HPT-Annex 46
Domestic Hot Water Heat Pumps

Annex 46

Task 1 Market Overview

Country Report France

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Preface

This project was carried out within the International Energy Agency Technology Collaboration Program on Heat Pumping Technologies (HPT TCP).

The IEA

The IEA was established in 1974 within the framework of the Organization for Economic Cooperation and Development (OECD) to implement an International Energy Program. A basic aim of the IEA is to foster cooperation among the IEA participating countries to increase energy security through energy conservation, development of alternative energy sources, new energy technology and research and development (R&D). This is achieved, in part, through a Program of energy technology and R&D collaboration, currently within the framework of over 40 Implementing Agreements.

Disclaimer

The HPT TCP is part of a network of autonomous collaborative partnerships focused on a wide range of energy technologies known as Technology Collaboration Programs or TCPs. The TCPs are organized under the auspices of the International Energy Agency (IEA), but the TCPs are functionally and legally autonomous. Views, findings and publications of the HPT TCP do not necessarily represent the views or policies of the IEA Secretariat or its individual member countries.

The Technology Collaboration Program on Heat Pumping Technologies (HPT TCP)

The Technology Collaboration Program on Heat Pumping Technologies (HPT TCP) forms the legal basis for a Program of research, development, demonstration and promotion of heat pumping technologies. Signatories of the TCP, called participating countries, are either governments or organizations designated by their respective governments to conduct. The Program is governed by an Executive Committee (ExCo), which monitors existing projects and identifies new areas where collaborative effort may be beneficial.

Annexes

The core of the TCP are the "Annexes". Annexes are collaborative tasks conducted on a cost-sharing and/or task-sharing basis by experts from the participating countries. Annexes have specific topics and work plans and operate for a specified period, usually a number of years. The objectives range from information exchange to the development and implementation of heat pumping technologies. An Annex is in general coordinated by an expert from one country, acting as the Operating Agent (manager). This report presents the results of one Annex.

Triennial Heat Pump Conference

The IEA Heat Pump Conference is one of the three major products of the Technology Collaboration Program on Heat Pumping Technologies. The Executive Committee supervises the overall organization and its quality and selects from a tender procedure the host country to organize the Conference and establishes an International Organization Committee (IOC) to support the host country and the ExCo.

The Heat Pump Centre

The Heat Pump Centre (HPC) offers information services to support all those who can play a part in the implementation of heat pumping technologies. Activities of the HPC include the publication of the quarterly Heat Pumping Technologies Magazine and an additional newsletter three times per year, the HPT TCP website, the organization of workshops, an inquiry service and a promotion Program.

The HPC also publishes results from the Annexes under the TCP-HPT.

For further information about the Technology Collaboration Program on Heat Pumping Technologies (HPT TCP) and for inquiries on heat pump issues in general contact the Heat Pump Centre at the following address:

Heat Pump Centre
c/o RISE - Research Institutes of Sweden Box 857, SE-501 15 BORÅS, Sweden
Phone: +46 10 16 55 12

Disclaimer

The information and analysis contained within this document is developed to broadly inform on developments in France. Whilst the information analysed was supplied by representatives from various companies and sources a number of assumptions, simplifications and transformations have been made in order to present information that is easily understood. Therefore, information should only be used as guidance.

The market of domestic hot water heat pumps (DHWHP) is developing fast and at the moment of publication some information can already be overtaken by new developments. There are some websites listed at the reference pages of the report.

Contents

Key Facts in France

Heat pump benefits

	2017	Potential*
Sales	245k	991k
Stock	2m	13.7m
Renewable energy produced	34.1 TWh	229 TWh
CO2 emissions saved	8.7 Mt	58.4 Mt
Final energy saved	43.7 TWh	295 TWh
Full time jobs provided	12 511 Jobs	84 262 Job

* The potential is calculated based on the method presented in chapter 4.6.

Key facts

Capital	Paris	
GDP per capita	31 200 €	rank

Housing

Dwelling stock by category		
Total	33 543 942	% of tot
Single	18 043 541	53.8%
Two	1 208 943	3.6%
Multi	14 291 457	42.6%
Non residential	-	-
Average energy consumption per m²	205 kWh/m²	
Space heating	138 kWh/m²	67.1%
Water heating	19.4 kWh/m²	9.5%
Other	48 kWh/m²	23.4%
Growth of new building permits	7%	

Renewable energy

Share of renewable energy of total consumption	-
EU 2020 target for the share of renewable energy	23%
National emission factor of electricity	61 g/kWh

Energy consumption

Dwellings by energy source used for space heating		
Gas	11 259 300	41.6%
Oil	5 034 500	18.6%
Biomass	1 099 100	4.1%
District heating	1 115 200	4.1%
Electricity	8 432 700	31.2%
Coal	97 800	0.36%
Final energy prices (euro cents per kWh of thermal energy)		
Electricity	0.17 €/kWh	
Gas	0.08 €/kWh	
Heating oil	0.1 €/kWh	
District heating	0.07 €/kWh	
Pellets	0.08 €/kWh	

Source: Nowak, Thomas; Westring, Pascal; European Market and Statistics Report 2018; European Heat Pump Association, Vacaldata Ltd.; Brussels 2018.

1. French Energy Demand

The French final energy demand in domestic sector has been slightly decreasing for several years, considering a normal climate. It represents about 362 TWh in normal climate, 357 TWh in real climate. The share of electricity is 39.8%, whereas gas and oil represent respectively 37.3% and 14.8% of this final energy demand (in normal climate).

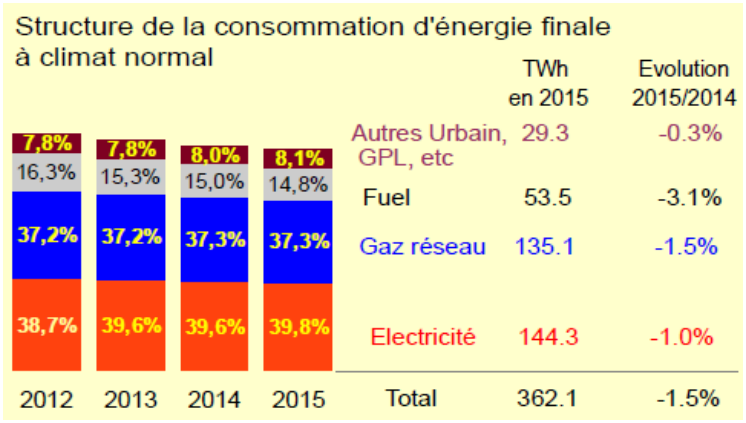


Fig 1.1 French final energy consumption in domestic sector (source CEREN)

For electricity, the main application remains “specific uses” with almost 52%, followed by heating (23.7%) and domestic hot water (16.6%) purposes.

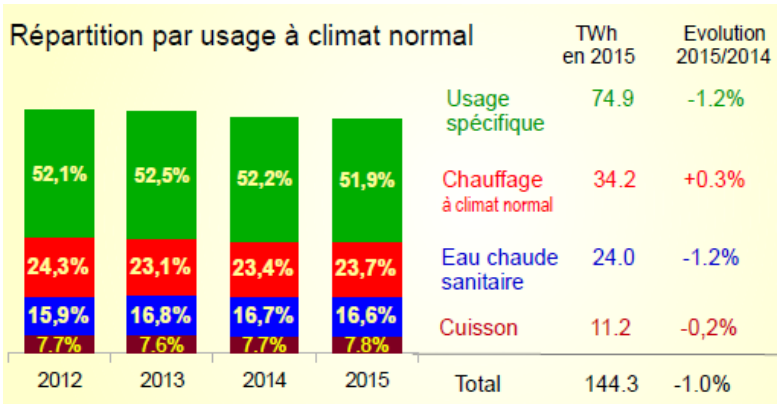


Fig 1.2 Uses of electricity in French domestic sector (source CEREN)

2. Policy framework

In addition with the European legislation (see annexe), France has developed a specific regulatory scheme to encourage renewables and reduce energy consumption in buildings sector.

Indeed, this building sector, which represents 45% of the final energy consumption in 2013, is a major issue of the energy efficiency policies. The up-grading of the thermal performances of buildings is essential to reach the objectives in terms of energy efficiency, greenhouse gases reduction and renewable energy development. The targets are ambitious:

- generalizing the low consumption buildings in 2013 for new constructions and positive energy buildings in 2020;
- refurbishing 500 000 old dwellings per year until 2017.

To do this, France adopted a range of diversified tools: regulations, financial incentives (fiscal and tax), training, information and awareness actions.

2.1. Thermal Regulations

The 2012 thermal regulation reinforces the requirements regarding the thermal performances of new buildings, starting from 2013: they may not consume more than 50 kWh of primary energy per square meter for space and water heating, space cooling, ventilation and lighting. This reference value depends on climate zone, altitude, type of use of the building and the average area of housing. This is a significant tightening compared with previous legislation, which modulated the energy consumption allowance by type of heating system. This new regulation has strong impact on insulation requirements and guides strongly the space heating modes. In particular, the reference to primary energy without any consideration for CO_2 emission levels leads to promote indirectly gas heating systems at the expense of electrical solutions (for which a conversion coefficient final/primary energy of 2.58 is applied). This aspect is partly offset by another rule included in this thermal regulation: among the energy consumed in a new built house, 5 kWh/m^2.yr have to come from renewables.

