



Project

Promotion of efficient heat pumps for heating

(ProHeatPump)

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Deliverable N° 13

Comprehensive guideline for installers

**Review of comprehensive guideline(s) on heat pump
technology and installation (Installers / engineers)**

An evaluation of material against requirements set by the RES Directive

Author: Thomas Nowak

VORWEG GEHEN

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1	Motivation and scope of study	3
1.1	Policy background: RES Directive.....	3
1.2	Project focus & inquiry.....	5
1.3	Evaluation criteria.....	5
1.4	Evaluated material.....	5
2	Comparison of education documents	6
2.1	Training material of the European Heat Pump Association.....	6
2.1.1	Scope.....	6
2.1.2	General overview.....	6
2.1.3	Provision of marketing support to the installer.....	7
2.1.4	Provision of technical data/information on the peculiarities of heat pump technology and its appropriate integration in efficient system design.....	8
2.1.5	Certification/acknowledgement in government education	8
2.1.6	Assessment.....	9
2.2	Ground source heat pumps.....	9
2.2.1	Scope.....	9
2.2.2	General overview.....	9
2.2.3	Provision of marketing support to the installer.....	10
2.2.4	Provision of technical data/information on the peculiarities of heat pump technology & its appropriate integration in efficient system design.....	10
2.2.5	Certification/acknowledgement in government education	10
2.2.6	Assessment.....	10
2.3	French website: geothermie-perspectives.fr.....	11
2.4	Handbook of the German Energy Agency (dena): "Der Wärmepumpen- Berater"	11
2.4.1	Scope.....	11
2.4.2	General overview.....	11
2.4.3	Provision of marketing support to the installer.....	11
2.4.4	Provision of technical data/information on the peculiarities of heat pump technology & its appropriate integration in efficient system design.....	12
2.4.5	Certification/acknowledgement in government education	12
2.4.6	Assessment.....	12
2.5	Manufacturer installation guides	12
2.5.1	Scope.....	12
2.5.2	General overview.....	13
2.5.3	Provision of marketing support to the installer.....	13
2.5.4	Provision of technical data/information on the peculiarities of heat pump technology & its appropriate integration in efficient system design.....	13
2.5.5	Assessment.....	13
3	Conclusion	13
4	Sources	15
5	Appendix 1: Article 14 Information and training	17

1 Motivation and scope of study

According to the project goals the task of the deliverable was the review of existing material for installers/planners/engineers in heat pumps. According to the dissemination activities (workshops / seminars / trade fairs) suitable material had to be selected and if necessary redesigned. Additional information had to be provided on heat pumps and renewables (see WP 5).

Content of the analyzed documents had to be

- an overview of typical heat pump applications
- the advantages of heat pumps compared to other heating systems
- important facts on the different heat sources
- suggestions on how to interest customers for heat pumps
- technological details of best practice examples
- hints on simplified planning of heat pump installation

1.1 Policy background: RES Directive

The Directive aims at encouraging the use of energy from renewable sources. For the first time, energy from air and water (geothermal energy was recognized before) is acknowledged as a renewable source to be used by heat pumps.

It is accepted wisdom in the heat pump industry, that the quality of heat pump systems depends (among others) on the qualification and experience of the heat pump installer. Qualified installers provide a triple dividend: 1) individuals will receive a more reliable and efficient installation, 2) Industry benefits from improved perception and image of heat pumps. Installations with good quality reduce service efforts!, and 3) environment & society benefit, as heat pumps systems installed by trained and certified installers show an above average efficiency. This leads to lower heating cost for the individual and a reduced environmental impact of the heating system (reduced greenhouse gas emission). Efficient heat pumps systems do contribute significantly to the EUs energy savings and greenhouse gas reduction goals.

When the new Directive on the promotion of use of energy from renewable sources was developed, it was only consequential to integrate requirements, that would make support activities towards installer training and certification. Such requirements are formulated in Article 14 and the related Annex IV.

Article 14 defines requirements for MS and different stakeholders.

