# The challenges, dynamics and activities in the building sector and its energy demand in France

## D2.1 of WP2 from Entranze Project

**Written by:**

Bruno Lapillonne, Carine Sebi and Nicolas Mairet
Enerdata, with the support of ADEME


**Reviewed by:**

Eva Heiskanen

National Consumer Research Centre

**December 2012**

## ENTRANZE Project

| | |
|---|---|
| **Year of implementation:** | April 2012 – September 2014 |
| **Client:** | EACI |
| **Web:** | http://www.entranze.eu |

**Project consortium:**

| | | |
|---|---|---|
| | **EEG** | Energy Economics Group, Institute of Energy Systems and Electrical Drives at Vienna University of Technology |
| | **NCRC** | National Consumer Research Centre |
| | **Fraunhofer** | Fraunhofer Society for the advancement of applied research |
| | **CENER** | National Renewable Energy Centre |
| | **eERG** | end use Efficiency Research Group, Politecnico di Milano |
| | **Oeko** | Öko-Institut |
| | **SOFENA** | Sofia Energy Agency |
| | **BPIE** | Buildings Performance Institute Europe |
| | **Enerdata** | Enerdata |
| | | With the support of **ADEME** |
| | **SEVEn** | SEVEn, The Energy Efficiency Center |

# The ENTRANZE project

The objective of the ENTRANZE project is to actively support policy making by providing the required data, analysis and guidelines to achieve a fast and strong penetration of nZEB and RES-H/C within the existing national building stocks. The project intends to connect building experts from European research and academia to national decision makers and key stakeholders with a view to build ambitious, but reality proof, policies and roadmaps.

The core part of the project is the dialogue with policy makers and experts and will focus on nine countries, covering >60% of the EU-27 building stock. Data, scenarios and recommendations will also be provided for EU-27 (+ Croatia and Serbia).

This report provides an overview of the building stock of France and its related energy demand. It includes main buildings characteristics, space heating and cooling systems and energy consumption and is based on data collection that was carried out during WP2.

Supported by
**INTELLIGENT ENERGY**
**EUROPE**

# Content

# List of figures

# List of tables

## Some definitions/scope of country report

The common **database year** of these country reports is 2008. This year has been chosen because it is one of the most recent years with enough available data. And year 2009 has been avoided because of structural effects caused by the global crisis.

**The building sector**, as it is subject of this report, refers to two main categories of buildings: residential buildings and non-residential buildings. Whereas residential buildings are relatively homogenous and can further be divided into single/two-family houses and apartments blocks, non residential buildings are more heterogeneous. They refer to buildings in the service or tertiary sector and include several building categories (esp. office buildings, hospitals, schools and universities, hotels and restaurants, buildings in wholesale and retail trade). Within the residential stock, we consider only permanently occupied dwellings.

**Floor area**: The floor area as it is reported in the following sections is the net floor area; it does not include the common areas in multifamily buildings (e.g. corridors, etc.).

**Specific consumption for space heating is calculated at normal climate**: it corresponds to the energy consumption required to heat one dwelling on average, it is calculated in final energy.

**Climate correction (normal climate)**: Making climatic corrections enable to monitor energy indicator trends that are independent on the year-to-year variations in the winter climate. The climatic corrections are made only for the part of the final consumption corresponding to space heating.

**Central heating systems:** it includes district heating, block heating, individual boiler heating and electric heating; a central heating system implies that all rooms are well heated, as opposed to room heating, where generally a stove provides heat to the main room only.

Supported by
INTELLIGENT ENERGY
EUROPE

# 1. Building characteristics

## 1.1 Building sector

The total French building area is around 3 400 million m²: it is composed for about ¾ by residential dwellings (73%) and the rest by services buildings (27%) (Figure 1 and Table 1
). Slightly more than half of residential buildings are single-family dwellings (56% of the total. Multi-family dwellings are on average 41% smaller than single-family dwelling, with an average size of 66 m², compared to 112 m² for single-family dwellings. As a consequence, the share of single-family dwellings is even more dominant in the total floor area, with 69%.

The type of single-family dwellings has an impact on the space heating energy performances because of different insulation characteristics implying different specific space heating consumption (due to different wall area in contact with the outdoor): a semi-detached house consumes on average 15% less per m² than a detached dwelling[1]. In France, the stock of individual dwellings is composed by 32% of semi-detached houses while detached houses are dominant with 68%.

