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The Heat Pump Market, Its Market Drivers and How to Have an Impact on Them in Finland

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Abstract

There are already as many as 800,000 heat pumps in Finland, a country with a population of 5,5 million people. A heat pump is by far the most popular form of heating in new single-family houses, and heat pumps are rapidly replacing oil and electric heating as well as district heating in old buildings.

Although the prerequisites for heat pumps in Finland are excellent, the real market drivers thereof must be identified as well as the means as to how to have an impact on them. Active and understandable communication on all levels is in a key role, as is the effective influencing of politicians, rules, regulations, the behavior of authorities, and the contents of the messages that the press sends out. Adding tax pressure on fossil fuel prices is one of the main targets of lobbying to reach even better profitability for heat pumps. System quality, training systems as well as IEA HPP annex forums from universities, polytechnic colleges, research institutes and financiers for the creation of national projects must not be forgotten.

The required raw material for lobbying purposes can be acquired from, e.g., surveys that are conducted by independent consultants. In 2030, there will be 1,7 million heat pumps in Finland producing 15 TWh worth of renewable energy. By then, a total of 12 billion Euros will have been invested in heat pumps, and 3000 new jobs will have been generated. The savings that will have been made will by then be in the region of one billion Euros per year.

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1. Introduction

The significance of heat pumps has grown in Finland in the heating of single-family houses, multi-storey buildings as well as large service-facility buildings such as shopping centres and logistics centres. Also, the use of heat pumps is continuously increasing in heat-recovery and process solutions as well as in the production of district heating and cooling. The role of heat pumps as a producer of Finnish renewable energy is much greater than that of, e.g., solar and wind energy.

This article describes the size, development and structure of the Finnish heat-pump market as well as its special characteristics. The market has also been put into proportion to the heat-pump market in other European countries.

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The Finnish heat-pump market has increased a thousand-fold over the past couple of decades. The annual heat-pump purchases worth 400 million Euros that individual people have made form the biggest Finnish investment in renewable energy.

This article looks at the drivers that have had, and still have, an impact on the success of the heat-pump sector, and it considers whether those drivers can be influenced. The experiences of the rapid market development in Finland and an analysis of the market drivers, as well as the possibilities to influence those market drivers, may provide a basis for the development of the heat-pump market in countries where the significance of heat pumps is not yet this great.

2. The Heat Pump Market in Finland

2.1 Special Characteristics of the Finnish Heat Pump Market

On a European level, the Finnish heat-pump market is big and quite unique. When looking at the number of heat pumps per type, the heat-pump market is dominated by air-source heat pumps, whereas ground-source heat pumps lead the market when looking at the figures in Euros. 75% of single-family house builders choose a heat pump. Finland's largest geothermal site has 100km of drill holes. In Finland, heat is already being extracted from more than 100 000 geothermal wells, the combined depth of which totals half of the earth's circumference, i.e., 20 000km.

300 000 owners of oil and hydronic electric-heated houses have not yet replaced their heating with a heat pump even though the return on capital invested is, almost always without exception, 10%/a. More than half a million people who use electric heating are wondering whether there will be an increase to the affordable electricity price of 12 cents per kWh.

There have also been started to save energy in district heating that has been produced with combine power and heat production (CPH) or other means. This happens more and more often with exhaust-air heat pumps that have been installed in apartment and office buildings. Big buildings are also increasingly replacing district heating entirely with ground-source heat pumps. New, large shopping and logistics centres increasingly use large geothermal fields for cooling and heating instead of district heating. The largest geothermal site in Finland, a logistics centre, has 316 geothermal wells, each 300 metres deep, totalling 100km of drill holes.

The role of cooling in the Finnish climate is not great. However, the demand for it in housing, too, has increased due to living-comfort reasons as well as nearly zero-energy building. This is beginning to have an impact on the profitability of investments, since heating and cooling is provided through the same investment.

