EHPA was established in the year 2000 as a European Economic Interest Group to promote awareness and proper deployment of heat pump technology in the European market place for residential, commercial and industrial applications. EHPA aims to provide technical and economic input to European, national and local authorities in legislative, regulatory and energy efficiency matters.

All activities are aimed at overcoming market barriers and dissemination of information in order to speed up market development of heat pumps for heating, cooling and hot water production.

More information can be found at www.ehpa.org
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European Heat Pump Statistics
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Editorial

The fossil era is bound to come to an end and the world is looking for alternative solutions of energy supply. At last the world seems to be taking the threats of global warming seriously. 2008 will be remembered as a year when many important decisions were taken. With the launch of the Energy Package in March, the European Union finally agreed on putting words into action.

The recently adopted Directive on the promotion of the use of energy from renewable sources sets demanding targets on the European Member States and that is only one of several important Directives that will serve to benefit heat pump technology. The new deal will lead to a change of paradigm. The new paradigm will favour energy efficiency, renewable energy and low carbon technologies. Several technologies will need to be developed for all energy sectors. In the heating and cooling sector heat pumps uphold a unique position as being a technology contributing to all main targets.

In contrast to other highlighted technologies such as plug in hybrid cars and carbon capture and storage, heat pumps are proven available technology. In this sense heat pumps will pave the way for the third industrial revolution. The European heat pump markets are on the move.

Heat pumps are not any more only considered as an interesting technology for engineers. Heat pumps are already considered mainstream in a few countries and despite a worldwide economic crisis this year’s edition of European Heat Pump Outlook presents the highest sales volumes ever.

This unique set of heat pump statistics has been made available through the EHPA network. Our national editors have provided the focus reports. Our annual statistics serves as an important source of information for all stakeholders with interest on the European markets and as being the first publication to present information on renewable energy provided by heat pumps it will give an important first indication of the real contribution of renewable energy offered by heat pumps.

I am sure that our next annual report will present even higher values than what you will find in this report. Nothing can stop heat pumps now!

Martin Forsén

Chair Executive Committee, EHPA
In 2008, heat pumps became an established heating technology in the major European Countries. While it was necessary in previous years, to explain what a heat pump does, nowadays the technology is accepted, increasingly understood and more often chosen. Total sales in Europe have increased by nearly 50% from 2007 to 2008 (see figure 1).

The major markets reported here show double digit growth rates with the positive exception of France, where sales figures more than doubled (+127%) due to a beneficial subsidy scheme (see figure 2).

This is particularly remarkable for established markets such as Sweden (+37%) and Switzerland (+27%). It can be explained by a widening of the application base from new houses to the renovation segment and by an increasing number of installed heat pumps in commercial buildings.

The increasingly strong installation numbers of heat pumps in the renovation segment backs the existing trend towards air-source units. In cases, where the building envelope can not be upgraded to a standard suitable for the efficient operation of heat pumps, the use of domestic hot water heat pumps is an option to assist traditional gas and oil boilers as well as biomass burners. As several countries have inaugurated minimum shares of renewable sources in total energy supply to the building, this product segment sees exceptional growth.
A comparison to last year's statistics shows the influence of framework conditions on demand: Germany is up to speed (+47\%) after last year’s market was characterised by a consolidation due to an increase in VAT, the inclusion of heat pumps into the existing subsidy scheme shows initial positive effects. As mentioned already, success in the French market is a result of government action.

When looking at the type of energy source used, the general trend points towards air-source heat pumps. Generally, more and more heat pump units are reversible and provide heating, cooling and hot water. The majority of these units is again using air as the main energy source. A closer focus to the segment of heating only heat pumps reveals the strong growth of air-water units (see figure 3). This development is a strong indicator for the development of the renovation segment, as air-water and – in the Scandinavian countries and Southern Europe – reversible air-air are often simpler to employ when refurbishing a building. Sales numbers for tap-water only heat pumps have more than doubled (+122\%) from 2007 to 2008. As this type of heat pump is often used to augment a gas/oil fired boiler, increasing numbers do support the trend of using heat pumps in the renovation sector.

New European and national legislation, most prominently the Directive on the promotion of the use of energy from renewable sources has considerably improved framework conditions for heat pump markets in all European countries.

New European and national legislation, most prominently the Directive on the promotion of the use of energy from renewable sources has considerably improved framework conditions for heat pump markets in all European countries.

The total market size for the 8 countries surveyed here has reached 576,392 units in 2008, a 46.8\% increase over last years 392,756 units (see table 1). The outlook for 2009 is very positive with an expected two-digit growth in the range of 20\% for all countries and with additional markets reaching a development stage that justifies the preparation of sales statistics.
World final energy consumption is projected to grow by an annual average of 2.0% until 2010 and an annual average of 1.7% from 2010 to 2030. The projection for Europe shows a split picture. While western Europe’s energy demand is expected to grow slower, Eastern Europe and the CIS-States show a faster increase as result of stronger growth (see Table 2).

Governments and environmental institutions alike have stressed the importance of an increased share of renewable energy sources in the global energy mix. This is the result of two major streams of argument:

- Non-renewable energy resources are limited. Increasing demand raises their price level and makes countries that rely heavily on imports more vulnerable to political pressure.
- The employment of non-renewable energy sources pollutes the environment. Apart from other emissions, they lead to an increase of the CO2-concentration in the atmosphere.

Both effects are undesirable and make the search for replacements more important than ever. In comparison to other renewable energy sources ambient energy from air, ground and water – used by heat pump technology – is particularly suitable for this task. It does not pollute, it is locally available (reducing transport needs for oil and an expansive distribution grid for gas) and it needs only electricity or gas to function. When used with green electricity or biogas, a CO2-free energy solution is available.

Even though these are convincing arguments for an increased share of renewable energy sources and most stakeholders agree to and support these facts, the reality looks quiet different. In 2001 world energy demand was covered by traditional energy sources: oil (35.1%), coal (22.6%), natural gas (21.7%), nuclear energy (6.9%), traditional biomass (9.3%), hydro (2.3%) and modern biomass (1.4%). Renewable sources among them aerothermal, hydrothermal and geothermal energy sources had a share of only 0.8% (or 9 EJ).

The European perspective looks slightly better. For EU-27 in 2005 the share of final energy used for heating and cooling is estimated at 49% of the total final energy provided. The share of renewable energies in total final energy consumption is close to 9%. Figure 4 provides an overview on the share of renewables in gross final energy consumption in six (out of 9) scenarios used to estimate the impact of the EU energy and climate package. It clearly shows, that no action is no alternative for reaching the 20% share of renewables in total final energy consumption by 2020. Interestingly, nearly any other combination of activities makes the 20% target achievable, but falls short of the currently discussed 30% in 2030 target.

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1 European Commission (2003: 25). The fact that energy demand will increase is supported by other world energy studies by IEA and US-DOE.
3 Europe imports 50% of its final energy demand. This number is expected to increase to 70% in 2030.
None of the presented scenarios achieves a reduction in gross final energy consumption compared to the demand in the year 2000 and they all share the forecast that for the years to come oil will stay the dominant energy source, demand for coal is expected to decline with increasing importance of gas and slowly even renewable sources. This tendency is also reflected in other studies.\(^7\) It feeds existing doubts about the possibility of a wide scale replacement of non-renewable energy resources within the next decades.\(^8\)

It becomes obvious, that policy action currently deemed acceptable will not be sufficient to reduce energy demand and to change the supply structure towards independence from non-renewable sources. Much more far reaching policy decisions based on information as well as on institutional and financial support schemes are needed for a quick market uptake of all technologies using renewable sources. Due to their special characteristics beneficial towards the energy and climate protection goals, heat pumps should not only be acknowledged, but should receive intensified support in order to leverage their contribution potential. This step that has not yet been taken in many countries and only recently a move into the right direction could be observed with the RES-Directive coming into force on the EU level. It must be transposed to national law and it is now with the Member States to execute this Directive and – maybe most important – to draft implementation measures in a technology neutral way based on efficiency gains and/or emission values to achieve a development that does not distort market development.

Any future achievement of the given measures can only be measured based on extensive and robust data, a fact that underlines the need for and importance of the current heat pump statistics and official energy statistics including renewables.

\(^7\) WEO (2005)
European legislation affecting heat pumps

European energy policy aims at the unifying goal to ensure a safe, secure, and economic energy supply that avoids harming the environment. While the demand of individual countries is negligible on a world market, the joint European demand could make Europe a strong player in this market. As such only a joint energy policy of all EU countries can safeguard the communities long-term interest and overcome shortcomings of individual, national approaches.

Recent developments in European Energy policy seem to reflect this. They also indicate a shift towards strong support of the use of renewables, a reduction of energy demand of all buildings and an improved energy efficiency of Energy using products.

Directives affecting heat pump technology include the recently passed Directive on the promotion of the use of energy from renewable sources (RES Directive), the Ecodesign for energy using products-Framework Directive and their implementing measures for Lot 1 (Boilers), Lot 2 (water heaters) and lot 10 (AC-units), the energy performance of buildings Directive (EPBD), the regulation on energy statistics and the Ecolabel framework Directive. It is important to understand, that these Directives are not without overlap due to the process of their preparation. Consequently, EHPA and other affected stakeholders, national heat pump associations and manufacturers alike are closely monitoring the implementation process and provide input where necessary and when asked for.

Apart from this issue, these Directives must be considered very strong tools in establishing requirements for product and building efficiency, the use of renewables and the reduction of greenhouse-gas emissions (GHG). As heat pump technology is positively acknowledged in all mentioned Directives, the impact on market development originating in the legal framework will most likely be positive.

3.1 | The Directive on the promotion of the use of energy from renewable sources

The Directive on the promotion of the use of energy from renewable sources, 2009/28/EC, short RES Directive is part of the EU’s energy and climate package. In conjunction with the Directive on Carbon Capture and Storage (CCS) and the Directive on an Emission Trading Scheme (ETS) it aims at reducing final energy demand and related greenhouse gas emissions as well as securing a long term, stable and increasingly independent energy supply.

This Directive was accepted by the European Parliament in Strasbourg on 17.12.2008 and published in the official Journal of the European Union on 5.6.2009. It thus comes into force in all Member States on the 25.6.2009 and must be transposed into national law by the 5.12.2010. It sets the target for the overall share of renewables in total energy consumption and also presents the RES-shares (based on final energy demand) to be reached by the Member States. It also establishes a common framework of guidelines that Member States have to transpose into their legislation in order to reach the defined targets.

These guidelines apply to issues of eligibility, statistical transfers, joint projects, guarantees of origin, administrative procedures, information and training and access to the electricity grid for energy from renewable sources.

Heat pump technology is entirely acknowledged as a technology that makes
ambient energy from air, water and shallow ground useful (Art. 2 “Definitions”). This applies to electrically driven and to gas driven heat pumps alike. The amount of renewable energy used by heat pumps to provide heating and cooling will be calculated based on final energy. However, only the contribution from those heat pumps that reach a minimum efficiency (SPF) (see Article 5 in conjunction with Annex VII of the Directive), will be counted. The amount of renewable energy provided will be calculated according to the formula $\text{ERES} = Q_{\text{usable}} \cdot (1 - 1/\text{SPF})$. The Directive applies to heat pumps driven by electricity, gas and other energy sources.

It must be noted, that the contribution from heat pumps towards the 20% target will be calculated based on the heat pump stock installed in 2020, its systems efficiency and the average European electricity conversion efficiency of that year. In this example – assuming an annual energy demand of 15,000 kWh and an SPF for the heat pump system of 4 – the RES contribution from such system would be 11,250 kWh.

The effect on primary energy demand and greenhouse gas emissions depends on the mix of primary energy sources used to generate electricity. The emission related to electricity production depends in particular on the share of renewables in the electricity mix. This fact has several implications: a) whenever 100 % green electricity is used, the heat pump provides 100 % of renewable heating & cooling, and b) all installed heat pumps and thus also the environment benefit from an ever greener and more efficient electricity mix. Consequently, heat pump technology is becoming less polluting with every improvement step in the efficiency and RES share of its “fuel”-electricity.

Lastly, the parliament has acknowledged the strong dependence of small RES systems energy efficiency and reliability on knowledgeable installers, planners and architects. This is particularly true for heat pumps. Consequently, the Directive foresees the implementation of several measures towards information dissemination to all interested parties and towards the establishing of an accredited education and certification system (Art. 13).

The European Heat Pump Association’s own Certification and training program for heat pump installers (EUCERT)\(^9\) complies largely with the requirements set. Necessary adjustments are currently considered and will be executed by the Technical committee on education and training.

On a larger scale, EHPA is participating at the IEE project QualiCert (Common quality certification & accreditation for installers of small-scale renewable energy systems), to provide input on the training and certification program for heat pumps and to learn how other associations have dealt with similar qualification requirements.

The Directive will mainly have to be executed by the Member States. However different articles foresee a high frequency of information interchange between Commission, Member States and Parliament. The most prominent tool for communication will be the national Renewable Action Plan (RAP). This document will be based on a template to be provided by the Commission. It will initially be used to evaluate the contribution of the sectors mobility, heating & cooling, electricity production towards the individual national target.

It will also describe a development trajectory for the time horizon until 2020. From 2013 onwards, Member States are obliged to report biannually to the Commission on achievements made. This approach has been chosen to assure that the individual Member States will take sufficient efforts to make sure that their targets – as defined in the burden sharing – will be reached over the next 10 years.

\(^9\) See www.ehpa.org/eucert and chapter 3.2 for a detailed description of the program.
3.2 | Energy performance of buildings Directive

The Energy performance of buildings Directive (2002/91/EC, EPBD) was passed with the aim to promote the improvement of energy demand of new and existing buildings within the European Community. It asks Member States to set minimum requirements for energy demand for buildings, it advises them to install systems for the energy certification of buildings, and it provides guidance in how to calculate the energy performance of buildings in all Europe.

The Directive is currently under revision. The amended Directive was accepted by the European Parliaments ITRE committee earlier this year and is now subject to discussion in the Parliament itself.

As one of the major changes, the threshold of 1,000 m² of useful floor area is foreseen to be abandoned. Only buildings exceeding this threshold had to consider the use of energy supply systems based on renewable energy when constructed or undergoing major renovation. The recast does also suggest the amendment of several of the original recitals and articles in order to make the Directive more encompassing and stricter. In particular, it proposes to make all new and old buildings (in case of major renovation) subject to efficiency requirements and to express their energy performance by indicators for CO₂ emissions and primary energy demand. By 2019, all new constructions shall be net zero energy buildings. Member States shall provide incentives only for buildings that meet the minimum energy efficiency requirements. Whenever building components and systems are not covered by the Energy using Products Directive, they shall be subject to efficiency requirements set in the EPBD. In order to speed up market development and the implementation of this Directive, Member States are encouraged to reduce administrative barriers and to set up financial and fiscal instruments. Success shall be measured using a system of certification including reference values and energy certificates for all buildings.

It can be assumed, that heat pump technology benefits from the Directive, as it is perfectly suited for the triggered demand of more energy efficient buildings. Architects/planners that combine an adequate solar orientation of their buildings, an optimised building envelope, small scale electricity production from photovoltaic panels and heat pumps for heating, cooling and hot water production have all the tools necessary to start planning and constructing net zero energy buildings most areas of Europe even today.

3.3 | The Ecodesign for energy using products-Framework Directive

The Ecodesign Framework Directive (2005/32/EC) acknowledges the impact of energy using products on the energy demand of the whole society. As such it provides a framework setting up design requirements for all types of energy-using products. Individual implementing measures are currently developed for heat pumps (Lot 1), domestic water heaters (Lot 2), air conditioning devices (Lot 10) and 11 other product groups. Once passed by Commission and Council, they are implemented as Regulations without the need for further national transposition.