- **Paragraph 1** settles the availability of **information on support measures** and describes “relevant actors” as (non exhaustive list) consumers, builders, **installers**, architects, and suppliers of heating, cooling and electricity equipment and systems.
- **Paragraph 2** sets the need for suppliers or competent national bodies to inform the relevant actors on **net benefits, cost and energy efficiency** of renewable systems.
- **Paragraph 3** sets the need for MS to establish **certification schemes** or equivalent qualification schemes. They can be based on or integrate existing schemes and structures but shall follow specific criteria laid down in Annex IV to the Directive. In addition, MS shall mutually recognize their certification.
- **Paragraph 4** leaves it to MS to make lists of certified installers public.

- **Paragraph 5** targets the need for an optimal system design integrating (where appropriate) renewable energies, high efficiency technologies, district heating & cooling.
- **Paragraph 6** foresees the development of suitable information, awareness-raising, guidance or training programs to inform citizens of the benefits and practicalities of developing and using energy from renewable sources.

Annex IV

The certification (or equivalent qualification scheme) shall be transparent and clearly defined. Certification shall be performed by accredited bodies (training program or training provider).¹ The training program shall have continuity and shall be offered at least regionally, if not nationally. All training programs shall consist of a theoretical and a practical part. Consequently, training providers must have laboratory facilities. Basic and refresher courses shall be offered, the latter providing insight into technology development thus allowing for life-long learning. Bodies offering the training can be manufacturers, institutes or associations.

A scheme towards certification consists of the following steps

1. training course (theoretical and practical parts including knowledge on planning, installation and maintenance of reliable and efficient systems in line with applicable codes and standards.
2. examination leading to a certificate or qualification²
3. **certification**, which requires additional qualification. For the heat pump installer it includes a) training as plumber/refrigeration engineer, and b) basic electrical and plumbing skills **or** a vocational training with 3 years education providing the qualification mentioned before. The **theoretical training** shall include input on
 - a. market situation
 - b. understanding of regional differences
 - c. understanding of differences in applicable national and European legal codes, regulation, and standards.
 - d. Know-how on the fit between building and type of heat pump
 - e. In depth knowledge on heat pump technology, its functioning principle, components and installation
4. **Certificates should be time restricted**, continued certification will require refreshment of the certificate.

Summarizing, activities on the MS-level should provide

1. **general information** to the public (ie the user of energy systems), and
2. **specific information** to those planning and installing such systems.

Information should encompass **benefits of RES use, cost and efficiency of systems, information on support schemes as well as optimum systems design**. Installation should be done by **certified installers** as they are of major importance for efficient systems. Training activities should lead to a (time restricted) certificate issued by a competent, ideally certified, assigned body.

¹ On an international level, personal certification is done according to ISO 17024. This standard requests quality assurance of the body issuing the certificate and a clear distinction between bodies performing training and those responsible for certification.

² This wording is not clear, as the result of the exam could either be a certificate accd. to Article 14(3) or simply a document stating that the trainee has passed.

As these requirements will have to be executed by all MS by the end of 2012, they should be kept in mind for all existing and to be developed training and certification schemes for heat pumps. Roughly stated any program that wants to comply with these requirements would have to have a three-fold target:

1. It would have to provide **marketing support** to the installer (ie presenting data in a form that is understandable by consumers and interested parties).
2. It would have to provide **technical data/information** on the peculiarities of heat pump technology and its appropriate integration in efficient system design.
3. It would have to be acknowledged/strive for acceptance **as part of government education schemes** eventually providing the know-how required for certification.

Consequently, the evaluated documents are assessed against these categories.

1.2 Project focus & inquiry

Workpackage 6.1 of the proheatpump-project foresees a (...) **Review and adaptation of comprehensive guideline(s) on heat pump technology and installation (Installers / engineers)**

The initial task reads “Existing material for installers/planners/engineers will be reviewed. According to the dissemination activities (workshops / seminars / trade fairs) suitable material will be selected and if necessary redesigned. Additional information will be provided on heat pumps and Renewables (see WP 5)”.

Such guidelines should enclose content such as

- · overview of typical heat pump applications
- · advantages of heat pumps compared to other heating systems
- · important facts on the different heat sources
- · suggestions on how to interest customers for heat pumps
- · technological details of best practice examples
- · hints on simplified planning of heat pump installation

The participants of the project concluded in one of the project meetings, that the amount of existing guidelines covering the requested content is sufficient and very limited (if at all) need for additional guidelines exists. Consequently, it was decided to slightly modify the content of the deliverable to an assessment of existing material (see 1.4) against a set of common criteria.