The most important reason behind the success is clear, yet this reason is also distinctive on a European scale. Heat-pump systems are a very profitable investment. The return on capital invested is often 10-15%/a. The Finnish government does not offer any subsidy to heat pumps apart from the household tax rebate that can be claimed for the installation work of a heat pump.

Heat pumps are easy to use, they are carefree, they require little space and they have a cooling feature. These are arguments that also speak in favour of choosing a heat pump. Affordable electricity, the lack of a gas network, the high consumption of heating energy that is caused by the Nordic conditions, a suitable bedrock for drilling, the customer- friendly heat-pump system supply all create favourable preconditions for profitable investments.

2.2. The Finnish Heat Pump Market Is Big, Even on a European Level

2.2.1 6 TWh from around Buildings with 800 000 Heat Pumps

At the end of 2016, there will already be as many as 800 000 heat pumps in Finland, in a country with a population of 5,5 million people. A heat pump is by far the most popular form of heating in new single-family houses, and heat pumps are rapidly replacing oil and electric heating as well as district heating in old buildings.

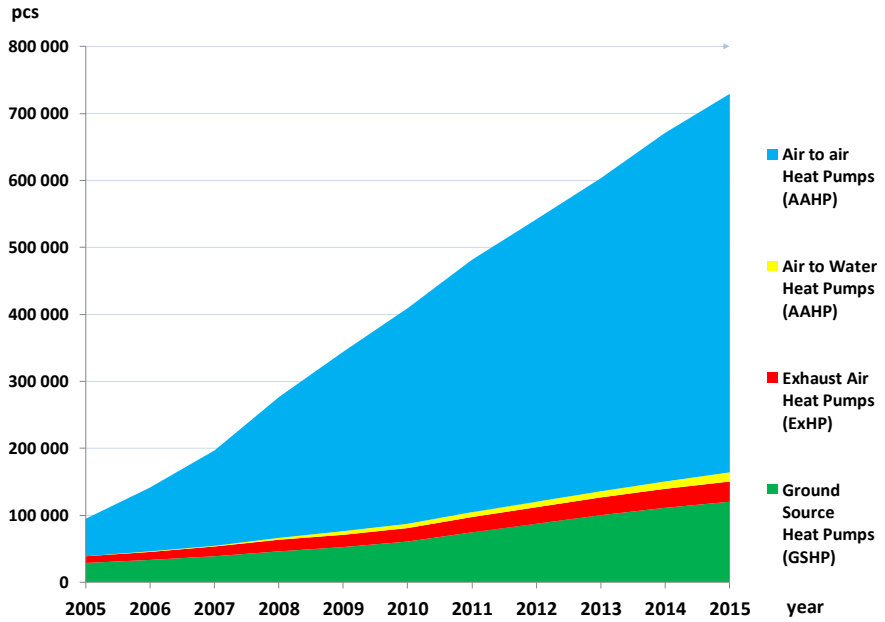


Fig. 1 Number of Heat Pumps Installed in Finland, Cumulative 2005-2015 [1]

The heat-pump industry has also done well during difficult times, albeit that new construction and renovations have decreased a lot. In 2011, 12 000 new, detached houses were built, as opposed to 2016 when the amount had fallen by half down to 6000. The 800 000 heat pumps in Finland produce 6 TWh/a of local heat, i.e. renewable energy, from around buildings, from the bedrock, the ground or the air. Finns annually invest approximately 400 million Euros in heat pumps, since it is profitable for them.