The implementation measure for Ecodesign and labelling of boilers applies to combi-boilers (using all energy sources), solar thermal collectors, micro-cogeneration and cylinders. It is based on European norms and provides a model for the calculation of primary energy efficiency of the whole system. An efficiency label based on seasonal space heating and water heating load. It includes climatic, buildings and installation characteristics and can be used to set calculated performance against set minimum efficiency requirements from other Directives.
(i.e. EPBD). It will be used to remove certain, very inefficient products (which will be sorted into the lowest 2–3 label categories) from the market.

Lot 1 is of special interest to the heat pump industry as it is the first energy label that will allow for straightforward comparison between different heating technologies, i.e. the overall energy efficiency of a specific heat pump may be compared with a gas boiler or an oil boiler under one and the same energy label. In order to allow for a cross-technology label the overall efficiency has to be calculated and expressed as primary energy efficiency. The final details of the calculation model will be finalised by the Commission in collaboration with a joint working group, constituting of a small group of experts representing the stakeholders. The implementing measures on lot 1 are expected to be finalised before the end of 2009.
4 Industry and technology trends

The structure of the heat pump industry is changing. Once characterized by large number of small manufacturers it is now moving towards the main stream of the European heating, ventilation and air-conditioning market. Due to positive market development over the last years and positive projections for the future, large companies formerly only producing oil and gas appliances are gradually introducing heat pumps in their product portfolios. Where independent development seemed too slow or not economically feasible, several big players have simply bought know-how, production capacity or access to market. The smaller manufacturers are finding it increasingly difficult to compete with multinational giants benefitting from economy of scale, capital resources, and established distribution networks.

This year’s ISH10 fair supported the notion that heat pumps have entered the main stream of the boiler business. While at last year’s exhibition the majority of manufacturers showed at least one heat pump model as part of their portfolio, at this years exhibition, nearly every exhibitor in Halls 8 and 9 presented an enlarged field of products and presented its technology innovations.

In an overarching exhibition, the German Heat Pump Association in cooperation with the Association of German heating appliances manufacturers (BDH) provided an overview on technologies using renewable energy sources including heat pumps.

Energy sources for heat pumps

One stream of innovation is developing around the combination of different energy sources. Most manufacturers offer bi-valent systems that combine heat pumps with solar-thermal collectors.11 In order to allow for an efficient application of such systems in harsh climates, they are often enhanced by a small gas-fired boiler or electric resistant heater to provide heating and cooling even at days without sunshine and low outdoor temperatures (tri-valent units). Several companies from the Netherlands are offering such systems as wall-hung units for, as a simple like-for-like replacement to existing boilers.

Air-source heat pumps are increasingly asked for as a result of the renovation market coming into focus in countries like Germany, Sweden and Switzerland. Air-source heat pumps, in particular air-water units are offered in several variations. Variations in products offered apply to the size/noise level of the outside unit and the temperature range covered.

Capacity control

Capacity modulating compressors are on the rise in several new heat pumps and may already be considered a standard in air-source units. Multi-compressor systems for air source units make use of the specific advantages of different refrigerants over low and high temperature ranges. They combine two compressors using different refrigerants to provide an efficient solution for the different requirements of the heating and hot-water operation modes.

Use of efficient components

This year’s improvement of overall systems efficiency was supported by the use of efficient components. In addition to the previously mentioned capacity modulating compressors this meant the use of high efficiency (class A and better) pumps for the heating and/or brine cycle, for air-water units, it meant the use of similar pumps for the heating cycle and high efficiency motors to power the fans.

10 ISH, the international fair for building technology, energy supply, climatisation and renewable energies, has a leading character for industry. The fair is visited by more than 200,000 visitors (approx. 33% from outside Germany) and takes place every two years. http://ish.messefrankfurt.com/
11 This type of integration is also the focus of the new Task 44: Heat pumps and solar integration to the IEA solar heating and cooling program. More information can be found at http://wp-effizienz.ise.fraunhofer.de/task44
High temperature heat pumps

The increasing importance of the retrofit market implies products that are capable of providing temperatures up to 65°C not only for domestic hot water but also for heating purposes. Nearly all manufacturers do offer such variants in their portfolio.

Large heat pumps

Large heat pumps are increasingly used in heating systems. They can be used in most applications: Commercial / industrial buildings, schools, hospitals, hotels, agriculture, and infrastructure projects. They are particularly applicable in cases where heating and cooling is used in low-energy industrial processes (up to 100°C), such as food processing or climatisation of large buildings. Large heat pumps are available in capacities up to 1.5 MW in single units or cascading applications. Different studies show that their potential is by far not used and that a widespread use would contribute considerably to energy savings and climate protection as well as provide cost savings for the user.

Challenges to market development

With the several positive developments of the heat pump markets framework condition, it is necessary to also look at the challenges.

An important issue may result from strong growth in the market – as it was experienced in the 80’s in several markets already, success draws competitors aiming at perceived easy to reap profits, but with limited experience and capacity for installing high quality units. Such market players are a risk to systems quality and their appearance in the market make education and training of installers as well as the distribution of know-how on the integration of heat pumps in buildings to planners/architects even more necessary. The EHPA operates the European education and training program for heat pump installers (EUCERT) in cooperation with its members (see chapter 7 for an overview). The association also participates in the IEE project Qualicert which is geared at establishing common qualification and certification criteria for all small RES-installers. The extent of industry efforts towards production, product and installation quality will largely decide whether quality and image problems can be avoided.

A more general threat to the whole industry comes from tendencies to completely ban HFCs from the market. CO₂, Ammonia and hydrocarbons are available options. Their use is discussed among policy makers. Extensive studies within industry have shown however, that the largest amount of greenhouse-gas emissions results from heat pump operation and only a comparatively minor fraction results from leakage during manufacturing and destruction of products. As the mentioned alternatives come at the cost of reduced efficiency, they can not overcome the benefits of the use of HFCs at the moment. Industry perspective is to use HFCs with care, to reduce refrigerant charge as much as possible and to re-collect refrigerant from heat pumps that have reached the end of their useful life. The fact that this requires qualified personal does only underline once more the need for appropriate training and certification schemes.

The increasing recognition of heat pumps by Member States and their integration into existing or newly established support schemes goes hand in hand with requirements for product and service quality. They are usually based on unit efficiency measured as coefficient of performance (COP) according to EN 14511 / EN 12309. Some countries (Switzerland, UK – under consideration) start to accept third party quality marks such as the EHPA quality label as sufficient proof. Such an approach positively to an easier and more cost efficient administration of the underlying schemes.

12 See chapter 7 for a description of the label.
European heat pump market statistics

As of today, heat pumps are still not part of official energy statistics of most countries. The technology has long played only a minor role in energy production and consequently is rarely been found sufficiently important for inclusion in statistics bureaus' questionnaires. This situation is slowly changing, not the least due to the requirements set by the RES Directive, but it is expected that the modification in the process of data gathering will take more time. The RES-Directive can be considered the most important driver to changing this situation: It sets mandatory targets in the use of RES for the Member States, oversees the implementation process and also monitors execution. Future monitoring is foreseen to be done based on national energy statistics.

Industry itself is collecting sales data via its different national heat pump associations and the result of such aggregated efforts is the basis of this report. The reason for a limited regional coverage is the same as mentioned in last year’s publication:

- heat pump markets are too small to be recognized in official questionnaires, in countries where the markets are growing – the process of official recognition takes time
- differences in the definition of different types of heat pumps, ie. existing data does not do justice to the reality of the market.

While data collection is rather simple for energy sources that are tradable commodities, only indirect assessment is possible for technologies using renewable sources for heating and cooling – such as heat pumps and solar thermal collectors.

Their contribution can only be assessed by a calculation method. Such a method is requested in the RES-Directive to be presented by 2012 for all systems using renewable sources and efforts towards it are already underway.

Consequently, the current heat pump outlook is still based on industry sales statistics collected by the EHPA and linked national heat pump associations. Even though 21 European countries are represented in the EHPA, only eight countries have a market support infrastructure able to provide reliable sales statistics in the format required by the EHPA (Annex II). Italy is a special case, as the current process of data collection does not match the EHPA questionnaire in its entirety. As this is an important market, the presented numbers are still included, however without the number presented for air-air units.

In addition to the above mentioned reasons for a lack of precise data on heat pump sales, privacy concerns of some industry actors limit the availability of data. In countries without heat pump associations or similar bodies, data is not collected, as trustworthy bodies to accomplish this task are missing.

The EHPA is continuously developing and extending the statistics with the ambition to provide comprehensive information on the development of the European heat pump market. The association is also closely working with statistic bodies to develop a universal approach towards small RES statistics in general and heat pump statistics in particular.

The presented outlook focuses on heat pumps marketed for space heating and/or preparation of domestic hot water. As air-air units are predominantly used for cooling in the middle and southern part of Europe, they are not included in this
statistics for these countries. Reversible air-air heat pumps are however included for countries, where their predominant use is for heating, i.e. Sweden, Finland and Norway.

The European Heat Pump Outlook 2009 analyses the sales statistics and market development for eight European countries; Austria, Finland, France, Germany, Italy, Norway, Sweden and Switzerland. A general outline describing the framework of the heat pump market is followed by a number of focus reports describing the national market conditions. A rough market overview is given for countries with yet insufficient statistical data.

5.1 | European heat pump market development

The European market is influenced by three major factors:

1. The energy-price ratio of different energy sources and technologies (in conjunction with the investment costs of the respective heating system),
2. the tendency towards an energy supply independent of non-renewable sources, and
3. a policy framework consisting of institutional and (even more important) financial subsidy schemes on a European and on a national level favoring renewable energy sources.

Energy-price ratio of different fuels

Heat pumps are an alternative to conventional, fossil-fuel based burners. These conditions apply to and influence the development potential of most renewable energy technologies.

Apart from a general awareness on the negative side effects of the use of non-renewable fuels, the investment cost is the major influencing factor towards any heating cost. Even though a total cost of ownership perspective including operating cost would be more appropriate, this overall view is often not given the appropriate attention by the investor/decision maker. As investment cost for heat pumps (and many other renewable energy systems) are still considerably higher than those for fossil fuel boilers, a short sighted decision based on up-front cost is quite often made in favor of the fossil fuel based alternative.

A subsidy scheme or incentive program can help to overcome this type of market barrier, but can only lead to long term market success of the technology if it reduces total cost of ownership below those of a comparable system. If this is not the case, market impact will almost inevitably drop as soon as subsidies are withdrawn.

Consequently, any major shift in heating systems used will only be realized if the change makes economic sense. The recent increases and the unpredictable developments of oil/gas prices have raised the awareness of the risks of being dependent on fossil fuels.

Operating cost for heating systems depend on the combination of the units efficiency and the cost per unit of fuel. With varying energy prices across Europe, the relative position of heat pumps vs. other systems varies and can either be advantageous or disadvantageous. Table 2 shows the relevant energy prices for 2008. In countries where electric utilities are supporting the use of heat pumps by offering special heat pump tariffs, these tariffs have been used for the price of electricity.
Table 3 is used as the basis for analyzing the market opportunities for electric heat pumps in a specific country. It is also used to develop the energy price ratio for different fuels. The energy-price ratio is the ratio between the price of 1 kWh of electricity and the price of 1 kWh of heating produced by a competing technology. Consequently, a heat pump system has a comparative advantage over competing technologies whenever the seasonal performance factor (SPF) in the location of application is higher than the energy price ratio. In general, the larger the difference between SPF and energy price ratio, the bigger the advantage in terms of operating cost. When looking at the present energy price ratios in Europe it is quite clear that the strongest heat pump markets are found in countries with beneficial energy price ratios.

Figure 5 shows energy price ratios for six European countries. Efficiency for the performance of the oil, pellets and gas is assumed to be 85%, and efficiency for district heating (DH) is assumed to be 100%. As long as the given price ratios are found within the orange boundary, the relevant energy price ratio is below 2.5. This would indicate an area where electric heat pumps are seen as an attractive alternative. Nevertheless, the given energy price ratios must be interpreted with care as they are currently highly volatile.
Tendency towards energy supply independent from non-renewable sources

Major impact on general market development could be observed over the last strong winter with its very high prices for oil, gas and pellets. Several individual decision makers facing the question of what type of system to install in their new or renovated building for heating or hot water production choose an environmentally friendly alternative and opted towards heat pump systems.

Russian threats of shutting down Europe’s gas supply brought further attention to the topic and highlighted the dependency of the Community and the individual on energy imports.

Policy framework

The direct link between official recognition, financial subsidies, and market success has been shown repeatedly for heat pump technology.

The recently adopted RES-Directive and related Directives under development or revision stress the need for national action towards increased energy efficiency, low carbon technologies, and renewable energy sources. They may lead to initial or prolonged support of such technologies on the national level. They may also bring RES technologies into the focus of the hitherto uneducated decision maker. This may proof particularly true for heat pumps that were for the first time accepted as technology using renewable energy from air, water and ground by the RES Directive. This step – including integration in support systems – will now have to be followed by Member States in their own policy frameworks.

An additional benefit for heat pumps may result from evidence showing that several countries will have difficulties in meeting the binding targets for the use of renewables by 2020 with their traditional set of “tools”. In this context heat pumps hold an exceptional position as being a technology that contributes to the accomplishment of all the targets set. Once this is realized by governments as it was observable for the Finish representation during the negotiations for the RES Directive a change from a rather ambivalent to an ambitious position towards heat pumps is likely.

The RES-Directive was triggered by the belief of many actors that a major change in energy policies is necessary. The reality on the national level shows, that the implementation status of existing Directives (e.g. the EPBD) is different among the Member States with some showing a very poor track record. While some countries have already adopted new building regulations and subsidy schemes for renewable energy technologies others are still hesitant to change. In an effort to maintain the status quo, fossil fuels are subsidized and existing infrastructure and industries are protected with governments claiming, that neither consumers nor industry was ready for a change. In any case, such change would risk security of energy supply and lead to increasing energy prices and fuel poverty.

Such a position is increasingly difficult to maintain in the future, making a policy switch including beneficial treatment of heat pumps more than likely.

5.2 | EU country overview

The European Heat Pump market is characterized by continuous growth. Sales have more than doubled over the last four years and have reached a total of nearly 600,000 units (see figure 6 for 2008 sales data).

All of the eight countries represented in the statistics, report an increase in sales for 2008. France more than doubled (+127%) the sales of heat pumps and is now the biggest heat pump market in Europe. The French market still benefits a strong subsidy scheme for heat pumps. After a rather slow 2007, the German market started off with low intensity but saw a remarkable recovery during the latter part
of the year. The market finished the year with a total increase of 47% over 2007 values. The general awareness of heat pumps in Finland is steadily growing and attracting interest from policymakers and media. Being a neighbour to Sweden the successful development of the Swedish heat pump market has not been unnoticed by the Fins. The Finnish government has recently been debating the contribution potential from heat pumps to the renewable energy production in the country. Today most officials are well aware of the technology and will support it in the future. Similarly, actors in Norway are trying to raise the awareness of heat pumps by highlighting the experiences from the Swedish market. Figure 7 indicates a sales increase of 37% for Sweden. This figure is somewhat misleading and the reason for this is that the official statistics report on air-air heat pumps are based on an estimation of annual sales. As these estimations from 2008 are based on sales statistics from a larger share of the actors it has become evident that the sales of air-air heat pumps were greatly underestimated for 2007.

The eight markets depicted in the chart above have reached a point where the industry has been active long enough and sales figures have reached a value that justifies to build up an adequate infrastructure to form and maintain quality assurance and information channels. The national industry associations play a vital role in representing the technology in all types of legislation and lobbying activities.

While heat pumps are sold successfully in Europe since the early 80’s, industry experts are convinced that the majority of units is yet to be sold. Still a short glimpse at the past is taken to provide a better picture on the heat pump stock. For
this reason, sales data for the last four years have been accumulated and are shown in Table 4. With current developments it is possible that this number will nearly double over the next two years.