The thermal regulation for retrofitted buildings of less than 1000 m^2 is based on minimal performance requirements for installed or replaced equipments. It deals with equipments of insulation, space heating/cooling and hot water production. This is called the “element by element” thermal regulation. A modification of this regulation is underway to make mandatory the energy performance indicator for the new installed element.

2.2. High Energy Performance Label

A label "high energy efficiency renovation" was also created. It includes two levels for buildings dedicated to residential use: the label "high energy efficiency renovation, HPE 2009» for buildings reaching a primary energy consumption of less than 150 kWh$_{ep}$ / m² / year for the afore mentioned 5 uses and the label "low energy consumption building renovation, BBC 2009» for buildings reaching less than 80 kWhep / m² / year. From January 2013, it is required to provide a certificate of inclusion of the RT delivered by a professional.

2.3. Incentive Schemes

Many incentive schemes for individuals have been implemented:

- The Energy Transition tax credit (CITE): From 2005 to 2015, the Sustainable Development Tax Credit (CIDD) allowed individuals to receive a tax credit for the purchase and installation of materials or equipment that are theoretically the most efficient in terms of energy-saving or energy production from

renewable sources (only in existing dwellings).More than 7 million homes have been renovated thanks to this measure. Since January 2016, this tax credit is called Energy Transition Tax Credit. This tax credit represents 30% of the material costs (installation costs not included) if the material is installed by a qualified installer (with a certificate) in a dwelling older than 2 years. Systems need to have minimum performances to be eligible for this tax credit, corresponding to EcoDesign requirements increased by few percents. The only system generally excluded is the air-to-air heat pump, accused to be used more for cooling application rather than heating, and then to increase consumption by adding a service.

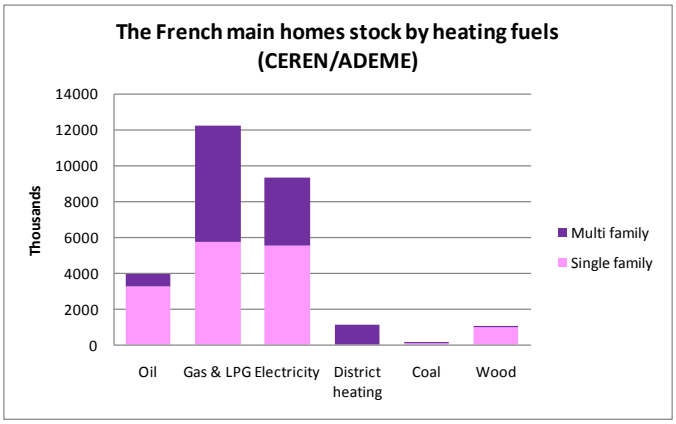
- The Eco-interest loan (eco-PTZ) is available from April 2009 and designed for individual homeowners or lenders to fund major renovation works. This loan finance up to 30 000 € improvements in energy efficiency of a home over a period of 10 years.
- The property tax exemption built: the amended Finance Act 2006 introduced the possibility for local authorities to exempt from property tax built for 5 years, with an exemption rate of 50 or 100%, constructions completed before January 1989 for which significant work to eligible CIDD has been made or constructions of new dwellings completed since January 2009 and bearing the low consumption building label.
- Reduced VAT rates for renovation: from January 2014, the energy renovation works of more than 2 years housings have a reduced VAT rate (5.5%). It concerns the work eligible for the tax credit Sustainable Development (CIDD).

2.4 Energy Savings Certificates

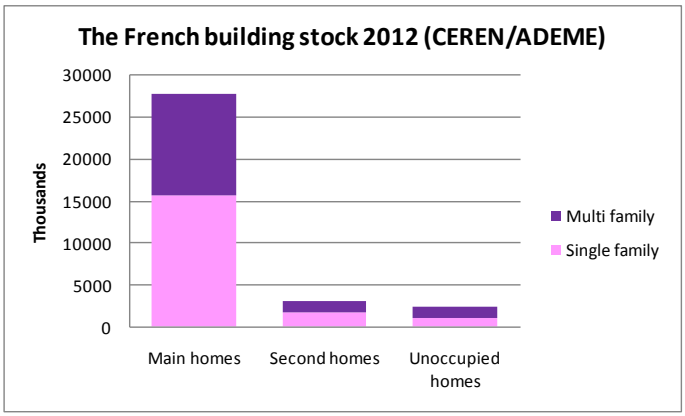
Created by the POPE law in 2005 [2], this mechanism encourages **energy suppliers** (suppliers of electricity, gas, fuel oil, and transport fuel from the second period) to **promote energy efficiency** to their customers by imposing a multi-year obligation of achieving energy savings. To fulfil its obligation, an energy supplier has to be an enabler of energy savings implementation (provided that this has an additional effect compared to business as usual actions). Certificates can be exchanged (bought and sold) between actors. All sectors are covered (residential, commercial, industrial, transportation, etc.), as far as all types of customers are covered (households, companies, public authorities, etc.). The major part of the actions performed is selected within a catalogue of **standardized operations** whose list is determined by ministerial order. At the end of the multi-year period and in case of failure to comply with their obligations, the suppliers must pay a penalty of 20 € per certificate. The unit used for the certificate is the "**MWh cumac**", which correspond to the **cumulated** energy savings brought by the action during its life duration, considering that each yearly saving is **amortised** at a 4% ratio. The first period objective (2006-2009) was fixed at 54 TWh cumac (distributed among suppliers). For the second period (2010-2013), the objective has increased up to 345 TWh cumac, alongside with an extension of the list of energy suppliers concerned. An additional objective of 115 TWh cumac was fixed for 2014. For the third period (2015-2017), a total of 700 TWh cumac has been decided, with an additional amount of 150 TWh dedicated to fuel poor households .

3. Building stock Characteristics

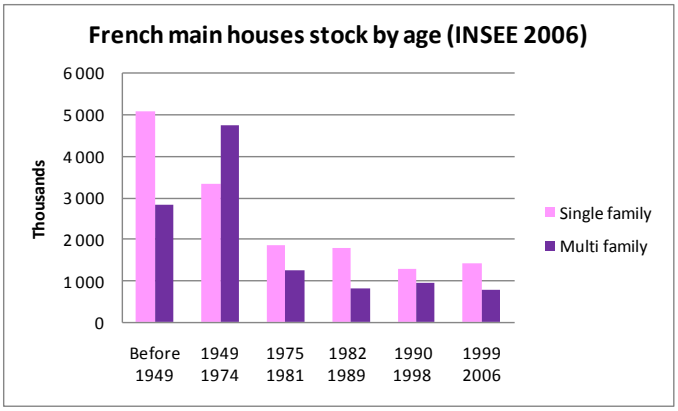
3.1. French Building Stock



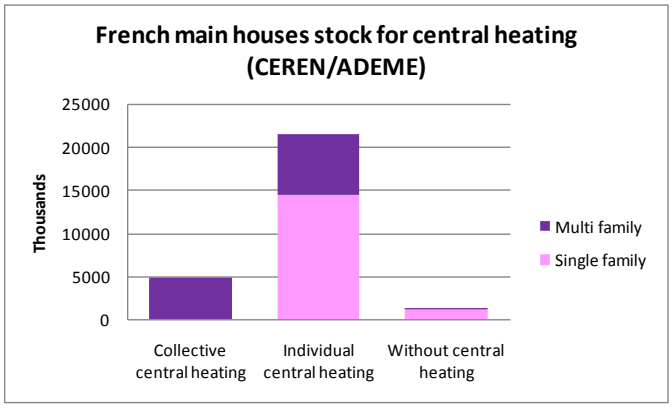
In 2012, France had 33.4 million residential housing . Among these, 27.8 million were main homes, 3.2 million were second homes and 2.4 million were unoccupied. If we consider the main homes only, 15.75 million are single-family homes whereas 12.04 million are multi-family homes.



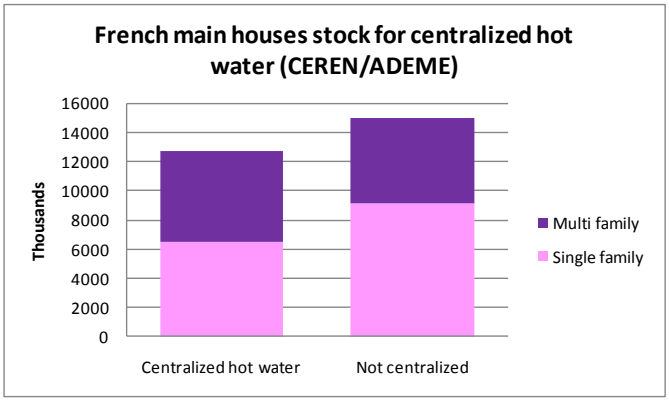
As precised before, the main houses stock was mainly built before the first thermal regulation (61% before 1975). The single family houses are the most numerous before 1949 whereas for the multi family houses it is between 1949 and 1974.



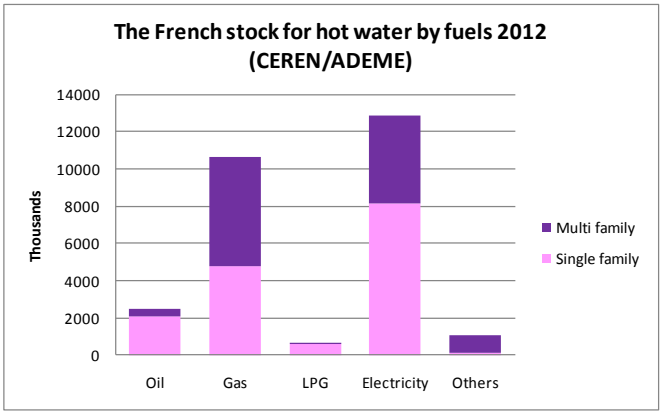
In 2012, 58.2% of the households are owner-occupiers, social housing and private renting representing respectively 17.1% and 22.%. Central heating is owned by 95% of the main houses. And collective heating represents about 18% for the multifamily houses.



