most plumbers were not capable of installing this type of product.
In Austria the heat pump market for example collapsed dramatically after a good start at the end of the 80ies [Faninger 2000]).
Beside the fact, that oil prices were falling again, the low quality of many installed systems destroyed the consumers confidence sustainably. Since the early 90ies the Austrian heat pump market for space heating systems increases again. This development was driven further by a common effort of industry, installers, the LGW,

the Austrian testing institute arsenal research and a close cooperation on quality aspects with Germany and Switzerland in the D-A-CH heat pump organisation.
Wherever studies on the development of the heat pump markets are published they came to almost the same factors of success:
1. The quality of the planning and installation is of major importance
2. The heat pump itsself has to be a quality product, which has to be tested
3. Maintenance of the systems has to be guaranteed
4. Heat pumps should be used with low energy buildings, together with low temperature heating systems.
During the last years many countries started initiatives and training programs to overcome the first point mentioned above, however the range of curricula is very diverse.

2. Heat Pump market and Quality Measures in Austria

Let us start with a short glimpse on the market characteristics in Austria [Faninger 2000]. All together there are about 153.897 heat pumps installed (space heating, hot water production, swimming pools). During the year 2000 in total 4891 heat pump systems were installed, 56 % for hot water preparation and 42 % for space heating and 2% for heating swimming pools.
The total amount of heat pump space heating systems was 2108, whereas about 77 % are ground coupled systems, 16 % are water/water systems and 7% are air/water systems. A special feature in Austria are direct expansion systems representing more than 60% of ground coupled space heating systems, the rest are sole/water systems as usual.
To summarize the market overview in Austria it is interesting to look at the federal states and their heat pump markets. Following different incentive policies of the state and the energy supplier and the pioneer work several installing companies did, the market development is very scattered, and the Austrian task is now what the European task should be too: find best practice examples and transfer know - how to other regions. Uniform training schedules could be one first and important step.
As a first step a task force - "Environmental Energy - heat pumps"- embedded in the Austrian chamber of commerce, was founded in 1976. Since 1990 the task force reorganised and founded the Austrian Heat Pump Association LGW (Leistungsgemeinschaft Wärmepumpe).
From the beginning the main goals where lobbying, market review, awareness raising and advertising. The LGW focused additionally strongly on quality aspects.
Quality of heat pump systems rely at least upon two factors - the heat pump machine on one hand and the whole system design and installation on the other hand. In Austria the producers started with a quality label for the machines.
Together with the federal German organisation (Initiativkreis Wärmepumpe) and Suisse organisation (Fördergemeinschaft Wärmepumpe) and the LGW the discussion of quality assurance was raised on a transnational level in the D-A-CH organisation. 1998 the D-A-CH quality label was passed. This label includes CE-conformity, minimum standards for planning documents, complete installation and maintenance manual, service network, guaranteed service in between 24 hours, 10 years of spare part guarantee, 2 years full guarantee after installation, testing according to EN 255, security tests, measurement of noise emissions, minimum performance factors, and so on.

To strengthen the quality campaign in Austria the LGW suggested to realise a heat pump test center. As direct expansion technology, as mentioned above, is very important in Austria, arsenal research developed together with Univ. Prof. Dr. Halozan from the Technical University in Graz a testing facility which is designed to test sole /water and water/water heat pumps as well as direct expansion machines. The testing center was opened in 1999. Since then the team in the heat pump test center is involved in testing, research and development, monitoring of systems, other projects and last not least education measures.

3. The Austrian Certified Heat Pump Installer

As mentioned before the efficiency and quality of heating systems not only depend on the machines but very strongly on the quality of the planning, design and installation of the whole system.
As we know heat pump space heating systems are more complicated than other heating systems. Any installer who wants to start with heat pump technology needs a mixture of skills which are normally covered by different professions (electro-technical engineer, installer for space heating, refrigeration engineering....). Additionally in some European regions we face the problem that at the moment markets are growing faster than the pool of qualified installers can satisfy. This situation could again result in badly installed systems which could have a similar dramatic effect on the stable development of the heat pump market as we witnessed already in the early 80ies.
To cope with these problems the LGW organised a first pilot training course in Linz in 1999.
More than 20 trainees attended the course, which consisted of mainly theoretical work on refrigeration and heat pump technology. The feedback was highly motivating, but organisational questions came up:

- The courses should be organised regularly and in different cities all over Austria.
- The training should include practical modules, which means that a suitable infrastructure has to be provided.
- The examination at the end of the courses should become a marketing asset.
  It should be possible to guarantee a common level of training targets across Austria.
- The training targets have to be updated regularly.
  Is it possible to add further quality assurance measures for installers around this training schedule (e.g. monitoring of systems).
- The price has to be kept on a reasonable level.

