

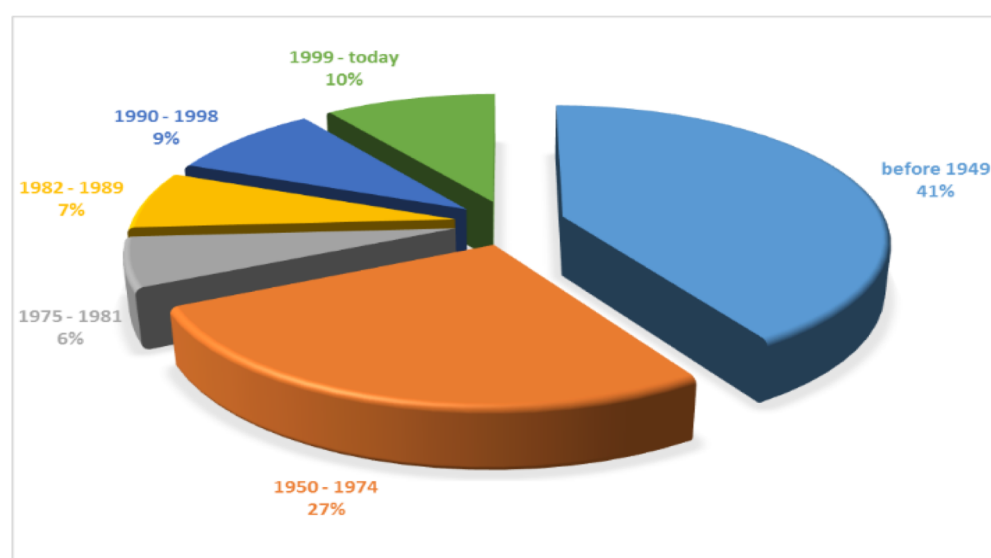


France - Technical Framework

When considering an energy efficiency retrofit within your national housing market, a wide plethora of consideration needs to be made. Below, we list key findings to facilitate your analysis of the retrofit investment. More details and backgrounds can be found on the website www.rentalcal.eu.

Residential buildings and building types in France:

- France's total housing stock comprises about 34.6 million units, of which 35.2 % or roughly 12.1 million are rental housing. 50% of the rental housing is market oriented. 95% of the private rented housing stock is owned by natural landlords, 5% only are owned by corporations. Nearly 70% of rental properties belonging to companies are located in the region "Ile-de-France".
- Regarding the entire rental stock, 41% was built before 1949 and 32% after 1975.



- Relevant building types for the private rental housing sector are mainly all multi-family houses (70% are located in MFH) but also single-family-houses are rented out (30% are located in SFH). This last percentage represents a significant difference compared with the social housing sector (only 18% are located in SFH).
- The average living surface of a private rental dwelling unit is 66 m².
- About 95 % of the residential buildings are supplied by central building or apartment heating systems.
- About 44% of the residential dwellings are mainly heated by natural gas, 33.5% by electricity, 14 % by oil, 4.2 % by district heating, 3.8 % by biomass (wood).
- Energy consumption rates vary over construction periods. Few of the highest annual energy consumption ($x \geq 330$ kWh/m²/year, category EPD = FG) can be observed in rental single-family houses (SFH) equipped with electricity heating systems during the early seventies as this equipment was significantly subsidized by E.D.F., the French National Company of Electricity. A significant difference in terms of energy efficiency can be observed for the housing built before 1974, it means before the first thermal building regulation.

Energy saving measures and investment costs in France:

- As the private natural landlords owned 95% of the private rented housing stock a relevant information can be extracted from the statistics of the 0% eco-loan.
- 70 % of the energy efficiency works targets the insulation of the building envelope and 30%, the heating system.
- One of the most common procedures is the installation of insulation in roofs, floors and ceilings (33%). The external wall thermal insulation composite systems are more and more used in the recent years. This is quite innovative in France.
- The second most common measure (27%) is the replacement of the old windows by a more performing double glazing or more rarely by a triple glazing window with a plastic, aluminum or wooden frame.
- Regarding the heating system, the usual system measure (11%) is the replacement of a conventional boiler for a gas condensing boiler. Other measures like improvement of the thermal regulation, replacement of the burner system... are also well deployed (19%)
- Future trends building measures: Increasing relevance of insulation measures, increasing shares of triple glazing.
- Future trends system measures: Increasing relevance of heat pumps (2%), solar and biomass system (4%), ventilation systems with heat recovery (2%).
- In 2015, the average costs for an investment combining 2 and 3 measures in energy efficiency was 22.041 € / dwelling.

Energy performance calculation methods in France:

- In the case of residential buildings, the decree published on the 17th of October 2012 makes mandatory to use the method 3 CL with its 60 points of control to calculate the energy performance of a building. The 3CL method of calculation combines various systems for heating, hot water and ventilation in the database and thus calculates the final energy of a building for a large number of equipments.
- Two other methods are available : DEL6-DPE and Comfie-DPE.
- The main difference between these three methods is the algorithm of calculation, but the result is the same.
- Another method of calculating is the TH- C- E ex 2008 which relates to the regulatory calculation conventional energy consumption of an existing building for heating, ventilation, cooling, domestic hot water and lighting and the regulatory calculation of conventional indoor temperature T_{ic} , reached in summer in an existing building.
- Three retrofit tools exist as well:
- Perrenoud and Design Builder are professional oriented softwares.
- Perrenoud gives a static calculation of the theoretical energy performance, based on RT 2012 calculation. Design Builder is a thermal dynamic simulation tool. It gives an energy calculation and a dynamic simulation (HVAC and day-light) together with a cost optimization of the solutions. It allows to compare design alternatives, modelling and thermal simulation.
- Bao Promodul is a web-based simulation software for improving energy performance and thermal comfort. It is non-professional oriented. .
- Several other retrofit tools for energy balance calculation and/ profitability calculation either EXCEL or web based are available.

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