While the analysis of the number of units sold provides a good view on the magnitude of the market, a different figure is commonly used to give an indication on market penetration. In figure 8 the number of heat pumps sold is presented as a function of 10,000 inhabitants.

Not surprising, the Scandinavian countries are still outstanding indicating that more than 1% of the entire population purchased a heat pump during 2008. It should however be mentioned that the statistics for these countries includes the estimated sales of reversible air-air heat pumps. This type of heat pump still dominates the sales of heat pumps on these markets. The figure itself is even more impressive, taking into consideration that not all inhabitants of a country will buy an individual heat pump, but that it is usually one heating system per household.

Nevertheless, the presented numbers show that all markets in Europe have a large growth potential.

Table 4: Accumulated heat pump sales by category and country. Total: 1,588,989 units.

<table>
<thead>
<tr>
<th>Category</th>
<th>Austria</th>
<th>Finland</th>
<th>France</th>
<th>Germany</th>
<th>Italy</th>
<th>Norway</th>
<th>Sweden</th>
<th>Switzerland</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating only HP (excluding exhaust air HPs)</td>
<td>37,974</td>
<td>16,650</td>
<td>40,520</td>
<td>129,629</td>
<td>5,267</td>
<td>16,985</td>
<td>158,192</td>
<td>56,041</td>
</tr>
<tr>
<td>air/water</td>
<td>8,652</td>
<td>3,350</td>
<td>520</td>
<td>63,585</td>
<td>2,767</td>
<td>10,685</td>
<td>55,656</td>
<td>36,342</td>
</tr>
<tr>
<td>water/water</td>
<td>4,558</td>
<td>0</td>
<td>3,396</td>
<td>9,723</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>937</td>
</tr>
<tr>
<td>brine/water</td>
<td>19,394</td>
<td>13,300</td>
<td>11,605</td>
<td>52,535</td>
<td>2,500</td>
<td>6,300</td>
<td>102,536</td>
<td>18,762</td>
</tr>
<tr>
<td>dir. expansion/water or dir. condensation</td>
<td>5,370</td>
<td>0</td>
<td>5,967</td>
<td>3,028</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>others</td>
<td>0</td>
<td>0</td>
<td>19,032</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Exhaust air HP</td>
<td>7,021</td>
<td>8,381</td>
<td>0</td>
<td>20,451</td>
<td>0</td>
<td>2,450</td>
<td>67,623</td>
<td>416</td>
</tr>
<tr>
<td>Tap water HP</td>
<td>17,352</td>
<td>0</td>
<td>5,400</td>
<td>41,819</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>426</td>
</tr>
<tr>
<td>Reversible HP</td>
<td>598</td>
<td>133,000</td>
<td>240,870</td>
<td>2,865</td>
<td>86,391</td>
<td>227,830</td>
<td>195,040</td>
<td>0</td>
</tr>
</tbody>
</table>

Figure 8: Heat pump sales per 10,000 inhabitants 2008.
5.3 | Market segmentation

Heat pumps are an increasingly important sub-market in the much larger but
stagnating market for heating, ventilation and air conditioning (HVAC). This
market can be distinguished into the segment of new buildings and that of
renovation. In turn, both segments can be distinguished in residential and non-
residential building classes (see table 5). All segments are characterised by
different development statistics and potential:

1. The sub-segment for new residential one/two family houses is best developed.
Markets like Sweden and Switzerland show a market penetration of > 90 % and
75 % respectively. In developing markets like Austria, Finland, France, Germany or
Norway heat pumps have reached a share greater than 20 %.

2. The sub-segment for renovation of one/two family houses is currently gaining
importance. Still, the efficient use of heat pumps in this segment often requires
large extra investments in new windows, heat distribution system or insulation.

3. The sub-segment for residential multi-family residencies is only slowly
developing.

4. The sub-segment for non-residential buildings is characterized by individual
projects. As large buildings often have a demand for heating and cooling alike,
heat pump systems are increasingly used in an optimized comfort design
approach. As investors do become increasingly sensitive for low operating costs
and understand about the contribution potential of heat pumps, they demand
this technology more often.

<table>
<thead>
<tr>
<th></th>
<th>New building</th>
<th>Renovation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>single/double</td>
<td>Mass market</td>
<td>Increasingly recognized</td>
</tr>
<tr>
<td>family house</td>
<td>currently</td>
<td>market (France, Germany,</td>
</tr>
<tr>
<td></td>
<td>developing</td>
<td>Sweden, Switzerland),</td>
</tr>
<tr>
<td></td>
<td></td>
<td>importance of domestic</td>
</tr>
<tr>
<td></td>
<td></td>
<td>hot water units increasing</td>
</tr>
<tr>
<td>Residential:</td>
<td>Small; market</td>
<td>Initial steps are made</td>
</tr>
<tr>
<td>Multi-family</td>
<td></td>
<td></td>
</tr>
<tr>
<td>residency</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-residential</td>
<td>Minority share in currently</td>
<td>Increasingly important</td>
</tr>
<tr>
<td>(commercial)</td>
<td>sold heat pumps. Several</td>
<td>with owners that value</td>
</tr>
<tr>
<td></td>
<td>demonstration projects</td>
<td>low operating cost. Special</td>
</tr>
<tr>
<td></td>
<td>available, potential for</td>
<td>application in sewage</td>
</tr>
<tr>
<td></td>
<td>heating and cooling projects</td>
<td>systems, subways and</td>
</tr>
<tr>
<td></td>
<td>by far not exploited.</td>
<td>tunnels.</td>
</tr>
</tbody>
</table>

Table 5: Market segments for heat pumps.

Within each sub-segment, heat pumps compete directly with established
technologies. Depending on the required functionality (heating, cooling, domestic
hot water) competitors are gas and coal fired burners, direct electric heaters, or
biomass burners. Solar thermal collectors are increasingly integrated into heat
pump systems. In markets requiring cooling functionality heat pumps do also
compete with electric air-conditioning and cooling devices. However in these
markets a clear distinction between heat pumps used for heating and air-
conditioning devices that also use heat pump technology, but are optimized for
cooling, is less and less appropriate, as reversible air-air units are optimized for a
broader temperature range to efficiently provide both functionalities.

Exhaust air/heat recovery heat pumps complement additional heat sources by
providing an efficient way of heat recovery to reduce energy losses to the buildings
ventilation system thus increasing overall energy efficiency. Sales of Domestic hot
water heaters as mainly sold in Germany and Austria see a strong increase in sales,
as they contribute towards the legal obligation to cover a share of energy demand
from renewable sources.
The general development trend for most countries is led by an early adoption of heat pumps in the segment for new residential one family housing followed by the segment for renovation in this housing type.

Ever changing market conditions and the introduction of new products are affecting and reflect consumer preferences and thus affect sales statistics. Figures 10 and 11 depict the European sales of heat pumps 2008 separated by type on a country and an aggregated EU level.

Figure 9: Estimated market status for selected EU countries – data for 2007 (source: EHPA).

Figure 10: Heat pump sales per country and type (* includes sales of reversible air-air heat pumps).
The most significant change between 2007 and 2008 is the strong growth of the sales of air-water heat pumps in the heating-only segment as shown in figure 12. While ground source units dominated the European market for heating only heat pumps in 2005 and 2006, they went on par with air-source units in 2007. In 2008 the sales of air-water heat almost doubled whereas the sales of GSHPs showed a more moderate increase. Reasons for this are:

1. Several new air-water heat pumps with enhanced efficiency are being introduced to the market at high pace. In this development it can be seen that several manufacturers have initiated interesting collaboration projects, where companies in possession of leading technology for outdoor units collaborate with manufacturers upholding long experience and strong brand names for brine-water heat pumps. Although sales of air-water heat pumps are growing most considerable in France the same trend can be seen in all of Europe.

2. The lack of qualified drillers is a bottleneck for GSHPs in some countries.

3. A noteworthy trend is the growing interest for dedicated tap water heat pumps. Sales of tap water heat pumps more than doubled in 2008, even though the overall sales of tap water heat pumps in Europe is still at a low level.
5.4 | Renewable energy provided by heat pumps

From a national perspective one of the most interesting aspects of employing heat pumps on a large scale is their contribution potential towards the energy savings and climate protection goals. This includes their potential of using renewable energy from air, water and ground. Currently, a Eurostat working group is elaborating the contribution based on energy statistics and based on the method as suggested by the RES Directive. As this work is not finished, the EHPA has compiled a calculation for eight countries based on recent sales statistics. The calculations are based on the number of heat pumps installed from 2005 to 2008 in the residential sector. It is assumed that this stock is still in operation in 2008. Heat pumps installed outside this time horizon and those used in industrial and commercial applications are not included.

<table>
<thead>
<tr>
<th>General assumptions Group 1 (Austria, France, Germany, Switzerland)</th>
<th>Group 2 (Norway, Sweden, Finland, Italy)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air-water 3.3</td>
<td>Air-water 3</td>
</tr>
<tr>
<td>GSHP 3.6</td>
<td>GSHP 3.2</td>
</tr>
<tr>
<td>Air-air 2.9</td>
<td></td>
</tr>
</tbody>
</table>

By the end of 2008, 1,356 mio\(^{13}\) installed heat pumps are contributing 16,92 TWh of renewable energy to the overall final energy demand for heating (see table 7 and figure 13). Figure 13 also shows that approx. 60% of the contribution result from air source units and approx. 40% from GSHP.

<table>
<thead>
<tr>
<th>Austria</th>
<th>Finland</th>
<th>France</th>
<th>Germany</th>
<th>Italy</th>
<th>Norway</th>
<th>Sweden</th>
<th>Switzerland</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.68</td>
<td>1.11</td>
<td>5.29</td>
<td>2.93</td>
<td>0.10</td>
<td>0.15</td>
<td>4.14</td>
<td>1.14</td>
</tr>
</tbody>
</table>

Table 6: SPF assumptions for central and northern European Countries.

Table 7: Renewable energy provided by heat pumps in TWh. Total 16,92 TWh.

Figure 13: Renewable contribution from air source and GSHP units (2005–2008, in TWh).

\(^{13}\) This number includes all air-water and all GSHP for all eight countries and the reversible air-air units for Finland, Norway and Sweden for the years 2005 to 2008.
Figure 15 shows the related reduction in greenhouse gas emissions in 2008. It refers to the number of heat pumps installed from 2005 to 2008 and is calculated with an average EU emission value of 400 g GHG/kWhel. The amount of GHG emitted by heat pumps is compared to the amount of GHG emitted by a modern gas condensing burner using an emission value for gas of 262 g/kWhth. The results should be considered a cautious estimate. It can be assumed that a larger number of heating systems has been replaced and that at least some of these were not gas, but oil boilers and direct electricity heating systems. Their replacement makes GHG savings larger.

In essence, all heat pumps installed from 2005 to 2008 do reduce greenhouse gas emissions by 6.74 Mt in 2008. This value will improve in the future not only from more efficient units being sold, but also from an expected improvement in the efficiency and the carbon footprint of the EU-electricity mix.
In order to gain a better understanding of the individual European heat pump markets the following section presents focus reports on selected markets in Europe. The focus reports have been provided by the national editors.
6.1 | Austria

Key facts

<table>
<thead>
<tr>
<th>Category</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population</td>
<td>8,336,549</td>
</tr>
<tr>
<td>Area</td>
<td>83,871 km²</td>
</tr>
<tr>
<td>Capital</td>
<td>Vienna</td>
</tr>
<tr>
<td>Number of single/two-family houses/multi-dwelling buildings</td>
<td>2,252,900¹⁴</td>
</tr>
<tr>
<td>Average heat demand single/two family house</td>
<td>20 - 25 MWh/year</td>
</tr>
<tr>
<td>Number of non residential buildings</td>
<td>282,257¹⁵</td>
</tr>
<tr>
<td>New constructed dwellings in single/two family houses in 2002</td>
<td>16,052¹⁶</td>
</tr>
</tbody>
</table>

Share of energy from renewable sources in final consumption of energy 2005: 23.3%

Binding target for the use of renewable sources by 2020: 34%

Generation of electricity 2008: National emission factor (g CO₂/kWhₑlectricity) 207,817

Energy prices

Average end consumer prices including distribution and taxes:

- Pellets¹⁸ (sack delivery) (Dec. 2008): 4.7 Euro cent/kWh
- Pellets (bulk delivery) (Dec. 2008): 4.1 Euro cent/kWh
- Electricity¹⁹ (Dec. 2008): 17.5 Euro cent/kWh
- Electricity for heating purposes (2nd qu. 2009): 15.2 Euro cent/kWh
- Domestic gas²⁰ (Dec. 2008): 6.9 Euro cent/kWh
- Heating oil (Dec. 2008): 6.1 Euro cent/kWh
- District heating²¹ (2nd qu. 2009): 9.2 Euro cent/kWh

In Austria the strong growth of the heat pump sector beginning from the year 2000 is also continued in 2008. Last year 18,690 units were sold in the home market. This figure consists of all types and performance classes. It shows an increase of 23.4% compared with 2007, where 15,241 plants were sold. Figure 16 shows the number of heat pumps for water and for space heating sold in Austria 1976–2008.

The historic development is characterised by the change from tap water heat pumps to heat pumps for heating. The background for this development can be found in the further development of the technology, the favourable conditions, when heat pumps are installed in energy-efficient buildings because of its low heating demand and flow temperature, and the effective energy policy instruments.

The growth of the market is caused by the fast growing segment of heat pumps for space heating (+21.4%) and the also fast growing segment of heat pumps for water heating (+30.8%).

Heat pumps for space heating are divided in three performance classes. The one up to 20 kW (used in private buildings) increased by 29.1%, whereas the heat pumps from 20 kW and above 80 kW had a downward trend of −13.9% and...
The increase in sales of dedicated tap water heat pumps is significant (+42%). Such growth has not been experienced since the year 2000.

Assuming the technical life span of a heat pump about 20 years, 156,482 heat pumps are in operation in Austria at the end of 2008 (see figure 18).
These units made 1.210 GWh\textsuperscript{22} of ambient heat usable. Considering the power requirement necessary for heat pump operation, the installed stock saved 497,297 tons of CO\textsubscript{2} in 2008.

Having a view on the export market it can be noticed that the export ratio is in general growing and higher in the upper performance classes, but in absolute figures most heat pumps (6,272 units) were exported in the performance class up to 20 kW.

In Austria heat pumps are on the one hand promoted by the federal states, when the heat pump is used in residential buildings, and on the other hand by "Kommunalkredit Public Consulting GmbH" for heat pumps used in the industrial sector.

Most heat pumps were supported in Lower Austria, followed by Upper Austria, Carinthia and Burgenland (see figure 19).

The actual diffusion of heat pumps profits from the continuous improvement of the energy-efficiency of buildings that need lower flow temperature. New scopes of application can be noticed e.g. in passive houses. Heat pumps are used for controlled living space ventilation with heat recovery. The increasing demand of cooling and air-conditioning that can be supplied by heat pumps due to their technical possibilities supports the market development. In the field of refurbishment of old buildings air source heat pumps are becoming more attractive as they can additionally be used for dehumidification. Furthermore a new technological field has been developed where heat pumps utilize geothermal heat in tunnels and sewage systems and as well as the waste heat from industrial and commercial buildings.