With this background the Austrian Heat Pump Association - LGW - asked arsenal research to develop and implement a training schedule.
To fulfill the need, that the training schedule should keep a harmonized quality level, that a marketing asset should be created and that the installers should rather be involved in a quality process than a single examination, the decision for a certification scheme was clear and the *Austrian Certified Heat Pump Installer* was created.
Basis for the certification process is the European Standard EN 45013, a standard which describes the requirements certifying bodies have to fulfill as well as the certifying process of personnel. This standard is based on international documentation, particularly ISO/IEC Guide 40 and describes the necessary administrative structure, requirements on the certification personnel, requirements for the certification and surveillance procedure, the quality manual, the withdrawal and cancellation of

certificates, questions of confidentiality and more. The training targets for the course are based on the European Standard EN 13313, which describes the competence of personnel for refrigerating systems and heat pumps. Additionally the design of the training targets for the profession of a heating installer and a refrigeration technicien were used as a basis.
Beside the training course and the examination other requirements have to be fulfilled to be certified:

- The person has learned one out of the following professions: water and gas installer, space heating installer, electricien, refrigeratian technicien or similar or he/she has finished a similar technical school or high school.
- The documentation of one planned system has to be presented.
- One system has to be monitored according to given rules.
- Every second year the certified person has to prove further training or attending specialised events.
- The certified person is obliged to document complaints about installed systems and has to provide this information to the certifying body.
- The installer has to be active in the field of heat pumps and has to document the installed systems and provide this information to the certifying body.
- A certification agreement has to be signed.

As mentioned above, every certified heat pump installer has to monitor at least one system. Beside the fact that this brings additional knowledge and confidence for the installers and even for the customers, the planned data base, including all monitored systems will be a very valuable marketing instrument for the heat pump market in Austria. Arsenal research will start a big monitoring program in autumn throughout Austria.

The development of the courses started with the selection and elaboration of the contents:

- Renewable Energy, world energy problems, sustainable energy supply
- Indoor house engeneering, heating technology, low temperature heating systems
- Heat pump technology, refrigeration technology
- Design and planning of systems, examples of best and worst practice
- Introduction into geological basic knowledge
- Marketing, Policies, Subsidies
- Legal framework conditions
- Practical training with heat pump models: evacuation, filling with refrigerants, describing and measuring the main values of the refrigeration cycle, search for failures, soldering...and so on. Based on these contents standardized booklets and examination catalogues were prepared.

As the maximum number of participants was 25 in one course it was possible so far to fulfill special requirements of each group to a certain extent.
The schedule consists of 4 modules a 3 days (Thursday, Friday, Saturday), three modules are theoretical modules and organised in the cities named above, the fourth module includes the practical work and the theoretical and practical examination at arsenal research. For the realisation of the courses the big Austrian vocational training institutes WIFI and BFI were partner institutions. At the end of this year a reassessment, reorganisation and upgrade will be organised.
The development of the schedule was an investment of arsenal research. The running costs of the courses are financed by the trainee´s fees. In 2001 courses were organised in

Linz, Wels and Wien, in 2002 in Klagenfurt and Innsbruck. The planning for 2003 started - Wels and Klagenfurt are already fixed. Until now in total over 100 installers attended the course. The feedback from the courses was extremely positive.

4. The European Vision

Because of emerging markets, the need for quality assurance and the conviction that a European effort would help this technology much more than diverse national actions, it is the right time to develop a common strategy. A common European certification scheme could be a major step and has to include the following topics:

- Jointly agreed training targets for heat pump installers
- European curricula for training courses
- Development of a European certification scheme training courses all over Europe
- Certified Heat Pump Installers on an European basis
- Standardised on-site monitoring data gathered from the certification process
- Initiation of the extension of the training & certification scheme to candidate countries, etc.

As mentioned at the beginning of this article, many European countries started training courses for heat pump installers. A very good overview of national activities throughout Europe gives the outcome of the Thermie project *Heat - Pump Training Programmes for targeted groups - a first overview* (Contract. No. DIS/1638/98), in which training courses are listed and compared.

As an example the market leader Sweden should be mentioned. Several courses started organised by different organisations. In April 2002 a new training schedule is lounched by Mid Sweden University and SVEP - the Swedish Heat Pump association, representing more than 600 installers. This training schedule will be coupled to a certification scheme.

In the previous meeting of the EHPA (European Heat Pump Association), a working group on education & training was started. An EU - SAVE Proposal was presented and supported strongly - the European Certified Heat - Pump Installer.

This project should develop and implement the Certified Heat Pump Installer on an European level, beside the EHPA, many countries are involved, like Austria, the Czech Republic, Ireland, Italy, France, Slovenia, Sweden and the UK. During the process of developing and implementing the European Certification scheme additional partners are welcome.

Beside the positive effects of having a growing pool of well trained heat pump installers, the

European Certified Heat Pump Installer is a perfect marketing instrument. A trademark could be created and promoted at national and international scale for improving customers perception of this technology.

Heat pumps are one of the suggested measures in the *White Paper Energy for the Future:*

Renewable sources of Energy as well as in the *Directive of the European Parliament and the Council on Energy Performance of Buildings*. This means that the political framework is given, but it is our responsibility to secure a high quality education all over Europe in order to promote and install high quality heat pump systems.

5. References

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