

THE FRENCH POLICY TO IMPROVE HEAT PUMP MARKET DEVELOPMENT - CONTRIBUTION OF ELECTRICITE DE FRANCE

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Abstract

Under the pressure of environmental requirements and in particular the reduction of CO₂ emissions into atmosphere, the development of heat pumps market has, since the beginning of the 1990s, been given a new start in Europe.

In France, EDF launched in 1997 a heat pump development program in France within the general framework of its new commercial offer intended to promote high quality electric heating for new homes. This offer provided a very strong stimulus for the market, which represented about 1 500 space heating systems a year before 1997 and which by 2001, had reached 15 000 systems installed. In five years, the market thus increased 10 fold and grew by more than 50 % between 2000 and 2001. France has thus become the second European heat pump market behind Sweden.

This article describes and then critically analyses actions carried out and results obtained by EDF, over the last five years, in contributing to the sustainable development of the heat pump market in France.

1. INTRODUCTION

As a result of various oil crises, industrial countries have sought, since the beginning of the 1980s, to reduce their energy dependency by reducing their energy consumption. Thermal comfort in residential and commercial buildings represented a considerable energy saving potential. Various measures have been implemented, including the development of heat pumps market.

The development of heat pumps in Europe at the beginning of the 1980s did not have anything like the success in the United States or Japan. Indeed, the predominance of water central heating systems and the very low degree of development of air conditioning in Europe meant that the conditions for replacing old systems by heat pumps were technically difficult and that the installers capable of installing this type of product were inexistent. Despite these conditions, the market took off very rapidly more or less everywhere in Europe as the running costs and financial incentives were attractive, but also turned down very rapidly with the first bad references and the drop in oil prices ! Then, the heat pump market in Europe went into a dormant phase for more than ten years.

Under the pressure of environmental requirements and in particular the reduction of CO₂ emissions into atmosphere, the development of heat pumps market has, since the beginning of the 1990s, been given a new start in Europe, in particular in Switzerland and Sweden.

In France, EDF also launched in 1997 a heat pump development program in France within the general framework of its new commercial offer for new homes.

This article describes and then critically analyses the actions carried out and the results obtained and the difficulties encountered by EDF, over the last five years, in contributing to the sustainable development of the heat pump market in France.

2. THE HEAT PUMP PROGRAM IN FRANCE

2.1 Background of the program launch

The French heat pump market suffered to a considerable extent from the failure of the development policy implemented at the beginning of the 1980s. In 1997, the sales of heat pumps for heating and/or production of domestic hot water came to about 1500 units per year. It was a dormant market, known about by a small number of adepts, in which a few modestly-sized companies produced a few hundred of systems a year, mostly on a by word of mouth basis.

At the same time, the market share of electricity for direct electrical heating in new homes continuously decreased in favour of gas mainly on account of its high operating cost and increasing dissatisfaction in terms of comfort. In view of this situation, EDF decided, in 1996, to launch a new commercial offer, known as "VIVRELEC", designed to promote quality heating solutions.

VIVRELEC is a set of high quality electric heating solutions associated to a very good thermal insulation designed by E.D.F. to provide a high level of comfort for the customer in the new residential house sector. VIVRELEC solutions concern at the same time the heating system, thermal insulation, domestic hot water, energy management, electric safety and customer advice.

In the VIVRELEC solutions, the heat pump has obviously been adopted for providing either the heating alone, or the heating/cooling of homes.