If we take a look at the fuel types used for heating, gas comes first with a 44% market share. Electricity is second with 33.5% of the heating systems oil is third with 14% but it is mainly installed in single-family houses. District heating for flats is not negligible with 1.1 million households and so is the wood for houses with 1 million households concerned.



Centralized (the centralized heating system warms the water) hot water concerns nearly 46% of the main homes. For the multi-family houses, it reaches 51.4%.



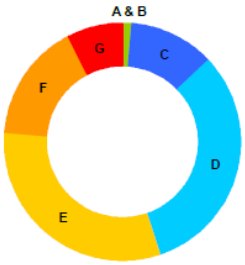
For hot water, electricity is first with a 46.5% market share and even dominates for houses (51.9%). Gas comes second for the whole stock with 38.4% but is near half the stock for flats (48.8%). For electricity, Joule effect with storage tank represents about 92% of the systems.

3.2. Typical Households

The energy demand in households is strongly influenced by the last thermal regulation for new buildings. Therefore, it is useful to separate the description of energy demand in some typical households in two main fields : existing and new buildings.

3.2.1. Existing households

An existing household has an average (primary) energy consumption of about 270 kWh/m^2.yr. This average figure hides some wide differences depending on the date of construction and the related thermal regulation (see figure below).



	Avant 1975	Après 1975	Après 2000	Ensemble
A (<50 kWh/m²/an)	0,03%	0,09%	0,20%	0,05%
B (51 à 90 kWh/m²/an)	0,61%	2,4%	5,0%	1,3%
C (91 à 150 kWh/m²/an)	7,4%	18,3%	27,9%	11,8%
D (151 à 230 kWh/m²/an)	27,5%	38,6%	43,9%	31,9%
E (231 à 330 kWh/m²/an)	32,2%	30,3%	20,3%	31,4%
F (331 à 450 kWh/m²/an)	21,1%	8,8%	2,4%	16,2%
G (>450 kWh/m²/an)	11,2%	1,6%	0,21%	7,4%
Total	**100%**	**100%**	**100%**	**100%**
Consommation moyenne (a)	301	224	187	270

Unité : % du total de l'échantillon
Note : (a) = en kWh(ep)/m²/an

Fig 3.7 Average consumption (primary energy) of French existing buildings (source MSI)

These consumption figures include heating, domestic hot water, ventilation, lighting and eventually cooling applications and gather flats (average heated surface of 61 m^2) and individual houses (average heated surface of 105 m^2).

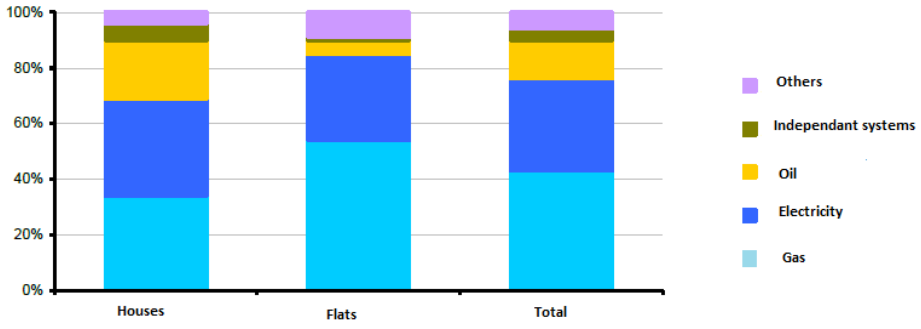


Fig 3.8 Heating and hot water energies used in existing dwellings. Oil or gas boilers equip about 60% of old dwellings.

The final energy demand in existing households is represented in kWh/household, for 2012, on the figure below. The final energy consumption depends on the construction date (related to the corresponding thermal regulation) for two cases: flats (IC) and individual houses (MI). The average parts of heating and DHW in the total consumption are respectively about 60% and 12% but decrease in recent buildings. The individual houses built before 1975 and the first thermal regulation represent about 60% of the building stock (of individual houses).

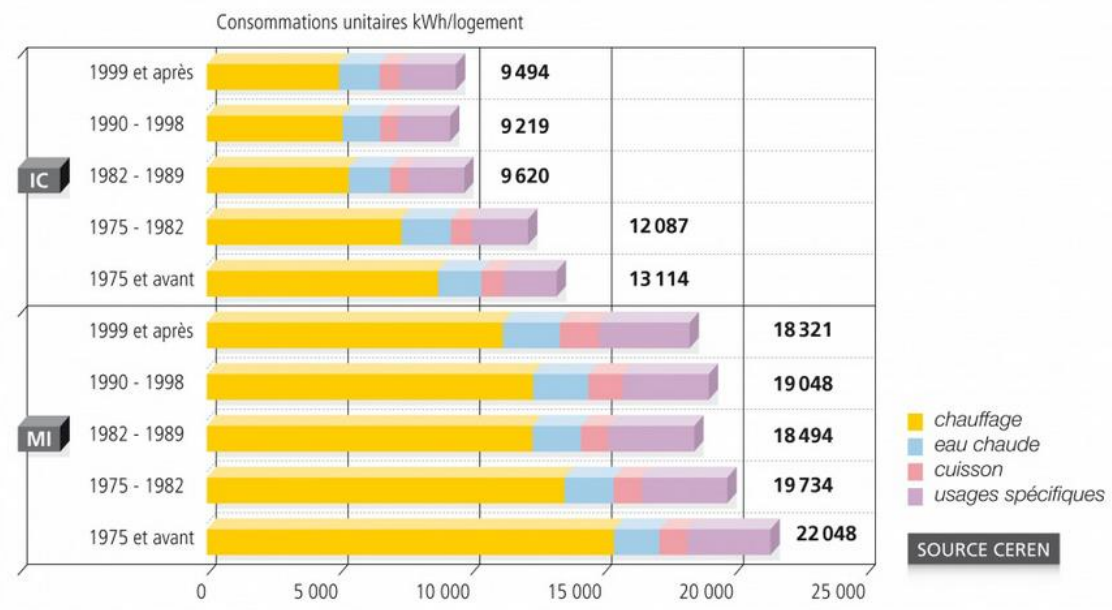


Fig 3.9 Final energy demand per household in France (2012, source CEREN)

3.2.2. New built households

The new built buildings have to follow the thermal regulation named RT2012 that imposes a ratio of primary energy consumption per year and m^2. This ratio is 50 kWh_ep/m^2.yr with a modulation depending on the climate. This figure takes into account heating, domestic hot water, ventilation, lighting and eventually cooling applications. As this regulation has been implemented on the 1st January 2013, real consumption figures are difficult to obtain. Common estimations for heating and DHW consumption ratio for a new built individual house are of 15-18 kWh_ep/m^2.yr and 22-25 kWh_ep/m^2.yr respectively.

3.3. Domestic Hot Water Use

In France, the common figure of hot water needs used to size the hot water systems is of 50 litters/day.person at 40°C. Some studies have been made to evaluate the real hot water consumption in France. The biggest one [18] gives some interesting results to be compared with the average value above. It is based on real consumptions of about 370 residential sites (flats and individual houses).

This study estimates an average consumption of 57 l/day per person at 40°C, close to the conventional figure. However, this average figure hides a lot of disparities, depending mainly on the number of persons in the dwelling or on the day of the week. The first figure below highlights the disparities in the hot water consumption per day and per person for all the 370 sites. The second one is a table that gives the average consumption per person in function of the total number of persons in the dwelling. It shows that the average consumption decreases when the number of persons increases.