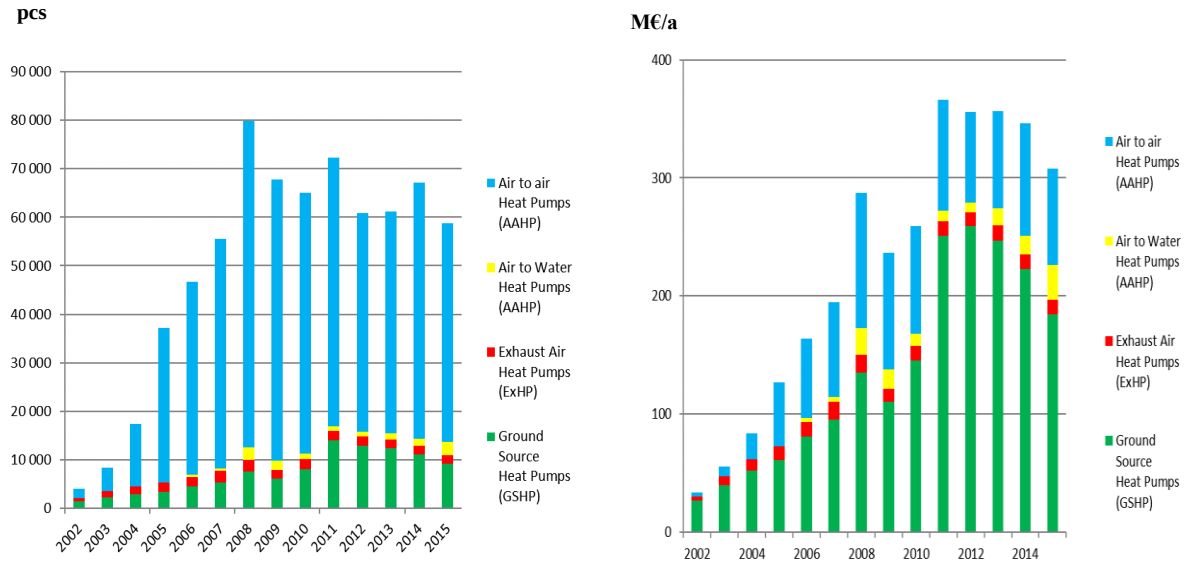
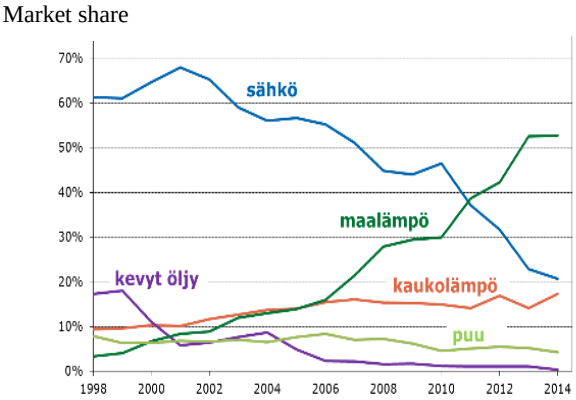


Fig. 2 Heat Pumps Installed in Finland per Type of Heat Pump; Quantities and in Euros, 2005-2015 [1]

2.2.2 Three Out of Four Builders Choose a Heat Pump

75% of single-family house builders choose a heat pump as their main heating system. 53% choose a ground-source heat pump, which apparently is a world record of its own in new construction. Just over 15% of builders choose an exhaust-air heat pump, and approximately 5% choose an air-to-water heat pump. Furthermore, electrically-heated houses are most often being fitted with air-source heat pumps as an electricity-saving and cooling fixture.



Translation of the Finnish text: sähkö=electricity kevyt öljy=light fuel oil, maalämpö=geothermal heat

Fig. 3 Single Family House Heating System Choices, 1998-2014. (Exhaust HPs are still in 2014 included in electricity heating) [2]

The greatest potential for heat pumps, however, lies in the already-existing houses. 200 000 oil heaters, more than 100 000 hydronic electric-heating users, and 500 000 direct-electric heating users most often pay double or triple the price for their heating energy as compared to heat-pump heating. With the current interest rates, in particular, not making the decision to invest in a heat pump is, in practice, merely due to ignorance.

Last year, Finns invested approximately 400 million Euros in heat pumps. Every day, Finns invest their money in more than 100 air-source heat pumps and 30 ground-source heat pumps. A couple of dozen oil-fired boilers are daily replaced with a heat pump.

