Growing for good? The European Heat Pump Market - Status and outlook

Thomas Nowak, Pascal Westring[a]1

[a]European Heat Pump Association (EHPA), Rue d'Arlon 63-67, B-1040 Brussels, Belgium

Abstract

The compilation of 2015 market report had a surprise in stock for many. After aggregating information from 21 markets and polishing up the results, the growth rate of the European heat pump market was more than a silver line on the horizon.

In 2015, European heat pump markets had grown by 12.2% in a still challenging economic environment.

This growth was the result of a combination of factors:

- The construction sector was recovering.
- Technology solutions for the renovation sector were maturing.
- Heat pump technologies were gaining attention in several pieces of European legislation with a trickle-down effect on national markets.
- Heat pumps have become the reference technology or are an integral part of reference buildings in many Member States of the European Union and are considered in both new build and renovation projects.
- Heat pump technology benefits from the price decline in PV – decentralised systems for the production and use of electricity for heating with heat pumps (and use of the heat pump system for storage) are gaining ground in the market.

This paper will look at the robustness of these trends and will aim to determine whether 2015 has put an end to five years of stagnation in heat pump market sales.

Note: A full description of the European heat pump market is available in at stats.ehpa.org.

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Keywords: Heat pumps; Markets; Digitalisation of heating; Decarbonisation

* Corresponding author. Tel.: +49 176 632901140
E-mail address: thomas.nowak@ehpa.org.

Growing for good?
The European Heat Pump Market - Status and Outlook

1 INTRODUCTION

The heat pump market in 2015 has grown by 12.2% - a double-digit growth for the first time in 8 years. This growth is not seen as an exemption but as the result of a political framework and technological developments that have long been assessed as favourable for growth and that are finally shaping markets.

The authors argue, that this can only be the start of a multi-year growth path as the political framework is expected to finally recognise heat pumps even more favourably. The current framework is based on the agreed need for an 80 – 95% CO_2 emission reduction as put down in the 2050 energy roadmap published by the EU Commission in 2011 [1]. Aiming to limit global warming "significantly below 2°C" will need even more political ambition and an update and integration of dispersed pieces of legislation. Following the latest IPCC reports, we need to arrive at negative emissions somewhere between 2045 and 2055 – the earlier the better [2]. With the bigger challenge, employing heat pump technology in more application areas continues to provide a feasible solution that will hopefully be used to its potential.

Heat pump markets will develop faster based on the current and short-term future policy framework and technology development that serves as accelerator: (1) the greening of the electricity grid, (2) decreasing cost for PV electricity and (3) the integration of heat pumps into the internet of things (IoT) due to the availability of sensors in heating systems and buildings as well as better connectivity to the internet to provide weather forecast data and allow for remote monitoring.
Solid business models from connecting electricity and heating sectors and from optimising self-consumption are expected as a result.

2 DEVELOPMENT OF THE EUROPEAN HEAT PUMP MARKET

The European Heat Pump Association collects heat pump market intelligence in 21 countries of the European Union (EU) and the European Free Trade Area (EFTA). Starting in 1989 with only a few markets, the number of countries covered has increased to 10 in 2009 and further to 21 in 2013.
So far, market development can be distinguished in 3 phases:

1990 – 2003 : slow growth,
2004 – 2008 : market acceleration,
2009 – 2014 : relative stagnation
2015 – 2050 : growth for good?

Market growth in 2015 is significantly different from the previous years: not only does the year show a 2-digit growth (12.2%), but also is this growth backed by most markets covered. The outlook of market players interviewed in 2016 is very positive and the industry expects the growth of 2015 to continue in 2016.

890 302 (+12.2%) heat pumps were sold in 2015 [3]. Assuming a continued market development in 2016 sales of more than 900 000 units are realistic, opening the way for more than a million units to be sold in 2017.

Such accelerated growth allows for a doubling of the installed heat pump stock until 2024 with related cost reductions from economies of scale improving the competitiveness of heat pumps and further accelerating sales.

When integrating data since 1989, the aggregated stock of the European market is close to 8.4 million units (see Table 1 and Figure 1).

Table 1: Heat pump sales in Europe 2005 - 2015 (Source: [3]).