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{fig19.png}
\caption{Supported Heat Pumps – Distribution in Austria.}
\end{figure}

\textsuperscript{22} This value exceeds the one stated in chapter 5.4, as the number of included heat pump units is larger.
### 6.2 | Finland

#### Key facts

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population:</td>
<td>5,300,000</td>
</tr>
<tr>
<td>Area:</td>
<td>338,000 km²</td>
</tr>
<tr>
<td>Capital:</td>
<td>Helsinki</td>
</tr>
<tr>
<td>Number of single/two-family houses:</td>
<td>1,100,000</td>
</tr>
<tr>
<td>Average heat demand single/two family house:</td>
<td>20–25 MWh/year</td>
</tr>
<tr>
<td>Number of all buildings:</td>
<td>1,400,000</td>
</tr>
<tr>
<td>Share of energy from renewable sources in final consumption of energy 2005:</td>
<td>28.5%</td>
</tr>
<tr>
<td>Binding target for the use of renewable sources by 2020:</td>
<td>38%</td>
</tr>
<tr>
<td>Rate of new construction single/two family houses 2008:</td>
<td>10,000</td>
</tr>
<tr>
<td>Generation of electricity 2008:</td>
<td></td>
</tr>
<tr>
<td>Net Supplies of Electricity 2008:</td>
<td>86,9 TWh</td>
</tr>
<tr>
<td>National emission factor (g CO₂/kWh electricity)</td>
<td>168</td>
</tr>
</tbody>
</table>

#### Energy prices:

<table>
<thead>
<tr>
<th>Energy</th>
<th>Average end consumer prices including distribution and taxes during 2008:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity*</td>
<td>10,3 Euro cent/kWh</td>
</tr>
<tr>
<td>Heating oil**</td>
<td>5,5 Euro cent/kWh</td>
</tr>
<tr>
<td>Pellets***</td>
<td>4,5 Euro cent/kWh</td>
</tr>
<tr>
<td>District heating****</td>
<td>6,2 Euro cent/kWh</td>
</tr>
</tbody>
</table>

#### Present market situation

The market for domestic heat pumps in Finland is growing rapidly. The technology is gradually reaching increased recognition and acceptance among the general public. Heat pumps are the preferred choice in new construction as well as for retrofitting the existing building stock. Heat pumps are now in use in nearly 20% of all Finnish single family houses. As the overall economic downturn has had a negative effect on the rate of new construction in the building sector the Finnish heat pump market is more focused on the retrofit and replacement market. Sales are stimulated by a subsidy scheme for renovation and extension works in private homes. The current challenge for the Finnish heat pump market is to overcome the barriers set by the economic situation and a general resistance against any changes in heating systems.

#### Market trends

The trend that can be observed is that sales of brine-water and air-air heat pumps is continuing to grow, and sales of exhaust air heat pumps (~10%) has decreased (see table 8). The natural explanation to this development is that the retrofit market is opening up and construction of new houses is slowing down. The sales of exhaust air heat pumps are expected to continue to fall in the future. This is due to the fact that the normal type of exhaust air heat pump does not comply with the new building regulations. Sales of the normal type of exhaust air heat pump will be restricted to houses with a very high insulation standard and replacements of old exhaust air heat pumps. A good guess could be a growing share of brine-water heat pumps in new construction. Air-water heat pumps are
new phenomena on the Finnish heat pump market. They will probably gain market shares in the retrofit market, in spite of cold climate conditions.

<table>
<thead>
<tr>
<th></th>
<th>2007</th>
<th>2008</th>
<th>Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground Source HP</td>
<td>5,300</td>
<td>7,500</td>
<td>42%</td>
</tr>
<tr>
<td>Exhaust HP</td>
<td>2,500</td>
<td>2,200</td>
<td>–12%</td>
</tr>
<tr>
<td>Air/Water HP</td>
<td>450</td>
<td>2,500</td>
<td>456%</td>
</tr>
<tr>
<td>Air/Air HP</td>
<td>38,000</td>
<td>48,000</td>
<td>26%</td>
</tr>
<tr>
<td>Total</td>
<td>46,250</td>
<td>60,200</td>
<td>30%</td>
</tr>
</tbody>
</table>

Table 8: Sales of heat pumps in Finland 2007–2008 *based on estimation of SULPU.

Costs

Table 9 depicts average end consumer prices, including VAT, for turnkey installation in single family houses. The turnkey solutions include everything to take the installation in operation, i.e. the heat pump, auxiliary equipment, material and labour costs.

<table>
<thead>
<tr>
<th></th>
<th>Air-Air</th>
<th>Air-Water</th>
<th>GSHP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Euro</td>
<td>1,500–2,000</td>
<td>8,000–12,000</td>
<td>11,000–20,000</td>
</tr>
</tbody>
</table>

Table 9: Typical end consumer prices for Finland.

Air-air heat pumps are predominantly installed in existing houses using direct electricity heating. This is currently the most cost effective solution for this type of house. A recent trend is to install air-air heat pumps in summer cottages. Several products offer new features enabling maintenance heating to avoid freezing during wintertime and long distance control systems via GSM-modem. The air-air heat pump is used as a complement to direct electricity heating.

Air-water heat pumps are generally replacing or complementing oil or electric boilers and for climatic reasons such replacement is more frequent in the southern part of Finland.

Ground source heat pumps are completely dominated by vertical indirect systems. Horizontal systems do exist but are restricted in use due to the significant space requirements. The main reasons that vertical systems have become so successful are:
1. Liberal regulations regarding drilling.
2. Favourable crystalline bedrock of high thermal conductivity.

**Brand names**
Some of the most significant brand names existing on the Finnish market are listed in alphabetical order below.

**Ground-source heat pumps:**
Carrier, CTC, Ekowell, Gebwell, Geopro, IVT, Karhu, Lämpöässä, NIBE, Stiebel-Eltron, Thermia, Vaillant, Viessmann.

**Air-water heat pumps:**
Carrier, CTC, Daikin, IVT, Mitsubishi, NIBE, Sanyo, Stiebel-Eltron, Thermia, Vaillant, Viessmann.

**Air-air heat pumps:**
Daikin, Electrolux, Fujitsu, IVT, LG, Mitsubishi, Panasonic, Sharp, Sanyo, Toshiba, Ultimate.

**Exhaust-air heat pumps:**
Carrier, Enervent, IVT, NIBE, Nilan, Meptek ComfortZone.

**Distribution channels**
Dedicated retail networks and wholesalers dominate the heat pump market. Nonetheless for the last couple of years air-air heat pumps are offered at construction material stores, mail-order firms and web-stores.

**Industry infrastructure**
The following sections highlight some of the existing industry supportive organisations and schemes that serve as part of the industry’s infrastructure.

**National industry associations**
The Finnish Heat Pump Association SULPU, formed 1999, has approximately 80 members. The members constitute of manufacturers and importers of heat pumps, installers and other companies with interest in the industry. The association serves as the official voice for the heat pump industry on a national level.

**Training and certification**
Training according to the European Certified Heat Pump Installer scheme is offered from the beginning of year 2009 by SULPU.

With contribution of SULPU Finland joined the IEA Heat Pump Program in 2009.

**Incentive schemes**
Heat pump installations qualify for the tax reduction scheme that applies to renovation and extension works in private households. According to the scheme up to 60% of the labour costs related to renovation and extension may be deducted from each owner of a private property. The maximum amount that may be deducted for each owner is 3,000 Euro.
6.3 | France

Key facts
Population: 63,937,000
Area: 551,000 km²
Capital: Paris

Number of individual houses: 15,019,000
Number of flats in multi-dwelling buildings: 11,624,000
Average heat consumption for all residential house: 123 kWh/m² per year
Surface of non residential buildings: ~ 800 million m²
Share of energy from renewable sources in final consumption of energy 2005: 10.3%
Binding target for the use of renewable sources by 2020: 23%
Rate of new construction (houses + flats) 2008: 369,000
(−15 % / 2007)

<table>
<thead>
<tr>
<th>2008</th>
<th>TWh</th>
<th>Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nuclear</td>
<td>418,3</td>
<td>76 %</td>
</tr>
<tr>
<td>Hydro</td>
<td>68,1</td>
<td>12 %</td>
</tr>
<tr>
<td>Wind</td>
<td>5,7</td>
<td>1 %</td>
</tr>
<tr>
<td>CHP</td>
<td>56,9</td>
<td>10 %</td>
</tr>
<tr>
<td>Total</td>
<td>549,0</td>
<td>100 %</td>
</tr>
</tbody>
</table>

Net import (+)/Export (−): −48 TWh

National emission factor (g CO₂/kWh electricity):
180 for heating,
100 for light,
60 for other residential use,
40 for base use (air conditioning, non-seasonal use)²⁶

Energy prices
August 2008²⁷
Average end consumer prices including distribution and taxes:
Electricity: 11,57 Euro cent/kWh
Oil: 8,93 Euro cent/kWh
Gas: 6,19 Euro cent/kWh
Propane: 11,72 Euro cent/kWh
District heating: 6,41 Euro cent/kWh
Coal: 6,97 Euro cent/kWh
Wood (log): 3,6 Euro cent/kWh

May 2009²⁸
Average end consumer prices including distribution and taxes:
Electricity: 11,34 Euro cent/kWh
Oil: 5,46 Euro cent/kWh
Gas: 5,79 Euro cent/kWh
Propane: 8,63 Euro cent/kWh

²⁵ CEREN
²⁶ Source: ADEME 2005
²⁸ Source CEREN, magazine Energie Plus, June 2009
Energy price ratios

One of the first things to look at when analysing the market opportunities for electric heat pumps in a specific country are the existing energy price ratios, i.e. the ratio between the price of electricity and the price of 1 kWh heating produced by competing technologies. The energy price ratio corresponds to the seasonal performance factor (SPF) that has to be overcome in order to result in lower heating costs for the heat pump system. Given below are the relevant energy price ratios for France in August 2008 (May 2009 in brackets). As a very rough assumption\(^{29}\) for the calculations below the annual performance of the gas-, propane- and district heating systems are set to 90 %, and 85 % for oil, and 80 % for coal and 70 % for wood.

<table>
<thead>
<tr>
<th>Energy price ratio</th>
<th>August 2008</th>
<th>May 2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity/Oil</td>
<td>1.10</td>
<td>1.77</td>
</tr>
<tr>
<td>Electricity/Gas</td>
<td>1.68</td>
<td>1.76</td>
</tr>
<tr>
<td>Electricity/Propane</td>
<td>0.89</td>
<td>1.18</td>
</tr>
<tr>
<td>Electricity/heating district</td>
<td>1.62</td>
<td></td>
</tr>
<tr>
<td>Electricity/Coal</td>
<td>1.33</td>
<td></td>
</tr>
<tr>
<td>Electricity/Wood</td>
<td>2.25</td>
<td></td>
</tr>
</tbody>
</table>

Present market situation

The market for domestic heat pumps in France has been increasing dramatically since 2005. One of the explanations to the development of the French market is the currently available subsidy scheme for high performing and environmentally friendly energy appliances, such as gas condensing boilers, solar thermal panels, PVs and heat pumps. The subsidy is offered by means of tax reduction. In the French scheme, it is the cost of the heat pump unit that serves as a basis for the deductible amount. The subsidies that have been available since 2005 vary depending on the year of purchase and type of heat pump. 2009 40 % of the cost for a GSHP- or air-water heat pump unit is deductible up to a maximum of 8,000 Euro (see table 12).

<table>
<thead>
<tr>
<th>Average cost</th>
<th>Air-air (Multi-split)</th>
<th>Air-air (Ducted system)</th>
<th>Air-water</th>
<th>GSHP (Horizontal)</th>
<th>GSHP (Vertical)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Euro</td>
<td>9,000</td>
<td>10,000</td>
<td>12,000</td>
<td>15,000</td>
<td>18,000</td>
</tr>
</tbody>
</table>

As a direct result of the subsidy scheme the domestic heat pump market has been growing, from 17,300 in 2004 to 152,500 (157,910 including tap water heat pumps) in 2008. The current scheme has effectively initiated a strong retrofit market in France. From being a negligible market segment 2004, almost 100,000 heat pumps were installed in existing buildings 2008. Within the same time period, the new building market for heat pumps has been increasing from 17,300 in 2004 to 54,300 in 2008.

Domestic air-water heat pumps have benefited the most from the subsidies. In 2004 they represented 32 % of the overall heat pump market, whereas they represent 64 % in 2008. One of the explanations is due to the easier installation offered by an air-water heat pump compared to a GSHP in existing houses. This tendency was enhanced by the market introduction of a new generation of heat pumps able to deliver water heating up to a temperature of 65°C, or even by some products 75°C, on the coldest days. That has allowed for retrofit installations with no additional requirements on improved insulation of the buildings.

Around 15 % of the new dwellings built in 2008 have been equipped with heat pumps\(^{10}\) (4 %, 2004): among them, 27 % were GSHP and 73 % were air-water heat pumps (in 2004, 68 % were GSHP).

\(^{29}\) to be adjusted according quality of boiler and fuel

\(^{30}\) Source: AFPAC (excluding air/air HP)
Sales of air-air heat pumps are generally excluded in the national sales statistics for France as it is rather impossible to distinguish whether they are marketed and sold to provide heating, comfort cooling or both. Nevertheless it is evident that this product segment has grown from an almost negligible share in 2004 up an estimated sales volume of around 160,000 (± 20 %) units in 2008. Air-air heat pumps are mostly installed with multiple indoor units (multi-split).

Note that, right now, exhaust air heat pumps are not very common in France. This may however change in the future due to a growing share of low energy houses. Sales of dedicated tap water heat pumps were 5,400 units in 2008, of which 11 % use exhaust air31 as heat source.

The present stock of heat pumps used in the domestic sector is estimated as follows:

• 263,000 air-water heat pumps
• 113,000 GSHP
• 500,000 air-air heat pumps (± 20 %)

There are presently no reliable heat pump statistics available for the tertiary sector. However the requests for Aquapac32, which has increased with a factor of four between 2006 and 2008, indicate a significant growth.

In France, the real competitors to heat pumps are:

---

31 Source: AFPAC
32 Aquapac is a guarantee for system using ground water/water HP in case of problems occurring on ground water
Owing to its low installation cost in new houses this alternative is competitive. Direct electricity is however foreseen to lose some of its competitiveness as more strict building regulations will come into force in 2012. These regulations will limit primary energy consumption (presumably, depending on the type of application, between 40 to 65 kWh/m²/year all electricity usage included).

Gas
Gas is the single most common source for heating in France and is still seen as a natural choice in urban areas with the existence of a well implemented gas grid.

Oil
Oil is most commonly used in isolated areas outside the gas grid. In these areas it might be difficult to employ heat pumps on a large scale as the electricity grid might set some limitations on extensive use of electricity.

Firewood (in log)
Firewood which is used in dense populated areas as a source of cheap heating at the cost of more work input from the house owner. Wood pellets are not as common as plain firewood.

Market trends
Short term trends: For the first four months of 2009, the sales in the French heat pump market have decreased. The first reason is of course the crisis that has had a negative impact on the rate of construction of new buildings. GSHP, whose market is more concentrated in new construction, seems to be more affected (−32 %) than air-water heat pumps (−8 %)33. Secondly, as subsidies were cancelled for air-air heat pumps from the beginning of 2009, we can expect that its sales will also decrease.

Medium term trends: As the development of the French heat pump market is affected by the economic crisis it is difficult to predict when the current negative trend may be broken. However as soon as the crisis is overcome, the heat pump market is expected to grow for the following reasons:

- Globally, the generation of electricity by non-renewable, fossil fuels will continue to decrease.
- At the European level, the challenging targets regarding the use of renewable energy stipulated in the recently adopted RES-Directive (2009/28/EC) may not be reached without a strong promotion of the use of heat pumps.
- On national level, heat pumps are expected to benefit from the new building regulations that will come into force in France 2012.

### Table 13: Estimated shares of heating systems in the building stock.

<table>
<thead>
<tr>
<th>Heating system</th>
<th>Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity (Mainly direct)</td>
<td>24%</td>
</tr>
<tr>
<td>Air-air heat pumps*</td>
<td>2%</td>
</tr>
<tr>
<td>Air-water heat pumps</td>
<td>1%</td>
</tr>
<tr>
<td>GSHP</td>
<td>0.5%</td>
</tr>
<tr>
<td>Oil boilers</td>
<td>20%</td>
</tr>
<tr>
<td>Gas boilers</td>
<td>38%</td>
</tr>
<tr>
<td>Liquified gas boilers</td>
<td>3%</td>
</tr>
<tr>
<td>District heating</td>
<td>5%</td>
</tr>
<tr>
<td>Biomass boilers</td>
<td>6%</td>
</tr>
<tr>
<td>Coal</td>
<td>0.5%</td>
</tr>
</tbody>
</table>
Costs

The table below depicts average end consumer prices, including VAT, for turnkey installation in single family houses. The turnkey solutions include everything to take the installation in operation, i.e. the heat pump, auxiliary equipment, material and labour costs.