2.2.3 On a European Scale, the Heat Pump Market Is Big

When comparing the heat-pump market success in European countries, the market has to be put in proportion to the population or to the number of houses. In the EHPA, the European Heat Pump Association, statistics of 2015, Fig. 4, the sales volumes have been presented in proportion to the number of households.

When looking at Fig. 4, two main observations can be made. Firstly, there are roughly three groups of countries. The first group comprises Northern European countries: Norway, Finland, Sweden and Estonia. All of these countries boast sales of more than 20 units per 1000 households. After these countries, there is rather a large gap. The second group is lead by Denmark, with sales of 12 heat pumps per 1000 households, followed by Switzerland (7,7), France (7,2) and Austria (6). The final two countries to be included in this second group are two Mediterranean countries, Italy and Spain, that both boast high air-to-air heat-pump sales of almost 5 heat pumps per 1000 households. The last group, which comprises the remaining 11, mainly Central European countries, is characterised by very low heat-pump market shares, or in other words, very high potential. This potential is substantiated by both high populations and a high demand for space and water heating. [3]

Secondly, albeit that sales in the mature markets may indicate a slowdown in growth, i.e. market saturation, the performance in these markets remains very high.

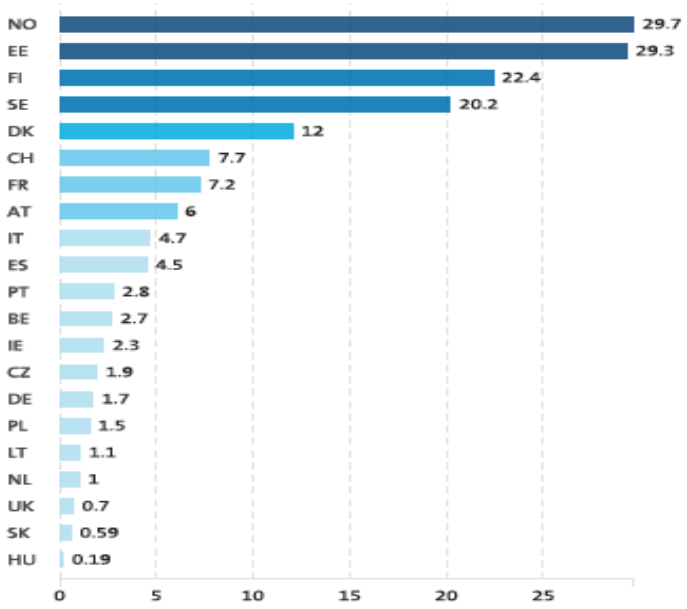


Fig. 4 Heat Pump Sales in Europe per 1000 Households, 2015 [3]

2.3 The Heat Pump Industry Is a Significant Producer of Renewable Energy

When renewable energy is discussed in Finland, heat pumps are often not even mentioned, despite the significance of the industry. Chart 1 shows the magnitudes of renewable-energy types, excluding industry and power-plant use of renewable energy. Firewood is burned at a rate of 15TWh annually, heat pumps produce 5TWh of renewable energy from around buildings, wind energy 2 TWh and solar thermal collectors and panels 0,1 TWh. The 60 000 heat pumps that were installed in 2015 alone increased the use of renewable energy in the heating of houses by 0,6-0,8 TWh.

Table 1. Comparison of Renewable Energy Production in Finland, 2015 [4]

	Output Capacity	Renewable energy
	kW	MWh/a

Detached house			
	Ground-source heat pump	10	20
	Air-source heat pump	5	5
	Solar panel (19m^2)	3	3
Apartment building			
	Ground-source heat pump	100	200
	Solar panel (190m^2)	30	27
Power plants			
	Solar (Largest in Finland, Kivikko 4500m^2)	800	720
	Windmill (1 pcs 3 MW)	3 000	9 000
	Logistic centre with 300 boreholes	8 000	24 000
Industries by the end of 2015		MW	TWh/ a
	Solar	10	0,1
	Wind	1 005	2
	Heat pumps	3 000	5
	Wood burning	20 000	15

It is also noteworthy that when looking at renewable-energy investments in 2015 in Finland, the major investors were private households. They invested approximately 1 billion Euros in renewable energy, and the major investing group was the buyers of heat-pump systems with 0,4 billion Euros worth of purchases. According to the study that was made for years 2009-2013 Energy Industry had 26 % and consumers 38% of investments on renewables [5].