	SUM EU-11	SUM EU-21	TOTAL STOCK
2005	446 037		1 015 607
2006	504 428		1 525 382
2007	568 131		2 109 519
2008	770 538		2 918 215
2009	686 076		3 620 372
2010	671 392	800 388	4 413 119
2011	666 873	808 591	5 212 290
2012	621 818	750 436	5 954 336
2013	635 273	769 879	6 716 770
2014	659 911	792 988	7 474 709
2015	712 891	890 302	8 384 541

Observed trends from the past remain intact:

1. Air[2] remains the dominant energy source for heat pumps. Most heat pumps sold are reversible air-air systems (48%) followed by air-water (20.4%) and sanitary hot water heat pumps (13.4%). Ground-coupled units (geothermal energy 9.9%), other reversible heat pumps (6%) and exhaust air heat pumps (2%) make up the remaining sales volumes. With Europe preparing for near zero energy buildings (nZEB) in 2020, the segment of exhaust-air heat pumps is expected to see accelerated growth, with products increasingly often integrating heating, cooling and ventilation (see Figure 2).

[2] It should be noted that „aerothermal energy“ or simpler „outside air“ is considered a renewable energy source by all 28 Member States of the European Union according to Article 2 of Directive 2009/28/EU. [4]

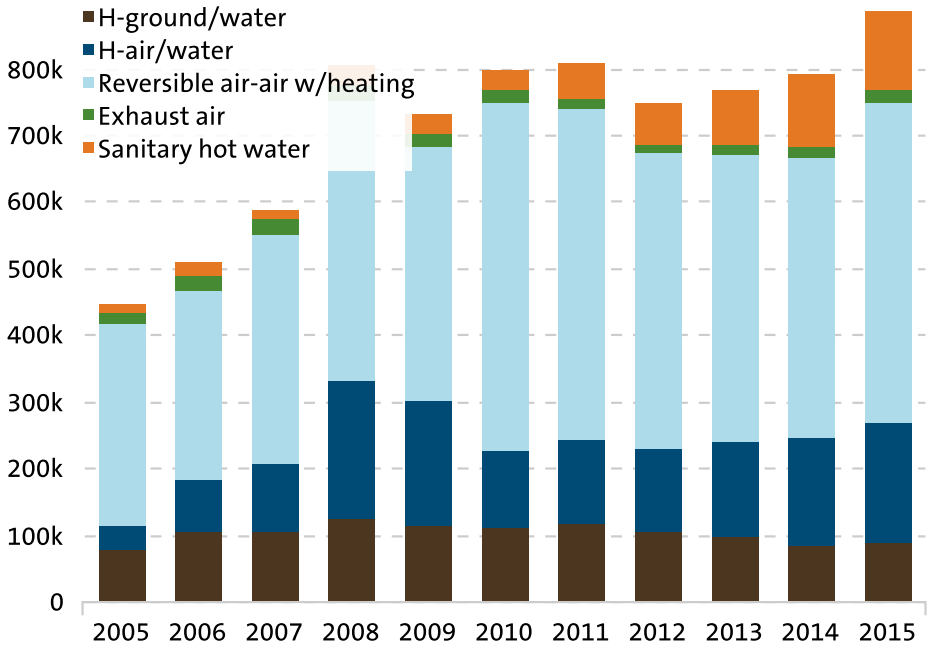


Figure 1: Development of heat pumps sales in Europe, 2005-2015 | by category
Countries covered: 2005-2008: 14; 2009: 19; 2010-2012: 21 (Source [3]).