<table>
<thead>
<tr>
<th>Average cost</th>
<th>Air-air (Multi-split)</th>
<th>Air-air (Ducted system)</th>
<th>Air-water</th>
<th>GSHP (Horizontal)</th>
<th>GSHP (Vertical)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Euro</td>
<td>9.000</td>
<td>10.000</td>
<td>12.000</td>
<td>15.000</td>
<td>18.000</td>
</tr>
</tbody>
</table>

The choice of heat pump used for refurbishment is mainly determined on the basis of the existing heating system:

- In case of the existence of a hydronic heat distribution system, air-water heat pumps are the most common choice. This type of heat pump benefits of lower investment costs and a less complicated installation than GSHP. However, air-air heat pumps are used in some cases due to lower cost and their possibility to provide comfort cooling.
- In case of direct electric radiators (mainly spread in France), air-air systems is seen as the obvious solution.

Air-water heat pumps is currently the predominant solution for new houses.

Brand names

As shown in the French market statistics, heat pump sales has been increasing dramatically for some years and consequently the manufacturers have grown and/or bigger ones have joined the competition. Market entry has been achieved repeatedly through acquisitions of smaller national heat pump manufacturers. The new market players often constitute of companies with at least one main business area being heating appliances, e.g. France-Energie was bought by Muller, Sofath by De Dietrich and Enalsa by Atlantic. The heat pump component manufacturer Danfoss integrated forward by the purchase of Thermia (Sweden) and Avenir-Energie. Another way of placing heat pumps on the French market, which has been taken by some large manufacturers of air-conditioning products, is through close cooperation with a nationally well established company. By this approach the French company may broaden its heat pump portfolio by offering branded products. Examples of this on the French market are the cooperation between Fujitsu – Atlantic and Toshiba – Carrier. Other actors that have recognised the growing interest and potential for air-water heat pumps have put a lot of effort in developing air-water heat pumps suitable for Europe and are since 2 or 3 years offering their products in France under their own brand name (Daikin, Hitachi, Mitsubishi Electric, Sanyo).

Most of the brand names existing on the French market are listed in alphabetical order below.

Ground-source heat pumps:

Air-water heat pumps:
Air-air heat pumps:

Distribtution channels
As in other European countries, there are mainly 2 distribution channels. The first one is direct sales by manufacturers to installers. The second one is indirect sales via wholesalers. GSHP more often encountered in the first one, whereas air-air heat pumps are mainly sold in second one, air-water is in both channels.

National industry associations
The French heat pump Association (AFPAC) was created in 2002, and today has around 50 members. A majority of the members are heat pump manufacturers. As other national heat pump associations AFPAC makes promotion of heat pumps and serves as the voice for the heat pump industry on a national level. The association handles all proposals for new national regulation and legislation related to heat pump appliances. Last, but not least, AFPAC has a strong activity in improving the quality of heat pump installations.

Training and certification
AFPAC is, since 2007, administrating a certification scheme called “QualiPAC” for heat pump installers.

To become a “QualiPAC” installer, two main conditions are required:

1. The installer must either be qualified according to French well-known qualification34 or have an employee (often the manager in small companies) who succeeds in EUCERT exam

2. In the first year two of the companies previous installations are audited on site by an independent body, according to a standard elaborated by AFPAC; in consecutive years, one installation, randomly chosen, is audited.

Product labels
NF-PAC is a French product label for heat pumps that was launched in 2007 with an active contribution of AFPAC. This label was approved by AFNOR Certification and is managed by Certita. This label sets a minimum level of COP to be reached. Test conditions used for declaration of COP are defined by EN 14511 (nominal and application conditions). Moreover, NF-PAC specifies requirements on minimum quality product management, which is controlled by random audits performed by an independent body. Discussions has started recently between EHPA Quality Label (previously DACH label) and NF-PAC to agree on mutual recognition of test results acquired from heat pump performance tests completed under the two quality label schemes.

Incentive schemes
A subsidy scheme for heat pumps is currently available in France. The subsidy is offered by means of tax reduction. In the French scheme, it is the cost of the heat pump unit that serves as a basis for the deductable amount. The subsidies, that have been available since 2005, vary depending on the year of purchase and type of heat pump. 2009 40 % of the cost for a GSHP- or air-water heat pump unit is deductable up to a maximum of 8.000 Euro. Purchase of Air-air heat pumps are omitted from the subsidy scheme since 1 January 2009.
6.4 | Germany

Key facts

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population</td>
<td>82,218,000</td>
</tr>
<tr>
<td>Area</td>
<td>357,104 km²</td>
</tr>
<tr>
<td>Number of single/two single family houses</td>
<td>34,200,000</td>
</tr>
<tr>
<td>Number of dwellings in multi-dwelling buildings</td>
<td>5,500,000</td>
</tr>
<tr>
<td>Number of non residential buildings</td>
<td>706,000</td>
</tr>
<tr>
<td>Share of energy from renewable sources in final consumption of energy 2005</td>
<td>5.8 %</td>
</tr>
<tr>
<td>Binding target for the use of renewable sources by 2020</td>
<td>18 %</td>
</tr>
<tr>
<td>Rate of new construction single/two family houses 2008</td>
<td>8</td>
</tr>
</tbody>
</table>

Structure of primary energy consumption in Germany 2007
Petroleum (34 %), Gas (22 %), Black coal (14 %), Brown coal (12 %), Nuclear (11 %), Renewables (6.7 %). Furthermore, Renewables consists of Hydro (0.5 %), Wind (1.0 %), Bio (4.9 %) and Others (0.3 %).

Energy prices (including VAT) in 2008
Average end consumer prices including distribution and taxes:

<table>
<thead>
<tr>
<th>Energy Type</th>
<th>Price (Euro cent/kWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity</td>
<td>21.43</td>
</tr>
<tr>
<td>Electricity heat pump tariff36</td>
<td>12 – 14</td>
</tr>
<tr>
<td>Heating oil</td>
<td>5.2</td>
</tr>
<tr>
<td>Gas</td>
<td>7.10</td>
</tr>
<tr>
<td>District heating</td>
<td>6.1</td>
</tr>
</tbody>
</table>

Present market situation: Booming heat pump market
The total sales volume in 2008 exceeded the numbers from 2007 by nearly 50 % with more than 60,000 ‘heating-only’ heat pump units being sold. The sales of air-water units increased super-proportional by 58 %.

In 2008, the total number of space heating heat pumps being sold in Germany amounts to approx. 62,500 units. In comparison to 2007’s, 44,633 space heating units its an increase of more than one third. Case one also includes domestic hot water heat pumps, the increase is even larger – from 52,630 units to 77,288. The German heat pump stock is estimated at 350,000 heat pumps – with a strong growth potential.

More and more German consumers are becoming aware of the benefits with heat pump technology and its advantages like cost-effectiveness, independency of energy imports as well as environmental awareness and sustainability. Another market driver is ”Marktanreizprogramm” (MAP) – a subsidy program for renewable technologies introduced by the government. In 2008, heat pump technology has been admitted to MAP-subsidies; as a consequence, it can benefit from this program, too. Therefore, industry experts estimate increasing sales figures, even though the increase in 2009 is expected to be rather moderate due to the general economic crisis.

Last year, air to water heat pumps accounts for the highest growth. In 2008, more than 28,000 units have been sold – an increase of 58 % in comparison to 2007 (17,748 units). Hence, air to water heat pumps have a total market share of 36 % (referring to all heat pumps being sold in 2008) and are more or less on the same
level as brine water heat pumps. Those got a market share of 37.4%, which is a total of 28,929 brine water heat pumps, and a rise of 33% in comparison to last year. Finally, 2008 experienced a remarkable growth of heat pump water heaters: Sales figures reached 13,861 – a nearly 100% increase over the 7,354 units sold in 2007 (see figures 23 and 24).

Figure 23: Sales of heat pumps in Germany from 1978–2008 (including sales for domestic hot water units).

Figure 24: Market segmentation Germany 2008.

Market trends

Over the last years, there was a continuous growth of the whole heat pump market in Germany. Especially, the air to water heat pump segment had a magnificent increase year by year. This trend is based on an increasing need of redevelopments for older buildings. In this sector, the air to water heat pump is the preferred solution, because it is easy to install and, furthermore, there is no need of a ground source. Compared to this trend, new building decreases so far. Since 2009, renewable energies like solar thermal, pellets and heat pumps are in focus of building restrictions (for new buildings) by government’s EEWärmeG. According to this Directive, it is necessary to use a minimum amount of renewable

Data source: figures published by "Statistisches Bundesamt"; www.destatis.de
energy in order to supply the building with energy. Requirements can be satisfied with a heat pump, which can realize a minimum Seasonal Performance Factor (SPF).

Also other renewable technologies have to reach minimum standards to fit into the requirements of the government’s restriction. As a consequence, the market share of heat pumps being installed in new buildings probably will increase within the next years. Furthermore, the government has launched a subsidy program for heat pumps in 2008. Based on the building restrictions in 2009, the subsidy has been changed for new buildings. The strategy of the government is to claim renewable energies for new buildings and to promote it with subsidies for old buildings. The main focus (according to SPF) is based on brine water heat pumps. This is also the reason why exhaust air heat pumps decreased over the last years.

Another trend was a significant increase of domestic hot water (DHW) Heat pumps in 2008, where the sales could be doubled in comparison to 2007. More and more, combinations of different systems such as heat pump and solar thermal are in focus of interest and will become a more important solution in the next years. Last but not least, heat pumps for capacities from 50 to a few hundred kW heating capacities are getting a better standing in the market. This market share is still on a low level, but heat pumps will gain importance in this segment, too.

### Existing building stock

<table>
<thead>
<tr>
<th></th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas</td>
<td>48.00%</td>
</tr>
<tr>
<td>Oil</td>
<td>30.70%</td>
</tr>
<tr>
<td>Coal</td>
<td>3.00%</td>
</tr>
<tr>
<td>Electricity</td>
<td>5.80%</td>
</tr>
<tr>
<td>District heating</td>
<td>12.50%</td>
</tr>
<tr>
<td>Heat pumps</td>
<td>-</td>
</tr>
<tr>
<td>Others</td>
<td>0.30%</td>
</tr>
</tbody>
</table>

### New buildings

<table>
<thead>
<tr>
<th></th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas</td>
<td>66.00%</td>
</tr>
<tr>
<td>Oil</td>
<td>3.00%</td>
</tr>
<tr>
<td>Coal</td>
<td>0.00%</td>
</tr>
<tr>
<td>Electricity</td>
<td>1.00%</td>
</tr>
<tr>
<td>District heating</td>
<td>9.00%</td>
</tr>
<tr>
<td>Heat pumps</td>
<td>15.00%</td>
</tr>
<tr>
<td>Others</td>
<td>6.00%</td>
</tr>
</tbody>
</table>

Above mentioned percentages referring to annual figures of 2006/2007, when total existing building stock represents approx. 3.790.000 houses. At the same time, roughly 220.000 new buildings had been built.

### Costs

The following table depicts average end consumer prices, excluding VAT, for installation in single family houses (new building). For ground source heat pumps, additional drilling costs of approx. 1.000 Euro per kW have to be taken into consideration. Water to water heat pumps can be used under specific geologic realities, only.

<table>
<thead>
<tr>
<th>System Type</th>
<th>Price Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>GSHP</td>
<td>14.000 – 19.000</td>
</tr>
<tr>
<td>Air-water</td>
<td>10.000 – 15.000</td>
</tr>
<tr>
<td>Water-ater</td>
<td>13.000 – 17.000</td>
</tr>
</tbody>
</table>

Table 16: Estimated share for different types of heating systems in Germany.

Table 17: Typical end consumer prices for turnkey solutions.
**Brand names**

Altogether, approximately 60 different heat pump brands (including OEM devices) can be found on the German market. Divided by technology, some of the most significant brand names are listed in alphabetic order below.

**Ground source heat pumps:**
Alpha-InnoTec, Bosch/Junkers, Buderus, Dimplex, Hautec; Nibe, Novelan, Ochsner, Roth; Stiebel Eltron, Tecalor, Vaillant, Viessmann, Waterkotte, Weishaupt, Wolf.

**Air to water heat pumps:**
Alpha-InnoTec, Bosch/Junkers, Buderus, Daikin, Dimplex, Hautec; Novelan, Ochsner, Roth; Stiebel Eltron, Tecalor, Vaillant, Viessmann, Weishaupt, Wolf.

**Heat pump water heaters:**
Alpha-InnoTec, Bosch/Junkers, Buderus, Dimplex, Hautec; Nibe, Novelan, Ochsner, Roth; Stiebel Eltron, Tecalor, Vaillant, Viessmann, Waterkotte.

**Distribution channels**
Depending on company’s strategy, different distribution channels are present at the German market. Major approaches are distribution via wholesaler (to retailer and final consumer), or via dedicated retail networks.

**Industry infrastructure**
The German Heat Pump Association e. V. (short: BWP) is an inter-trade organisation based in Berlin that covers the whole value chain. Its members comprise of approximately 700 craftsmen, architects and designers as well as drilling companies, heat pump and component manufacturers and energy providers, that promote the use of efficient heat pumps. The German Heat Pump Association organizes the marketing campaign “Wärmepumpen-Aktionswochen” and hosts the “Forum Wärmepumpe” – an annual conference of the German heat pump market. It is a member of the German Renewable Energy Federation BEE (Bundesverband Erneuerbare Energie e.V.) and of Geothermische Vereinigung – Bundesverband Geothermie e. V. (GtV-BV). Its members employ in the heat pump sector approximately 5,000 employees and generate more than 1.5 billion Euro turnover. The BWP represents 95 percent of the German heat pump industry.

Bundesverband Wärmepumpe (BWP) e. V. (German heat pump association)
Charlottenstraße 24
10117 Berlin
phone: +49 30 20 8799 711
fax: +49 30 20 8799 712
E-mail: info@waermepumpe.de

**Incentive schemes**
EnEV is the German implementation of the European Building Directive (EPBD), which regulates maximum value of primary energy consumption (including losses of the heating system and heat demand, i.e. insulation) in new buildings. Required values can be reached with help of a very good insulation or with environmental friendly technologies like heat pumps. The regulation was launched in 2001 and has since then been modified several times.

This year, the RES Directive has been launched as EEWärmeG in Germany. For new buildings, this Directive determines a certain amount of renewable energy for heating and DHW. In order to meet the requirements of the Directive, heat pumps have to reach a minimum SPF, that has to be calculated in accordance with VDI 4650.

Since 2008, heat pumps are part of the Government’s subsidy program called MAP (Marktanreizprogramm). For this purpose, it is also necessary to reach a minimum SPF, calculated in accordance with VDI 4650. Based on the different type of heat
pump (air to water or ground source), the owner will get a different amount of state subsidy.