1.3 Evaluation criteria

All material is evaluated against a set of questions that are partly derived from the project outline and partly from the requirements as created by the RES-Directive. The latter has been added to the report, as activities aiming at updating/modifying/improving existing material as well as those targeted at creating new documents must have these requirements in mind.

1.4 Evaluated material

Project participants suggested a range of guidelines from their area/institution. Based on the described focus, the following material was evaluated against the project interest:

- Training material of the European Heat Pump Association
- CORGI training guidelines
- French website
- Handbook of the German Energy Agency “Der Wärmepumpen-Berater
- Wärmepumpen-guide 2007/08 (Heat pump guide) alphainnotec (German)
- Projektierungs- und Installationshandbuch Wärmepumpen 2007, Dimplex (German)

All material is geared towards the installer and usually has a double focus:

1. Support of the installers marketing activities
2. Provision of general knowledge on the use of efficient heat pump systems.

Some of the publications offer checklists and other support material to ease the planning, installation and maintenance process and to avoid mistakes.

2 Comparison of education documents

2.1 Training material of the European Heat Pump Association

Today's EUCERT training program is the result of a successful IEE project: EU-Cert.HP. This project was executed by 10 partners from 7 countries with the goal to create an EU-wide standard manual for heat pump installer training, for the preparation and execution of a certification system and for dissemination of information on these activities to all interested parties. The project finished at the end of 2006 and the majority of involved parties decided to continue with the program under the umbrella of the EHPA.

Currently, EUCERT training programs are executed in 9 European countries: Sweden, Austria, Slovakia, UK, Czech Republic, Finland, France, Germany and Italy. A roll-out in Hungary is planned in the near future.

2.1.1 Scope

Scope of the program is the creation of a European training program for heat pump installers. This includes the training material as well as the execution of trainings, exams and certification. It also foresees organizational requirements for the process of executing the program on the level of the member states. The **EUCERT program is geared towards installers with a background in heating systems/electric installation and with basic plumbing skills**. The target of the program is to provide the installer with all knowledge necessary to successfully market, plan, install and maintain all type of heat pump units.

2.1.2 General overview

The EUCERT program is organized within the EHPA education committee. The complete set of documents is only available to participants in the program. Evaluation was possible with kind permission from the education committee.

The program encompasses the following documents:

- organizational aspects of the program: Rules and regulations for the EHPA Education Committee, laboratory specifications, set of requirements for national coordinator, set of requirements for training institutes, requirements for trainers and for trainees.
- training material: EUCERT installer manual, slides, trainer guideline, train-the-trainer manual
- examination documents and procedures.

For the scope of this assessment, only the EUCERT installer manual is evaluated against the developed criteria!

The training course shall provide the installer with the skills required to layout and install a high quality heat pump system according to existing national and regional codes and standards. The system must operate efficiently and reliably meeting the needs of the customer,

The Installer must be able to demonstrate the following key competencies:

- Marketing skills
- Understanding of factors influencing the Costs of heat pump systems
- Understanding of HP Environment & ecology impact
- Knowledge about Geology, climate & national regulations
- Knowledge about Energy Efficient Buildings
- Understanding of the operating principle of heat pump, of technical details of the heat pump circle as well as of heat distribution & hydraulic system integration
- Know how about electrical basics
- Know-how about different Heat sources
- Knowledge about Operating modes & control
- Ability to conduct a site assessment
- Ability to install heat pumps and auxiliary components
- Ability to perform a system check
- Ability to provide maintenance
- Understanding of the need for Customer education & warranty
- Ability to execute Fault diagnostic and to find typical mistakes.

The manual is divided in 15 chapters:

1. Marketing
2. Costs
3. Environmental Relevance of Heat Pumps
4. Geology and Climate and National Regulations
5. Energy Efficient Buildings
6. Technical Details of the Heat Pump Cycle
7. Heat Distribution Systems and Hydraulic System Integration
8. Heat Sources
9. Operating Modes and Controls
10. Conducting a Site Assessment
11. Installation and Commissioning
12. Electrical Basics
13. Customer Handover and
14. Maintenance
15. Common Mistakes and Practical Experience

In summary, the installer will be provided with all knowledge necessary to plan, install, operate and maintain an efficient system and should also be able to sell such systems to the final consumer. He shall be able to explain the cost, efficiency and environmental impact of using a heat pump system over other heating systems and should be able to consult the consumer towards the most appropriate decision for his/her specific set of heating comfort requirements.