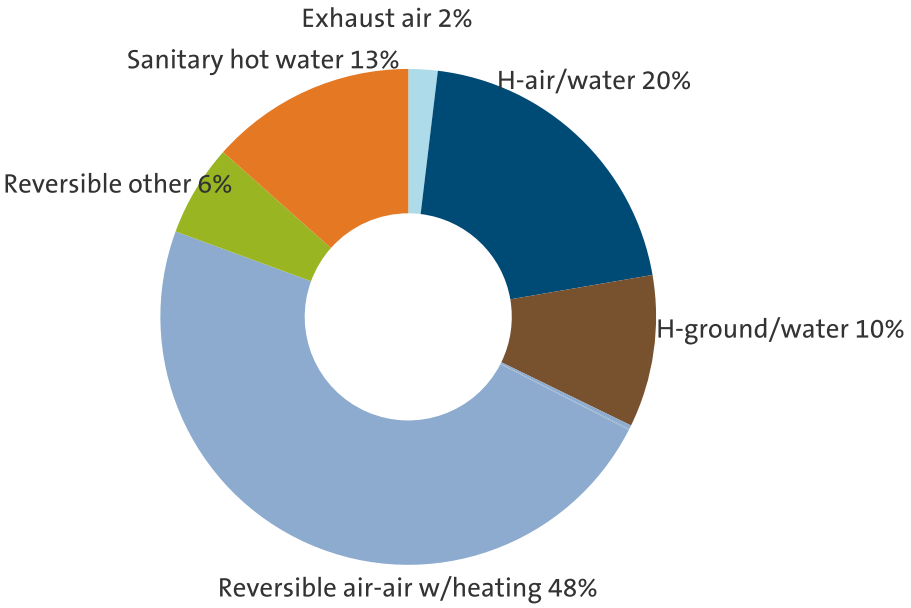


Figure 2: Heat pump sales in Europe 2015 | shares by type of heat pump (Source [3]).

2. In terms of **annual growth**, air-source heat pumps are also growing the strongest, manifesting the dominant position in annual sales and installed stock. Compared to 2014 sales, reversible air-air are the strongest sub-segment (+49k, +13%) followed by air-water (+22k, +14%), VRF (+9k, +21%) and exhaust air (+3k, +23%). Sales of ground coupled units could stop the downward trend from the previous year (+3k, +3%). Finally, sanitary hot water heat pumps continue their growth, but it slowed down slightly (+9k, +8%).

3. **Large heat pumps** for commercial, industrial and district heating applications are gaining popularity, yet not enough data exists for this important market segment to provide detailed analysis.

Future market growth is expected because of technological progress and a more heat pump friendly political framework. Both will mutually re-inforce each other in a virtuous circle.

3 THE POLICY FRAMEWORK AS A FOUNDATION FOR GROWTH

Heat pumps are heavily regulated on the product, buildings and system level. The following overview only shows the major pieces of legislation and does not address product safety, circular economy and waste related legislation [5].

Table 2: Most important legislative acts influencing the uptake of heat pump technology in Europe [5].

Year	Name	Focus
2009	Renewable Energy Sources Directive (RES Directive)	European Union / Member State
2010	Energy Performance of Buildings Directive (EPBD)	Building
2009	Ecodesign for Energy related Products-Framework Directive (ErP)	Product/system
2009	Energy Labelling Directive	Product/System
2010	Energy Efficiency Directive (EED)	European Union / Member State
2013	Regulation on Ecodesign for heaters and water heaters	Product/System
2013	Regulation on the energy label for heaters and water heaters	Product/System
2014	F-Gas regulation (review of 2006 regulation)	European Union / Member State
2014	Ecolabel Framework Directive with the Ecolabel for heat pumps, for hydronic heating systems and for office buildings	Product/System
2014	Green Public Procurement	Product/System

It has taken European legislators a long time to accept heat pumps as positive and to recognise their benefits via the aforementioned legislation. After all of them have come into force over the past two to three years, their impact can now be felt in the market place.

However, high level discussions on renewable energy quite often meant and *still mean* a discussion on renewable electricity, downplaying or even ignoring renewable heating and cooling. This was done despite better knowledge ignoring that heating and cooling are responsible for 51% of final energy demand in Europe and roughly 25% of all CO_2 emission. While the decarbonisation of society was aimed for, the decarbonisation of the heating sector did not receive top priority. What was missing until now was a comprehensive approach addressing the specificities of heating and cooling.

The situation changed with the announcement of the European heating and cooling strategy in early 2016 [6]. It was the result of increasing stakeholder pressure highlighting the need to address the hitherto unused potential of heating and cooling towards meeting the continent's climate and energy targets.

The heating and cooling strategy focussed on the need to decarbonise both the energy supply of buildings and that of industry. Important building blocks addressed in the communication are

- introduction of highly efficient heating and cooling equipment including heat pumps and heat pump systems,
- automation and control,
- the use of waste heat and cold,
- new financing tools to make building renovation easier and increase the renovation rate but also an improved framework for market based business models,
- system based improvements by using district heating and cooling, combined heat and power and smart building technologies.