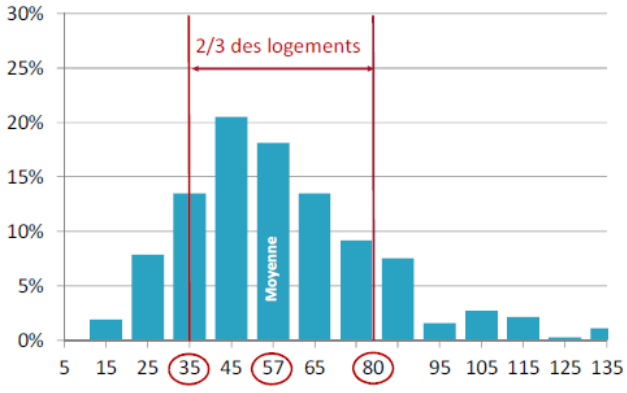
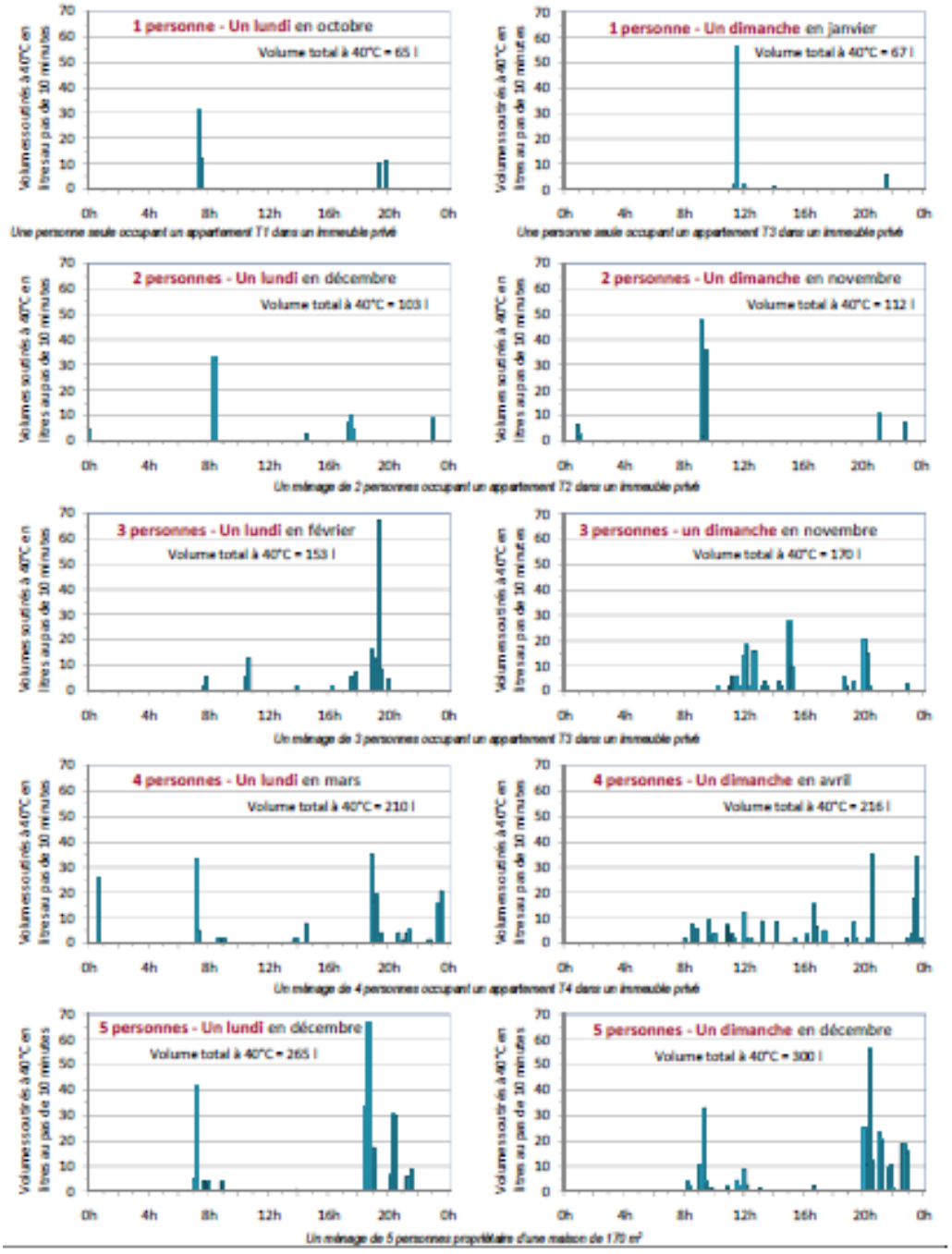


Fig 3.10 Daily consumption per person at 40°C

	Nb of persons in the dwelling				
	1	2	3	4	5
Nb of sites	16	45	28	50	17
Average consumption per person (l/day)	95 ±30	65 ±25	50 ±20	45 ±20	45 ±20
Average consumption per dwelling (l/day)	95 ±30	125 ±50	155± 50	175± 70	220 ±105

Fig 3.11 Daily consumption per person or per dwelling at 40°C

Finally, this study gives interesting consumption profiles, depending on the number of persons and the day of the week. They are shown on the figure below. We can notice, for a working day and 1 person, two peaks of consumption in the morning and in the evening. On Sunday and when the number of persons in the dwelling increases, the consumption is more distributed all along the day.



4. Hot water Systems

4.1. The stock in 2014

The stock of hot water systems installed in France at the end of 2014 is described on the figure below. The individual double-service boilers represented almost 16 million units (12.55 million gas boilers and 3.25 million oil boilers) ; electrical water heaters represented 15.6 million units ; gas water heaters represented 1.25 million units ; solar water heaters were about 500 000 units with 300 000 individual systems and finally heat pump water heaters represented 230 000 units.

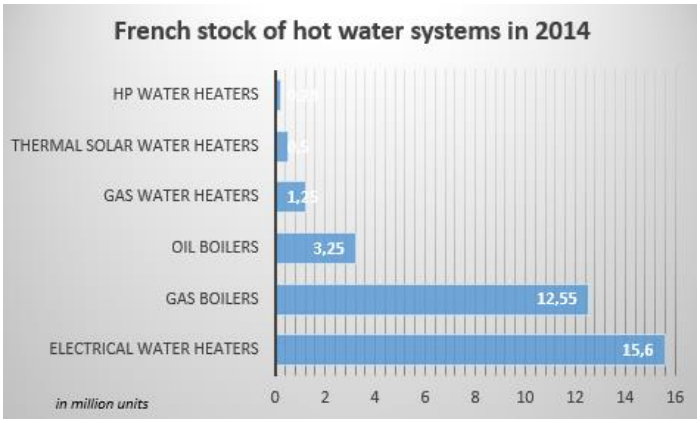


Fig 4.1 French stock of hot water systems in 2014 (source MSI)

4.2. Penetration rates per building type

The stock figures lead to the following ratios per system, depending on the building type.

4.2.1. Existing buildings

For existing buildings, the penetration rates for hot water systems are shown on the figure below. The existing buildings stock represented 34 million dwellings in 2014 in France, with 19 million individual houses and 14.8 million collective housing.

The traditional technologies, such as electrical water heaters and gas/oil boilers, are predominant (94%) for historical, cost or know-how reasons. However, the renewable solutions (heat pumps, heat pump water heaters, solar water heaters…) expand progressively.

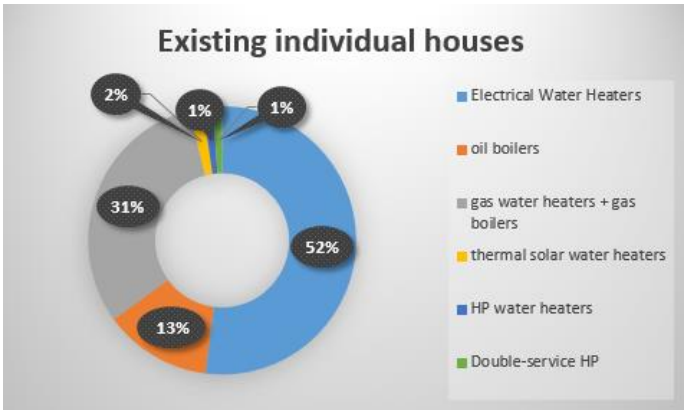


Fig 4.2 Penetration rates of hot water systems in existing individual houses (source MSI)

With a stock ok about 230 00 units, the share of heat pump water heaters was estimated around 1.2% at the end of 2014. This percentage is explained by a very recent development but is expected to grow in the individual housing.

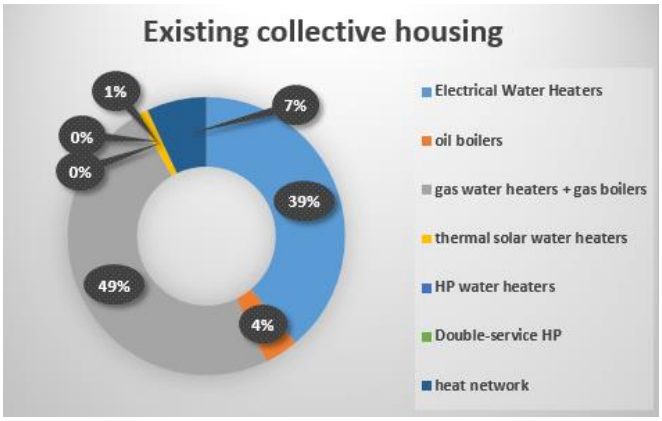


Fig 4.3 Penetration rates of hot water systems in existing collective housing (source MSI)

In collective housing, the heat pump water heaters are almost absent . Important technical improvements (compactness, noise, etc.) are needed in order to create a valuable market.

4.2.2. New individual houses

The situation is quite different in new individual houses, where new and renewable technologies for domestic hot water production are predominant. This phenomena is mainly due to the last thermal regulation for new buildings: as specified previously, among the energy consumed in a new built house, 5 kWh/m^2.yr have to come from renewables. This rule encourages the development of renewable systems for hot water production associated with conventional heating systems, or double-service renewable ones. The figure below indicates that the Heat Pump Water Heaters constitute the major technology in new housing (with a share of 63%).