2.2 Advantages of heat pumps

Heat pumps have many advantages and are consistent with the VIVRELEC approach :

- **a rational use of energy which enhances the environment's free energy:** with a heat pump, to cover 100% of a home's heating needs, 20 to 40% of the electricity is generally needed to supply the heat pump. The remaining 80 to 60% comes from the free heat provided by air, water or the ground. This provides heat pumps with an exceptional energy efficiency compared with other heating systems.
- **low operating cost:** as a very significant portion of the energy used in a heat pump is free, the operating cost is very low and for the customer is competitive compared with other energies used for heating. In addition, the potential for improving the performance of heat pumps is considerable whereas such potential is low for conventional heating systems,
- **has little impact on the greenhouse effect :** through its production of electricity mainly of nuclear and hydraulic origin, France has a source of energy with a low content of greenhouse effect gases: the French electrical kWh has the lowest equivalent CO₂ content in Europe (equivalent to 95g of CO₂ per kWh against 513g for the European kWh). The combustion of the fossil fuels (coal, oil, gas) which are used to produce the heat needed to heat homes generates large quantities of CO₂, a greenhouse effect gas. As a replacement for conventional heating systems, heat pump considerably reduces CO₂ emissions thus effectively combating the greenhouse effect provided the sealing integrity of the cooling circuits is brought under control and fluids are recovered at the end of service life.
- **a sustainable development tool:** heat pumps have a favourable effect on the environment: by enhancing local, renewable energy sources which could not be used otherwise, they produce virtually no waste, do not pollute the air and are not hazardous. They are thus conducive to the local development of renewable energies and thus have a positive economic effect notably in terms of employment.

2.3 A marketing position in terms of "All year round" comfort

Compared with other European countries, it should be noted that in France, EDF has developed both heating and heating/cooling solutions. This choice was dictated by two main reasons :

- being located in the centre of Europe, French climate is very different between the North and the South. Indeed, while climate in the North and East regions of France is of continental type and similar to that of Germany and Switzerland, in the South of France, climate is on the contrary very similar to that of mediterranean countries like Spain or Italy where there are considerable needs in terms of air conditioning in the residential sector,
- heat pumps are seen as an alternative to conventional fossil fuel heating systems. The possibility of providing cooling using the same unique equipment has provided us with this marketing differentiation aspect readily identifiable by the customer.

2.4 Offer definition

2.4.1 Technical content

When VIVRELEC was launched in January 1997, we had very few products to offer. It mainly comprised reversible split-type systems and direct-expansion heating floors coupled

to a horizontal ground-source exchanger. Thanks to a sustained effort, the product range has gradually been enhanced by several other systems :

- reversible air-to-water heat pumps coupled with a heating floor or a heating/cooling floor and/or fan coil units,
- brine water-to-water heat pumps coupled with horizontal or vertical ground-source exchangers and with a heating floor or a heating/cooling floor,
- reversible air-to-air heat pumps coupled with a duct network or a blowing plenum and air diffusers.

2.4.2 Quality approach

The program also includes a significant quality procedure with a view to reassuring customers and avoiding bad references. This quality approach is based on the PROMOTELEC label, the selection of heat pumps through a joint EDF - EUROVENT Certification program and voluntary quality agreements made by certain EDF's industrial partners.

PROMOTELEC is an independent certification organization, which certifies the conformity of a home's construction (building, electrical installation, heating system, domestic hot water system, etc.) against a technical specification. This certification is accomplished by examining each file and systematically inspecting each site. The initially very poor content of technical specifications for heat pumps, has been gradually improved by a number of rules and recommendations coming out of cooperation meetings between professionals and EDF R&D engineers.

In parallel, a common approach between EUROVENT Certification and EDF has made it possible to set up a directory of high-performance heat pumps meeting the technical criteria of the PROMOTELEC label (namely two minimum COP in heating mode for the test points at outside air temperatures of 7 and -7°C for air-to-air and air-to-water equipment and a minimum COP at the water input temperature test point of -2 °C for brine-to-water equipment). More than 50 manufacturers present at least one range of products and more than thousand products are referenced.

And finally, in the framework of commercial conventions, EDF has adopted a voluntary approach, with some partners, for the development and promotion of a "secure packaged offer". Compared with strict compliance with the PROMOTELEC label, this approach provided for a detailed, customized thermal survey, a projected calculation of the heating consumption cost, site assistance by the design office, the supplying and installation of a consumption indicator for specifically monitoring energy consumption for heating and cooling, customized commissioning and a two-year maintenance contract.