2. Market Drivers and How to Have an Impacy on Them

The prerequisites for heat pumps in Finland are excellent. In a cold climate, a lot of energy is needed. In a typical single-family house, the usual annual consumption for heating and domestic hot water is 15 000-25 000 kWh of electricity or 2 000-3 000 litres of oil. Since Finland is a big country with a small population of 5,5 million, having e.g. a comprehensive gas network is unprofitable. The lack of this competitor favors heat pumps.

When considering the recent general developments in the construction business, the heat-pump business has clearly strengthened its position in the heating and cooling of houses. However, it is only in the early stages of its success. The direction of the heat-pump market development is clear, but the right type of advocacy, lobbying, will have an enormous impact on the degree of this development. The real market drivers have to be identified as well the means with which to influence them. The areas of this lobbying are multifaceted and, therefore, here are a few examples of current, genuine sectors in which lobbying is conducted in practice.

The heat-pump market has increased a thousand-fold in Finland during 20 years. It is necessary to look into the true market drivers and to consider whether they can be influenced and how.

3.1 Profitability

The most important of them is certainly profitability. The investor is a consumer, the user of energy, a house owner, most often a private individual. They must, at least, get the feeling that they are getting a sufficient return on their investment.

This they very often get in Finland. Fig. 5 shows the investments and the savings in both energy as well as in Euros for different types of heat pumps, indicating the price levels of 2016, in single-family houses as compared to electricity and oil heating. Approximately the same investment and savings ratios are reached with larger facilities where the comparison is usually with district heating.

Heat-pump type	Savings per year, kWh	Savings per year, €	Investment, €
Ground-source heat pump	14 000…17 000	1 800…2 200	14 000…20 000
Air-to-water heat pump	8 000…13 000	1 000...1 700	8 000…12 000
Exhaust-air heat pump	3 000…7 000	400…800	6 000…10.000
Air-source heat pump	2 000…7 000	250…800	1 500…2 500

Fig. 5 Savings and Investments of Various Heat Pump Types in Single Family Houses [1]

Is it possible to have an impact on profitability? Yes, it is, at least on a long-term basis. As the market grows, market mechanisms bring the system investments to the right level. Various subsidies are, in practice, always temporary and may boost the market for a short while, but should not be allowed to disturb market-based development in the long run.

The profitability of heat pumps is very dependent on the price of fuels, electricity and district heating. In any case, they include a lot of taxes. Having an impact on these taxation structures is possible in the long run. Indeed, this is one of the foremost objectives of lobbying for the Finnish heat-pump industry. For instance, by taking away the tax subsidy for fuel oil and by putting it in the same tax class as diesel transport fuel, heat pumps would receive a 20-30% leap in profitability. This is, after all, what our neighbour Sweden already did in the 1990s. The flourishing of the heat-pump business that this, in part, created is something that we as a neighbouring country have been left to envy for a couple of decades now already.

Furthermore, the increase of electricity-price taxation would suit the heat-pump business, since the competitiveness of heat pumps would improve in 700 000 electrically-heated houses.

3.2 Information, Communication and Visibility

Consumers, decision-makers, politicians must all have as correct information as possible and as much of it as possible. If they do not know that the profitability of heat pumps is excellent, business will not flourish, nor will heat pumps feature in discussion agendas, nor will they be acknowledged in regulations, law, rules or instructions.

Here, if anywhere, is the place for advocacy, for lobbying. The Finnish heat-pump interest organisation, the Finnish Heat Pump Association SULPU, has extensively focused on providing this information, both qualitatively as well as quantitatively, in various media such as the press, TV, radio, the social media, with presentations, panel discussions, statements, and expressions of opinion. In regard to the development of the heat-pump market, it is also very important to participate in the preparatory work of regulations, laws and instructions in ministries.