**Figure 1: Decomposition of buildings by type (2008[2])**
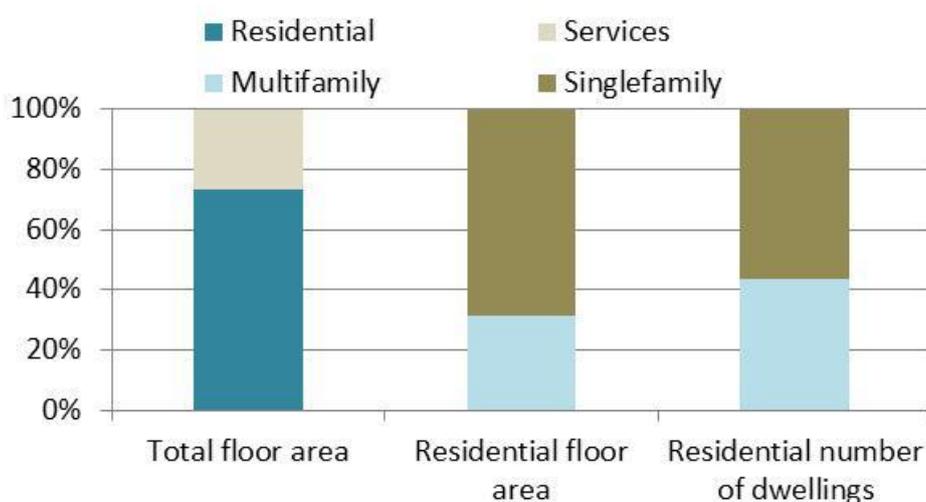


Source: Odyssee

---

[1] Source ECN for The Netherlands and simulation with EQTOR model for France (http://www.anah.fr/fileadmin/anahmedias/eqtor).

[2] The reference year chosen for this report is 2008, in order to get as much as possible available data among European countries.

**Table 1: Decomposition of buildings by type (stock and floor area, 2008)**

|  | Stock (k) | Floor area (Mm2) |
|---|---|---|
| **Total Residential** | **27 039** | **2 480** |
| **Multi-family** | 11 786 | 777 |
| **Single-family** | 15 252 | 1 703 |
| **Service** |  | **907** |

Source: Odyssee

Figure 2 represents the distribution of the total building floor area according to the status of occupation. Before services (27%), the main building stakeholders in France are owner occupant of single-family dwellings, with 41% of the total floor area. Social rental housing arrives in third position and accounts for 11% of total floor area; they correspond to dwellings provided by 'HLM' organisation (non-profit association). Private rental apartments make up 9% of total floor space. Rented single-family dwellings and owner occupied multi-family dwellings make up 6% each.

**Figure 2: Breakdown of floor area by ownership structure (2008)[3]**
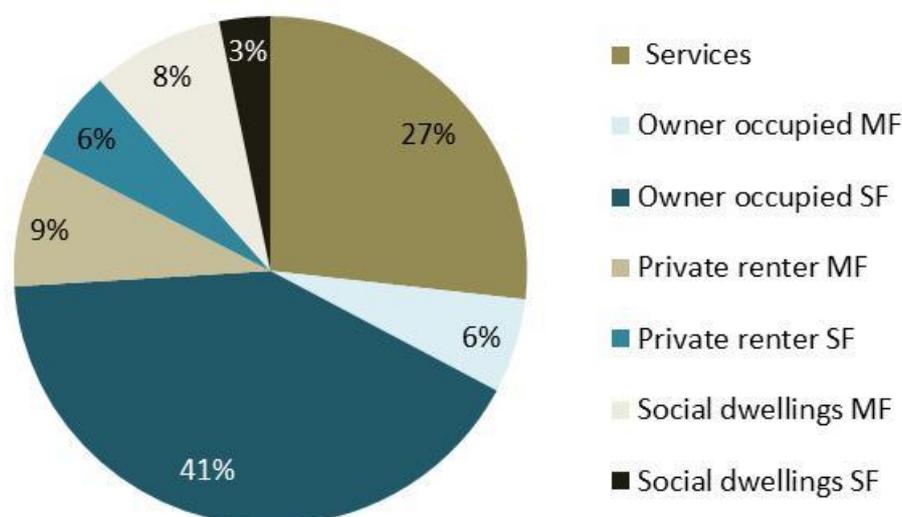


Source: Eurostat and Odyssee

Between 2000 and 2010, 3.8 M of residential dwellings have been constructed, i.e. 384 000 per year on average. In 2008, dwellings built after 2000 represents 12% of

---

[3] MF: Multi-family dwellings ; SF: single family dwellings.

total stock (Figure 3). While construction increased on average by 13%/year between 2000 and 2007, it has been significantly affected by the global crisis in 2008 and 2009 (decrease of 10% and 19% respectively), followed by a slight rebound in 2010.