### Table 18: Overview of the subsidies (MAP) for electric heat pumps in Germany.

<table>
<thead>
<tr>
<th>Ground-coupled heat pumps</th>
<th>New houses built in 2009 or later</th>
<th>New houses built before 2009</th>
<th>Renovation</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Water/water</td>
<td>• 7.50 €/m² of inhabited area</td>
<td>• 10 €/m² of inhabited area</td>
<td>• 20 €/m² of inhabited area max. 3,000 € for each apartment</td>
</tr>
<tr>
<td>• Brine/water</td>
<td>max. 1,500 € for each apartment</td>
<td>max. 2,000 € for each apartment</td>
<td>Houses with more than two apartments: max. 15% of the net-investment for the heat pump</td>
</tr>
<tr>
<td></td>
<td>• Houses with more than two</td>
<td>• Houses with more than two</td>
<td></td>
</tr>
<tr>
<td></td>
<td>apartments: max. 7.5% of the net-investment for the heat pump</td>
<td>apartments: max. 10% of the net-investment for the heat pump</td>
<td></td>
</tr>
</tbody>
</table>

| Air source heat pumps     | • 3.75 €/m² of inhabited area    | • 5 €/m² of inhabited area   | • 10 €/m² of inhabited area max. 1,500 € for each apartment |
|                           | max. 6,375 € for each apartment  | max. 850 € for each apartment | Houses with more than two apartments: max. 10% of the net-investment for the heat pump |
|                           | • Houses with more than two      | • Houses with more than two  |                         |
|                           | apartments: max. 7.5% of the net-investment for the heat pump | apartments: max. 10% of the net-investment for the heat pump |                         |

**Additional subsidy is available**

- for combining heat pumps with other renewable energy heating, e. g. solar heat,
- for especially energy efficient buildings and for efficient circulation pumps.

Furthermore, for especially efficient heat pumps (minimum SPF of 4.5 in renovation and 4.7 in new houses) the subsidy increases by 50 per cent.
### Key facts

<table>
<thead>
<tr>
<th>Category</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population 2007</td>
<td>7,593,500</td>
</tr>
<tr>
<td>Area</td>
<td>41,290 km²</td>
</tr>
<tr>
<td>Capital</td>
<td>Berne</td>
</tr>
<tr>
<td>Number of new single/two-family houses 2007</td>
<td>11,982</td>
</tr>
<tr>
<td>Number of new dwellings (2007)</td>
<td>42,982</td>
</tr>
<tr>
<td>Dwelling Stock (2007)</td>
<td>3,835,370</td>
</tr>
<tr>
<td>Average heat demand single/two family house</td>
<td>n/a</td>
</tr>
<tr>
<td>Share of energy from renewable sources in final consumption of energy 2007</td>
<td>18.27 %</td>
</tr>
<tr>
<td>Binding target for the use of renewable sources by 2020</td>
<td>n/a</td>
</tr>
</tbody>
</table>

### Market trends

In the Swiss market, heat pumps have the largest market share in new units sold (41%) and have surpassed oil (24%) and gas (35%) burners. The share is expected to remain stable in the near future due to a generally low inclination for investments in the building sector and into renovation of heating systems. It is expected to increase further in the medium to long term, once the economic crisis subsides.

This trend is fueled by ambitious targets set by the Swiss government. It has recently stated the goal to reduce demand in fossil fuels by 1.5% per year and to stabilize electricity demand at 2006 levels. The use of renewables is expected to increase to 50% of total final energy demand in 2020. The subsequent activities should also lead to a drastic reduction of CO₂ emissions from heating (currently 45% of total emissions). The government has particularly stressed the large contribution potential from heat pump technology.

According to calculations, an expected additional 400,000 heat pumps to be installed until 2020 will lead to a reduction of CO₂ emissions by 8%. A first step in a row of measures is the new subsidy program from the Swiss federal government aiming at a widespread replacement of electric direct heating systems with heat pumps. This program is equipped with 10 million Swiss francs (CHF) for funding. As the average heat pump system in Switzerland costs between 5,000 and 8,000 CHF the program will fund approx. 1,200 units or an additional 6%. It is expected that the effects in sales numbers will become visible in 2009 figures. Only heat pumps with a quality label are eligible for funding – as such, it is a European premiere that government subsidy scheme is based on the EHPA quality label.

With increasing activity in the renovation segment, the importance of air-water units is increasing in Switzerland. This type of heat pump has now the largest share (58.3%) compared to brine-water (39%), and water-water units (2.7%).

In general, activities within the Swiss heat pump association towards quality assurance are increasing. Apart from quality assurance on the product level, the Swiss heat pump association is preparing a working group to assist the Swiss countries (Kantone), to streamline the application process for drilling permits while at the same time maintaining quality, reliability and environmental appropriateness of the drillings.

In order to overcome critique on heat pumps using electricity as a fuel, several heat pump manufacturers have started cooperations with electric utilities. They offer...
packages of a heat pump unit and a certain amount of electricity from 100% renewable sources. As such, the installed system is providing 100% renewable energy for heating, cooling and hot water in an efficient and reliable manner.

Figure 25: Heat pump sales Switzerland in 2008.

Figure 26: Sales of heating systems by energy source used.

Heat pump association
Fördergemeinschaft Wärmepumpe Schweiz (FWS)
Steinerstrasse 37
CH-3006 Bern
phone: +41 31 350 40 65
fax: +41 31 350 40 51
E-mail: stephan.peterhans@fws.ch
6.6 | Sweden

Key facts*

| Population: | 9,182,927 |
| Area: | 450,000 km² |
| Capital: | Stockholm |
| Number of single/two-family houses: | 1,744,000 |
| Average heat demand single/two family house: | 20–25 MWh/year |
| Number of dwellings in multi-dwelling buildings: | 2,430,000 |
| Number of non residential buildings | 62,725 |
| Share of energy from renewable sources in final consumption of energy 2005: | 39.8% |
| Binding target for the use of renewable sources by 2020: | 49% |
| Rate of new construction single/two family houses 2008: | 11,000 |

<table>
<thead>
<tr>
<th>2008</th>
<th>TWh</th>
<th>Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydro</td>
<td>68.3</td>
<td>46.8%</td>
</tr>
<tr>
<td>Wind</td>
<td>2.0</td>
<td>1.4%</td>
</tr>
<tr>
<td>Nuclear</td>
<td>61.3</td>
<td>42.0%</td>
</tr>
<tr>
<td>CHP</td>
<td>14.2</td>
<td>9.7%</td>
</tr>
<tr>
<td>Total</td>
<td>145.8</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

National emission factor (g CO₂/kWh electricity) 34

Energy prices

Average end consumer prices including distribution and taxes during 2008:

| Electricity: | 12.3 Euro cent/kWh |
| Heating oil*: | 11.4 Euro cent/kWh |
| Pellets* (sack delivery): | 5.2 Euro cent/kWh |
| Pellets* (bulk delivery): | 4.5 Euro cent/kWh |
| District heating: | 7.2 Euro cent/kWh |

* Distribution included if delivery exceeds a specified quantity

Energy price ratios

While analysing the market opportunities for electric heat pumps in a specific country one of the first things to look at are the existing energy price ratios, i.e. the ratio between the price of electricity and the price of 1 kWh heating produced by the competing technologies. The energy price ratio corresponds to the seasonal performance factor that has to be overcome in order to result in lower heating costs for the heat pump system. Given below are the relevant energy price ratios for Sweden. As an assumption for the calculations below the annual performance of the oil and pellets systems are set to 85% and 100% for district heating.

| Electricity/Oil | 0.9 |
| Electricity/Pellets (sack delivery) | 2.0 |
| Electricity/Pellets (bulk delivery) | 2.3 |
| Electricity/District heating | 1.7 |

Present market situation

The market for domestic heat pumps in Sweden is mature. The technology has reached full recognition and acceptance among the general public. Heat pumps are the preferred choice in new construction as well as for retrofitting the existing building stock. As a consequence of the high sales figures during the last decade heat pumps are now in use in nearly 50% of Swedish single family houses. The market is now focused on sales to the late majority and laggards. While sales in the market segment for single family houses are slowing down, the interest for heat pumps in multi-family houses and commercial buildings is picking up. The well known company IKEA has adopted a strong renewable energy policy which has resulted in several large heat pump projects around the world. IKEA and other large real estate companies are pioneers and serve as door openers for heat pumps in this undeveloped market segment. An increasing number of real estate owners have recognised the economical benefits and are in some cases abandoning district heating in favour of heat pumps. The present market decline in the segment of single-family houses is somewhat compensated by a growing market for replacement of old heat pumps and a recently introduced subsidy scheme for renovation and extension works in private homes. The real competitors to heat pumps are district heating and pellets, of which district heating offers the strongest competition. District heating is completely dominating the segment for multi-family dwellings and commercial buildings in densely populated areas. District heating companies, which are often owned by municipalities, sometimes try to set up barriers for the use of heat pumps.

The prevailing energy policy is pushing the use of biomass and trying to limit the use of electricity for heating. This has had a strong influence on decision makers and energy advisers who tend to promote biomass based district heating and pellets systems rather than heat pumps. The market for pellet burners, typically replacing the oil burner in an existing heating system, has since its peak in 2006 dropped by more than 80%. The reason behind the peak 2006 was strong promotion and an existing subsidy scheme for replacing oil heating. Since then the subsidy scheme has been finalised and price of pellets have increased. Many of the installations have failed to live up to expectations, mainly due to malfunctioning systems and due to the fact that the workload required by the customers was underestimated in the first place. A growing number of pellets systems that were installed only a few years ago are now being replaced by a heat pump.

Market trends

Historically heat pump sales have been characterised by high sales during the autumn and significantly lower sales during the rest of the year. This pattern was however less pronounced during the years of continuous strong sales growth. As the market is clearly beyond its recent peak the sales pattern is getting back to normal conditions. Consequently 2008 was characterised by low sales until September when the market picked up remarkably and managed to completely recover the drop in sales earlier in the year. As a general trend the sales of air-water heat pumps is growing (+22%), while sales numbers of brine-water (−10%) and exhaust air heat pumps (−10%) are decreasing. Exhaust air heat pumps have been the predominant solution for new construction. Its sales have been directly correlated to the rate of new construction of single family houses. The downturn in the sales of exhaust air heat pumps is a direct result of the recession that has led to an overall decline in the building sector. The sales of exhaust air heat pumps are expected to continue to fall in the future. This is due to the fact that the normal type of exhaust air heat pump does not comply with the new building regulations that came into force 1 February 2009. Sales of the normal type of exhaust air heat pump will be restricted to houses of very high insulation standard and replacements of old exhaust air heat pumps. Several analyses, confirmed by construction companies, anticipate a growing share of brine-water heat pumps in...
new construction. Exhaust air heat pumps may however become a feasible option if an additional heat source is connected to the heat pump. As the general knowledge of the heat pump technology has reached a high level in Sweden, customers have become more sensitive in their choice of a heat pump. Features such as remote control, capacity control and online connections through internet are gaining interest. It is important to note that the availability of gas is very limited in Sweden, thus gas boilers have only a negligible market share in the heating sector. As Sweden historically, has benefitted from relatively low prices of electricity, direct electricity heating is in use to a large extent. As a consequence of the new building regulations direct electricity heating will only be allowed in houses meeting passive house standards and for houses in areas where no other viable option exists.

<table>
<thead>
<tr>
<th>Heating system</th>
<th>Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct electricity</td>
<td>4 %</td>
</tr>
<tr>
<td>Air-air heat pumps</td>
<td>15 %</td>
</tr>
<tr>
<td>Electric boilers</td>
<td>5 %</td>
</tr>
<tr>
<td>Exhaust air heat pumps</td>
<td>9 %</td>
</tr>
<tr>
<td>Oil boilers</td>
<td>3 %</td>
</tr>
<tr>
<td>Biomass boilers</td>
<td>10 %</td>
</tr>
<tr>
<td>Combi boilers elec/bio</td>
<td>19 %</td>
</tr>
<tr>
<td>District heating</td>
<td>13 %</td>
</tr>
<tr>
<td>Brine-water heat pumps</td>
<td>18 %</td>
</tr>
<tr>
<td>Air-water heat pumps</td>
<td>4 %</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Heating system</th>
<th>Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>District heating</td>
<td>82 %</td>
</tr>
<tr>
<td>Combinations with heat pumps</td>
<td>8 %</td>
</tr>
<tr>
<td>Heating oil</td>
<td>1 %</td>
</tr>
<tr>
<td>Electricity</td>
<td>3 %</td>
</tr>
<tr>
<td>Other combinations</td>
<td>6 %</td>
</tr>
</tbody>
</table>
Costs

Table 23 below depicts average end consumer prices, including VAT, for turnkey installation in single family houses. The turnkey solutions include everything to take the installation in operation, i.e. the heat pump, auxiliary equipment, material and labour costs.

<table>
<thead>
<tr>
<th></th>
<th>Air-air</th>
<th>Air-water</th>
<th>GSHP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Euro</td>
<td>1.500 – 2.300</td>
<td>8.000 – 11.000</td>
<td>11.000 – 15.000</td>
</tr>
</tbody>
</table>

Air-air heat pumps are predominantly installed in existing houses using direct electricity heating. This is currently the most cost effective solution for this type of houses. A recent trend is to install air-air heat pumps in summer cottages. Several products offer new features enabling maintenance heating during wintertime and long distance control systems via GSM-modem. The air-air heat pump is used as a complement to direct electricity heating. As ducted air systems for heating are very rare in Sweden almost all air-air heat pumps in the residential market are of single split type in the single family houses. Additionally air-air heat pumps are used in small shops, offices and restaurants. The larger ducted air-air systems are used in hotels and office buildings.

Air-water heat pumps are generally replacing boilers and for climatic reasons they are more frequent in the southern part of Sweden. Due to strict limitations of electric peak power demand set by the new building regulations air-water heat pumps may, for new construction only be used in the southern part of Sweden. As the strict electric power restrictions only apply to new construction, air-water heat pumps may still be used without any restrictions in all of Sweden for retrofits.

Ground source heat pumps are completely dominated by vertical indirect systems. Horizontal systems do exist but are restricted in use due to their significant space requirements. The main reasons that vertical systems have become so successful in Sweden are;

• Liberal regulations regarding drilling
• Favourable crystalline bedrock of high thermal conductivity
• Reasonable costs for drilling (23–25 Euro/meter including VAT)

Ground-water heat pumps are mainly used in areas where the bedrock is covered by a thick layer of soil (>15 m) and thus results in high costs. Such areas are however quite often enriched with large quantities of ground water and consequently enabling the use of ground water heat pumps.

Brand names

Some of the most significant brand names existing on the Swedish market are listed in alphabetical order below.

Ground-source heat pumps:
Bosch, CTC, Euronom, EVI, IVT, NIBE, Stiebel-Eltron, Therma, Vaillant, Viessmann, Qvantum.

Air-water heat pumps:
Aermec, Bosch, CTC, Daikin, Euronom, IVT, Mitsubishi, NIBE, Sanyo, Stiebel-Eltron, Therma, Vaillant, Viessmann, Qvantum.

Air-air heat pumps:
Bosch (Sharp), Daikin, Electrolux (Sharp), Foma, Fujitsu, IVT (Sharp), LG, Mitsubishi, Panasonic, Sharp, Sanyo, Toshiba.

Exhaust-air heat pumps:
IVT, NIBE, Nilan, ComfortZone.
**Distribution channels**
Wholesalers and dedicated retail networks dominate the Swedish heat pump market. Nonetheless during the last couple of years air-air heat pumps are offered at DIY-stores (do it yourself stores), mail-order firms, web-stores and IKEA.

**Industry infrastructure**
The following sections highlight some of the existing industry supportive organisations and schemes that serve as part of the industry’s infrastructure.

**National industry associations**
The Swedish Heat Pump Association (SVEP) was founded in 1982. It has approximately 700 members. The members constitute of manufacturers and importers of heat pumps (21), installers and other companies with interest in the industry (689). The association serves as the official voice for the heat pump industry on a national level. The association handles all proposals for new national regulation and legislation as well as international standards that are sent for circulation. SVEP serves as a coordinator for common research activities within the national research programmes for the refrigeration and heat pump industry.

**Training and certification**
Training according to the European Certified Heat Pump Installer scheme (EUCERT) is offered by Mid Sweden University, IVT, Thermia and NIBE. Third party certification is voluntary and available according the European Certified Heat Pump Installer scheme.

