CERTIFICATION OF HEAT PUMP INSTALLERS

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Abstract: In the EU countries different quality concepts and certification procedures exist in the building and installation process, next to standards and installation guidelines. Different existing certification schemes for heat pump installers in the participating countries have been analysed in the European SEPEMO-project. As certification is one of the important topics in the European Renewable Energy Directive, important questions are discussed such as: mandatory or voluntary certification, company or personal certification, methods for auditing and training courses. On certification for heat pumps other European directives have to been taken into account as well as legislative measures on local level for ground source systems. Also the question is raised if certification only is sufficient to guarantee the performance, as in a well designed and tuned installation the performance gets more and more dependent on the quality of the building envelope.

Key Words: European Certification, Quality Label, Installers, Domestic Buildings, Training, System Certification

1 INTRODUCTION

It is widely recognised that heat pump systems performance largely depends on the climate, user behaviour and quality of installation and not only on the product itself. While quality labels exist that set a minimum performance level (i.e. EHPA Quality Label for HP, EU ECO-label) performance of heat pumps in the field varies widely. This triggers a lot of criticism and mistrust, affecting the acceptance in the market considerably.

Basis for an improvement of this situation is a set of comparable data of heat pump performance in real application. The European SEPEMO project takes on this task. It was started to gain experience from existing and new heat pump projects by monitoring real performance of various heat pump concepts in different climate zones of Europe and different building traditions. A standard definition for the season performance factor (SPF) has been developed and will be used in field test. This will be presented in session 4 of the Conference by Anreas Zottl and Roger Nordman. SEPEMO has three main goals

- development of a universal measurement approach on seasonal performance of heat pump systems

- gaining knowledge on the impact of system configuration on system performance by analyzing measurement data and to identify best practices solutions
- identify installation issues and develop and standardise training programs for installers

The results from the project are expected to lead to guide lines for system quality and input for training programs which can be used as a basis for certification of system quality. Thus increasing the performance, economy in practical applications and therewith the general acceptance of heat pumps as an efficient and reliable energy systems using renewable sources.

Important observations from practical projects have shown that in well designed and tuned installations the performance gets more and more dependent on the quality of the building envelope. This is leading to the practice in some projects that in the quality process a commissioning protocol and a quality guarantee on the building process is needed. Therewith a need has occurred to get the certification process as much as possible in line with the existing building codes.

2 EUROPEAN DIRECTIVE ON RENEWABLE ENERGY

On 23 April 2009 the European Parliament and Council passed Directive 2009/28/EC dealing with the promotion of the use of energy from renewable sources. The Directive discusses various subjects related to the development of renewable energies in the European Union and sets among others the legally binding share of renewable energy in gross final energy consumption to be achieved in the Member States. This Directive is the first document, which officially acknowledges that (low enthalpy) air, water and shallow ground are renewable energy sources to be used by heat pumps technology.

In Article 4 of the Directive each Member State is requested to provide a National Renewable Energy Action Plan (NREAP) by 30 June 2010, in order show how it expects to meet its 2020 target, including the technology mix and the trajectory to reach it. Article 14.3 of the Directive deals with certification of installers and states that: “Member States shall ensure that certification schemes or equivalent qualification schemes become or are available by 31 December 2012 for installers of small-scale biomass boilers and stoves, solar photovoltaic and solar thermal systems, shallow geothermal systems and heat pumps. Those schemes may take into account existing schemes and structures as appropriate, and shall be based on the criteria laid down in Annex IV. Each Member State shall recognise certification awarded by other Member States in accordance with those criteria.”

In Annex IV it is stated that a certified heat pump installer must have the skills required to install the relevant equipments and systems to meet the performance (SPF as under AnnexVII) and reliability needs of the customer. The certification or qualification process shall be transparent and clearly defined by the Member State or the administrative body they appoint. This clearly states that the responsibility for the certification process lies with the government, just as in the case of typical environmental legislation as with the F-gas regulation and/or the EPBD on HVAC.

AnnexIV focuses on relatively small renewable energy installations typical for domestic buildings and small commercial buildings. Conventional technologies do not fall under directive.