During this last decade, the share of multi-family dwellings in annual construction became more important: from 35% of total construction in 2000, it increased to 45% in 2010. This phenomenon might be explained by cities' urbanisation accompanied by public local policies that define urban rules.

Over the period 2000-2010, one third of the new floor area constructed has been in the service sector. Service buildings constructed between 2000 and 2008 represent only 18% of total floor area of service sector buildings in 2008 stock. Construction has been as well affected by the crisis.

**Figure 3: Dynamics of building construction**
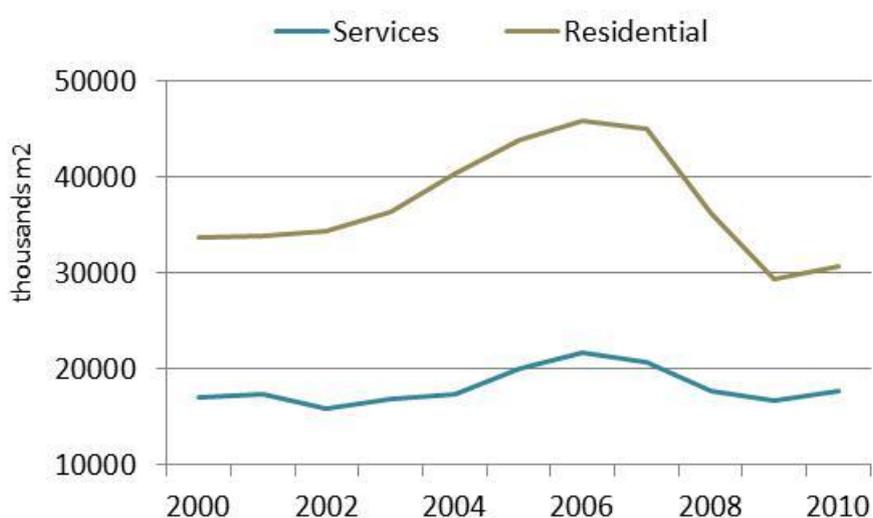


Source: MEDDE

## 1.2 Residential sector

The average age of buildings and the share of new buildings in the total stock represent a good indicator of the quality and standards of construction. The higher the share of recent dwelling, i.e. built with more efficient standards, the higher the energy performance of the stock: in France, 43% of the dwelling stock existing in 2008 was built after 1975, date of the first thermal regulation (Figure 4).

**Figure 4: Residential dwellings according to construction date (2008)[4]**
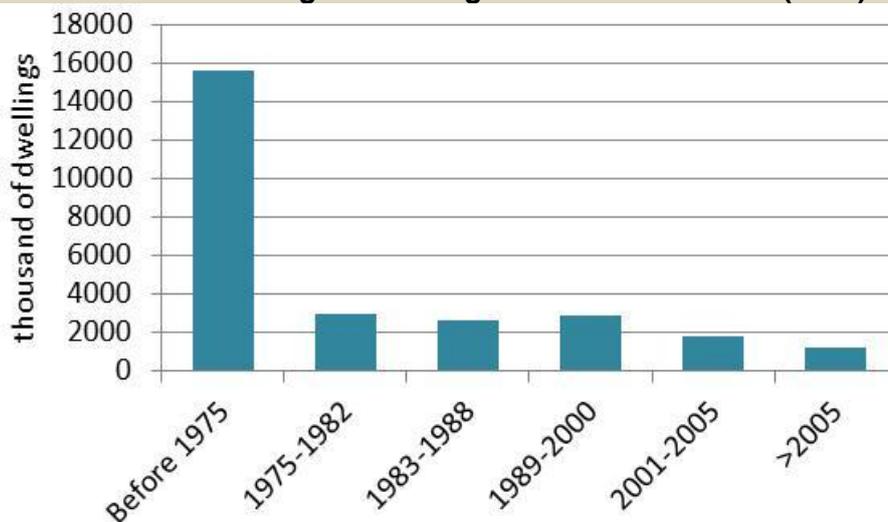
Owner occupants are dominant in residential buildings, 60% of total stock and more than 80% in single-family dwellings. Ownership structure is distributed more homogeneously in multi-family dwellings: 26% of owner occupant, 38% of private renter and 36% of social dwellings (Figure 5).