**Consumer complaints board**
Since 1989 SVEP administrate a consumer complaints board for heat pump installations. The board was initiated by SVEP and the Swedish Association for HVAC Installers on request by The Swedish National Board for Consumer Complaints as the national board was unable to uphold the required technical competence to handle complaints related to heat pump installations. The board is composed of representatives for the installers and manufacturers. The board is chaired by a highly qualified district court judge. SVEP is only administrating and preparing the documentation for the board and takes no part in the final decision of the board. The decision of the board has no legal status but serves as a strong recommendation and members of SVEP are bound by the statutes to obey the recommendations given by the board. Since the start the board has dealt with 490 complaints. Presently about 60 cases are handled per year.

**Product labels**
Existing product labels covering heat pumps are

- **EHPA Quality Label:** Sweden is a full member of the EHPA Quality Label scheme. The national quality commission is chaired by SVEP.
- **P-Mark:** issued by the Swedish Testing and Research Institute, SP
- **Nordic Swan:** Ecolabelling scheme administrated by SIS-Miljömärkning

**Incentive schemes**
Since 8 December 2008 heat pump installations qualify for the tax reduction scheme that applies to renovation and extension works in private households. According to the scheme up to 50 % of the labour costs related to renovation and extension may be deducted from each owner of a private property. The maximum amount that may be deducted for each owner is 50,000 sek (approximately 4,500 Euro).
Like for many other European countries the heat pump market in Norway developed after the first oil crisis in the 1970s. The 1980s saw a government-funded program to support the introduction of heat pumps. The main emphasis was on commercial heat pumps and industrial heat pumps. Many of these heat pumps are still working properly after many years of operations. The households in Norway are mainly heated with direct electricity and electricity prices have been very low in Norway during the post war period up to 2000s. There were just a few pioneers who installed heat pumps in private homes during the 1980s and 1990s. The production of hydro power in Norway varies from 90 to 150 TWh per year, depending on weather conditions. Normal consumption is about 120 TWh.

Electricity supply in Norway, with indigenous production dependent on weather conditions, benefits from connection to countries having power generation based on nuclear power, natural gas, coal or oil. The disadvantage for Norwegian consumers is that electricity prices rise significantly when it is necessary to import electricity. In 2002/2003, with a dry autumn and winter, prices rose to a maximum of up to about 250 % of previous years price levels. Sales figures for heat pumps rose about 150 % from 21.000 units to 55.000 units in 2008. Both the electricity prices and heat pump sales decreased the next years, but in 2006 we had another dry autumn with high electricity prices and sales figures for heat pumps at 78.300. Most households in Norway have no hydronic heating distribution system. The most obvious and popular type of heat pump is then air-to-air heat pumps. These heat pumps have an installation cost of about 2.500 Euro and save 5000–8000 kWh a year. In recent years it has become more popular with low temperature floor heating, and most of these houses choose a heat pump as heat source. More than 20 % of Norwegian households today have a heat pump.

In 2008 the total heat pump sales in Norway were 84.700 units 76.800 of which were air-to-air heat pumps. For the future a higher penetration of air-to-air heat pumps in the retrofit market for houses with direct electric heating is expected. As well, it is seen as very like that up to 100.000 houses currently still equipped with an oil heating systems will switch to some kind of heat pump solution. Commercial applications of heat pumps are receiving increased interest, particularly where both heating and cooling are needed. Energy sources in this case are mostly ground source boreholes and seawater.

**Institutional and financial support**

The Norwegian Government has established a public company Enova SF to support renewable energy and energy efficiency in Norway. Enova gives a subsidy of 1.100 Euro for private households who install a ground source or air-to-water heat pump system. There are no subsidies for air-to-air heat pumps. For commercial buildings and industrial heat pumps you can receive a financial support with a requirement on the return on investment which means that not all heat pumps get financial support. In 2009 Enova was given a higher budget because of the financial crisis and green projects are a priority of the Norwegian government to prevent a rising unemployment rate.
### Key facts

**Population:** 10,340,000

**Area:** 78,864 km²

**Capital:** Prague

**Binding target for the use of renewable sources by 2020:** 13%

**Average heat demand single/two family house:** 30–32 MWh/year

**Number of family houses:** 1,406,806

**Number of multi-dwelling houses:** 195,270

**Number of dwellings in multi-dwelling buildings:** 2,160,730

**Number of newly-built non-residential buildings in 2007:** 1,841

**Total number of non-residential buildings in the Czech Republic:** not available

**Number of new dwellings finished in 2008:** 38,380

Data concerning number of dwellings, especially family houses are difficult to provide as the Czech Statistical Office does not gather such data every year, only once in ten years during census.

**National emission factor g CO₂/kWh:** 730 (751 when including the whole life cycle e.g. emissions during mining etc.)

#### 2008

<table>
<thead>
<tr>
<th>Energy source</th>
<th>TWh</th>
<th>Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal-fired</td>
<td>51,2</td>
<td>61,3%</td>
</tr>
<tr>
<td>Nuclear</td>
<td>26,6</td>
<td>31,9%</td>
</tr>
<tr>
<td>Wind</td>
<td>0,2</td>
<td>0,2%</td>
</tr>
<tr>
<td>Hydro</td>
<td>2,4</td>
<td>2,9%</td>
</tr>
<tr>
<td>Steam-gas plant</td>
<td>3,1</td>
<td>3,71%</td>
</tr>
<tr>
<td>Other alternative plants</td>
<td>0,01</td>
<td>0,02%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>83,5</td>
<td>100,0%</td>
</tr>
</tbody>
</table>

#### Energy prices

**Electricity:** 11,2 Euro cent/kWh

**Electricity heat pump tariff:** 8,9 Euro cent/kWh

**Heating oil:** 100 Euro cent/kg

**Gas:** 4,45 Euro cent/kWh

#### Present market situation

The number of heat pump installations grow year by year. The first modern heat pumps started to be installed in the nineties of the last century. The rising trend led to the monitoring of heat pumps. More detailed information on heat pumps on the Czech market has been monitored since 2005 (see figure 27). Although the Czech market is primarily based on other heating sources, people are beginning to become aware of the benefits with heat pumps. Heat pumps are mainly installed in family houses. **Table 26 provides an overview of average cost for**

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45 Source: Czech Statistical Office
46 Source: Cityplan
47 Source: Energeticky regulaci urad ERU
48 Special tariff for heat pumps 22 hours per day
heat pump systems. The percentage of brine-water and air-water systems is more or less almost equal. It seems that the number of heat pumps will grow in the following years as the potential of the market is relatively high.

**Brand names**

The names listed below are the main players on the Czech market. The other „unknown“ brands usually from Asia are not listed.

Ground-source heat pumps:
IVT, Nibe, Thermia, Stiebel-Eltron, Alphalinnotec, Dimplex, Viessmann, Vaillant, PZP komplet, Mastertherm.

Air-water heat pumps:
PZP komplet, Stiebel-Eltron, Dimplex, Alpha-Innotec, Viessmann, Vaillant, AC heating.

Air-air heat pumps:
Sharp, Toshiba, Daikin, LG, IVT.

**Prices of heat pumps units**
(for an average family house with heat losses around 10 kW):

<table>
<thead>
<tr>
<th></th>
<th>Air-air</th>
<th>Air-water</th>
<th>Brine-water</th>
</tr>
</thead>
<tbody>
<tr>
<td>Euro</td>
<td>1,500</td>
<td>3,000 – 7,700</td>
<td>4,600 – 6,200</td>
</tr>
</tbody>
</table>

**Distribution channels**

Heat pumps are sold and distributed only by firms that are focused on the sale and installing of heat pumps. It is also possible to buy a heat pump from „distributors“, however they do not provide installation and any other services (no guarantees when a failure occurs).
**Industry infrastructure**

The Czech Heat Pump association CHPA (Asociace pro využití tepelných erpadel AVTC) was established in 2001 and includes 60 members which are high schools and companies dealing with installation, distribution, maintenance and import. The activities of CHPA are aimed at cooperation at solving energy, financial and strategic conception of the state. The main goal of the CHPA is to be particular about minimizing incorrect installations and take care of the technical level of the members. It also arranges contacts with institution in the section of renewables and other industrial companies.

**Training and certification**

Two different types of courses are provided by CHPA. The first one is the course for heating engineers who decided to install heat pumps and this is the first step on how to get the first information and knowledge. The other course is the EUCERT course which takes place once a year in spring. The number of participants in every course counts 20 installers. These are people with some experience in contrast to the group mentioned above. EUCERT course has been given since 2007. Also single companies provide their own lectures and workshops for potential installers, however the general overview is only given at the courses of CHPA (the firms usually promote their products).

**Incentive schemes**

A new system of subsidies has been valid since 1st April 2009. The system supports the change of fossil-fuel boilers for a heat pump, in newly-built houses if they fulfil conditions of low-energy houses. The subsidy can reach 30% of costs but only up to a maximum of 75,000 CZK (2.885 Euro) for GSHP and 50,000 CZK (1.923 Euro) for air-water systems. Additionally the heat pump must fulfil particular requirements such as a minimum COP.
### Key facts

The estimated population of Ireland in 2008 was 4,422,100 persons (CSO).

<table>
<thead>
<tr>
<th>Capital</th>
<th>Dublin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of occupied dwellings</td>
<td>1,500,000</td>
</tr>
</tbody>
</table>

Over the period 2002 to 2006, the number of house completions rose each year to a peak of 88,200 in 2006. The number of houses completed in 2007 decreased by 12% to 78,000. Figures for the first two quarters of 2008 show a significant slowdown with only 70% of the number of completions when compared to the same period in 2007.

In 2007 the “average” dwelling consumed a total of 25,899 kWh of energy based on climate corrected data. This was comprised of 20,395 kWh (79%) in the form of direct fossil fuels and the remainder (5,505 kWh) as electricity.

Average floor areas of new houses grew from 130 m² in 1990 to 161 m² in 2007 (an increase of 24%). The average declined slightly in the early 1990s and then grew at a rate of 2% per annum in the latter half of the decade. Average floor areas of houses increased by 1.5% in 2007. Average floor areas of new flats showed a stronger growth over the period from 64 m² to 82 m² (27%). The average floor area of flats increased by 0.8% in 2007.

Number of dwellings in multi-dwelling buildings: 148,600 occupied flats, apartments or bed-sits.

Share of energy from renewable sources in Total Final Consumption of Energy (TFC) for 2007: 3.3%

Binding target for the use of renewable sources by 2020: 16%

Gross domestic product in Ireland in 2007 was €160.603 million (CSO).

In 2007 energy use increased by 1.4% and energy-related CO₂ emissions increased by 0.8% while the economy grew by 6%. If international aviation was excluded then there was an increase of 0.5% in emissions.

Overall final energy consumption increased by 1.9% in 2007. Transport energy demand increased by 5.5% and the services sector by 3.0%. Energy demand in industry remained at 2006 levels and residential energy demand reduced by 2.5%.

Imported oil and gas accounted for 82% of energy supply and Ireland’s overall import dependency was 89% in 2007. Over the period 1990 to 2007 there was a doubling (108% increase) of total net imports.

Renewable energy increased by 11% in 2007, including a 21% increased in wind energy. Renewable electricity generation accounted for 9.4% of gross electricity consumption in 2007, with wind energy accounting for 71% of this.
Renewable energy contribution to heat energy was 3.5% in 2007.

Estimated amount of CO₂ avoided from renewable energy increased 6.2% per annum on average between 1990 and 2007 reaching 2.1 million tones of CO₂ in 2007.

Carbon intensity of electricity reduced again in 2007 by 9.7% to a figure of 543 CO₂ g/kWh due to a reduction in energy-related emissions from electricity.

Industry’s final energy use increased by 0.1% (to 2.7 Mtoe) in 2007.

Final energy use in the residential sector fell by 2.4% in 2007 however when corrections for climate effects are taken into account this becomes an increase of 5% in 2007.

**Gross production (GWh) – Provisional 2008**

<table>
<thead>
<tr>
<th>Source</th>
<th>Value (GWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydro</td>
<td>1,300</td>
</tr>
<tr>
<td>Wind</td>
<td>2,410</td>
</tr>
<tr>
<td>Combustible Fuels</td>
<td>25,166</td>
</tr>
<tr>
<td>Imports</td>
<td>753</td>
</tr>
<tr>
<td>Exports</td>
<td>303</td>
</tr>
<tr>
<td>Used for pumped storage</td>
<td>523</td>
</tr>
</tbody>
</table>

---

**Table 27: Electricity generation (in ktoe).**

**Figure 29: Renewables by sector.**

**Figure 30: Electricity by sector.**
Energy Prices

<table>
<thead>
<tr>
<th>Energy Type</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity:</td>
<td>18 Euro cent/kWh</td>
</tr>
<tr>
<td>(9 Euro cent/kWh night saver)</td>
<td></td>
</tr>
<tr>
<td>Heating oil:</td>
<td>5.85 Euro cent/kWh</td>
</tr>
<tr>
<td>Pellets* (sack delivery):</td>
<td>7.15 Euro cent/kWh</td>
</tr>
<tr>
<td>Pellets* (bulk delivery):</td>
<td>4.71 Euro cent/kWh</td>
</tr>
</tbody>
</table>

Heat Pumps in Ireland – Current Market Situation and Trends

Renewable energy heating systems are new technologies which, while proven, established and increasingly popular across the EU, however, they are still relatively new to us here in Ireland. The Irish Government, through SEI, are committed to the low energy building agenda and introduced the Greener Homes Scheme in 2006 to encourage people to “green” their homes by contributing to the initial investment cost of installing a renewable energy heating system. The government believes that this will help ensure a faster uptake of renewable heating systems which will underpin the development of a long term market, while enabling homeowners to play their part in reducing carbon dioxide emissions.

Launched in March 2006 the scheme provides financial incentives to support the installation of heat pumps and since then the market has been buoyant with over 5000 units installed in the residential sector. Note: Prior to the Greener Homes Scheme the market was small and no accurate statistics on the number of units installed are available.

Following the introduction of the Greener Homes Scheme the technology reached a wider recognition and acceptance among Irish home owners and the Irish heat pump market expanded very rapidly. Backed by grants we witnessed a rapid increase in heat pump sales as the technology became the preferred choice in the new housing sector. This sector was identified as a key market going forward, the number of house completions had increased each year from 2002 to a peak of 88,200 in 2006, and whilst the number of houses completed in 2007 decreased to 78,000 the heat pump market was still expanding. For example since early 2006 the Irish heat pump industry has developed greatly, most notably the number of companies involved in supplying and installing heat pumps has increased ten fold since the launch of the Greener Homes Scheme. Most of the major European heat pump companies are active and represented in Ireland. Today, we have over 5,100 units installed, some 350 products and ranges registered and over 310 registered installers.

At the same time as witnessing a market decline in the residential heat pump sector the slow down is not so evident in the biomass and solar sectors where the initial investment costs are seen as less prohibitive.

Greener Homes Scheme Phase III

The Greener Homes Scheme Phase III provides assistance to homeowners who intend to purchase a new renewable energy heating system for existing homes. The scheme is administered by Sustainable Energy Ireland (SEI) and aims to increase the use of renewable energy and sustainable energy technologies in Irish homes.

In July 2008 a change in the Building Regulations 2008, made the inclusion of renewable energy in new homes compulsory. The existence of this new legislation basically meant that it would no longer be appropriate to grant aid their installation in new homes. Consequently the qualifying criteria changed with the main change being that only existing (at least one year old) houses will be eligible for support.

It was recognized that the installation of renewable heating systems in existing homes is typically more complex and expensive and the decision taken was to
continue support in the short term at least while the market reaches ultimate maturity. Table 29 provides an overview on available grants.

The level of grant available for heat pumps is as follows:

<table>
<thead>
<tr>
<th>Heat Pump Type</th>
<th>Grant Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat Pump – Vertical Ground</td>
<td>3,500 Euro</td>
</tr>
<tr>
<td>Heat Pump – Horizontal Ground</td>
<td>2,500 Euro</td>
</tr>
<tr>
<td>Heat Pump – Water to water</td>
<td>2,500 Euro</td>
</tr>
<tr>
<td>Heat Pump – Air Source</td>
<td>2,000 Euro</td>
</tr>
</tbody>
</table>

Only registered equipment and installers are eligible for use under the Greener Homes Scheme – these lists are maintained by SEI’s Renewable Energy Information Office.