The principal messages when relaying this information must be carefully chosen and repeated systematically in the media, regardless of the channel of communication. A heat pump is profitable, the return on capital invested is excellent, it improves Finland's current external balance, it offers employment, and is a major and profitable environmental act. These arguments must be expressed repeatedly in all communication.

There is never enough of this type of lobbying, influencing. Nevertheless, it has been rewarding in Finland and can be seen in the development of the heat-pump market.

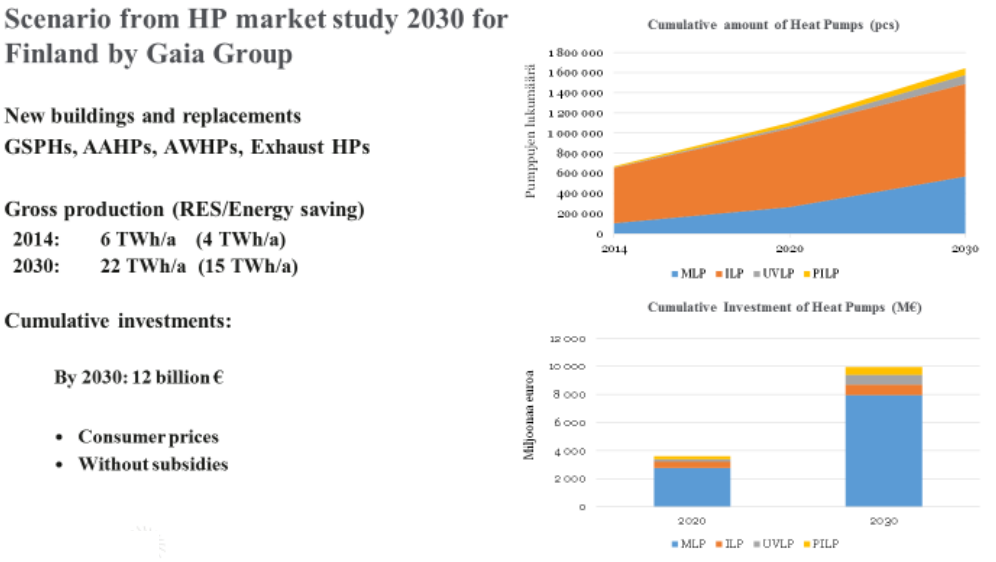
3.3 Surveys Are the Best Fuel for Lobbying, Increasing Information, and for Quality

The heat-pump business has carried out and participated in surveys that shed light on the possibilities of heat pumps and future prospects; surveys that have an impact on the status of heat pumps in regard to the

implementations of EU regulations in Finland. Here are three survey examples in which the heat-pump industry has been involved and has used in its lobbying.

3.3.1 By 2030, a Total of 12 Billion Euros Will Be Invested in Heat Pumps

According to a survey conducted by the independent consultants Gaia Ltd, a total of 12 billion Euros will be invested in heat pumps by 2030, creating approximately 3000 new jobs in the field. By then, heat pumps will be producing 22 TWh/a, 15TWh of which is renewable energy that is extracted from around houses. These investments will also have a billion-class effect on Finland's current external balance and the value of its building stock. [6]



MLP= GSHP, ILP=AAHP, UVLP=AWHP, PILP= ExHP

Fig. 6 The Role of Heat Pumps in 2030 [5]

The breathtaking result of this survey has brought heat pumps a lot of credibility and weight now when, e.g., the Finnish Climate and Energy Strategy is being prepared.

3.3.2 Exhaust Air Heat Pumps Save 40-50% of District Heating in an Apartment Building

More than 30 000 apartment buildings release exhaust air that is warmer than 20 degrees Celsius. The entire air volume of the building is changed once every two hours, and that air vanishes up into thin air. Therefore, exhaust-air heat pumps have gradually become more common also in apartment buildings. More than 500 apartment buildings have already been fitted with a heat pump that retains the heat of the exhaust air. This reduces even as much as 50% of the district-heating or other energy consumption of the building. After the fitting of this heat pump, it is also often decided that the remaining energy need will be covered with a ground-source heat pump, and district heating becomes redundant.