**Figure 5: Breakdown of ownership & tenure (2008)**

---
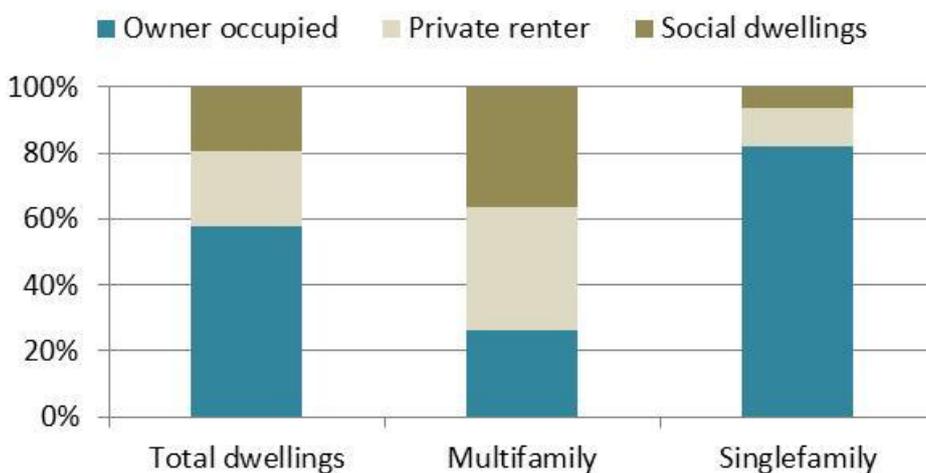
[4] The age categories correspond the revision of building standards (i.e. 1975, 1982, 1989, 2001 and 2005).

Figure 6 shows the U-values that measure heat loss in building elements, such as wall, floor or roof, i.e. how well the buildings components are insulated. In France, U-values have decreased, and thus insulation improved, by minimum 60% in 30 years, biggest improvements occur for ceiling and wall insulation.

**Figure 6: U-values by construction period (multifamily and single family, 2008)**
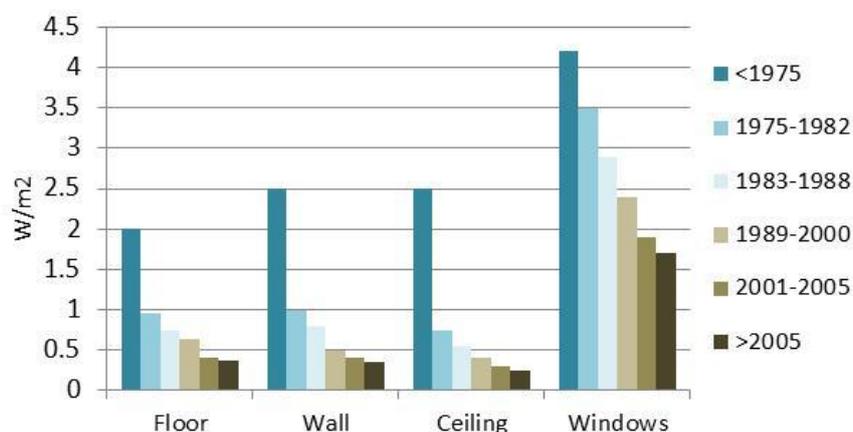


Source: BPIE

## 1.3 Service sector

Wholesale and retail trade represent the highest share of total service sector floor area in 2008 (23%). It is followed by education buildings (21%), private offices (18%), health (13%), hotels and restaurants (7%) and public offices 4%.

**Figure 7: Decomposition of service building areas by type (2008[5])**
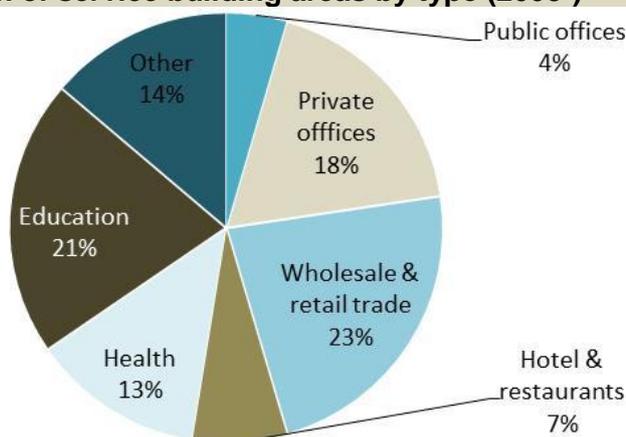


Source: Odyssee

---

[5] Official data provide only total offices, i.e. without distinction between private and public sector. Public offices stock has been estimated by CEREN and French government data. Private sector has been calculated by difference.

## 2. Space heating and cooling systems

Natural gas is the main source of energy for household and service space heating: 42% of residential dwelling are heated with gas (and 40% in service sector), 31% and 24% respectively in residential and service sector with electricity, and 20% with oil; other energy sources are marginal such as biomass and district heating (4% each). While gas heating systems are dominant in multifamily dwellings, oil heating and bio-mass are more important in single family dwellings (27% and 7% respectively).