2.1.3 Provision of marketing support to the installer

Marketing skills are provided in chapter one. It comprises of basics in marketing planning, principles of sales meetings, creation of comprehensive offer and quotation and several check lists. The importance of good customer relations is explained and tools for successful marketing (including the preparation of press releases, open days, trade fairs and site visits) are provided.

Considerations on calculating the full cost and assessing the environmental impact of heat pump systems are given in chapters 2 and 3. The installer is also enabled to correctly assess the feasibility of using a heat pump for a given building (chapter 10). Further focus is given on handing over the finished system to the consumer as well as on maintenance and error correction in the case of failure. Due to the importance of these questions for the consumer, these chapters pro-

vide important background information to the installer interested in successfully marketing himself and his products.

While these chapters have a specific marketing relevance, it can also be argued, that all other chapters with a more technical focus (as presented in 2.2.4) have a relevance for marketing support, as only a well trained, knowledgeable installer will be able to assess the needs of the consumer and to identify the appropriate heating system.

2.1.4 Provision of technical data/information on the peculiarities of heat pump technology and its appropriate integration in efficient system design.

The more technical chapters deal with general information on the framework conditions of using heat pumps, on the heat pump unit itself and on different combinations of system integration (alternative heat sources, heat distribution system, modes of operation and control). Information is given on Geology and Climate as well as on National Regulations. As such the installer is enabled to plan for an appropriate heat pump system taking into consideration legal requirements for the use of ground and air-energy sources. Similarly, the installer is provided with a good overview on the effect of building design and materials on living comfort of the occupants and on the efficiency of the whole system. Taking into consideration market realities, the options for integrating heat pumps and other renewable technologies is explained. The refrigeration cycle and the main components of a heat pump are explained in great technical detail. Information is given on different types of refrigerant, super heating, sub-cooling and the possibilities of using heat pumps for cooling. In order to efficiently use heat pumps in buildings, the necessary information on different distribution systems, together with the heating loads, typical distribution temperatures and safety aspects is given. Similarly the range of usable heat sources is reviewed and variations in the design of heat sources (brine/water; direct expansion; water/water; collector types; air/water, exhaust air; innovative systems) are reviewed and their installation is explained. With regard to the several possible configurations and uses of heat pump systems, a single chapter explains operating modes and controls also giving guidance in determining the most suitable operating mode, the required load of any secondary heater, operating characteristics and calculating the heating curve.

On a more practical side, the trainee is informed on the steps necessary for a site assessment (as described in 2.2.4 – this has strong marketing relevance) and the installation and commissioning of the final system. For completeness, the manual does include electric basics to maintain safety of the installer and enable him to understand wiring diagrams and to correctly connect the heat pump. The concluding chapters cover Customer Handover and Warranty, Maintenance and training on identifying common mistakes in case of system failure.

As the EUCERT program is geared towards EUROPE, all chapters have a general part and a section for national requirements. This is particularly useful to maintain a set of information that is valid for every heat pump installer independent of his location. At the same time the national coordinators of the EUCERT program can enrich the manual with national requirements that are indispensable for installers required to cover national building codes and regulations.

2.1.5 Certification/acknowledgement in government education

The EUCERT program comprises of regulations for training and for certification. In order to receive a certificate, all installers have to take an examination. In case they pass they receive test report. For the EHPA certificate they have to hand in this report together with additional credentials on vocational or other information in the field of heating systems, plumbing or electric installation to a (accredited) external body which then issues the certificate (this approach is similar

to the process as prescribed by ISO 17024). Each certificate is valid for 3 years and can be renewed after this time. A list of certified installers can be found on the internet pages of the respective heat pump associations.

Examples:

www.waermepumpe.de : German HPA

www.svepinfo.se : Swedish HPA

2.1.6 Assessment

The EUCERT training program is extensive as it covers the majority of heat pump systems currently in the market. The training material gives equal focus on technical details of the heat pump, the heat source, and the building envelope as well as on aspects of planning, commissioning, maintenance and marketing.