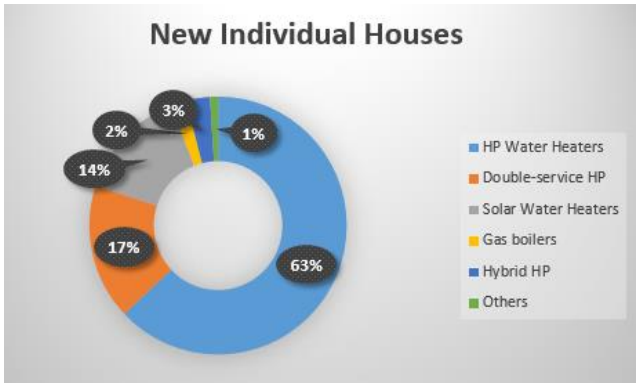


Fig 4.4 Penetration rates of hot water systems in new individual houses (source MSI)

It can be interesting to identify the heating system with which each hot water system is preferably associated. It is shown in the table below. For instance, we can notice that heat pump water heaters are often installed with boilers or electrical heating. In case of conventional heating system, it is necessary to associate a "renewable" hot water system to respect the thermal regulation; and the heat pump water heater is often the cheaper solution.

Heating System / Hot Water system	Gas Boiler	Hybrid HP	A/W HP	A/A HP	Wood Stove	Elec. heating	WHOLE
HP Water Heaters	60		43	84	91	74	63
Double-service HP			54	8			17
Solar Water Heaters	33		3	8	9	26	14
Gas boilers	7						2
Hybrid HP		100					3
TOTAL	100%	100%	100%	100%	100%	100%	100%

Table 4.1 Heating and Domestic Hot Water Systems (source MSI)

5. Heat Pump Water Heaters in France

5.1. French Market in 2015

5.1.1. Sales distribution in new and existing housing

The French market of Heat Pump Water Heaters (HPWHs) was really "born" in 2010 when this product has been integrated in the CITE subsidies scheme, dedicated to the retrofit market. However, since 2013 and the entry in force of the thermal regulation (RT2012), the sales of HPWHs are more important in the new individual houses sector (60-65% of whole sales).

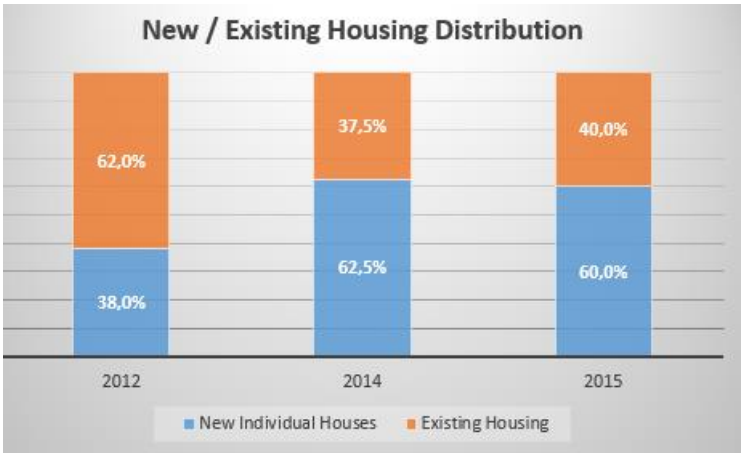
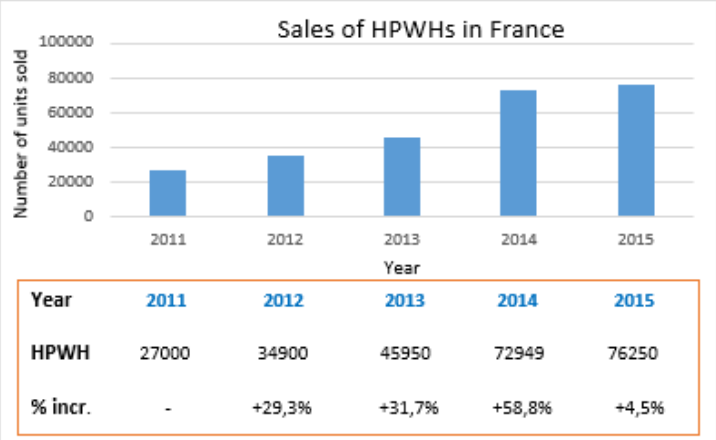


Fig 5.1 Sales distribution in new and existing buildings (source : MSI)

5.1.2 Global sales in France



Year	2011	2012	2013	2014	2015
HPWH	27000	34900	45950	72949	76250
% incr.	-	+29,3%	+31,7%	+58,8%	+4,5%

Fig 5.2 Whole sales in France (source AFPAC, Uniclima)

In 2015, the total number of sold HPWHs was of 76250, consisting in a relative increase of 4.5% over the past year (72949 units sold in 2014). Even if this increase seems promising, it is worth to relate it with the relative increase of the year 2014: +60% over 2013. This result is linked with the fact that almost 2/3 of the sales are realized on the new built market. Now that HPWHs have reached a good penetration ratio in the new built housing sector, their progression is slower. Moreover, HPWHs seem to be more and more in competition with double-service HPs.

5.1.3 Sales distribution depending on the cold source

In France, 4 types of HPWH have a significant market share:

- Ambient air one-piece system
- Outside air split system
- Outside air duct (one-piece) system
- Exhaust air one-piece system

Until the entry into force of the RT2012 thermal regulation in January 2013, the ambient air systems sold in existing individual houses were predominant. Since 2013, the development of sales in new built individual houses make the market shares of other technologies increase.

Nowadays, the ambient air systems represent 40% of the whole sales but remain predominant on existing buildings market, due to particular costs and installing constraints.

By contrast, ambient air systems are a minority in new built individual houses.

Fig 5.3 Sales distribution of HPWHs depending on their cold source (source MSI)

5.2. Analyses of Market Trends

5.2.1. New built sector

We do not expect a spectacular growth of HPWHs market in this sector in the coming years. The positive effect of the thermal regulation RT2012 has been sensible in 2013-2015 and now the penetration rate of HPWHs in new built individual houses is stabilized and even slowly decreases, due to double service heat pumps or combination systems including photovoltaic panels. The evolution of HPWHs market in this sector mainly depends on the rebound of the new built sector, which is quite uncertain for the moment (see figure below, evolution of new built sales over 12 months compared to the previous 12 months).

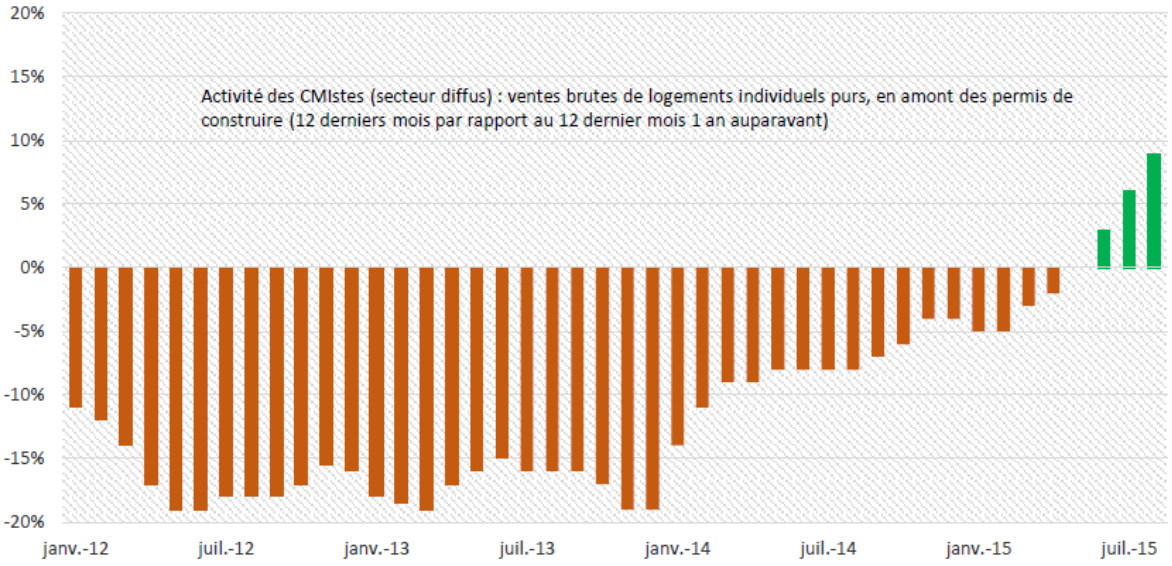


Fig 5.4 Evolution of new built sales over 12 months compared to the previous 12 months

Some studies forecast that in 2020, about 35% of new built individual houses will be equipped with a heat pump water heater, i.e. about 60000 to 65000 units sold per year (vs 50000/year in 2015). This figure is based on a estimation of 180 000 new built individual houses in 2020 (vs 135 000 in 2015).

5.2.2 Existing buildings

In existing buildings, the main growth potential remains in the retrofit of electrical water heaters and other traditional water heaters. As seen previously, the stock of electrical water heaters represents almost 16 million units and about 1.3 million units are replaced every year.

