THE SUCCESS FACTORS BEHIND THE RAPID GROWTH OF THE HEAT PUMP MARKET IN FINLAND

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Abstract: The heat-pump branch has experienced huge growth in Finland. The prerequisites for heat pumps in Finland are excellent. Nevertheless, the impact of active lobbying, incentive schemes, system quality, product and installer certification and training 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 when talking about the success factors behind the rapid growth of the heat pump market in Finland. Of course**,** the fact that the return on a heat-pump investment already today is more than 10% per year is a key factor in the rapid market development. Heat pumps play**,** and will play**,** a significant role in the transition of heating systems when trying to meet the requirements that the EU Renewable Energy Directive has set for Finland. It can be predicted that in 2020, in a country with a population of 5 million**,** one million heat pumps will be producing annually more than 8 TWh of renewable energy The purpose of this paper is to present the success factors so that other countries can learn from Finland.

Key Words: market development, success factors, lobbying, system quality, return on investment

1 INTRODUCTION

Figure 1: In Finland in North East Country of the European Union with a population of 5 million already 600.000 heat pumps are producing 5 TWh/a of renewable energy.

The heat-pump industry experienced growth even though the construction of new houses as well as renovation building decreased considerably in 2013. The 600,000 heat pumps in Finland extract 5 TWh/a of local heat – renewable energy – from around buildings, from ground rock, from the ground or from the air. Finns invested approximately 400 million Euros in heat pumps (SULPU 2014).

One of the key issues in the Finnish energy discussion is the share of renewable energy sources (RES) in end-use consumption. Finland has the European Union's binding target of

increasing this share by approximately 10 percentage points (from 28.5 % to 38 %). This corresponds to an increase of approximately 38 TWh in RES per year.

When taking into account the rapid growth of the Finnish heat-pump market, the good climate conditions, the advanced house technology and the expected environment-policy trends, the total of one million heat pumps that are predicted for 2020 will provide 15 -20 % of the increase of the renewable-energy goal for Finland.

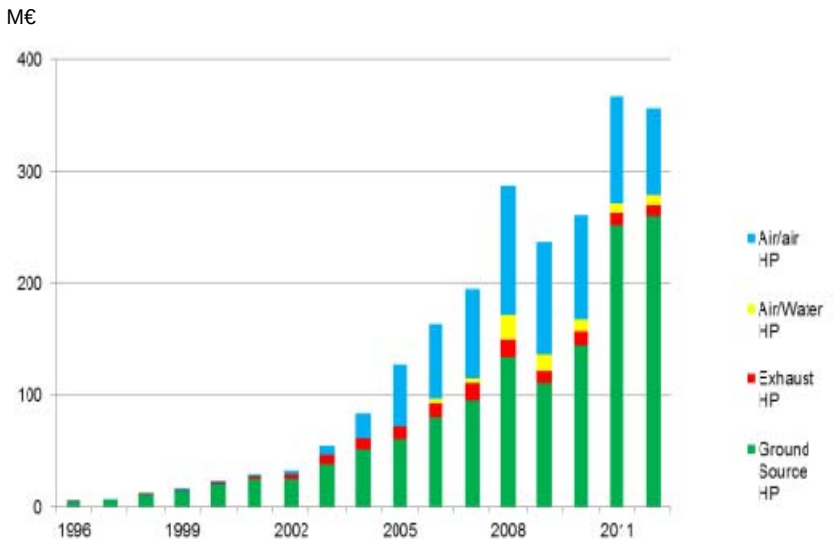

Figure 2: Finns are already investing 400 million Euros a year in heat pumps. And the reason is clear. Most of the time, the return on this investment is more than 10% per year.

It is clear that Finland has a strong heat-pump market with large potential. The different market segments are the arenas for the different types of heat pumps. Passive and low-energy construction present their own challenges for heat-pump solutions in the Finnish cold climate conditions. One million existing houses have electricity or oil heating, and the replacement market for these will offer great potential for ground-coupled, air-to-water, exhaust and air-to-air heat pumps.

The Finnish subsidy policy and punitive tax policy for CO_2-emitting fuels will also contribute to helping the heat-pump industry meet the challenging RES goals of 2020 in Finland.

The purpose of this paper is to present the success factors so that other countries can learn from Finland.