**Figure 8: Dwelling stock according to space heating systems by energy (2008)**
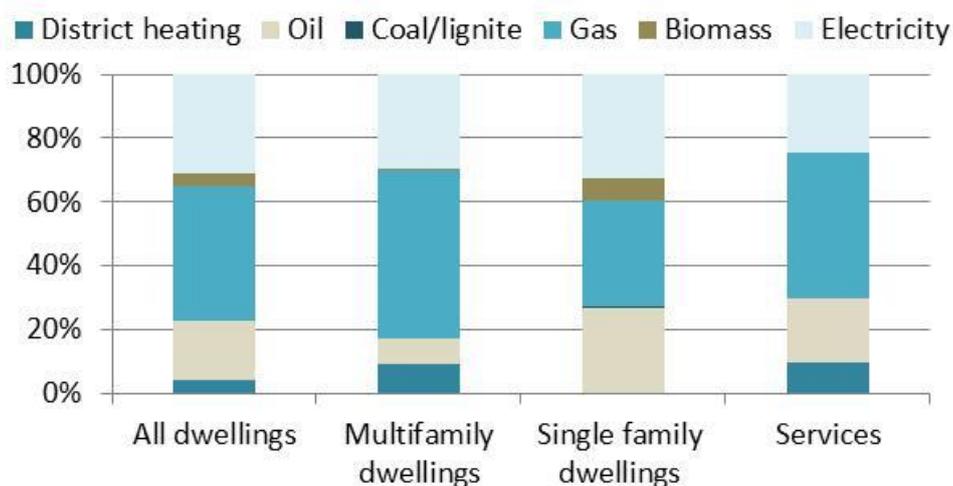


Source: Odyssee

Figure 9 shows the penetration of heating systems. In France almost the entire housing stock is heated by central heating systems[6]: room heating has almost disappeared, except in rural areas in single family dwellings. Collective heating systems[7] represent around 40% of multi-family dwellings. Only 4% of dwellings are heated by district heat-ing. Altogether, about 80% of dwellings have an individual central heating system.

---

[6] Electric heating is considered as a central system as all the rooms have usually and electric convector.
[7] Including district heating.

**Figure 9: Dwellings according to centralisation of heat supply (2008)**
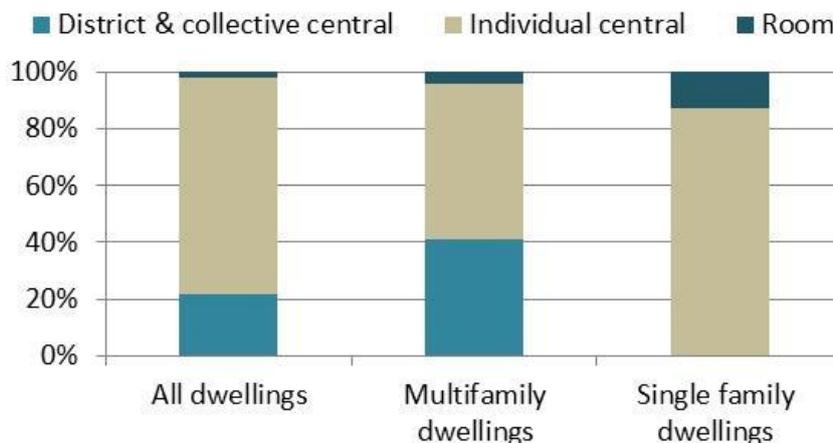


Source: Odyssee

The diffusion of efficient and renewable heating systems, such as condensing boilers, heat pumps, and solar thermal, promoted by several subsidies or tax credits, significantly improve the average heating energy efficiency. The sales of condensing boilers, heat pumps and solar thermal are increasing over time, except from 2008, for instance incentives where removed for air/air heat pumps. However only 2% of dwellings are equipped in 2008, thus it has a limited impact on energy performance. Geothermal[8] heat pumps represent around 10% of total heat pumps sales.