As emphasis is laid in the RES-directive on the conditions for the training courses it seems to focus on a certification on personal basis. The training for installers shall include both theoretical and practical parts where at the end of the training, the installer must have the skills required to install the relevant equipments and systems to meet the performance and reliability needs of the customer, incorporate quality craftsmanship, and comply with all applicable codes and standards, including energy and ECO labelling. However certification of installer companies also fall under the RES-directive and it completely depends on the interpretation of the member states (see also the discussion under paragraph 6.

Notable under Annex IV is the need to meet the performance and reliability needs of the customer. This means that the focus in de Directive is also a method to give a certain guarantee for performance. Thus the quality concept is directly translated into 'delivering according to the demands and needs of the customer'. Which is basically what quality is all about!

In general the theoretical part of the heat pump installer training should give an overview of the market situation for heat pumps. It should further cover geothermal resources and ground source temperatures of different regions, soil and rock identification for thermal conductivity, regulations on using geothermal resources, feasibility of using heat pumps in buildings and determining the most suitable heat pump system, and knowledge about their technical requirements, safety, air filtering, connection with the heat source and system layout.

The installer should demonstrate the following practical key competences:

- a basic understanding of the physical and operation principles of a heat pump, including characteristics of the heat pump circle: context between low temperatures of the heat sink, high temperatures of the heat source, and the efficiency of the system, determination of the coefficient of performance (COP) and seasonal performance factor (SPF);

- an understanding of the components and their function within a heat pump circle, including the compressor, expansion valve, evaporator, condenser, fixtures and fittings, lubricating oil, refrigerant, superheating and sub cooling and cooling possibilities with heat pumps; and

- the ability to choose and size the components in typical installation situations, including determining the typical values of the heat load of different buildings and for hot water production based on energy consumption, determining the capacity of the heat pump on the heat load for hot water production, on the storage mass of the building and on interruptible current supply; determine buffer tank component and its volume and integration of a second heating system.

On national level, training courses are often based upon installation guide lines which have been developed on local experience. It can be imagined that these training courses do not include all these topics. Further it can be expected that within smaller installer companies the knowledge is only available on heat pump technology itself and not on building technology

and physics needed for the ability size an installation with a heat pump. The design of the system however according to the Directive is therewith a responsibility for the installer, which in practice in larger housing projects is not the case. Especially in larger domestic projects and commercial buildings these tasks being taken up by a consultant. The demands made for certification therewith go further than the traditional more technical oriented skills.

The certification schemes for heat pump installers shall take into account that accredited training programmes should be offered only to installers with work experience, who have undergone, or are undergoing: training as a plumber or refrigeration engineer and have basic electrical and plumbing skills (cutting pipe, soldering pipe joints, gluing pipe joints, lagging, sealing fittings, testing for leaks and installation of heating or cooling systems) as a prerequisite.

The installer certification should be time restricted, so that a refresher seminar or event would be necessary for continued certification. However there are no audits in the certification process asked for.

3 EUCERT CERTIFICATION FOR HEAT PUMP INSTALLERS

Already in 2004 the SAVE project EU-CERT.HP was started by seven partners and associates from ten countries, aimed at initiating a European training and quality campaign for installers in the field of heat pump technology. It was supported by the European Commission within the Intelligent Energy Programme and was completed in December 2006.

The project developed a common training framework and a certification scheme for heat pumps installers. The project followed the vision that the training and certification programme should be recognized all over Europe and ideally become a common standard for voluntary further education in the field of heat pump technology in all participating countries. The certificate is delivered to the individual installer (person).

The project focused on training, certification and dissemination.