2 THE HEAT PUMP BRANCH HAS DEVELOPED RAPIDLY

The Finnish heat-pump market has developed very strongly during the last ten years. The actions and reasons that have enabled this growth are diverse. The sales figures have increased during the last twenty years by 20-30%/a. Even in 2013**,** the heat-pump industry experienced growth even though the construction of new houses as well as renovation building decreased considerably. In 2013**,** 60,000 heat pumps were sold. It is realistic to predict that the millionth heat pump will be installed before 2020.

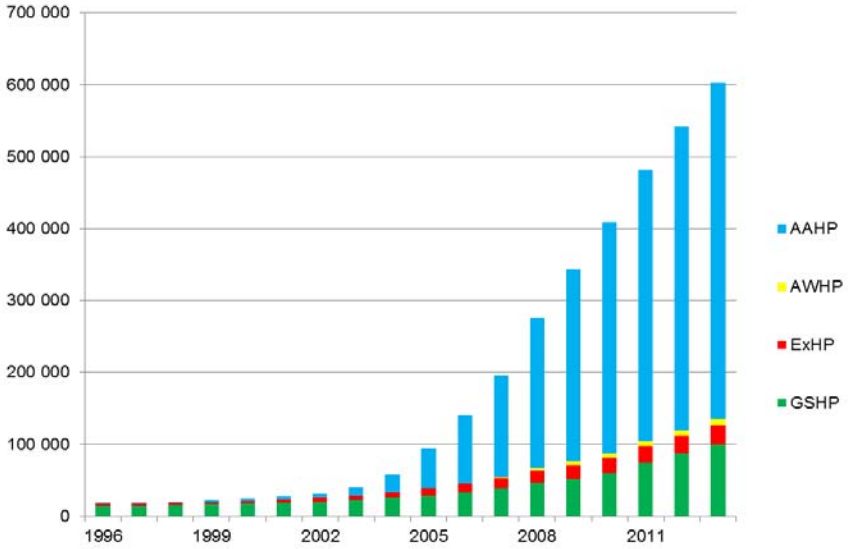

Figure 3: The cumulative number of heat pumps in Finland reached a total of 600,000 in 2013. They are already extracting 5 TWh/a of RES local renewable energy from the ground, the rock or the air from around the houses (SULPU, 2014).

The prerequisites for heat pumps in Finland are excellent. In a cold climate, a lot of energy is needed. Since Finland is a big country with a small population of 5 million, having e.g. a comprehensive gas network is unprofitable. Therefore, the lack of this particular competitor, the relatively cheap electricity and good drilling conditions favour heat pumps. Lobbying, incentive schemes, system quality, product and installer certification and training as well as national IEA HPP annex forums from universities, polytechnic colleges, research institutes and financiers creating national projects have all played, and will play, an important role in the success story of heat pumps in Finland

3 LOBBYING REMOVES BARRIERS, MAKES WAY FOR HEAT PUMPS AND DISSEMINATES

3.1 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. The branch organisation, The Finnish Heat Pump Association SULPU, as well as the active role it has taken in the European Heat Pump Association EHPA, has cleared the path for heat pumps into the heating market. Lobbying decision makers and opinion leaders, dissemination, measures in preparing rules and regulations, incentive-scheme directives and education systems have been at the top of the strategy list of the association.

The Finnish Heat Pump Association SULPU has participated actively also in the debate and fight against oil and electricity heating as well the monopoly of district heating.

3.2 Visibility

An important part of lobbying is media visibility. Every year, SULPU produces or is the initiator of hundreds of newspaper articles, TV, radio or panel discussions, or other public appearances that increase people's awareness of heat pumps and their trust in heat pumps as well as facilitate the sales of heat pumps.