The strategy is a first step to align the goals of society with those of the individual decision maker. “Consumers must be at the centre of this strategy, using modern technologies and innovative solutions to shift to a smart, efficient and sustainable heating and cooling system that can unlock energy and budgetary savings for companies and citizens, improve air quality, increase well-being for individuals and provide benefits to society as a whole.” [7]. It will be a challenge to balance the sometimes diverging targets of environmental protection, consumer health and affordability, in particular as they develop along different time horizons.

Heat pumps cater to the different demands of the strategy. The heat pump stock installed at the end of 2015 has a capacity of 73.6 GW. It introduced 94.7 TWh renewable energy into the mix and made use of excess energy otherwise wasted. All heat pumps installed reduced primary and final energy demand by 56.8 TWh and 121 TWh, respectively. CO_2 emissions to the atmosphere were reduced by 24.4 Mt (see Table 3). There is no official data on the reduction of particulate matter by replacing fossil fuel boilers with heat pumps. However, internal calculations using the data set from the GEMIS Model reveal annual savings of around 14.1 kg particulate matter per installation. Replacing all 8.3 million coal boilers in Europe with heat pumps could save Europeans 116.6 thousand tonnes of dust emitted to the atmosphere each year [8]. This value is based on the current emissions of the EU electricity mix and will increase with greening electricity.

Table 3**:** Installed capacity, energy demand reduction, RES integration and CO_2 emission reduction from the heat pump stock installed in 2015 (Source: [8]).

	Sales 2015	Stock 2015
Installed capacity (GW)	7.4	73.6
Qusable (TWh)	14.4	148.0
RES integrated (TWh)	9.1	94.7
in mio €	910	9 470
GHG savings (Mt)	2.3	24.4
in mio €	81	854
Final energy savings (TWh)	11.6	121.0
in mio €	870	9 075
Primary energy savings (TWh)	5.2	56.8

This strategy is now translated into political action with the "Clean energy for all" package, announced on 30.11.2016 [9]. The package contains – among others – these pieces of legislation

- the revised Renewable Energy Directive (RED II)
- the revised Energy Performance of Buildings Directive (EPBD)
- the revised Energy Efficiency Directive (EED)
- the revised Electricity Market Directive and Regulation

With this package, the European Commission is not only addressing the heating sector in a more consistent way, but is also finally giving more consideration to heat pump technology. This is reflected in the introductory communication of the package where heat pumps are explicitly mentioned as a positive example of the set of solutions that need to be implemented. It is also mentioned that heat pumps use both ambient and waste energy to reduce overall energy demand.

A first review of the contents of the package from a heat pump perspective is positive. It shows positive, yet often indirect benefits for the deployment of the technology:

1. An increased energy efficiency target or suggested measures for energy providers to annually increase their renewable energy share can be met by deployment of heat pumps.
2. New financing mechanisms and a new primary energy factor for electricity will make it easier to do so, thus creating a more favourable overall framework for heat pump industry stakeholders.
3. The promotion of self-consumption and the support of an increasing share of green electricity in power conversion mix make heat pumps prime candidates for smart homes, cities and regions and one of the candidates to provide demand response services connecting the electricity and heating sectors.
4. New provisions to increase the share of renewables and waste heat in district heating, where the untapped potential of industrial and commercial heat pumps is explicitly highlighted.

Once implemented in the member states, these measures should not only increase the demand for efficient and renewable heating and cooling systems, but also encourage policy makers to incentivise their installation.

In addition, sustainable heating and cooling will be addressed in the 10 actions identified under the SET plan and via several tools from the financing sector. This will firmly establish heat pump technologies in the future of European research and innovation funding and hopefully alert and educate stakeholders from the financing sector on the benefits of heat pump technology (and their long term positive contribution to almost any business case).

A positive recognition of heat pump technology is at hand. If properly communicated, it will shift research budgets to this technology and encourage industry to align development and manufacturing resources accordingly. A growing market also makes it more attractive to become a heat pump installer. Being the main gate keepers,

installers will then use their influence on end-users and decision makers to promote heat pump technology.