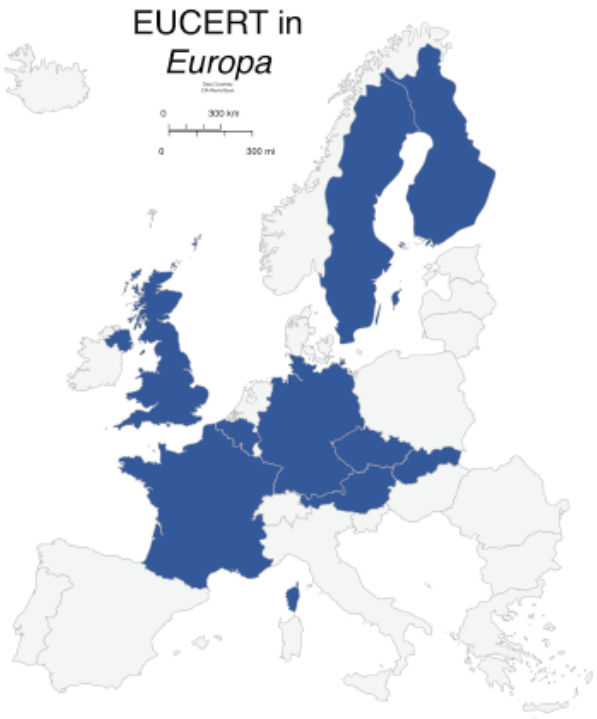
- Training: Development of a common European training programme for heat pump installers. This included piloting the first training courses and examinations in all participating countries.

- Certification: Development of a European Certification Programme for heat pump installers and the pilot certification of installers from the participating countries. Eligibility for the certificate depends on passing the installer examination and demonstration of experience. The aim of the certificate is to identify competent specialists, who can design and install reliable, faultless and efficient heat pump systems and promote customer confidence.

- Dissemination: Promotion of the training and certification programme and EU-CERT trademark at a national and international level via the EHPA web site, national heat pump associations and training agencies. As a consequence awareness amongst government agencies, manufacturers, installers and customers has been raised, giving the programme and certificate increasing importance in the market place.

Following completion of the EU-CERT.HP project, management and development of the training and certification program it was agreed by the partners to hand the results of the project to the European Heat Pump Association. EHPA is now coordinating the operation and further development of the "EUCERT program" via the Education Committee of the association. This committee is overseeing the quality of the training and certification process and provides new material for the training course as heat pump technology continues to develop.

EUCERT training courses are implemented since 2006 in twelve countries Austria, Belgium, Czech Republic, Finland, France, Ireland, Italy, Slovenia, Sweden, UK, Germany, and Slovakia). An overview on the active countries is shown in the graph on the right. France is an exemption from this as only the training, not the certification part is used. In the countries where the certification scheme is valid, each EU-CERT installer is registered on the reference list of certified installers.



EHPA and members associations are managing the EU-CERT program which follows the ISO 17024 standard. The National Certification bodies in the different countries have been involved in the project.

The installer has to fulfil the following requirements to obtain the EU-CERT label:

- Proof of vocational training
- Proof of participation certificate confirming completion of the EU-CERT.HP training or of an equally valid training course.
- Certificate of successfully passed EU-CERT.HP final examination
- The employer of the applicant must be operating as an electrician, installer or HVAC engineer and be providing heat pump system planning and/or installation services. Alternatively, the applicant must be the owner of his/her own business in one of these sectors providing heat pump system planning and/or installation services.
- Proof of relevant professional experience.
- Completion of a certification contract between installer and the national certification body.

The persons within the certification body should be industry experts and have relevant experience in the field of Heat Pumps.

The quality scheme does not contain an audit component at the moment but this aspect is under consideration.

Once delivered, the certification is valid for 3 years and may be renewed. The certified installer has to prove he/she has been active in the field. Additionally, the installer has to

undergo a further training of half a day within the three-year period. A three-full-day training within 3 years is recommended. However, every 6 years, the installer will have to undergo a written and oral presentation.

Moreover, the certified installer is obliged to record any written complaints in respect of quality relating to the installations planned or installed by the certificate holder. The certificate will be withdrawn in the case of:

- Non-fulfilment of conditions for certification
- Announcement of false statement at application
- Certified person has been sentences in court for environmental crimes
- Certified person has not fulfilled the economical obligations towards the certification board

The EUCERT training should be provided by a training institute accredited by EHPA. The training centres should have adequate laboratory equipment following technical specifications. Trainers should have sufficient experience in the related field and have attended a train-of-the trainer seminar. Also, they must not be involved in the certification process. In order to control the quality of training delivered, members of the EHPA education Committee visit the training centres infrequently.

The training standards were developed as part of the EU-CERT.HP project and are frequently updated by the EHPA education committee members.

The installer has to attend the EUCERT training and pass a final examination. The training course is composed of 4 days of theory and one day of practical training.