3.3 Participation in the preparation of law enforcement and surveys

As a practical example of lobbying, the active participation in the preparation of national construction codes, subsidy programs, drilling licensing codes and the EU-wide F-gas Act can be mentioned. The Association also performed heat pump customer-satisfaction surveys with amazingly positive results

Recently, the heat-pump industry commissioned an independent expert consulting company to study the economic and environmental impacts of heat pumps. The study analyzed what would happen if 320,000 Finnish households were to switch from oil heating and electric heating to ground-source heat pumps. The study found that the switch would reduce the heating costs of these households by €2.3 billion during the next 20 years. (Gaia Consulting Oy, 2014)

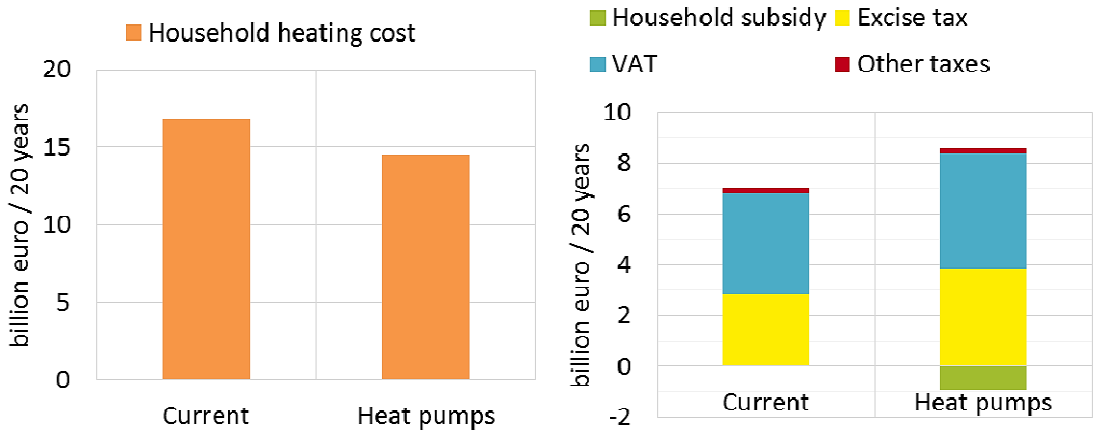

Figure 4: **Impacts on household heating costs when switching to ground-source heat pumps (current and after the switch), and impacts on the central government finances during a period of 20 years (Gaia Consulting Oy, 2014)**

The study has taken into account the economic impacts and the job impacts of reduced oil use on the oil-distribution sector, and the impacts of the changes in the use and maintenance of heating systems. A switch to ground-heating pumps would add 1,500 new jobs and would annually improve the trade balance of Finland by €260 million. Moving away from oil heating would also reduce greenhouse gases by 1.6 MtnCO2-eqv. This reduction equals 5 % of Finland's non-EU ETS emission reduction target for 2020.(Gaia Consulting Oy, 2014)

3.4 Technology and business models were available from Sweden

Finland is the neighbour country of Sweden which in the nineties was the most developed heat pump market in the world. Heat pump branch in Finland cannot underestimate that it had the best heat pump market of the world next us. For the Scandinavian climate conditions and houses developed heat pump models were available also for the Finnish market as well as the working marketing, sales and business models. Thank to Swedes the Finnish heat pump market got almost a running start in the late nineties and was able to pass the Swedish annual heat pump sales figures per capita in 2012.

4 THE CERTIFIED HEAT PUMP INSTALLER AND QUALITY LABELLING SCHEMES ARE AN ESSENTIAL PART OF SYSTEM QUALITY

Finland has joined the European-wide EUCERT Certified Heat Pump Installer Scheme and the EHPA Quality Labelling Scheme. The system quality of heat pumps and their installations are in a key role when considering the key success factors of a new market penetrator. Training based on the European Certified Heat Pump Installer Scheme has been offered by three training institutes to hundreds of heat-pump installers. The commissioning of the EUCERT training has activated also other heat-pump education in the institutes.

Up until now**,** the main importance of an EHPA Quality Label has been in the export activities of the Finnish manufacturers but in future**,** the label will be an essential part of product quality and probably a part of e.g. incentive schemes.

Figure 5: The EUCERT Certified Heat Pump Installer Scheme and the EHPA Quality Labelling Scheme developed by the European Heat Pump Association EHPA has been introduced to improve system quality

5 SUBSIDIES AND INCENTIVE SCHEMES

Subsidy policy plays a role in**,** and makes a contribution to**,** the heat-pump industry. The industry has seen some good results during some subsidized years. Nevertheless, incentive schemes have also caused a lot of fluctuation and uncertainty in the market, and in the long run their impact can even be seen as questionable. The best results have been achieved from the tax-deduction scheme that applies to renovation and extension work that is done in private households. Based on this scheme**,** up to 45-60% of the labour costs related to renovation and extension work are tax-deductible for each owner of a private property. The maximum amount that may be deducted per each owner has been between 2 000 to 3 000 Euros. Furthermore, there was a subsidy programme in which a subsidy of up to 20% of the investment was available when oil and electric-heating systems were replaced by a heat pump, biomass or a district-heating system. This program ended in 2012.