Finnish Energy Industry, with the support of the heat-pump industry, commissioned VTT Technical Research Centre of Finland Ltd to study the effects of exhaust-air heat pumps on the district-heating network as well their market potential.

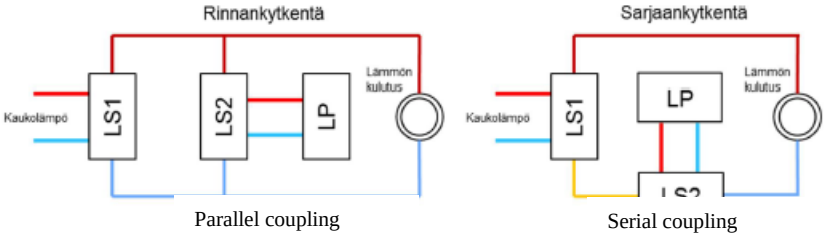


Fig. 7 Coupling Exhaust Air Heat Pumps to the District Heating Network (=kaukolämpö) [7]

The heat-pump industry found that the study, which was done based on Finland's building stock, provided a tentative estimate of 2,7 TWh/a heating-energy savings potential for exhaust-air heat-pump systems. This result is central in increasing the development activities of this said heat-pump product on all levels, and has also prompted district-heating companies to consider new business models and energy-sales service products. [7]

3.3.3 Study on the Energy Saving Potential of Exhaust Air Heat Pumps in Single Family Houses

There are 600 000 air-source heat pumps in Finland, and approximately 50 000 more are installed every year. It is common knowledge that in a Finnish house they save money, they cool the building, they work, and people buy them. There was no reliable information available as to how much energy they actually extract from around a building.

Commissioned by the Ministry of the Environment and the heat-pump industry, VTT Technical Research Centre of Finland Ltd modelled an air-source heat pump for the heating system of a few houses and studied their energy-consumption effects in old, new and in the upcoming nearly zero-energy single-family houses. For the first time now, it has been possible to reliably define, in figures, the energy-saving potential of an air-source heat pump in Finnish conditions. The study took into consideration, in detail, the characteristics of the heat pumps and the buildings [8].

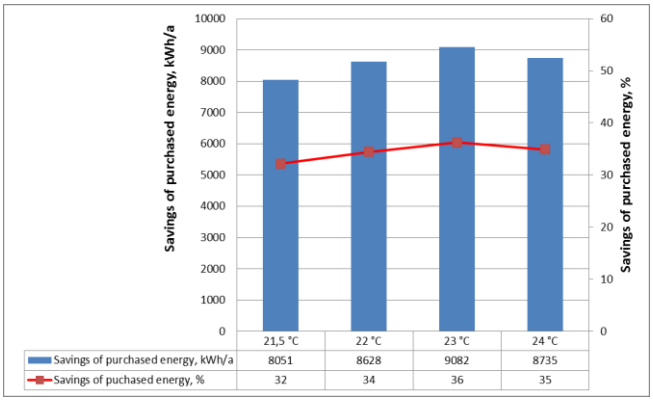


Fig. 8 Net savings of purchased energy (=RES use) with different room air temperature settings of the AAHP, An example from study [8]

The result of this complicated and challenging modelling was that air-source heat pumps can provide 40-60% of the heating of a single-family house. The authorities, constructors and single-family house inhabitants will benefit from these results. These results have been used, e.g., in the nearly zero-energy buildings (NZEB) regulations that will be finalised shortly. Naturally, these results have been used to acquire lots of positive visibility in the Finnish media.

3.4 Quality and Training Systems

The quality of products, systems, installations and operations is important. Putting it the other way around, if the quality is poor it eats away at the achievements of the other market drivers. The quality of heat-pump deliveries is currently good and is not in the way of market development. However, quality must be nurtured, it must be developed, and there must be systems to do this. Developing training systems is a central part in the maintenance of high quality.