The approach to provide a pan-European education document augmented by national annexes is very promising and enables a mutual acceptance in different countries while at the same time ensuring an installer, that can start to work in his home country immediately. The existing organization structure and foreseen certification procedure are very close to what is documented as future requirements in the RES Directive.

2.2 Ground source heat pumps³

2.2.1 Scope

“Ground source heat pumps” is a booklet on ground-source heat pumps. The target group is the craftsman with experience in designing and installing domestic heating system who aspires to extent his/her knowledge to installing ground source heating systems (GSHP). It is clearly put, that the understanding of those variables affecting heat pump system performance must be well understood by the installer in order to deliver efficient and reliable systems to the expectation of the consumer. Consequently, the booklet is intended as a foundation for the required knowledge but does not intend to replace formal training. The guide is limited in scope to ground source heat pumps up to 30kw, however general principles referred to do also apply to larger units and air source heat pumps.

2.2.2 General overview

The booklet is structured in eight chapters:

1. Introduction,
2. An overview of ground source heat pump systems,
3. GSHP theory,
4. Design of GSHP systems,
5. Installation,
6. Maintenance,
7. Definitions, and
8. References.

It thus covers the process from understanding heat pumps to installing and maintaining them. The instruction repeatedly stresses the need of the installer to seek support of experienced installers or manufacturers in case of uncertainty. , case studies on heat pump application, background information on how to design efficient and reliable heat pump systems, technical background of heat pump technology, and guidance as well as check lists for system design.

³ Corgi (2008).

The document has a clear structure and a nice design. Its small format (with smaller type, small graphics etc.) makes it more difficult to read. It clearly belongs into the study of the individual reader than on the presentation table in a client meeting. While interested parties will find the manual understandable, the use of technical terms and icons in text and graph make clear reference to the experienced installer.

As such, the booklet serves up to its promise. While the guide is focusing on GSHP application in the UK, examples from other types of heat pumps and/or other parts of the world are used for illustration. Efficiency of the heat pump system is paramount to the text. Its influencing factors are explained and the need for their consideration by the installer is stressed repeatedly.

2.2.3 Provision of marketing support to the installer

Marketing support of this booklet is very limited. While the content provides the installer with the necessary knowledge on the design, installation and operation of efficient systems, the transfer of this knowledge into a unique selling proposition remains with the installer.

2.2.4 Provision of technical data/information on the peculiarities of heat pump technology & its appropriate integration in efficient system design.

The guide takes the user on a journey starting at explaining that heat pumps do use renewable energy of largely solar origin. It explains the need of and parameters for efficient system design. The whole structure of the text is easy to follow. Starting with an overview on heat pump systems, a detailed description of heat pump technology in general is given. All major configurations including heat/cooling/DHW using different layouts are presented. Specific focus is given on ground source design. After this theoretical introduction, the process of planning a GSHP system is described in detail. Consideration is given to **legal requirements** including health (legionella) and environmental (ground water pollution) aspects as well as administrative issues.

The necessary steps to install the system based on previous planning are outlined in similar depth. While this may rarely be necessary in well designed systems, a chapter is dedicated to maintenance and fault finding. As it is well understood that this booklet can neither provide all heat pump related information (including norms and legal standards) nor replace thorough training, resources for further reading and information are provided.

2.2.5 Certification/acknowledgement in government education

“Ground source heat pumps” is not targeted at certification or integration into national education systems. Consequently no information on such systems is given.

2.2.6 Assessment

The booklet provides in-depth knowledge on the installation process of GSHP including aspects of heat source development. The text includes technical aspects, efficiency considerations, health and safety as well as legal aspects. It fulfills its promise to the educated installer that seeks additional information to enlarge his know-how to the field of heat pumps. The structure leads the interested installer through the whole process from understanding heat pump technology, via planning and installation, to operation and maintenance. It references UK building codes where applicable. The whole text is supported by illustrative graphs. Readability could be improved with larger font size and graphics. Some sections are printed white on green – which is not the best choice from a typography perspective.

2.3 French website: geothermie-perspectives.fr

The website is divided into a publicly available and a closed part. During the preparation of this analysis it was impossible to receive an access code to the closed part – consequently this part was not included in the analysis.