4 TECHNOLOGY DEVELOPMENT AS AN ACCELERATOR

Because of an intra-industry change, the following developments are expected to increase the field of application for heat pumps in residential, commercial and industrial applications:

1. **Advancements in product design** will make heat pump units more compact and easier to install.
2. **Advancements in the refrigeration cycle** will reduce refrigerant charge and create opportunities for the use of natural refrigerants. They are also expected to positively impact efficiency.
3. **Advancements in controls** are expected to make heat pumps a key component of smart grids, enabling full deployment of their demand response potential and the creation of related business models, improving the economics of heat pump based systems [10].
4. **New product developments** are expected to provide efficient heat pump solutions for more and more demand scenarios, namely the **renovation segment, large buildings and industrial** solutions where a parallel demand for heating and cooling makes heat pumps particularly suitable.

Next to intra-industry developments, a few other mutually overlapping areas will provide a positive feedback on heat pump development:

1. The continuing price decrease of **photovoltaic electricity** makes an integration of heat pumps and PV attractive. Several solutions are available in which the PV inverter and the heat pump controls communicate to optimise and even maximise self-consumption of electricity. The expected short term increase of electricity end-user prices in parallel with the continued reduction of cost for self-generated electricity make this model attractive in more areas across Europe (and even world-wide).
2. The reduced cost of **electric storage** will bring batteries more and more into homes and commercial buildings. In combination with the already very cost efficient thermal storage from heat pump systems, buildings can become more and more energy independent. The development of simple yet highly integrative home energy management systems is a key driver for the **digitalisation of heating**. This has also been understood by industry with most manufacturers and utilities developing digitalisation strategies.
3. The integration of sensors in buildings and their connection to online data makes much more precise **data sets on building user behaviour and weather data** available. This enables the efficient provision of comfort from heating, cooling and hot water solutions. Again, the unit, building and even area controls are key to success in this development.

5 CONCLUSION

Heat pump sales have developed sideways from 2009 to 2014 with growth rates slightly above zero. 2015 is the first year showing significant growth. This growth however is still insufficient considering the need for a decarbonised heating sector in 2050.

While heat pumps are among the most efficient (and thus least polluting) technologies today, they are not (yet) identified and promoted as integrator technology by the Member states of the European Union and the European Economic Area. Changing this approach would allow Member States to commit to more ambitious targets on energy demand and emission reduction.

Considering available alternatives, heat pumps must become the anchor technology of heating and cooling in Europe with a dominant market share in all sectors. A decarbonised society is impossible without a decarbonised heating sector. In a decarbonised heating sector the current dominance of fossil boilers must be replaced by an equally strong dominance of heat pump technology. Building up these markets in parallel to decarbonising the electric grid will accelerate decarbonisation of heating, as all heat pumps installed multiply the effects of decarbonisation of electricity.

It can thus be concluded that either heat pumps are on a growth trajectory for the next 35 years, or the goal of a decarbonised society will be missed. Giving up on this goal will however not come for free – investment in heat pumps could very well be much cheaper than investing in abatement technologies to remedy the consequences of climate change.

The level of success of heat pump technology will directly impact the level of success of limiting global warming. The technology is of strategic importance for Europe, if not the world in this endeavour.

6 RESOURCES

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[6] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: An EU Strategy on Heating and Cooling, 2016 COM 51 final.

[7] ibid., p. 13.

[8] Internal calculations based on the replacement of a coal boiler with a heat pump using data from Gemis 4.7 (http://www.probas.umweltbundesamt.de) and ENTRANZE (www.entranze.eu).and annual thermal energy demand of 15 000 kWh.

[9] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee, the Committee of the Regions and the European Investment Bank: Clean energy for all Europeans, COM/2016/0860 final

[10] Under framework contract ENER.C3.2012-418-lot 1 the European Commission has given the task of a preparatory study on Smart Appliances to Wuppertal Institute, Viegand Maagøe, Armines, Universität Bonn and Vito. The key aim is an analysis of all technical, economic, environmental, market and societal aspects that are relevant for a broad market introduction of smart appliances. The work of the study team has finished in September 2016 and the reports can be found at http://www.eco-smartappliances.eu/. Heat pumps are specifically mentioned as promising technology.