Since 2010, Finland has been involved in the European heat pump EHPA Quality Label Scheme, and has implemented the European EUCERT Training and Certification scheme already in 2009. This scheme has also been used as a basis when the Renewable Energy Certified Heat Pump Installer Scheme has been created in Finland.

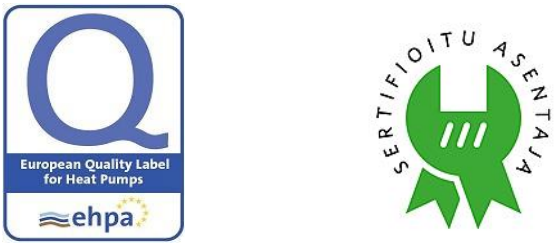


Fig. 9 Heat Pump EHPA Quality Label Scheme and the Certified Heat Pump Installer Scheme (UE SERT, LP) [9-10]

It is important that the heat-pump industry is actively involved in developing quality and training schemes. This involves cooperation with the Ministry of Education And Culture, with educational institutes, and with other interest groups. These activities are not only important for quality control within the business, but also a very effective means of lobbying.

4. Summary

The heat-pump industry has become a significant renewable-energy business in Finland. 800 000 heat pumps produce 9TWh/a of energy, 6TWh of which is energy that is extracted from around houses. This already represents as much as 15% of the heating energy of all Finnish buildings. The prospects for heat pumps are good. The market will certainly develop in the future. The heat-pump business can be described as an integrator that operates amidst and between renewable energy, electricity, and heating and cooling production. Heat-pump technology and its applications can also be seen as an interface to a carbon-free age.

This paper looked at the Finnish heat-pump market, at market drivers and whether they can be influenced. The heat-pump industry market drivers must, indeed, be identified in order to be able to influence them. Finnish heat-pump industry market drivers include profitability, the quality and quantity of information and communication, visibility, study results, and the quality of operations. It is certain that the significance of the heat-pump industry will become greater. However, the degree of that significance can be influenced by influencing these drivers.

Profitability is affected by not only investments but also by the price of energy. The state taxes both fuels as well as electricity heavily. The structure and the scale of taxation are not, however, carved in stone. The price of oil, for instance. One of the aims of the heat-pump industry is to achieve what has been done in Sweden: to have the same price for fuel oil and for diesel transport fuel. They are the same liquid, after all. This approximately 30% rise in oil consumer prices, or in other words taking away the subsidies for fuel oil, would expedite the replacement of the 200 000 oil heaters in Finland with heat pumps immediately and considerably.

The quality and quantity of information and communication as well as visibility have an immediate impact on the market. Increasing these is challenging in terms of resources, know-how and shaping the media environment. It has, however, proved to be possible and rewarding. Research that supports the development of the heat-pump industry, research that is preferably conducted close to the market interface, plays a significant role in the management of this information. Developing quality and training schemes alongside the development of the heat-pump market is important, and it is also a means for lobbying.

Far too often, the importance of lobbying is forgotten, even though it is a very essential aspect in creating the preconditions for a new industry. The heat-pump industry is a challenger, a change maker, an alternative to the traditional and conventional heating systems. Moreover, at the beginning it was considered a threat and a surprising competitor. Lobbying decision-makers and opinion leaders, dissemination, measures in preparing rules and

regulations, incentive-scheme directives and training systems have to be at the top of the strategy list of the heat-pump industry.

The required raw material for lobbying, and the vision and goal for the heat-pump industry, can be acquired from, e.g., surveys that are conducted by independent consultants. In 2030, there will be 1,7 million heat pumps in Finland producing 15 TWh worth of renewable energy. By then, a total of 12 billion Euros will have been invested in heat pumps, and 3000 new jobs will have been generated. The savings that will have been made will by then will be in the region of one billion Euros per year.

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