6 IEA HPP AND ITS ANNEX WORK

Finland joined the IEA HP Programme in 2009. This opened the channel to international forums and to information and, in particular, to annexes and the national work surrounding them. After becoming a member, we in Finland have witnessed unparalleled forums from universities, polytechnic colleges, research institutes and financiers for the creation of national projects to participate in the IEA HPP. Finland already participates in Annex 38

"Systems using solar thermal energy in combination with heat pumps", in Annex 39 "A common method for testing and rating of residential HP and AC annual/seasonal performance" and in Annex 40 "Heat-pump concepts for near zero-energy buildings". The creation work of a national project for Annex 42 "Heat Pumps in Smart grids" is in the making.

7 FINNISH TARGET FOR RENEWABLE ENERGY IN 2020 IN THE EU RES DIRECTIVE

The RES Directive states the country-specific goals for renewable energy use for 2020. For Finland, the Directive stipulates an increase from 28,5% of RES to 38%, i.e. 38TWh. In 2020, there will have to be an increase of 38 TWh/a in the energy generated from renewable energy sources out of the total amount of energy that is used in Finland. In other words, six years from now an amount that is the equivalent of 10 Loviisa nuclear power-plant units. The plan of the Ministry of Employment and the Economy, published in 2010, on how to manage this challenging target is presented in table 1.

Table 1: Renewable Energy Source (RES) targets 2020 by the Ministry of Employment and the Economy in Finland

Renewable	More RES 2020	In practice
Bio	18 TWh/a	A lot of heat and power plants from fossile fuels to wood chips and pellets
Wind	6 TWh/a	1000 windmills 3 MW each
Heat Pumps	6 TWh/a	Heat pumps 300.000 ->1.000.000 pcs (2 TWh/a => 8 TWh/a)
Others	2 TWh/a	Additional hydropower, usage of wood chips and pellets in small houses, solar, bio gas
Traffic	6 TWh/a	Adding ethanol and biodiesel in traffic fuels upto 20%
Total	**38 TWh/a**	RES from 28,5% to 38 %. Corresponds annual energy production of 10 Loviisa nuclear power plant units (470 MW)

The major part of RES growth, 18TWh/a, is planned to be supplied by increasing the use of woodchips in the electricity and heat production of power plants. 6 TWh/a will be covered by adding biodiesel and ethanol to transportation fuels. Finland's remaining 2 TWh/a RES burden would be covered by other means, such as the use of biogas, pellets and solar energy. Today, Finland is a developing country in wind power with its total of 209 (447 MW) wind mills at the end of 2013. The planned 800 new wind farms (3 000 MW) for 2020 will produce approximately 6 TWh/a of renewable energy per year. Incidentally, the same target has been set for heat pumps.

8 THE ROLE OF HEAT PUMPS IN THE RENEWABLE ENERGY TARGETS OF FINLAND IN 2020

600,000 heat pumps have made their way into the market on market-based terms, without any remarkable subsidies or political clamour. That number, in itself, represents 5 TWh/a worth of RES. Finns are already investing 400 million Euros a year in heat pumps. The role of heat pumps is important already today in space heating in a cold country such as Finland. In 2012, 11,6 % of space heating could be traced to heat pumps (figure 6)

