

# HEAT PUMPS IN THE CZECH REPUBLIC AND THEIR RELIABILITY

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**Abstract:** Number of heat pump installations is continuously increasing in European countries. Beginnings of the use in the Czech Republic are dated back to the 1990s and since that time heat pumps have been becoming more and more popular. Popularity is given by many virtues that the devices provide one of which is high operational reliability which contributes to their long operational life. This paper deals with the state of heat pumps in the Czech Republic as well as with problems of heat pump reliability.

**Key Words:** *heat pumps, reliability, replacement reasons*

## 1 INTRODUCTION

Development of society leads to the increase in energy consumption. No matter whether they are highly developed regions or developing countries. All these need energy for their development - rich countries for keeping the standard of living and developing countries for the development. Especially wealthy regions realize that it is necessary to look for alternative energy sources as the demand for energy is going to increase and traditional energy sources will not be enough to satisfy the demand. One of the possibilities is using devices which are environmentally friendly and which use energy of renewable sources.

## 2 HEAT PUMPS IN EUROPE

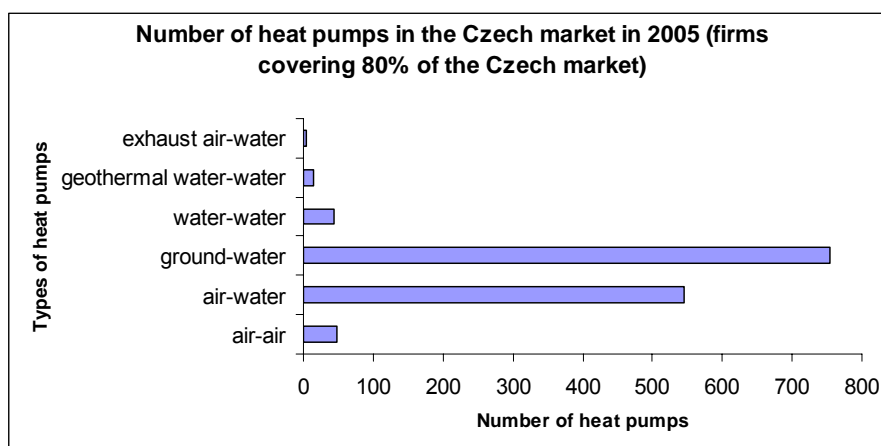
Oil crisis in 1973 meant a big increase in energy prices in the world. People tried to prevent from this crisis by looking for other alternative energy sources which would partially help solve the situation. Just since that time heat pump technology has been passing through a huge boom with a small decrease in the 1980s. However especially in a few last years heat pumps have become very popular not only in Nordic countries but also in other European regions.

### 2.1 Development of heat pumps in the Czech Republic

Rapid development of heat pumps in Central Europe started in the 1990s. The political situation was the main cause of the delay in comparison to the rest of Europe. In former Czechoslovakia a few heat pump units were used in the fifties and sixties while in the eighties some foreign pumps were installed. At the time only several Czechoslovakian companies made such devices. Frigera Kolín was specialized in heat pumps of low and mean power while ČKD Chocẽň aimed its production at high power units. At the beginning of the 1990s there were known a few heat pump installations.

Statistics before 2004 are not presented here as the data used for the statistics were provided only by a few distributors and the information would be therefore biased. Since 2004 the Ministry of Industry and Trade of the Czech Republic has been monitoring the state of heat pumps in the Czech Republic and has been publishing annual reports on them. These surveys can be considered as credible. The following graphs show representation of particular kinds of heat pumps in the Czech market in 2005 and 2006. Unfortunately even

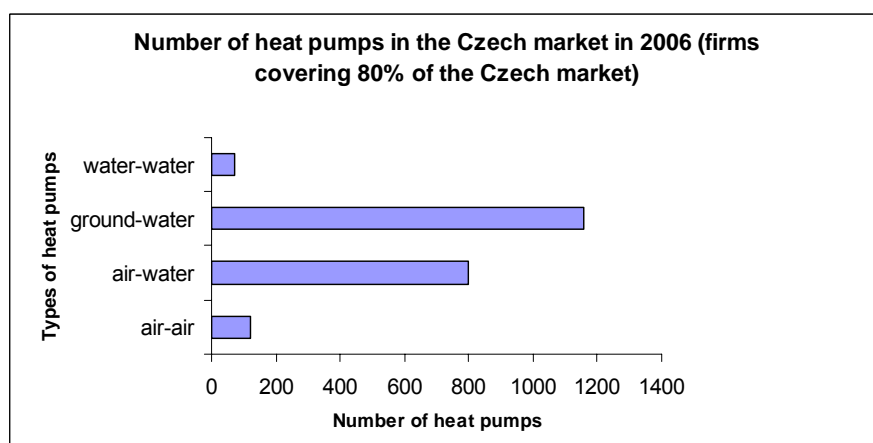
these graphs represent data from the companies covering only 80% of the Czech market as other 20% of heat pumps distributors did not provide the required data. The data for 2007 have not been processed yet.



**Figure 1: Graph of number of heat pumps in 2005**

**Table 1: Number of heat pumps in 2005**

type of heat pump	number	power / kW
air-air	47	190
air-water	546	8701
ground-water	755	8896
water-water	43	1257
geothermal water-water	14	630
exhaust air-water	5	9
total	1410	19674



**Figure 2: Graph of number of heat pumps in 2006**

**Table 2: Number of heat pumps in 2006**

type of heat pump	number	power / kW
air-air	122	470
air-water	797	14961
ground-water	1159	16024
water-water	71	2714
total	2149	34169

From the numbers that were used for the statistics it is clear that number of heat pump units in the Czech market is increasing every year.