4 NATIONAL CERTIFICATION SCHEMES

As under Article 4 of the Directive each Member State is requested to provide a National Renewable Energy Action Plan (NREAP), certification has been under survey by all 19 member states which have written an NREAP. The policy questions raised are:

- Are there difficulties implementing the criteria of Annex IV of the RES Directive?
- Are there certification schemes already in place or being planned?
- Which are the responsible body/(ies) for setting up and authorising certification/qualification schemes by 2012 for installers?
- How are the different stakeholders involved?
- Are the certification schemes voluntary or mandatory?

QualiCert the project running parallel to SEPEMO gives a good overview and tries to answer a few of these questions. QualiCert stands for “Common quality certification and accreditation for installers of small-scale renewable energy systems” and has main objective to develop and mutually recognize accreditation and certification schemes for installers of small-scale renewable energy installations.

Within QualiCert, a manual of key success criteria for accreditation & certification systems has been developed and validated among key stakeholders. QualiCert is relying on an interdisciplinary multi-stakeholder approach involving builders and installers through their EU associations, existing training providers and accrediting bodies, the RES industry through its European associations, and a number of national energy agencies.

Parallel to this and in order to get information on the various certification schemes for heat pump installers a questionnaire was sent out tot the SEPEMO-participants. This analysis gives an overview of Austria, France, Germany, Greece, Netherlands and Sweden. Although this is only covering 6 European countries it gives a good idea how certification schemes for heat pumps are built up and accepted in the various countries.

A major difference between some of the schemes is whether they apply to a company or an individual. Both schemes are practised and have their legitimisation. The argument brought forward in favour of granting certification or equivalent qualification to a company is that the company is liable for the quality of the installation. Furthermore this approach reduces the danger that employees having gained the relevant qualification will be headhunted by the competitor. The argument in favour of certifying a person is that the installation should be carried out by the actual person having gained the required qualification, which is not guaranteed if certification/qualification is granted to a company.

Experience shows that both options can work well; the choice very much depends on the common practise of a country.

There are various certification requirements for installers of renewable energy systems already existing and ‘under construction’. This is especially a problem for installers of heat pumps. From various environmental legislation and safety regulations (pressure vessels, F-gases, ground sources) to the requirements on maintenance for Air Conditioning under the EPBD are developed certifications and/or qualifications independent from each other.

There is a strong need for these various certificates to develop into one full heat pump certificate. For the sake of easy implementation of a certification or equivalent qualification scheme for installers of small-scale renewable energy installations in buildings, the set-up of one centrally managed scheme for all technologies, i.e. PV, solar thermal, biomass, geothermal and heat pumps, is advisable as this reduces the administrative burden on the installers and makes integral communication on the scheme easier. A centrally managed system reduces cost and the basic management structure can support the whole range of technologies. Furthermore, it is also easier for the consumer to find their way to qualified professionals.

For the market acceptance of a certification/accreditation or equivalent qualification scheme, the linking of such a scheme to a subsidy scheme, e.g. local/regional/national subsidies for small-scale renewable energy installations or building codes is advisable. Even if this may be politically more complicated, experience has shown that strictly voluntary schemes take much longer to gain market acceptance than schemes coupled to a subsidy scheme or building code.

Some installers’ unions have already expressed their disagreement with a mandatory certification which would oblige already active installers to go through an additional process to be able to continue performing their activities. On the other hand installer unions tend to

'defend' the weaker companies against administrative burdens and do have problems with ISO based certification schemes for these companies.

Concern is expressed as regards the costs and administrative burden of a certification and accreditation process. Renewable energy systems can become less competitive as conventional heating systems are not under the scheme.