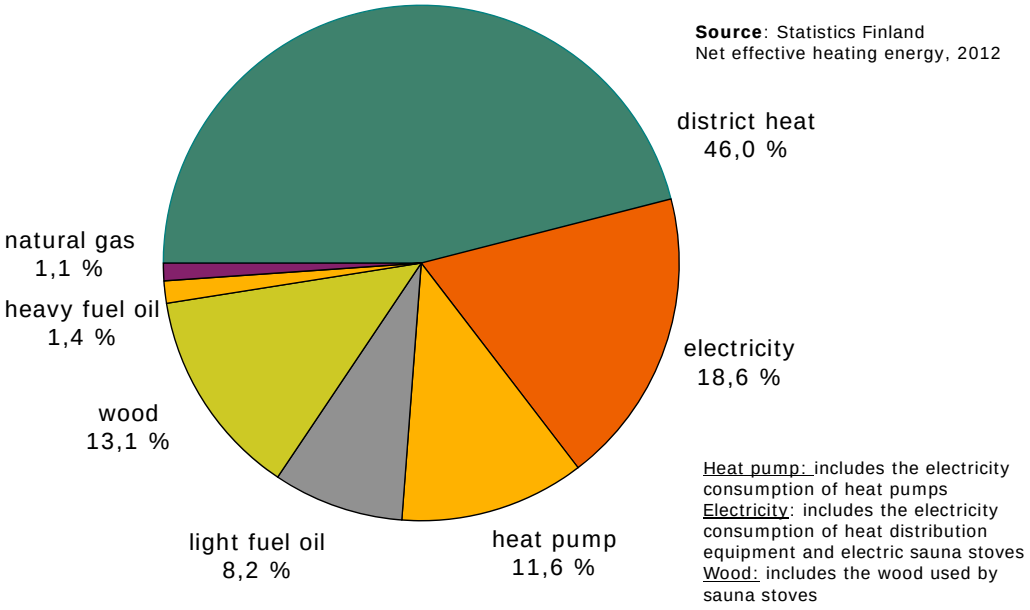

Figure 6: In 2012, 11.6 % of space heating in Finnish residential, commercial and public buildings was produced by heat pumps.

Finland participated in the IEA HP Annex 39 “A common method for testing and rating of residential HP and AC annual/seasonal performance” with a national project. The object of the national SPF project was to define a national seasonal performance-factor calculation for heat pumps in co-operation with the Annex 39 work. The other goal was to estimate the energy savings and renewable energy potential of heat pumps on the Finnish building stock. The SPF project defined a national hourly**,** seasonal performance-factor calculation method for air-to-air heat pumps, air-to-water heat pumps, ground-source heat pumps and exhaust-air heat pumps in co-operation with the international Annex 39 work.

The energy use of the Finnish building stock was estimated by using standard building types further adapted to different decades: a detached house, an apartment building, an office building and a summer cottage. The energy use of these standard building types was calculated with different heat-pump types looking into energy savings and the renewable-energy use of the heat pumps in different buildings.

The current and future cumulative energy consumption of the building stock was modelled using the REMA model developed at VTT Technical Research Centre of Finland. The future effects of heat pumps on the energy use and emissions of the Finnish building stock were modelled by comparing a conservative Business as Usual scenario and a Heat Pump scenario to the REMA model.

The total number of heat pumps were estimated to reach approx. 950 000 units by 2020. These estimations take into account the part of the heat-pump sales that are replacements.

Thus, the total heat-pump sales will be higher than the numbers shown in Figure 6. The scenario of the heating capacity of the heat pumps is presented in Figure 7.