2.4.3 EDF commercial aids

The offer also includes a mechanism providing commercial aids for financing the investment in order to launch the market. In 1997, the aid amount set was between 15 and 25 euros per m² heated according to the building's level of thermal insulation and the type of heating systems installed. In June 2001, this arrangement was modified and the following was adopted :

- a quality aid of 300 euros per home, associated with the PROMOTELEC label,
- an energy performance incentive notably depending on the thermal insulation and the heating system installed amounting to between 1.5 and 4 euros per m² heated,

- the possibility of obtaining an improvement loan, the maximum amount of which is 100 euros / m² heated at a rate of about 3 % and over a variable term of three to ten years.

2.4.4 Government aids

The French government extended, within the framework of the 2001 and 2002 finance law, the benefit of the tax rebate to heat pumps (in the same way as for the acquisition of heating and domestic hot water supply equipment operating off solar energy, wood or other sources of renewable energy). The tax rebate amount is 15% of the equipment cost (the heat pump and the ground heat exchanger systems, if any, are taken into account in the tax rebate). This tax rebate is limited according to family situation (for example, the total amount to take account for this tax rebate is 8000 Euros for a married couple with no children and the tax rebate for this amount is 12000 Euros).

3. EDF'S ACTIONS WITHIN THE VIVRELEC FRAMEWORK

3.1 From the commercial standpoint

To promote heat pumps commercially, EDF set up a four-man team in 1998 which was reinforced by the arrival of five additional people in 1999. Led by a national coordinator, the team consisted of seven regional contacts and one full-time national technical contact, made available to EDF's commercial Division by the R&D Division.

The team carried out the following assignments for four years:

- the creation of the tools and means needed for the commercial actions, in other words the production of reference sheets, commercial brochures, system sheets, sales justifications, diaporama, panels for stands and exhibitions, etc.
- internal training of sales forces through the design, setting up and coordination of specific training courses to promote products and systems and train EDF's sales representatives in selling heat pumps,
- supporting local commercial agencies to set up and implement their regional commercial action plans,
- outside training of promoters, design offices, architects, etc. to promote heat pumps and help them take on the sales techniques of these products,
- the presentation of heat pumps within the framework of EDF inside or outside regional or national events,
- the setting up and monitoring of commercial conventions with voluntary partners committed in the safe packaged offer approach,
- the monitoring of sales within the framework of the commercial objectives set by the company and the feedback of lessons learned in the field.

3.2 From the technical standpoint

From the technical standpoint, EDF group's R&D Division has, since 1996, also been called on substantially to accompany VIVRELEC's development. On average, this work has mobilized eight people full time since 1997 and has involved :

- contributing to defining the technical rules to be followed to build a quality system. This work has been performed in the framework of close-knit cooperation with the profession within a heat-pump technical commission set up for the occasion and including all the professions involved,
- technical/economic investigations to establish the position in terms of operating and investment costs of the various systems,

- the development of scientific models to predict the behaviour of systems or components. An experimental numerical investigation thus made it possible to define sizing and regulation rules for a cooling floor and another investigation provided a better understanding of heat-pump frosting/defrosting phenomena,
- in partnership with certain manufacturers, the design, development and optimization of new products and systems meeting market requirements,
- the development of a test platform to test the various ground-source heat pump solutions and allow simultaneous tests to be carried out on seven products during a heating season and a cooling season,
- characterisation tests in climatic chambers of products and systems to assess their suitability for the function,
- contributing to the technical training of sales forces and intermittently providing regional technical support for particularly difficult projects,
- organizing a number of days for visiting test facilities and presenting our work to EDF's partners in this market,
- setting up a structure for examining, capitalising on and dealing with bad references able in the last resort to take direct action with customers to solve their problems,
- energy monitoring on reference installations to check consumption status reviews and validate technical/economic models.

4. SUCCESSES OBTAINED AND DIFFICULTIES ENCOUNTERED

With the hindsight of the work carried out in France over the last few years and also by comparing our actions against those of other European countries, we have sought to analyse the successes obtained and the difficulties encountered.