2.4 Handbook of the German Energy Agency (dena): "Der Wärmepumpen-Berater"⁴

2.4.1 Scope

The Handbook of the German Energy Agency is dedicated towards installer, planner or architects that want to know more about heat pump technology, its advantages and technical prerequisites. The guide can be seen as a tool for the target group to educate themselves but can also (and is clearly designed with this goal in mind) be used as a sales tool in the discussion with the final consumer.

2.4.2 General overview

The guide is structured in five chapters: Consulting, case studies on heat pump application, background information on how to design efficient and reliable heat pump systems, technical background of heat pump technology, and guidance as well as check lists for system design.

The document has a clear structure and an appealing design. The combination of general and in-depth technical information presented via technical texts and examples is informative to all interested stakeholders and thus makes this booklet appealing to a wide target group.

Technical information on heat pumps covers all energy sources (air/water/ground) and includes electric heat pumps for heating, cooling, air conditioning and domestic hot water (DHW). Is always presented with the systems approach in mind. As such, it includes the building envelope, considerations for the overall energy demand of the building, a potential integration of solar thermal energy as well as the different options for the heat distribution system.

Heat pump based systems are compared to oil, gas, and pellet boilers with regard to **primary energy use, greenhouse gas (GHG) emission savings and economic performance**.

With regard to the legal framework, the guide is covering the situation in Germany. While the technical information is valid for other countries, the fact that it is written in German language limits its use.

2.4.3 Provision of marketing support to the installer

Support is given to the user of this report by well illustrated background information on heat pump technology and application as well as by best practice examples. For Air/water/ground heat pumps in new, renovated and passive-house buildings. The examples focus on residential buildings.

---- scan of example ---

⁴ Deutsche Energie-Agentur GmbH (dena) (2007).

2.4.4 Provision of technical data/information on the peculiarities of heat pump technology & its appropriate integration in efficient system design.

On top of the general information key questions around efficient systems design are addressed. They are described on a general level and require the basic know how on the installation work of heat pumps and heating systems to be existing with the user of the guide. Reference to efficiency measurements based on EN 14511 is given. The distinction between coefficient of performance (COP) and seasonal performance factor (SPF) is made.

The Quality label of the European heat pump association is mentioned. A list of links to internet sites providing additional information as well as to government support programs on a national and regional level is presented.

The appendix provides rules of thumb and comparison values for a first assessment of the possibility to use heat pumps in several application fields. Check lists cover the collection of background information for the planning & decision process as well as for the documentation of setting into operation of such a system.

All technical information is provided on a level easily accessible by all interested parties. The guide is helpful to guide the work of an already educated and interested user. They also enable the interested user to ask the right questions in discussion with his installer/planner/architect. No technical drawings etc. are provided. In order to eventually install such systems, some technical background from vocational or university education is absolutely necessary.

2.4.5 Certification/acknowledgement in government education

No information provided on training and certification of heat pump installers.

2.4.6 Assessment

The guide is well suited to support the interested user to get an overview on heat pump technology and to better understand whether a heat pump can be operated efficiently under the given circumstances.

2.5 Manufacturer installation guides ⁵

As examples three "Installation guides" from renowned manufacturers have been selected. This selection should not be understood as a quality criterion or a statement of specific value of these manufacturers or their products. As most manufacturers offer such guidelines, they are exemplary for the type of information geared towards the specialized heat pump installer.

2.5.1 Scope

Most handbooks prepared by heat pump manufacturers are prepared with the heat pump installer in mind. As such, they expect a certain level of background information on the installation of heating systems. Quite often, these documents are not publicly available, but are only provided to an educated public. They are often part of the manufacturer training or are distributed at specialized trade fairs.

2.5.2 General overview

The “heat pump guide” is structured in four chapters: planning, heat pumps, system technology and knowledge. The initial chapter provides a general overview on heat pump technology (technical principle, heat sources, efficiency, design issues, performance in comparison to other heating systems). Chapters two and three give a very detailed overview on alpha-innoTec-products and their integration in heating systems. The last chapter lists typical questions from customers, typical design issues and typical installation mistakes. It provides check-lists to guide the installer towards an efficient and reliable installation.

The document has a clear structure and a very “technical” design. Information provided shows a high level of detail and is clearly prepared for the installer with the need for extra knowledge.