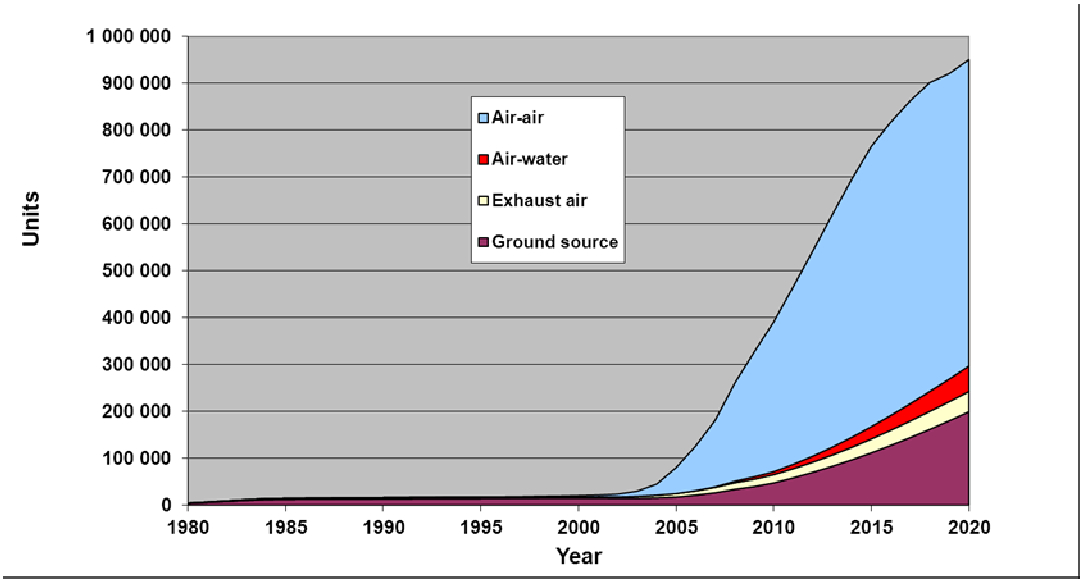

Figure 7: Scenario of the heat-pump stock

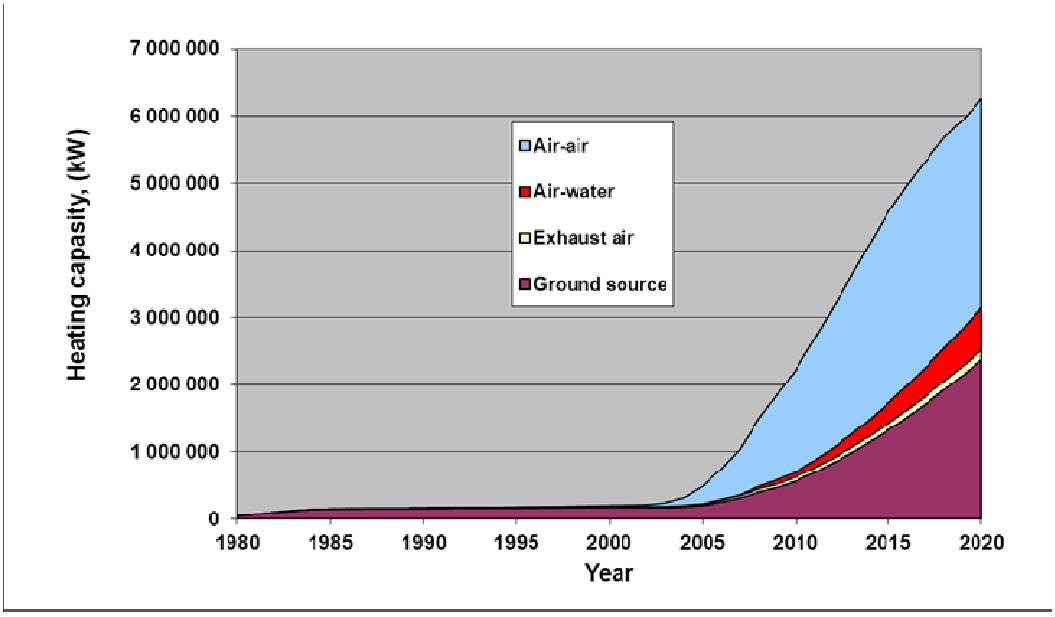

Figure 8: Scenario of the heating capacity of the heat pumps

Figure 9 presents energy savings for the different heat-pump types in accordance with the heat pump (HP) scenario presented in the previous section. This is an approximate also for renewable-energy use, except for exhaust-air pumps where only part of the savings can be considered renewable energy.