4.1 Flattering commercial results in terms of sales volumes

Figure 1 shows the trend in sales of heat pumps in various European countries between 1997 and 2001. Heat pump solutions of the VIVRELEC offer gave a boost to the heat-pump market, which was about 1500 installations / year before 1997 and which, in 2001, reached 15 000 installations produced, representing a turnover of about euro 150 million for the profession. In five years, the market thus increased 10 fold and grew by more than 50 % between 2000 and 2001. **France has thus become the second European heat pump market behind Sweden.** Although installations mainly concern detached houses, some systems are also being installed in blocks of flats. 45% of the systems installed are air-to-water heat pumps, 30% are ground-source heat pumps and 25% are air-to-air heat pumps. A fairly strong regionalization of the program has gradually emerged. In the west of France where the climate is of the oceanic type, the system mostly installed is the air-to-water heat pump. In the south of France where the climate is very hot in summer, air-to-air systems are developing rapidly as they are adapted to answer to air conditioning needs. And finally in the east of France where the winters are very severe, there is a rapid development in ground-source heat pumps.

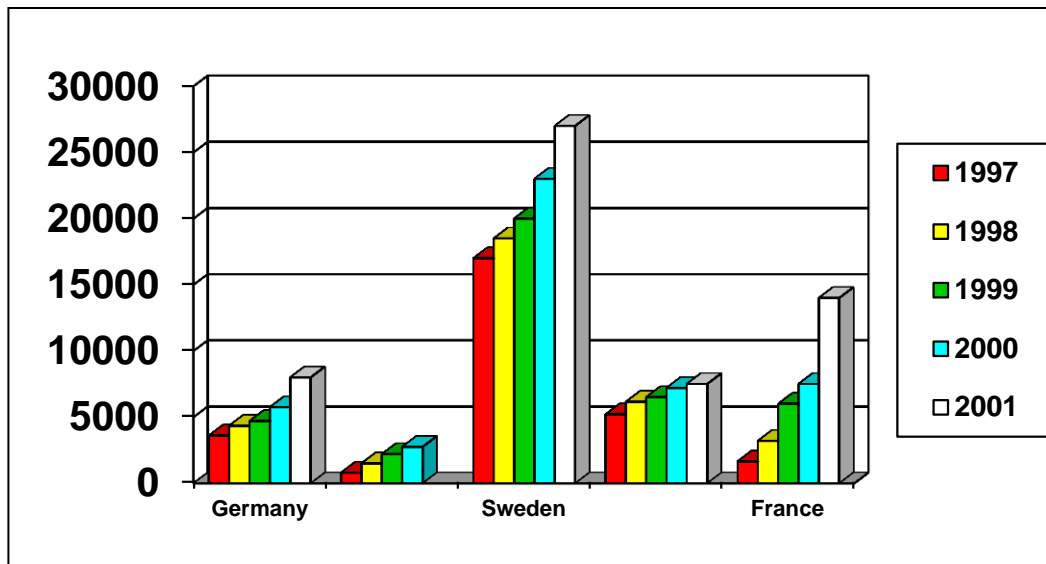


Figure 1: Annual sales in heat pumps between 1997 and 2001

4.2 Customers generally satisfied with their installations but with an initial investment which is still high

Two customer satisfaction surveys based on 200 households were conducted in 2000 and 2001. Virtually all owners of heat pumps consider that their installations fulfil “entirely” or “fairly well” their original motivations and **97% of them are satisfied with their investment and would buy again**. Installation-related costs are considered to be high, with the installation of an air-to-water heat pump associated with a floor costing 10 000 Euros on average against 6 900 Euros on average for the installation of an air-to-air heat pump.