2.5.3 Provision of marketing support to the installer

Chapters “planning” and “knowledge” provide background information that can be very useful in the direct discussion with the final consumer. Information is prepared in a way that can also be understood by the consumer when properly explained. While the guide pictures the complete heat pump program, discussion with the final consumer should rather be based on the sales material created specifically for this purpose.

2.5.4 Provision of technical data/information on the peculiarities of heat pump technology & its appropriate integration in efficient system design.

The “heat pump guide” provides in-depth technical information on the different heat pump types manufactured by alpha-innoTec. Technical data is provided on all heat pump units. Detailed instructions are given for the design of the heat pump system and its installation. Hydraulic charts, Illustrations and graphs support the instructions.

2.5.5 Assessment

The guide completely fulfills its designated purpose. It provides a wealth of general and technical information and educates the installer on almost all heat pump related questions with regard to planning, design, installation, maintenance and error detection. While the share of marketing support is limited, any installer that knows the content of this guide can answer the vast majority of question that may occur in a sales meeting.

3 Conclusion

The assessed material was intended by the respective editors for a specific target group. All sources did fulfill their purpose as proposed. The documents assessed range from the guide of the German energy agency which was the most marketing orientated and end-consumer-feasible, due to its clear, modern design and simple yet precise language to the EUCERT manual being the most comprehensive. The dena-tool can be used by an individual to get familiar with the topic or by an installer for marketing purposes, but it will not educate the installer. Documents like the corgi guide, the manufacturers planning books or the EHPA training program are much more suitable for education purposes. It is interesting to note, that a large overlap exists among these materials with regard of the technical data provided. Roughly speaking an installer will be able to learn the basics on heat pump technology, on planning, on design & layout issues, on installation and on maintenance and error detection from all sources. As manufacturers provide a wide range of data of a very general nature, it can not be argued, that only independent third party information (as provided by corgi) would be sufficiently neutral. In the contrary – an interested installer can probably learn a lot by exposing himself to the manufacturer training manuals and comparing them for similarities and differences. Even though manufacturers have direct influence on the heat pump unit only, their handbooks do start considerations with the buildings

perspective, outlining the impact of a good overall systems design. With increasing importance of solar integration into heat pump systems, this technology is also covered, particularly in chapters on layout issues and on correctly connecting the storage tank to a bi-valent or tri-valent system.

With regard to the criteria derived from the RES-Directive only the EUCERT program is wide enough in scope to foresee certification and to integrate the required EU wide acceptance of the certificate. As EUCERT is not available in all EU countries and is not integrated into national education systems, there is still need for further development. A check with the European Heat Pump Association revealed, that the roll-out of EUCERT in additional countries is planned and that government acceptance in the different countries is sought for.

	Marketing support	Technical data	Certification	RES-Directive compliance
EHPA EUCERT	yes	Yes	Yes	Yes
Ground source heat pumps	Limited	Yes	Indirect Benefit	Maybe, however limited to GSHP
Geothermie perspectives	./.	./.	./.	./.
Der Wärmepumpenberater	Yes	Limited	No	No
Manufacturer guides	Yes	Usually in depths	No	No

	Administration	Energy agencies	Architects/planning engineers/developers	installers	consumer
EHPA EUCERT	.*	.*	x	x	.*
Ground source heat pumps	o	o	o	o	limited
Geothermie perspectives	./.	./.	./.	./.	./.
Der Wärmepumpenberater (dena)	o	o	X (overview only)	X (overview only)	O
Manufacturer guides	X (maybe too detailed)	X (maybe too detailed)	O	O	X (maybe too detailed)

* the training material is not publicly available. It is geared towards the educated craftsman that wants to enlarge his knowledge in the field of heat pumps. Still, interested parties might benefit from the content.