**Figure 10: Sales of energy efficient and renewable systems in recent years**
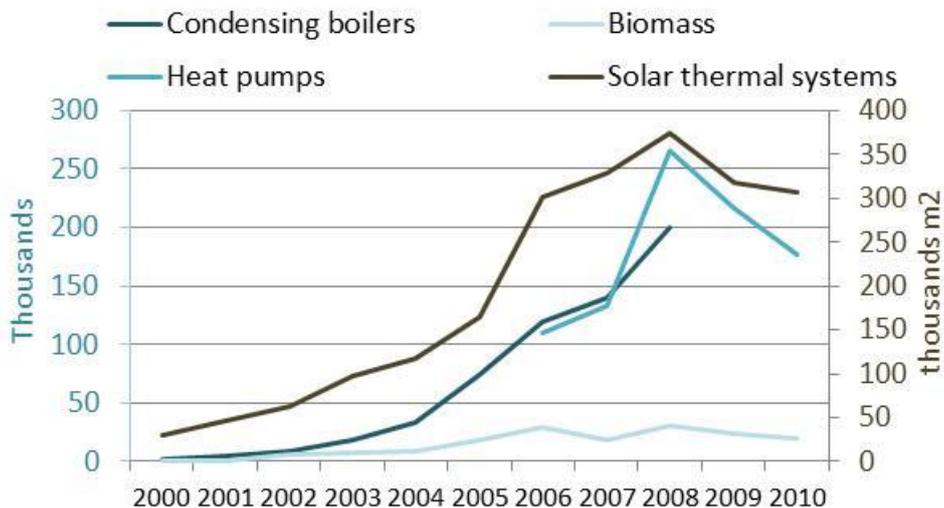


Source: Odyssee, ADEME, Enerdata

---

[8] Geothermal heat pumps include water/water, ground/ground and ground/water heat pumps.

Diffusion of air conditioning is steadily increasing in the residential sector: the share of dwellings with air conditioning increased from 0.5% to 5% in 2010 (Figure 11).

The penetration of air conditioning is even more important in the service sector; it is above 25% of service buildings, providing a better working environment.

**Figure 11: Penetration of air conditioning**
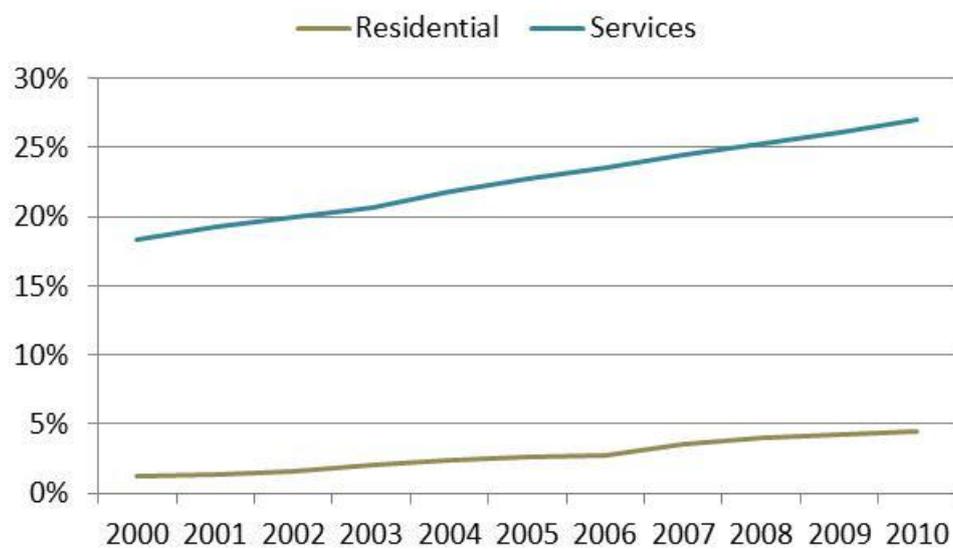


Source: CEREN for residential, and Enerdata estimation concerning services

## 3.  Energy consumption

Electricity and natural gas are the dominant source of energy in French buildings with each around 33% of the total and residential market (Figure 12). Oil is slowly being phased out but still represents 19% in 2008 both in total and residential stock.

In the service sector, electricity is the dominant source of energy with 44%; its share has increased a lot due to the greater use of electricity especially for information/communication technologies and air conditioning. Gas represents 33% of total service sector energy consumption.