4.3 An as-yet modest penetration in the sector of new homes and a consequent effort to be made to retrofit existing heating systems

Figure 2 shows the market share of heat pumps in new homes in three countries: France, Switzerland and Sweden. Heat pump systems currently represent about 5 % of the market for heating systems in new homes in France. This is evidently a very modest result compared with the market share of heat pumps in this same market in Switzerland and Sweden. Three main reasons explain this situation:

- heat pump development actions in France are as yet recent whereas in Switzerland or Sweden, such actions with the help of public authorities began ten years or so ago now,
- the relative cost of energy in Sweden is very favourable to heat pumps due to a significant production of electricity of hydraulic origin and a total absence of natural fossil fuel energy resources,
- and finally, the general public’s ecological awareness is more highly developed in these countries than in France.

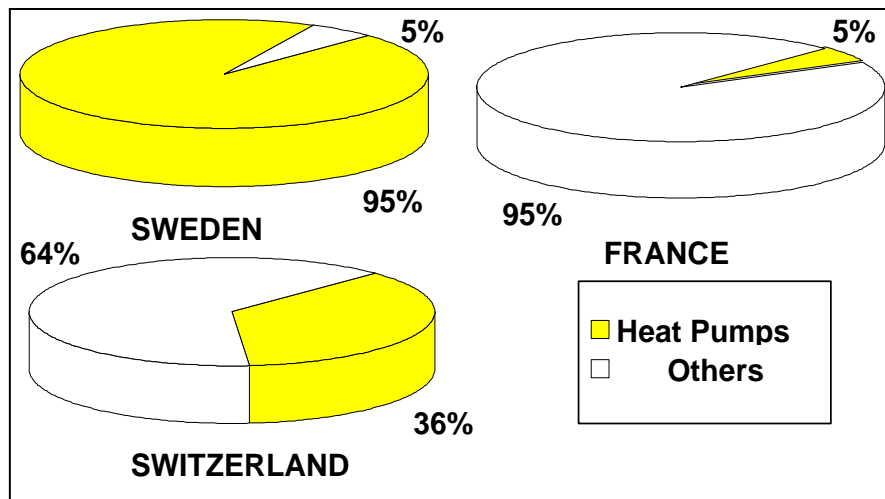


Figure 2: Market share of heat pumps in new homes in Switzerland, Sweden and France

Figure 3 shows the market share of heat pumps in replacement of a former heating system in these same countries. In the heating renovation sector, one installation out of two in Sweden is fitted with a heat pump. Switzerland is just getting into this market and is seeking to follow Sweden's example with a current market share of about 5%. And finally, in France, there is currently no market for heat pumps in the renovation sector. **No action has as yet really been taken to penetrate this difficult market. The Vivrélec solutions only concern new homes. This is nevertheless an essential condition for sustainably imposing heat pumps as a heating means.**

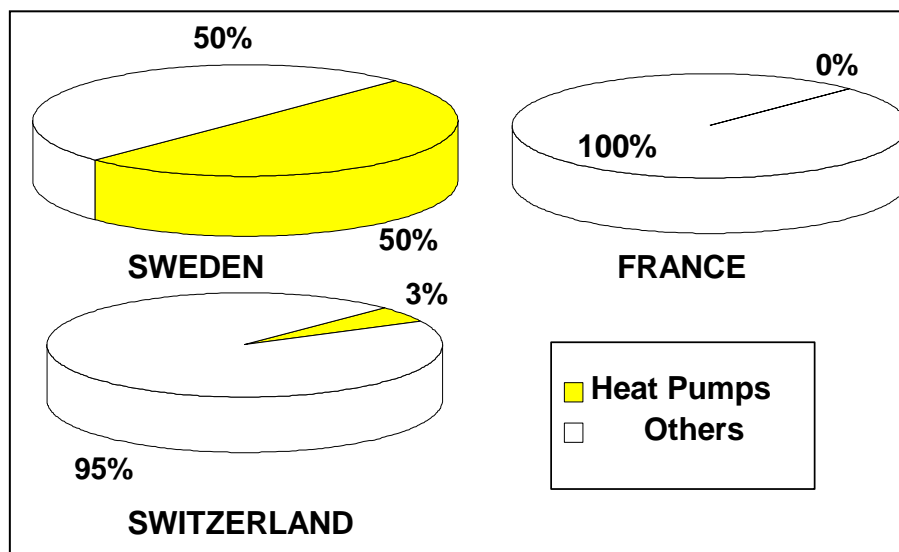


Figure 3: Market share of heat pumps in replacement for a former heating system in Switzerland, Sweden and France