Currently, the effect of retrofitting the electrical water heaters by HPWHs is negligible. This retrofit will develop under several conditions that lead to an improvement of the HPWHs return on investment:

- Decrease of capital costs of HPWHs
- Continuation of the tax credit “CITE” for HPWHs or global revision of the margins taken by each actor of the professional channel
- Increase of energy prices, in particular electricity

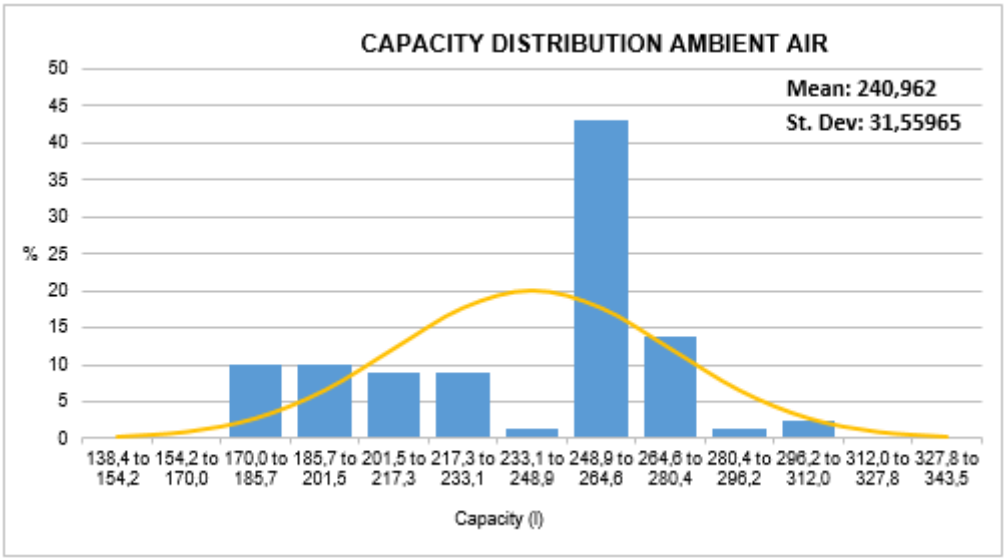
5.3. Certified Products on the French Market

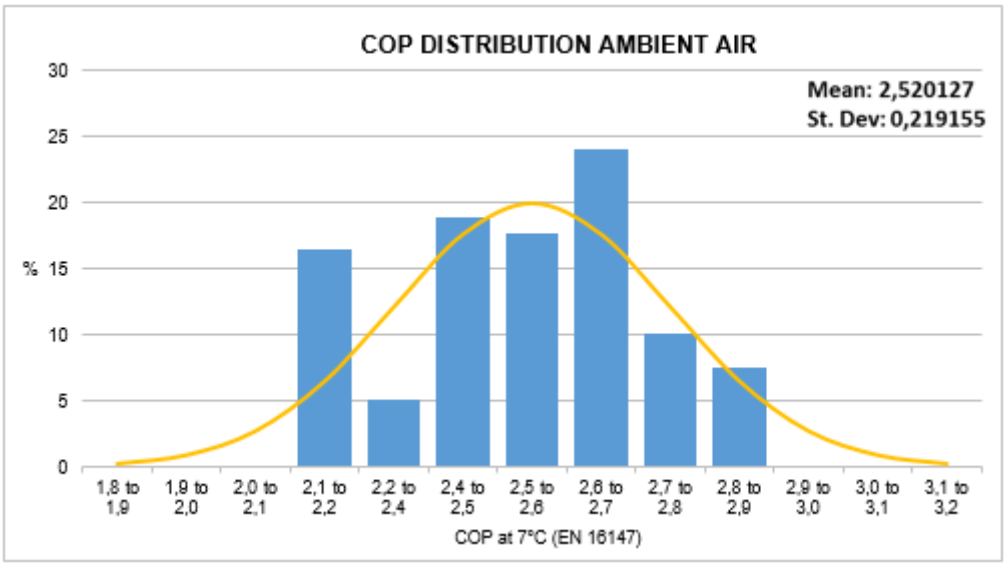
To describe the HPWHs products available on the French market, we chose to analyse the products certified by LCIE (Laboratoire Central des Industries Electriques). In February 2016, 349 models were certified for the 4 main products on the French market (ambient air, outside air duct, outside air split and exhaust air).

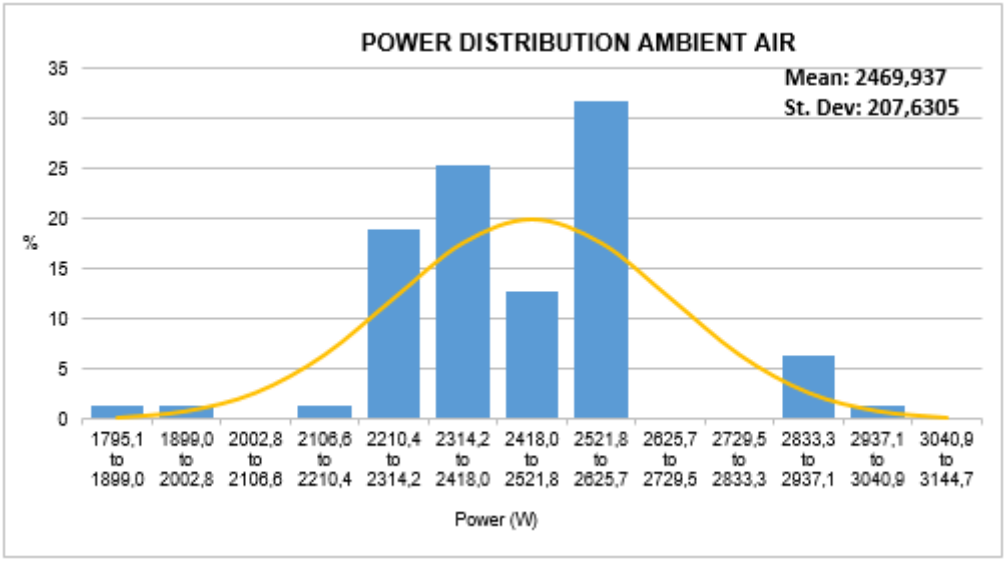
5.3.1 Ambient air HPWHs

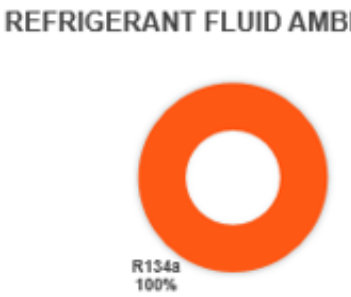
About 80 ambient air products are certified. These products have an average water capacity of about 250 litters, an average COP (7°C, EN 16147) of 2,5 and an average heating capacity of about 2,5 kW.

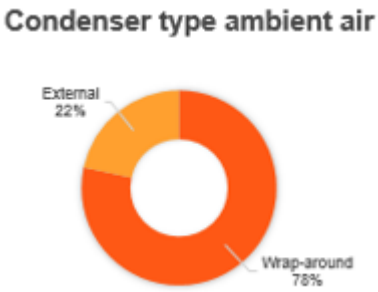
All the ambient air HPWHs use the R134a refrigerant and the major part of them has a wrap-around condenser.


CAPACITY DISTRIBUTION AMBIENT AIR
Mean: 240,962
St. Dev: 31,55965
%
50
45
40
35
30
25
20
15
10
5
0
138,4 to 154,2
154,2 to 170,0
170,0 to 185,7
185,7 to 201,5
201,5 to 217,3
217,3 to 233,1
233,1 to 248,9
248,9 to 264,6
264,6 to 280,4
280,4 to 296,2
296,2 to 312,0
312,0 to 327,8
327,8 to 343,5
Capacity (l)


COP DISTRIBUTION AMBIENT AIR
Mean: 2,520127
St. Dev: 0,219155
%
30
25
20
15
10
5
0
1,8 to 1,9
1,9 to 2,0
2,0 to 2,1
2,1 to 2,2
2,2 to 2,4
2,4 to 2,5
2,5 to 2,6
2,6 to 2,7
2,7 to 2,8
2,8 to 2,9
2,9 to 3,0
3,0 to 3,1
3,1 to 3,2
COP at 7°C (EN 16147)

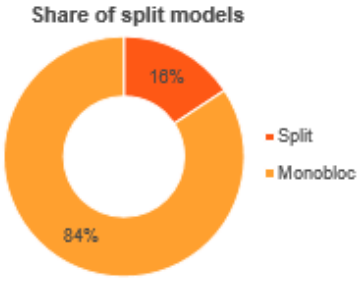

POWER DISTRIBUTION AMBIENT AIR
Mean: 2469,937
St. Dev: 207,6305
%
35
30
25
20
15
10
5
0
1795,1 to 1899,0
1899,0 to 2002,8
2002,8 to 2106,6
2106,6 to 2210,4
2210,4 to 2314,2
2314,2 to 2418,0
2418,0 to 2521,8
2521,8 to 2625,7
2625,7 to 2729,5
2729,5 to 2833,3
2833,3 to 2937,1
2937,1 to 3040,9
3040,9 to 3144,7
Power (W)