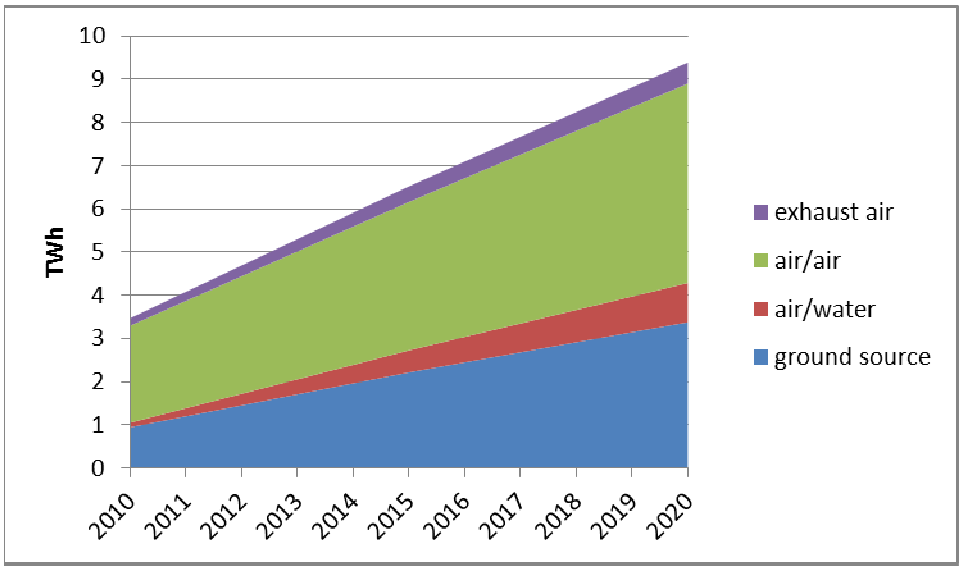

Figure 9: Estimate of energy saved by heat pumps in 2010-2020. For heat pumps other than exhaust air, it also represents renewable energy production.

9 CONCLUSION

The heat-pump branch has experienced huge growth in Finland. The prerequisites for heat pumps in Finland are excellent. In a cold climate, a lot of energy is needed. Since Finland is a big country with a small population of 5 million, having e.g. a comprehensive gas network is unprofitable. Therefore, the lack of this particular competitor, the relatively cheap electricity and good drilling conditions favour heat pumps. Nevertheless, the impact of active lobbying, incentive schemes, system quality, product and installer certification and training 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 when talking about the success story of heat pumps in Finland

Finns are already investing 400 million Euros a year in heat pumps (Figure 9). And the reason is clear. Most of the time, the return on this investment is more than 10% per year. The impact that the amount of fuel saved has had on the Finnish trade balance is already in the region of a hundred million. Furthermore, the reduction in CO_2-emissions is in the region of a megaton, since as many 600,000 heat pumps in Finland are extracting local energy from the ground, the rock or the air around the houses.

The outlook for the heat-pump industry is promising. This decade is going to be the decade of renewable energy and energy saving. More than half of all new single-family house builders end up choosing a heat pump in one form or another. Nevertheless, there still remain 220, 000 oil boilers, half a million direct-electricity heated houses and over 100, 000 water-based electrical-heating solutions in Finnish houses and properties, regardless of the high heat-pump sales figures. Replacing these with renewable-energy solutions is crucial for Finland when trying to meet the requirements the EU Renewable Energy Directive has set for Finland. Heat pumps will play a significant role in this transition.

Heat pumps will have a very good competitive advantage in the upcoming, almost zero-energy construction, and they already currently do so in the renovation of existing heating systems. They represent local energy from our immediate surroundings. With the same machinery, heat pumps also offer a cooling system for buildings and they reduce CO_2 emissions. It is easy to predict years of strong growth for the industry.

It can be predicted that in 2020, in Finland, in a country with a population of 5 million**,** one million heat pumps will be producing more than 8 TWh/a of renewable energy, which will be the equivalent of 15% of Finland's EU renewable-energy increasing requirements. The increase in the number of heat pumps will, naturally, be reflected in the reduced use of oil. Furthermore, due to the extensive reduction of electricity heating in our country, the consumption of electricity that is used for heating will also decrease.

The Finnish heat pump branch has developed well and rapidly. However, these results can only be achieved by securing the success factors of the industry and by providing the prerequisites for the industry. The system quality has to be secured among other things by developing the quality of work by training and the certification systems of installers and products. Active lobbying will eliminate the obstacles that stand in the way of the operations of this growing industry and will make room for heat pumps in the prevailing, conservative world of oil heating, electric heating and district heating. Lobbying will, furthermore, influence the state energy-policy control and subsidy systems. Indeed, filling the information void that surrounds heat pumps can also be considered a part of lobbying. The importance of participation in national and international research projects cannot be underestimated.

Experience shows that challenges are best overcome by keeping a branch organisation strong, genuinely active and sufficiently resourced.

The success factors behind the rapid growth of the heat pump market in Finland presented in this paper can definitely be used when developing heat pump branch in other countries.

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