In order to be eligible for support under the grant, the equipment to be installed should meet the following criteria:

**Definition of eligible product and identification**

The eligibility applies to heating-only heat pumps using one of the following ambient heat sources for central heating purposes:

- outdoor air;
- the ground;
- ground water or surface water (river, lakes, etc.).

The following types of heat pump systems are not eligible for funding under the scheme:

- comfort air conditioner (factory-made units intended to produce cooled air for air conditioning);
- heat recovery heat pumps using waste heat from ventilation as a heat source;
- heat pumps producing sanitary hot water only.

The use of refrigerant with a low level of Global Warming Potential and no Ozone Depleting Potential are favored. HCFC (e.g. R22) cannot be used in new equipment since 2001.

There is no “quality mark” as such in Ireland for heat pumps. Any heat pump or heat pump range which appears on the Greener Homes Scheme list of registered heat pumps has met the requirements for registration of the scheme. Products have been tested in accordance with EN standards and have to meet the requirements for registration of the scheme. Products have been tested in accordance with IS EN 14511- parts 1–4 (Air conditioners, liquid chilling packages and heat pumps with electrically driven compressors for space heating and cooling and must comply with the Electromagnetic Compatibility (EMC): 89/336/EEC, Low Voltage Directive (LVD): 73/23/EEC, 93/68/EEC, Pressure Equipment Directive (PED): 97/23/EC § 3.3.

The heat pumps also have to have confirmed minimum warranty period of two years for the heat pump, and full installation and user manuals are available in English. Heat pumps on this list are also assumed to be proper materials for the purpose of Part L of the Building.

**Greener Homes Scheme Application Statistics**

<table>
<thead>
<tr>
<th>Technology</th>
<th>Scheme Applications Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat Pump</td>
<td>26,352</td>
</tr>
<tr>
<td>Biomass</td>
<td>23 %</td>
</tr>
<tr>
<td>Solar</td>
<td>54 %</td>
</tr>
</tbody>
</table>

50 for details on requirements see: www.sei.ie/Grants/Greener-Homes/Manufacturers/Suppliers/How_to_get_listed/Questionnaire_Hot_Pumps_v05.pdf, for the list of pumps registered check: www.sei.ie/Grants/Greener-Homes/Homeowners/Product_List/HeatPumpRegisteredList.pdf

51 Regulations see the following: www.environ.ie/en/Publications/Developmentand-Housing/BuildingStandards/FileDownload,19069,en.pdf

Table 30: Greener homes scheme heat pump installations – residential by volume.
Sustainable Energy Ireland also administers the Renewable Heat Deployment Program (ReHeat) launched in March 2007, this program provided assistance for the deployment of renewable heating systems in industrial, commercial, public and community premises in Ireland.

Financial support is provided to assist new renewable energy based heating systems in the following Heat Pump categories:52

• Horizontal ground collector
• Vertical ground collector
• Water (well) to water
• Air source

The following types of heat pump systems are not eligible for funding under the programme:

• comfort air conditioner (factory-made units intended to produce cooled air for air conditioning)
• heat recovery heat pumps using waste heat from other processes as a heat source;
• heat pumps producing sanitary hot water only.

The use of refrigerant with a low level of Global Warming Potential and no Ozone Depleting Potential is favoured. HCFC (e.g. R22) cannot be used in new equipment since 2001.

Training and certification

SEI in conjunction with the Renewable Energy Installer Academy (REIA) has developed training courses for each technology. These courses are FETAC accredited. Currently throughout Ireland there are a number of course providers offering renewable energy training courses, which include heat pump training courses.

National Industry Association

The Geothermal Association of Ireland (GAI) was formed in January 1998 to promote the development of geothermal resources in Ireland. The GAI is a member of the European Geothermal Energy Council and of the International Geothermal Association. The GAI promotes the development of geothermal energy in Ireland in: Research, Education, Promotion, and Lobbying Government bodies and agencies for geothermal development.
7 | Product and installation quality

7.1 | EHPA Quality Label

In 1998 heat pump associations from Germany, Austria and Switzerland created the D-A-CH quality label, which was a major step towards better quality and increased efficiency of heat pumps, improving their acceptance in the market significantly.

Meanwhile the transformation of this DACH quality label into a European EHPA/DACH quality label is implemented. Sweden was the first country outside the D-A-CH region which joined this organisation. This was an important step, because Sweden is the country with one of the largest heat pump markets in Europe. In the meantime also Finland is in the process of joining the scheme.

This quality label shall only be granted to durable, reliable and energy efficient products with a high service standard. In particular, it

- provides buying security and improved long term benefits to the customer.
- provides strong arguments for all parties seeking governmental support – institutional as well as financial.
- supports the current image of heat pumps as energy efficient, reliable, high quality products.
- contributes to establish heat pumps as innovative technology to »produce« renewable and environmentally friendly ambient heat.
- helps to protect heat pump markets against low-quality competition.

First steps have been the harmonisation of the rules for the heat pump quality label itself and the testing procedures based on the European standard EN 14511, which is the follow-up standard of the former standard EN 255; EN 255-3 is still used for testing domestic hot water heat pumps. Presently the test regulation for air/water, water/water, brine/water, and direct exchange ground source heat pumps are in force.

As test centres presently three test centres from Germany, and one from Austria, one from Switzerland, and one from Sweden, all accredited, are performing the tests for this quality label. The test centres are also observing the development of standardisation, which is a continuous process, and they are also looking on new developments on the market.

That means that the work of the quality label committee is not finished:
- new countries have to be interested in this quality labelling scheme,
- new developments on the market require new tests for air/air units, which play an important role in some markets,
- new developments in heat pump technology such as units with variable speed compressors have to be considered and new test regulations have to be developed, and
- test procedures for large heat pump units have to be decided.

There is strong interest from other European countries like the Belgium, Czech Republic, Denmark, France, which have an own quality label NF PAC, Ireland, Italy, Netherlands and Spain. Especially France is very interested, at least in a close cooperation with the EHPA quality label committee and the test centres working group.

But there is also a strong interest of the heat pump industry, and whenever it is possible representatives of the industry are invited to attend the meetings.
The EHPA Quality Label Committee together with the test centres working group had in 2008 three working meetings in Vienna, Boras and Offenbach, and the countries mentioned above have been invited to these meetings. Especially France was very active at these meetings, and the contributions from France will have some influence on the further development of the EHPA heat pump quality label, may be also on the NF-PAC, because the problems there are very similar.

An outcome of the meetings was that there has to be a stronger participation in and co-operation with the different standardisation working groups to transfer the results of testing into the work of this groups. On the one side tests have to be limited due to cost, on the other hand tests have to describe the characteristics of heat pumps in real operation.

Presently heat pump units with variable speed compressors are a real problem, especially the comparison with constant speed units. Taking the rules of EN 14511 a variable speed heat pump is always worse compared with a constant speed unit; in real operation the result is most commonly the other way round. Therefore, ideas came up to use prEN 14825 and to modify it into a direction that it can be used for testing both constant speed and variable speed units and making them comparable for the end-user.

The next meeting will take place in Winterthur, Switzerland, and hopefully all countries and test centres will attend this meeting and contribute to a successful development of the EHPA heat pump quality label with the requirements

• end-user friendly,
• comparability of different units,
• covering European standards, and
• easy testing of air/air, water/water, brine/water, direct exchange ground source/water and domestic hot water heat pumps.

Hermann Halozan, Heinrich Huber

7.2 | European Certified Heat Pump Installer Program (EUCERT)

The European Certified Heat Pump installer program aims at implementing a training program for heat pump installers, establishing a certification program for this target group and disseminating the trademark certified heat pump installer. Key element of the program is identical training material (in local language) for all trainings throughout Europe to enable an easy mutual acceptance of certificate.

The project material was developed in the EU supported EU-CERT.HP project and is currently coordinated by the EHPA quality label committee. This committee is one of the Technical Committees of EHPA (European Heat Pump Association). Its members are the national coordinators of the training programs. Key tasks of the committee is the maintenance of the programs content, namely the education manual, the certification requirements and the laboratory manual. The committee is the forum for the national coordinators to exchange program related issues, to discuss future modifications and development aspects as well as to inform interested parties on setting up a training and certification scheme in their respective country.

The national coordinators (one body per participating country) set-up and overview training activities on national level. National coordinators can either be the national heat pump association or a cooperating institution which they assign. They can offer training activities themselves or assign a third party – typically one or several training institutes – with this task. Each training institute must comply with the quality requirements of the EUCERT program. Each trainee with sufficient qualification that successfully passes the education course can apply for a certificate as „EU certified heat pump installer“ with the national certification body.
Over the past two years, the Education committee – lead by Brigitte Bach – was occupied with updating the complete program material and defining the process to integrate new participating countries. On a national level, training activities took place in Sweden, Austria, Slovakia, the Czech Republic, France and Germany – in total, more than 1,300 installers participated in the education courses. As activities in the UK were re-organised, the next training is planned for mid 2009 and will be executed by CITB. The group of countries offering trainings according to the EUCERT program was joined by Finland in 2009 with SULPU – The Finish Heat Pump Association – being the national coordination partner. Currently 5 training courses with approx. 100 participants are planned for 2009 in Finland. For the year 2009, approx. 1,900 participants in EUCERT education classes are expected.

The next country to be part of the program is Italy. The last meeting of the education committee took place in Genova – on invitation of Daikin Italy and supported by the Italian Heat Pump Association.

The program is open to other countries. Requirements include the existence of a national heat pump association, active membership in the EHPA, a national education committee and education labs that comply with the programs requirements. Interested bodies should check www.ehpa.org/eucert for more information or contact the committees chair directly.

Brigitte Bach
### Annex I | Consolidated sales of heat pump units 2005 – 2008

<table>
<thead>
<tr>
<th>Year</th>
<th>Austria</th>
<th>Finland</th>
<th>France</th>
<th>Germany</th>
<th>Italy</th>
<th>Norway</th>
<th>Sweden</th>
<th>Switzerland</th>
<th>Subtotals</th>
<th>Growth by Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>Heating only HP (excluding exhaust air HP)</td>
<td>6.100</td>
<td>3.500</td>
<td>25.200</td>
<td>17.281</td>
<td>0</td>
<td>3.000</td>
<td>44.972</td>
<td>11.877</td>
<td>111.930</td>
</tr>
<tr>
<td></td>
<td>Air/water</td>
<td>867</td>
<td>0</td>
<td>12.000</td>
<td>4.529</td>
<td>0</td>
<td>1.500</td>
<td>10.409</td>
<td>6.769</td>
<td>36.054</td>
</tr>
<tr>
<td></td>
<td>Water/water</td>
<td>720</td>
<td>0</td>
<td>1.700</td>
<td>1.972</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>292</td>
<td>6.884</td>
</tr>
<tr>
<td></td>
<td>Brine/water</td>
<td>3.174</td>
<td>3.500</td>
<td>2.000</td>
<td>9.319</td>
<td>0</td>
<td>1.500</td>
<td>34.563</td>
<td>4.836</td>
<td>58.922</td>
</tr>
<tr>
<td></td>
<td>Dir. expansion/water or dir. condensation</td>
<td>1.339</td>
<td>0</td>
<td>3.700</td>
<td>908</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>5.947</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dir. exp./dir. cond.</td>
<td>0</td>
<td>0</td>
<td>5.800</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>5.800</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Others</td>
<td>0</td>
<td>0</td>
<td>533</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>533</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Exhaust air HP</td>
<td>0</td>
<td>1.800</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>11.158</td>
</tr>
<tr>
<td></td>
<td>Tap water HP</td>
<td>3.158</td>
<td>0</td>
<td>12.000</td>
<td>4.529</td>
<td>0</td>
<td>1.500</td>
<td>10.409</td>
<td>6.749</td>
<td>36.054</td>
</tr>
<tr>
<td></td>
<td>Reversible HP</td>
<td>598</td>
<td>17.000</td>
<td>0</td>
<td>553</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>553</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Air/water</td>
<td>1.618</td>
<td>400</td>
<td>35.060</td>
<td>13.292</td>
<td>2.000</td>
<td>2.000</td>
<td>14.757</td>
<td>8.610</td>
<td>77.737</td>
</tr>
<tr>
<td></td>
<td>Water/water</td>
<td>945</td>
<td>0</td>
<td>2.500</td>
<td>4.401</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>301</td>
<td>7.933</td>
</tr>
<tr>
<td></td>
<td>Brine/water</td>
<td>4.714</td>
<td>4.500</td>
<td>2.600</td>
<td>21.544</td>
<td>2.500</td>
<td>2.500</td>
<td>40.017</td>
<td>6.829</td>
<td>85.204</td>
</tr>
<tr>
<td></td>
<td>Dir. expansion/water or dir. condensation</td>
<td>1.576</td>
<td>0</td>
<td>6.350</td>
<td>1.069</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>8.955</td>
<td>51.25%</td>
</tr>
<tr>
<td></td>
<td>Dir. exp./dir. cond.</td>
<td>0</td>
<td>0</td>
<td>7.000</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>7.000</td>
<td>20.69%</td>
</tr>
<tr>
<td></td>
<td>Others</td>
<td>0</td>
<td>0</td>
<td>205</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>205</td>
<td>-62.93%</td>
</tr>
<tr>
<td></td>
<td>Exhaust air HP</td>
<td>0</td>
<td>2.050</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>9.385</td>
</tr>
<tr>
<td></td>
<td>Tap water HP</td>
<td>3.863</td>
<td>0</td>
<td>10.604</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>14.64%</td>
</tr>
<tr>
<td></td>
<td>Reversible HP</td>
<td>0</td>
<td>30.000</td>
<td>0</td>
<td>712</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>14.64%</td>
</tr>
<tr>
<td></td>
<td>Growth 05–06</td>
<td>29.02%</td>
<td>65.70%</td>
<td>112.34%</td>
<td>100.61%</td>
<td>66.65%</td>
<td>38.75%</td>
<td>20.87%</td>
<td>33.08%</td>
<td></td>
</tr>
<tr>
<td>2007</td>
<td>Heating only HP (excluding exhaust air HP)</td>
<td>10.398</td>
<td>5.750</td>
<td>69.600</td>
<td>43.835</td>
<td>0</td>
<td>5.500</td>
<td>41.661</td>
<td>16.622</td>
<td>193.366</td>
</tr>
<tr>
<td></td>
<td>Air/water</td>
<td>2.110</td>
<td>450</td>
<td>51.000</td>
<td>17.762</td>
<td>0</td>
<td>3.200</td>
<td>13.705</td>
<td>9.181</td>
<td>97.408</td>
</tr>
<tr>
<td></td>
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<td>126.88%</td>
<td>46.85%</td>
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Notes/comments:

1 Heating Capacity
2 Hot tap water can be provided by the same heat pump (or not).
3 Small heat pumps for heat recovery from domestic exhaust air.
4 HP with heat exchanger
5 Please specify
6 Must be able to provide heating in winter (able to work below −7°C external temperature).
7 In Scandinavian countries primarily used for heating purposes.
8 Variable Refrigerant Flow / Variable Refrigerant Volume
9 Heating capacity >500 kW, smaller central heat pumps for heating several buildings have to be included under point 1.
EHPA was established in the year 2000 as a European Economic Interest Group to promote awareness and proper deployment of heat pump technology in the European market place for residential, commercial and industrial applications. EHPA aims to provide technical and economic input to European, national and local authorities in legislative, regulatory and energy efficiency matters.

All activities are aimed at overcoming market barriers and dissemination of information in order to speed up market development of heat pumps for heating, cooling and hot water production.

More information can be found at www.ehpa.org