**Figure 12: Total energy consumption of the building sector (2008)**
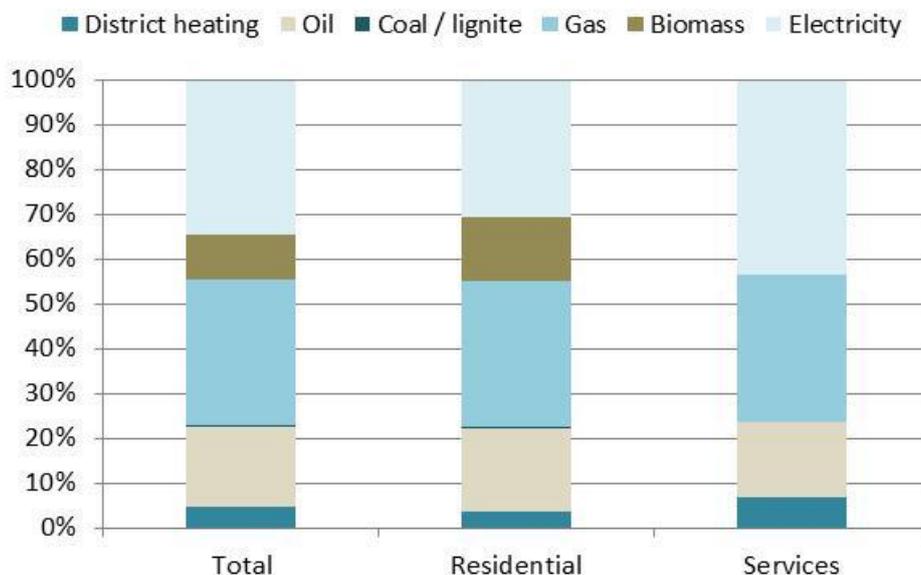


Source: Odyssee

Space heating represents the largest share of household energy use: it corresponds on average to almost 70% of total energy consumption. Water heating consumption equals 10% of the consumption. Lighting makes up 2.3% of household consumption. Air conditioning still represents a marginal share of residential consumption.

In the service sector, space heating and water heating represent 50 and 10% respectively of total consumption. Air conditioning is more significant than in the residential sector, and reached 7% of total consumption.

**Figure 13: Total energy consumption by end-use (2008, real climate)**
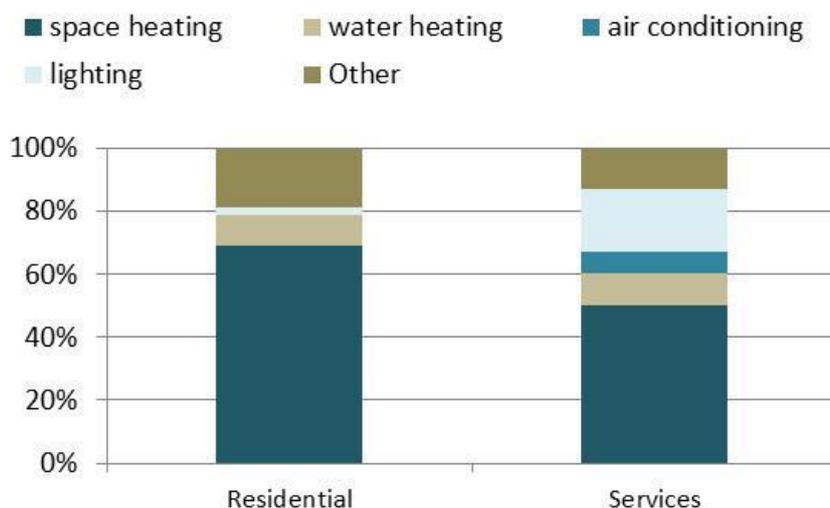


Source: Odyssee

Energy efficiency standards enforced on new dwellings have an impact on the space heating energy performance. However, the magnitude of this impact depends on the frequency of thermal regulations updates and on their severity. These standards require theoretical maximum heating unit consumption for new buildings, as shown in Figure 14. In France, six thermal regulations were implemented since the 70's. The last thermal regulation implemented in France in 2005 implies a specific consumption three times lower than the thermal regulation implemented in the mid 70's. The theoretical consumption of new dwellings was equal to around 0.7 toe/dwelling (or 8,100 kWh/dwelling), a level 55% higher than the last regulations of the Netherlands (2005), and twice higher than the last regulations implemented in Germany (2009).