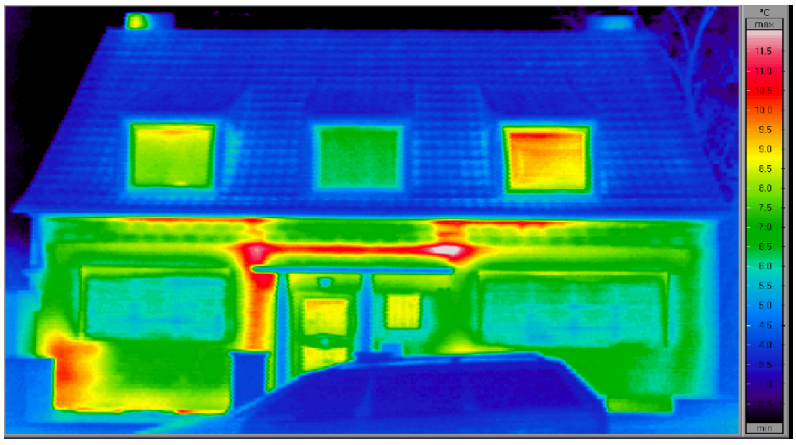
When it comes to audits, one should differentiate between administrative audits of installations and on-site audits of renewable energy installations in operation. There is a clear preference to on-site audits of installations in operation. Audits are a valid means to give evidence of the quality achieved; on the other hand, audits are quite expensive and time-consuming and therefore need to be limited to a random selection of installations. The size of the company (number of employees, turnover) should not be taken as a decisive factor when determining the number of audits. As a general rule, audits should be conducted during the period of validity of certification/accreditation or equivalent qualification and should be initiated based on random selection from installation references;

Audits might also be initiated on the basis of reports of complaints about installations. In case that audits reveal poor quality of an installation, these results should be discussed with the installer in order to guide them towards improving performance. Only in case of serious misconduct or repeated unsatisfactory installations audit results may lead to suspension of the certification/accreditation or equivalent qualification of an installer.

5 CONCLUSIONS

The clear objective of a certification/accreditation or equivalent qualification scheme is to increase the number of highly-qualified market players. The main question to be answered seems to be, if certification of installers and the supporting education of installers will give the needed improvement of heat pump operating performance in practice.

In this approach by looking into the quality of input (the front of the process) i.e. the design and installation process, it is expected that heat pump operating performance will increase as it is related to how well the equipment is actually designed, installed and subsequently maintained in the field. However, not only the quality of installation but also the quality of the building envelope plays a significant role.



Traditionally this was solved by the engineer and the installer by installing oversized equipment (a US-report states that this routinely is 50% oversized and often considerably more). With a gas boiler the failures in the building envelope thus were covered up by the higher installed capacity. With a heat pump such a solution will lead

to a poor performance and complaints, as heat pump installed according to the design guide lines which are a basis for the certified installer has a smaller capacity which does not cover the peak demands by failures in the insulation.

A difficulty in promoting sound installation and building practices is that the marketplace often incentivizes “cutting corners” so as to keep costs low, resulting in poor value for the customer. Generally, an underlying cause of this predicament is that the various industry participants (e.g., OEMs, distributors, designers, installers, etc.) – as well as the ultimate building owners/operators/customers – do not appreciate how small deviations in installation and envelope quality impact the performance. This causes heat pumps to operate inefficiently and waste considerable energy. However, it is still unclear whether small variances within a given field-observed practice are significant, whether the deviations have an additive effect on heat pump performance, and whether the attribute deviations (in various equipment applications and geographical locations) have a larger impact than others. If this information is known, better attention, resources, and effort can be focused on those parameters that are most important in the installation, and maintenance of heat pump equipment. Under the European SEPEMO project an extensive monitoring program is under the way to get insight in these.

If energy efficient technology is used at least the minimal building standard for insulation has to be adapted, lead down in the legislation for building regulation. Thus the need for low energy use incorporated in the building envelope is not needed. Heat pumps have recently gotten a boost by the increased need of better energy performance. This ‘simple’ technology measure is the cheapest way to increase the energy efficiency. However with the consequence of a lower insulation standard which is advised by some consultants to reduce the building costs!

One way to solve this problem is now being examined under the SEPEMO-project in which a group of project developers is working together with the Dutch Heat Pump Association on integral building and system quality. In this approach heat pumps are only applied when the building is built according to certain minimum standards on (quality of) insulation, thermal bridges and air tightness. In this coordinated interdisciplinary approach of building development low energy houses…

Another development is discussed in the paper by S.J Koster and O. Kleefkens in session V of the Conference, called: Performance of emerging concepts of heat pump systems in low energy houses in the Netherlands. Especially for low energy buildings it is noticed that the integrated design of the building by the building developer is done together with the manufacturer of heat pumps. In these cases no installer is even involved and the customer buying the house is given a guarantee on the performance of the heat pump system.

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