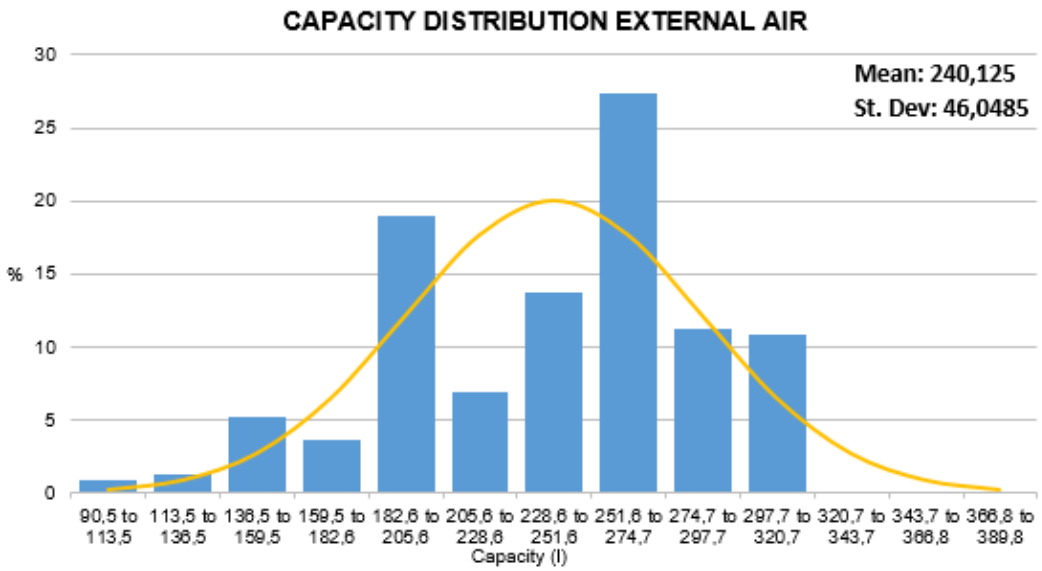
5.3.2. Outside air HPWHs

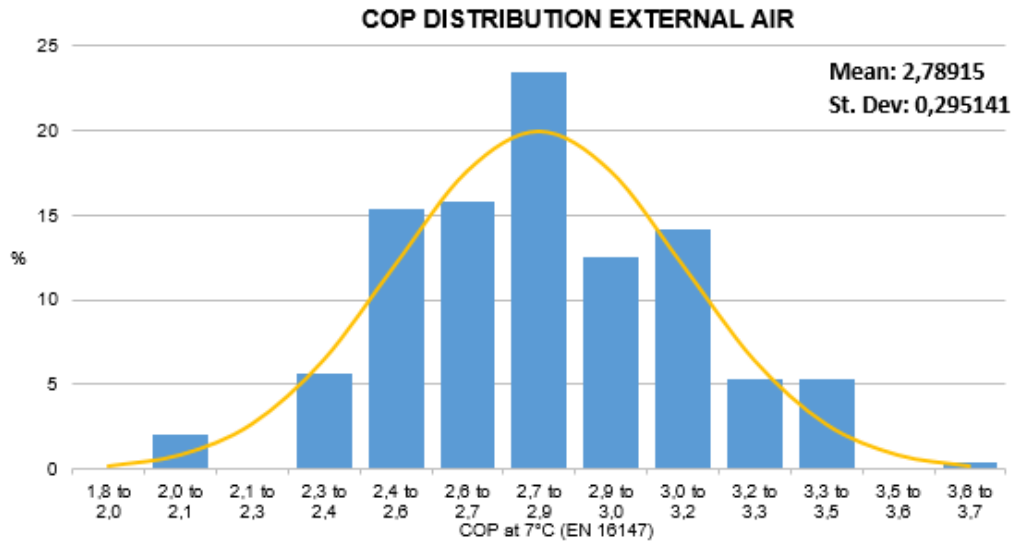
About 250 models of outside air HPWHs are certified. This figure has to be compared with the number of certified models of ambient air HPWHs (80). It has to be noticed that many manufacturers choose to certify their one-piece models as outside air (duct) models but sell them as ambient air models as well as outside air (duct) models. About 85% of certified models as outside air HPWHs are duct models and 15% split models.

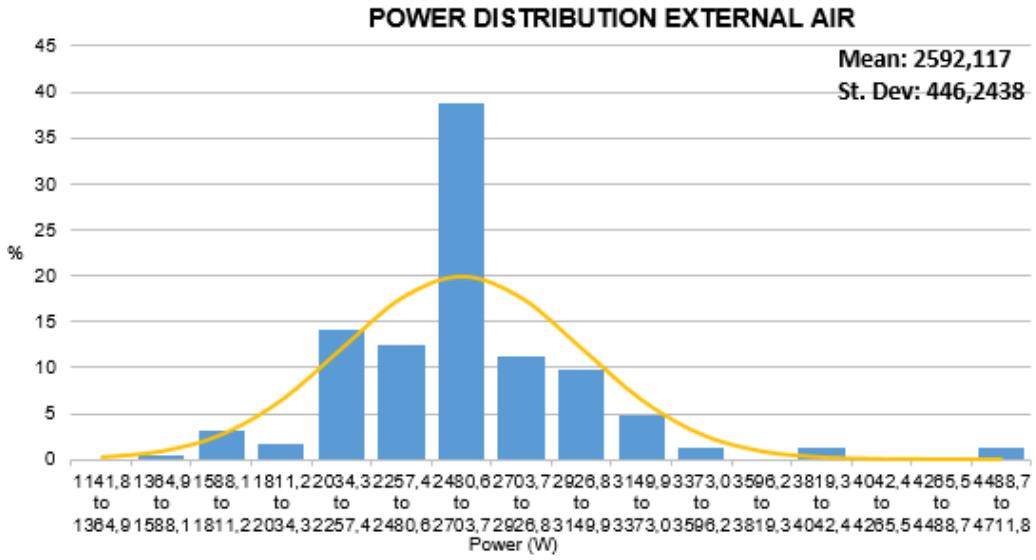


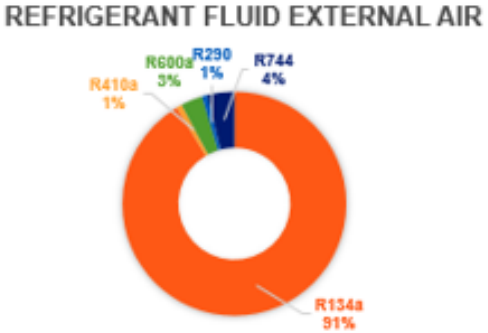
These products have an average water capacity of almost 250 l, an average COP (7°C, EN 16 147) of 2.8 and an average heating capacity of 2.6 kW.

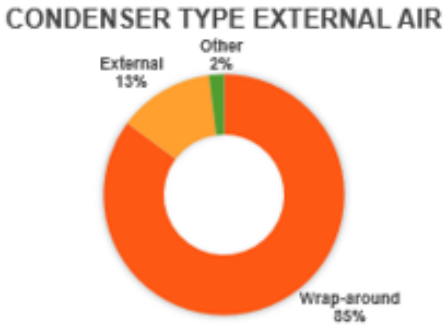
90% of outside air HPWHs uses R134a refrigerant and 85% have a wrap-around condenser.




COP DISTRIBUTION EXTERNAL AIR
Mean: 2,78915
St. Dev: 0,295141
%
25
20
15
10
5
0
1,8 to 2,0
2,0 to 2,1
2,1 to 2,3
2,3 to 2,4
2,4 to 2,6
2,6 to 2,7
2,7 to 2,9
2,9 to 3,0
3,0 to 3,2
3,2 to 3,3
3,3 to 3,5
3,5 to 3,6
3,6 to 3,7
COP at 7°C (EN 16147)


POWER DISTRIBUTION EXTERNAL AIR
Mean: 2592,117
St. Dev: 446,2438
%
45
40
35
30
25
20
15
10
5
0
1141,8 to 1364,9
1364,9 to 1588,1
1588,1 to 1811,2
1811,2 to 2034,3
2034,3 to 2257,4
2257,4 to 2480,6
2480,6 to 2703,7
2703,7 to 2926,8
2926,8 to 3149,9
3149,9 to 3373,0
3373,0 to 3596,2
3596,2 to 3819,3
3819,3 to 4042,4
4042,4 to 4265,5
4265,5 to 4488,7
4488,7 to 4711,8
Power (W)