### 3 RELIABILITY OF HEAT PUMPS

People choose these devices due to many reasons. Ecology and energy savings belong to the clearest reasons although initial investment can be debatable. However despite the huge investment (especially in the case of ground-water heat pump system) money increases in value as heat pumps are highly reliable and thus their lifetime reaches more than 20 years during which they rarely meet a failure. Nance Lovvorn (Lovvorn Consulting Services, Birmingham, Ala.) who was interested in the reliability of heat pumps dealt with the lifetime of heat pumps and reasons which led customers to the replacement of the units. He compared the state of heat pumps in two of his reports. The graph in figure 3 (report from 2001) shows the most often cited respondents' reasons. The age of the unit was cited most frequently as a replacement reason (in 33 %) and the failure of the unit was mentioned in 31 %. Other reasons do not include such a big percentage. In comparison to the first Lovvorn's report (1985) the number of failures and thus replacements of heat pumps lowered significantly.

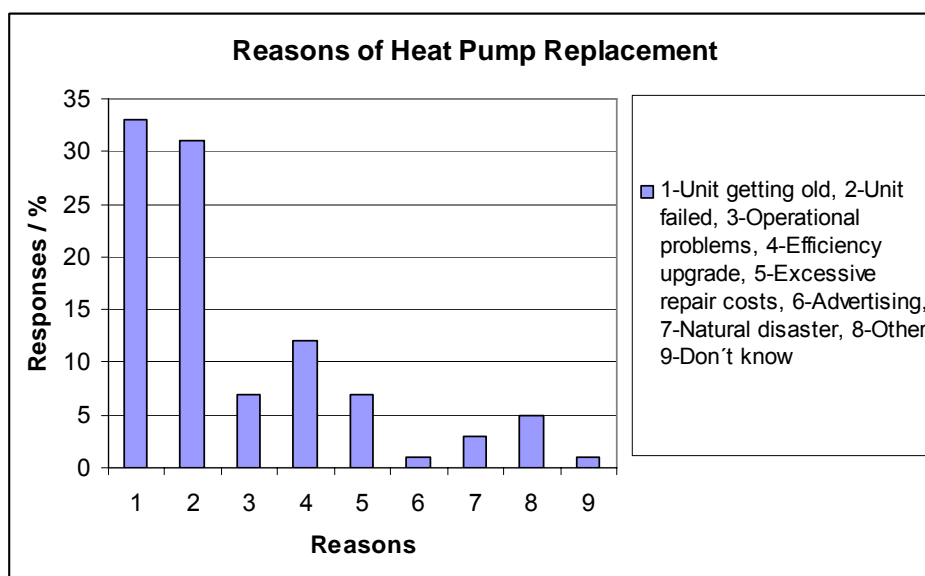


Figure 3: Heat pump replacement reasons

I tried to make a similar survey in the Czech Republic. There was made a questionnaire which included several questions that were related to the problems of heat pump reliability, failure rate, replacement reasons and main players in the Czech market were asked to fill in the questionnaire. All distributors that were asked have not been in the Czech market for more than 18 years. In general problems with heat pumps occur in not more than 10% (percentage depends on the size of a company and number of installations). Replacements of units do not happen frequently. It seems that the devices are very quality and also people installing them are well-educated which contributes to a failure-free operation as well. Let's have a more detailed look at particular problems that have been met.

There is not any impulse which would lead people to the change of heat pump due to its age as firstly the awareness of the high quality of heat pumps is well-known and secondly, according to the information on the mean lifetime of heat pumps in countries where they have been operating for more than 25 years, heat pumps installed in the Czech Republic have not reached the mean lifetime yet and therefore the first replacement reason (unit getting old) was not introduced.

Failure of the unit has happened in a few cases. However this problem was solved by repairing and only an insignificant percentage of units (in comparison to all installations) were replaced. The most frequent failures which appear mainly at the beginning of operation arise during the process of manufacturing, transportation and installation and there usually appear problems with small parts as bad mounted screws, bolts and other components. Problems with failures of the main components of the system occur very rarely as heat pumps before distributing come through multistep checking.

Next reason "Unit having operational problems" was cited as well and in more cases compared to the number of failures. However even here the percentage (0.1 %) is very low in the whole number of installations. Other reasons that led people to the heat pump replacement are insignificant (e.g. natural disaster (two cases) - the Czech Republic lies in Central Europe where natural disasters do not happen as often).

Relatively "high" percentage of replacements was included to "Other reasons". Customers changed their heat pumps for heat pumps of a new generation whereby they gained better water heating. All those working units that were replaced were subsequently sold to other customers as used devices.

Some users also changed the unit after extending heated area (additional building or swimming pool) to reach the required thermal comfort. Unfortunately even though this may create the biggest percentage of replacements I was not given exact numbers about this point.

#### **4 CONCLUSION**

Heat pumps are expanding in the region of the Czech Republic as it is evident from the number of installations. Heat pumps are a good energy source using low-potential heat of an ambient environment. They are thus environmentally friendly and they save energy compared to other devices using traditional energy sources. They are characterized by high operational reliability which is shown in a very low percentage of replacements or repairs. Heat pumps have gone through a big development in all areas (technology, particular components - new compressors etc., education of people installing them and other which contribute to the increase in the reliability) since heat pumps were installed for the first time. Of course, there cannot be drawn precise statistics on the lifetime of heat pumps and their reliability because the market with them has not been in the Czech Republic for long but as it was indicated heat pump lifetime is really high even thanks to their operational reliability. To the future it will be necessary to monitor number of installations as well as problems associated with the operation so that it could be possible to get statistically valuable data in this area.

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