4.4 A marketing position to be specified and commercial justifications to be developed concerning the environment

Purchasing is always a deliberate action primarily for economic reasons – favourable operating cost, purchasing discount – and thereafter for comfort reasons. These two points have been effectively dealt with in the design of the VIVRELEC offer. However, two other points would have been worth investigating in more detail:

- **the marketing situation of heat pump ranges compared with direct heating systems.** Heat pumps and direct electrical heating are aimed at very different customers. Basically speaking, the heat pump is well adapted to large homes (in 2001, the average floor area of homes fitted with heat pumps was 139 m²), whereas the natural market for the direct electrical heating range is small houses and flats. Salesmen not being given a clear message and quantified commercial objectives differentiated for each market segment decreased the effectiveness of our commercial action to a certain extent.

- **the ecological justification, related to the favourable effect of heat pumps on the environment in terms of the reduction of CO₂ emissions and the used of free energy from environment was initially absent from the commercial justification.** Our line of argument was principally based on “all year round” comfort and comparison in running cost with other energies. Undeniably, the possibility of providing winter comfort and summer comfort was a significant advantage, which, in many cases, was a decisive factor in the end customer choosing a heat pump. However, the use of a winter comfort line of argument makes it difficult to use the ecological justification associated with the energy savings made through the use of heat pumps. Indeed, these two approaches contradict partially each other with one approach satisfying the customer’s need for increased comfort but with an increased energy consumption as a direct consequence, and the other being a sustainable development approach seeking to preserve natural resources as far as possible. The ecological justification was gradually introduced (in 2001, seven heat-pump owners out of ten considered that they had chosen an ecological system), but we have never really succeeded in defining a line of argument for our salesmen that effectively reconciles these two approaches.

4.5 The emergence of packaged systems sold by a single partner

One of the most significant steps forward is the emergence of several packaged systems supplied to the end customer by a single contact responsible for relations with his customer for the whole heating installation. **Indeed, unlike the previous situation, the French market now has ten or so systems all the components of which have been designed, optimized and tested to operate optimally between each other.**

4.6 More than 10 000 technical guides distributed

As a result of the difficulties encountered at the beginning of the Eighties, it appeared essential to fixed technical rules for implementing thermodynamic systems. This work was carried out by the heat pump commission, with the technical support of EDF R&D. To date, more than ten technical guides have been drawn up for the various types of heat pumps. **In all, more than 10 000 guides have been circulated within the profession. These guides have also been used as a basis for establishing check points in the framework of the PROMOTELEC label.** These guides address all the aspects involved in the correct implementation and operation of installations (description of the system designed, reminder of current standards and regulations, sizing, technical criteria to be complied with in selecting products, regulation, commissioning, maintenance and after-sales service, etc.).

4.7 A sales and installations sector still to be established and which is now the weak link

In spite of the work carried out on the technical guides, we have identified and dealt with about 400 installations having malfunctions out of the 30 000 heat pumps installed since 1997. The main causes of malfunction generally stem from incorrect implementation in the field, as a result of installers having been insufficiently informed and trained in the field. A survey of the status of training courses provided for those involved in the sector showed **that no training really adapted to the needs of an emerging sector of installers of heat pump type heating for the residential sector is currently available.** We have evidently

underestimated both the time and the means needed to provide a competent, qualified sector covering the whole of France. **The lack of this sector is now one of the main obstacles to the sustainable development of heat pumps in the residential sector.**

4.8 The lack of associated services is an obstacle to the development of heat pumps

One of the factors impeding the development of heat pumps in France is the bad experience of the beginning of the 1980s which makes the consumer wary of this technology. And consumers now increasingly call for services associated with the products they purchase. To promote market development, it is thus essential to develop certain sectors such as :

- financing (loan with special rate, contracting) to overcome the obstacles to high investment,
- a consumption guarantee to give customers confidence in the reality of the savings they are going to make terms of operating costs,
- round-the-clock assistance to overcome the reticence of certain consumers with regard to new technologies that they consider to be not very reliable.