**Figure 14: Specific consumption by age and by type of dwellings**
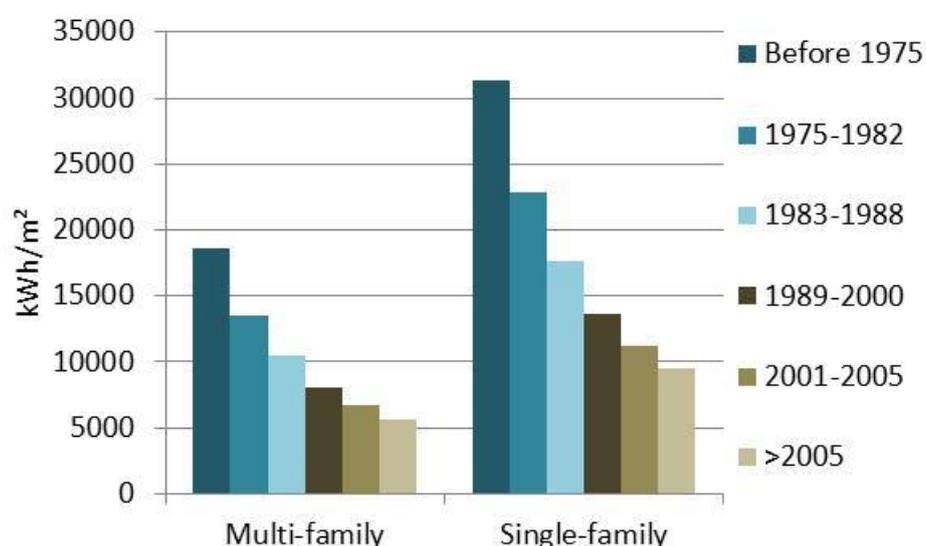


Source: Odyssee

## 4. Conclusions

Residential buildings represent 73% of total floor area and the main stakeholders in France are owner occupant of single-family dwellings, with 41% of the total floor area. This last decade, around 4 M of residential dwellings have been constructed, i.e. 12% of 2008 total stock. France has renewed its residential dwelling stock quite fast compared to other European countries: 33% of the dwelling stock was built after 1982.

U-values decreased by a minimum of 60% in 30 years, thanks to six thermal regulations implemented since the mid70's: the largest improvements occur for ceiling and wall insulation.

In France almost the entire housing stock is heated by central heating systems. 42% of residential dwellings are heated with gas systems, 31% by electricity, and 19% by oil.

Other energy systems are marginal such as biomass and district heating (4% each). Space heating represents the largest share of household energy use: it corresponds on average to almost 70% of total energy consumption. Water heating consumption equals 10% of total energy consumption. Air conditioning still represents a marginal share of residential dwelling consumption. Diffusion of air conditioning is steadily increasing in the residential sector. The sales of condensing boilers and heat pumps are increasing rapidly in recent years over time: in 2008, however only 2% of dwellings were equipped with these heating systems.

In the service sector, space heating and water heating represent 50 and 10% respectively of total consumption. Air conditioning is more significant than in the residential sector, and reached 7% of total consumption with around 25% of service buildings equipped with air conditioning.

## 5. References

ADEME, chiffres clés du bâtiment, http://www2.ademe.fr/servlet/getDoc?cid=96&m=3&id=82617&p1=30&ref=12441

Bertoli, P. and Atanasiu, B.: Electricity Consumption and Efficiency Trends in the Enlarged European Union – Status Report 2006. European Commission: DG Joint Research Centre 2007.

BPIE, Data Hub for the energy performance of buildings, http://www.buildingsdata.eu/results

Centre d'Ettudes et de Recherches Economiques sur l'Energie, CEREN, http://www.ceren.fr/index.aspx

Institut National de la Statistiques et des Etudes Economiques, INSEE, http://www.insee.fr/fr/

Eurostat, Population and social conditions, distribution of population by tenure status, type of household and income group (Source SILC) (ilc_lvho02) http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=ilc_lvho02&lang=en ,

ODYSSEE, database http://www.odyssee-indicators.org/

TABULA, Typology Approach for Building Stock Energy Assessment, http://www.building-typology.eu/country.html

## 6. Appendix

**Table 2: Total energy consumption by sector (2008)**

| Mtoe | District heating | Oil | Coal / lignite | Gas | Bio-mass | Elec-tricity | Total |
|---|---|---|---|---|---|---|---|
| **Residential** | 1.5 | 7.9 | 0.2 | 13.9 | 6.1 | 12.9 | 42.5 |
| **of which: space heating** | 0.4 | 6.8 | 0.4 | 12.1 | 6.1 | 3.7 | 29.3 |
| **of which: water heating** | 0.3 | 0.7 | 0.0 | 1.4 | 0.1 | 1.7 | 4.1 |
| **of which: air conditioning** | | | | | | | 0.0 |
| **of which: lighting** | | | | | | 1.0 | 1.0 |
| **Services** | 1.3 | 3.1 | 0.0 | 6.0 | 0.0 | 8.0 | 18.4 |
| **of which: space heating** | 0.9 | 2.4 | 0.0 | 4.5 | 0.0 | 1.4 | 9.2 |
| **of which: water heating** | 0.2 | 0.3 | 0.0 | 0.9 | 0.0 | 0.5 | 1.8 |
| **of which: air conditioning** | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.2 | 1.2 |
| **of which: lighting** | | | | | | | n.a. |

Source: Odyssee