4 Sources

1. alphaInnoTec (2007): Wärmepumpen-guide 2007/08 (Heat pump guide). Kasendorf.
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Abbreviations

BHE	Borehole heat exchanger (vertical loop)
EPBD	EU Directive on Energy Performance of Buildings
CFC	chlorofluorocarbon
CHP	combined heat and power units
COP	coefficient of performance
EdF	Electricité de France
EHPA	European Heat Pump Association
FWS	Fördergemeinschaft Wärmepumpen Schweiz FWS - »Swiss support initiative for heat pumps«
GHG	green house gas emission
GSHP	Ground source heat pump
GWP	global warming potential
HCFC	hydrochlorofluorocarbon
HFC	hydrofluorocarbon
HPC	Heat Pump Centre
HVAC	heating ventilation and air conditioning
IEA	International Energy Agency
LCCP	life cycle climate performance
ODP	ozone depletion potential
PER	primary energy ratio
PPS	Purchasing power standards
SPF	seasonal performance factor
TEWI	total equivalent warming impact
UNDP	United Nations development programme
VDI	Verein Deutscher Ingenieure

Appendices

4.1 Appendix 1: Article 14 Information and training

1. Member States shall ensure that **information on support measures** is made available to all relevant actors, such as consumers, builders, installers, architects, and suppliers of heating, cooling and electricity equipment and systems and of vehicles compatible with the use of energy from renewable sources.
2. Member States shall ensure that **information on the net benefits, cost and energy efficiency** of equipment and systems for the use of heating, cooling and electricity from renewable energy sources **is made available either** by the **supplier** of the equipment or system or by the **national competent authorities**.
3. 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.**
4. Member States shall **make available to the public information on certification schemes** or equivalent qualification schemes as referred to in paragraph 3. Member States may also make available the list of installers who are qualified or certified in accordance with the provisions referred to in paragraph 3.
5. Member States shall ensure that **guidance is made available** to all relevant actors, notably for planners and architects so that they are able properly to consider the optimal combination of renewable energy sources, of high-efficiency technologies and of district heating and cooling when planning, designing, building and renovating industrial or residential areas.
6. Member States, with the participation of local and regional authorities, shall develop suitable **information, awareness-raising, guidance or training programmes** in order to inform citizens of the benefits and practicalities of developing and using energy from renewable sources.

4.2 Appendix 2: Appendix IV of the RES Directive

Certification of installers

The certification schemes or equivalent qualification schemes referred to in Article 14(3) shall be based on the following criteria:

1. The certification or qualification process shall be transparent and clearly defined by the Member State or the administrative body they appoint.
2. Biomass, **heat pump**, shallow geothermal and solar photovoltaic and solar thermal installers **shall be certified by an accredited training programme or training provider**.
3. The accreditation of the training programme or provider shall be effected by Member States or administrative bodies they appoint. The accrediting body shall ensure that the training programme offered by the training provider has continuity and regional or national coverage. The training provider shall have adequate technical facilities to provide practical training, including some laboratory equipment or corresponding facilities to provide practical training. The training provider shall also offer in addition to the basic training, shorter refresher courses on topical issues, including on new technologies, to enable life-long learning in installations. The training provider may be the manufacturer of the equipment or system, institutes or associations.
4. The training leading to installer certification or qualification shall include both theoretical and practical parts. At the end of the training, the installer must have the skills required to install the relevant equipment 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.
5. The training course shall end with an examination leading to a certificate or qualification. The examination shall include a practical assessment of successfully installing biomass boilers or stoves, heat pumps, shallow geothermal installations, solar photovoltaic or solar thermal installations.
6. The certification schemes or equivalent qualification schemes referred to in Article 14(3) shall take due account of the following guidelines:
 - (a) **Accredited training programmes should be offered to installers with work experience, who have undergone, or are undergoing, the following types of training:**
 - (i) in the case of biomass boiler (...);
 - (ii) **in the case of heat pump installers: 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;**
 - (iii) in the case of a solar photovoltaic or solar thermal installer: (...) or
 - (iv) a vocational training scheme to provide an installer with adequate skills corresponding to a 3 years education in the skills referred to in point (a), (b) or (c) **including both classroom and workplace learning.**
 - (b) The theoretical part of the biomass stove and boiler (...).
 - (c) The theoretical part of the **heat pump installer training** should give an overview of the market situation for heat pumps and 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 training should also provide good knowledge of any European standards for heat pumps, and of relevant national and Community law. The installer should demonstrate the following key competences:

- (i) 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);
 - (ii) 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
 - (iii) 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.
- (d) The theoretical part of the solar photovoltaic and solar thermal (...).
- (e) The installer certification should be **time restricted**, so that a refresher seminar or event would be necessary for continued certification.