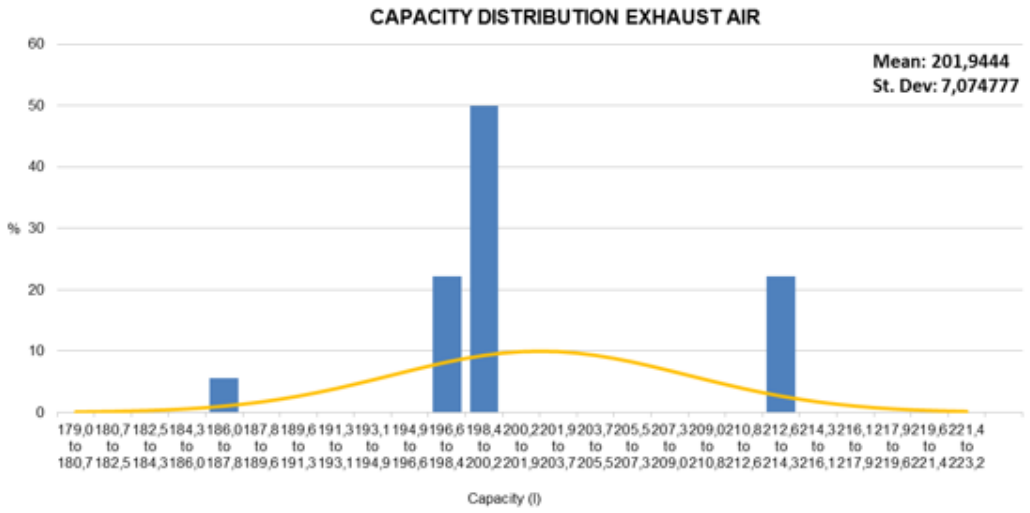

REFRIGERANT FLUID EXTERNAL AIR
R600a 3%
R290 1%
R744 4%
R410a 1%
R134a 91%

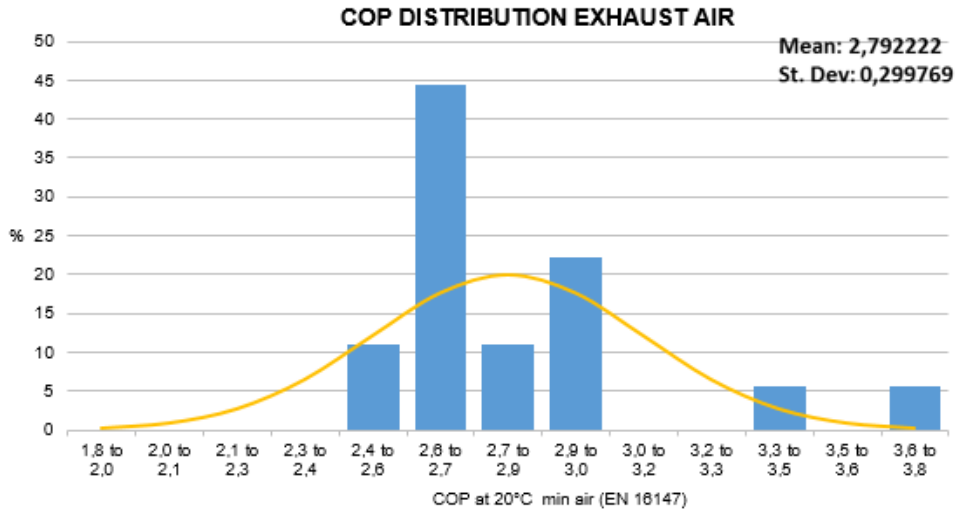

CONDENSER TYPE EXTERNAL AIR
Other 2%
External 13%
Wrap-around 85%

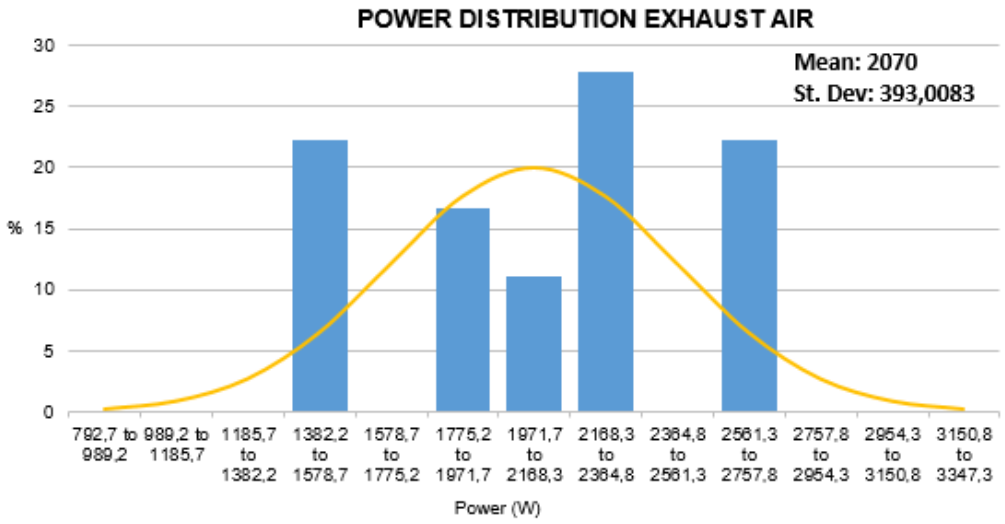
5.3.3 Exhaust air HPWHs

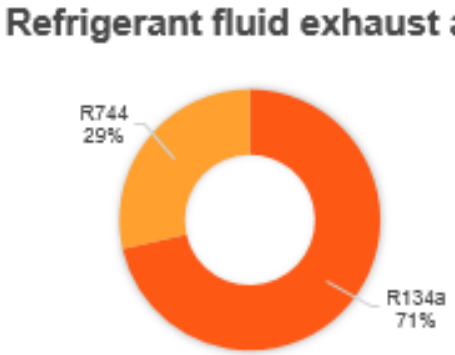
About 20 products are certified as exhaust air HPWHs. This type of HPWHs has a smaller capacity than the others one, about 200 l. The average COP (*20°C*, EN 16147) is 2.8, very similar to the COP (7°C) of outside air HPWHs. The average heating capacity is 2.1 KW. It has to be noticed that these average values are less significant compared to the other systems, due to the small number of models.

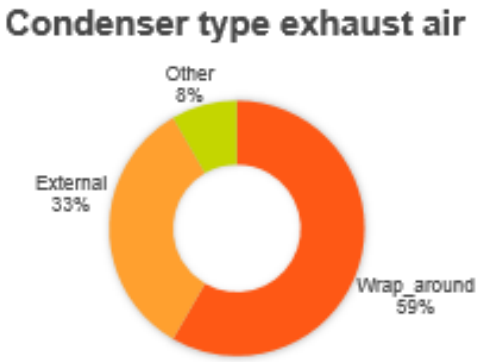
These HPWHs uses mainly R134a refrigerant (70%) but 30% of them uses CO_2 as refrigerant. The condenser is then more often an external one (with CO_2 refrigerant).





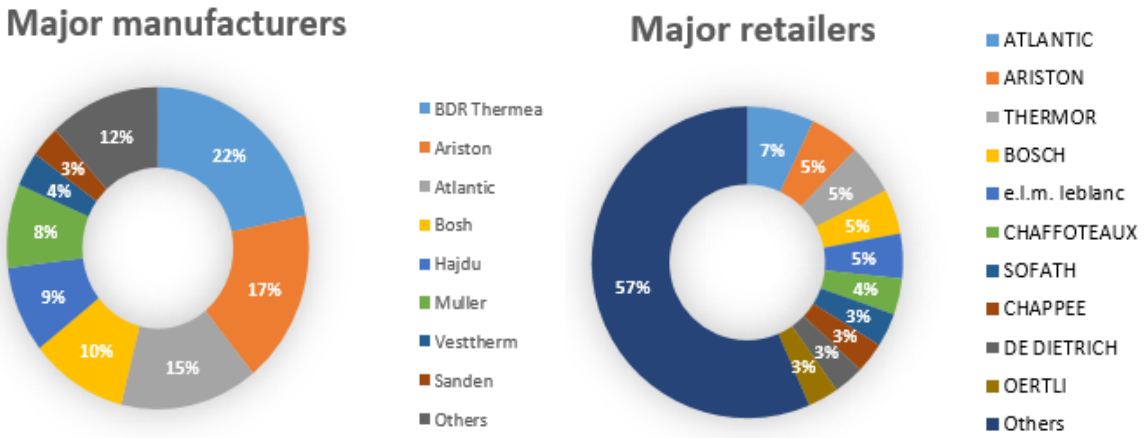






5.4. Main Brands

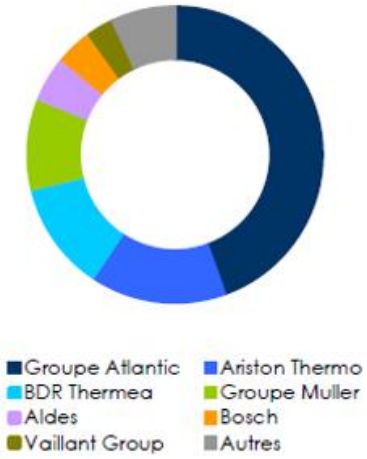
If we rely on the data provided by LCIE on the certified products, we identify a lot of actors on the market with each a very small share. Below are the main manufacturers and retailers in terms of certified products.



The table below indicates, for each manufacturer, the corresponding brands and products.

Groupe Atlantic *Usines de La Roche-sur-Yon (Atlantic Industrie) et de Fontaine (SATE)*	France	Atlantic (Odyssée, Aéraulix, Calypso), Thermor (Aéromax), Enalsa (Obono), Sauter (Arialis)
BDR Thermea Group *Usines de Mertzwiller (De Dietrich Thermique) et de Portes-lès-Valence (Syta Industrie)*	Europe	De Dietrich Thermique (Kaliko), Oertli (OecaPac), Sofath, Chappée (Td), Brötje (Td), Ideal Standard (Td)
Ariston Thermo Group *Usine de Lucé*	Italie	Chaffoteaux (Aquanext), Ariston (Nuos), Styx (Eco Styx), Régent (Eco Regent)
Groupe Muller *Usine de Feuquières-en-Vimeu (Auer)*	France	Auer, Noirot, Applimo, Airelec (Cylia, Xiros, Edel), Allemagne Air (Kinta Air)
Aldes Aéraulique *Usine de Châtillon-en-Vendelais (Airpac)*	France	Aldes (T.Flow)
Bosch Thermotechnik *Usine d'Aveiro (Bosch Thermotechnologia)*	Allemagne	e.l.m. leblanc (Ondéa), Bosch (Compress)
Nibe Energy Systems (Nibe Industrier AB) *Usine de Helsinge (Metro Therm A/S)*	Suède	Nibe, Alpha-Inno Tec (BWP), Technibel (Liberty)
Vaillant Group	Allemagne	Saunier Duval (Magna Aqua), Vaillant (aroSTOR)

The reality of the French market is quite different from this distribution. This market is in reality much more concentrated with, for instance, a market share of Atlantic of about 40-50%.



Groupe Atlantic	40 à 50%
Ariston Thermo Group	± 15%
BDR Thermea	± 12%
Groupe Muller	± 10%
Aldes	± 5%
Bosch Thermotechnik	± 4%
Vaillant Group	± 3%
Autres	± 7%
Total	**100%**

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