As we had not correctly identified the contribution made by services as a market development tool (strategy adopted in many others countries), we and our partners omitted to investigate, test them and propose them to customers, which undeniably held back market growth.

4.9 A quality procedure to be improved in terms of the qualification of installers and the services provided to the end customer

In VIVRELEC framework, the quality procedure adopted concerns the heat pump and the whole heating system. This approach is essential and has made a significant contribution to the quality of the systems produced. However, if we had to do it all over again, **a quality aspect concerning the certification of installers** would also have to be set up from the launching of the program. This certification of installers could, for example, take the form of initial training endorsed by a final examination and followed up over time by an annual check of a few installations by an independent organization. **And finally, it is also advisable to set up a quality approach concerning the services provided to the end customer.**

4.10 A project conducted by a single company and not by all those involved with the backing of public authorities

The main difficulty encountered in this project was to have imagined being able to develop the market using our own resources alone. Indeed, this type of action is a long and exacting task. At least ten years of efforts are needed for the new home market and at least five additional years for the existing home market. The means to be mobilized (marketing, R&D, sales) are thus considerable and of course extremely costly. **To develop the market, it is thus necessary to set up a consortium preferably including all the partners concerned by the project, under the authority of the public authorities.** This is now the way forward that should be considered to continue the development of heat pumps in France. As such, the tax rebate is an initial recognition by the public authorities of the significant contribution that heat pumps can make to combating the greenhouse effect.

4.11 Running in project mode to be improved and better use of the lessons learned from other countries

To conclude concerning the difficulties encountered, two points connected with our organization are also worth mentioning in this paper:

- a program of this scale mobilizes a considerable number of people and, in a company of EDF's size, the coordination and information of all of these participants through **an organization in project mode needs to be promoted,**

- **a more detailed examination of the lessons learned from the countries having preceded us in this approach** would probably have allowed us to avoid some of the difficulties encountered and to save time in implementing our actions.

5. CONCLUSIONS

In 1996, EDF decided to launch a new commercial offer, known as "VIVRELEC", designed to win back market shares in the heating sector. Among the VIVRELEC solutions, the heat pump quite naturally found its place. In this article, we have sought to analyse the successes obtained and the difficulties encountered. Some of the successes obtained were as follows:

- VIVRELEC has very considerably dynamized the heat pump market. France has thus become the second European heat pump market in terms of volume of sales,
- the choice of proposing "all year round" comfort solutions is a strong marketing argument for standing out from competitive solutions,
- virtually all owners of heat pumps consider that their installations fulfil their original motivations and 97% of them are satisfied and would buy again,
- VIVRELEC has allowed the emergence of several packaged systems supplied to the end customer by a single contact responsible for the whole heating installation,
- the quality procedure has made it possible to draw up and distribute technical guides which have also been used to establish check points for each installation.

Some of the difficulties encountered were as follows:

- heat pumps only represent about 5% of the market for heating installations in new homes in France and the market for existing installations has yet to be conquered,
- the marketing positioning of heat pumps would be worth clarifying,
- the time and means needed to provide competent and qualified installers were underestimated. These lack of installers is an obstacle to market development,
- the lack of services associated with sales has also held back the development of heat pumps,
- the quality procedure must be accompanied by an aspect concerning the qualification of installers,
 - to develop the market, it is thus necessary to set up a consortium preferably including all the partners, preferably under the authority of the public authorities,
 - an organization in project mode should be promoted,
 - a more detailed examination of the lessons learned from other countries would probably have allowed us to avoid some of the difficulties encountered and to save time.

In conclusion, it is undeniable that EDF's action, through the VIVRELEC offer, has allowed the emergence of a heat pump market for residential heating in France. It should be noted that the efforts made in France and in other countries would be more effective overall if they benefited from better coordination at European level.