



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

D2.1 of WP2 from Entranze Project

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## ENTRANZE Project

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### Project consortium:

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	<b>EEG</b>	Energy Economics Group, Institute of Energy Systems and Electrical Drives at Vienna University of Technology
	<b>NCRC</b>	National Consumer Research Centre
	<b>Fraunhofer</b>	Fraunhofer Society for the advancement of applied research
	<b>CENER</b>	National Renewable Energy Centre
	<b>eERG</b>	end use Efficiency Research Group, Politecnico di Milano
	<b>Oeko</b>	Öko-Institut
	<b>SOFENA</b>	Sofia Energy Agency
	<b>BPIE</b>	Buildings Performance Institute Europe
	<b>Enerdata</b>	Enerdata
	<b>SEVEN</b>	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.

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## Content

<b>The ENTRANZE project .....</b>	<b>3</b>
<b>Content .....</b>	<b>4</b>
<b>List of figures .....</b>	<b>5</b>
<b>1. Building characteristics .....</b>	<b>7</b>
1.1 Building sector .....	7
1.2 Residential sector .....	9
1.3 Service sector .....	11
<b>2. Space heating and cooling systems .....</b>	<b>12</b>
<b>3. Energy consumption .....</b>	<b>14</b>
<b>4. Conclusions.....</b>	<b>15</b>
<b>5. References.....</b>	<b>16</b>
<b>6. Appendix.....</b>	<b>17</b>

## List of figures

<i>Figure 1: Decomposition of buildings by type (2008)</i> .....	7
<i>Figure 2: Breakdown of floor area by ownership structure (2008)</i> .....	8
<i>Figure 3: Dynamics of building construction</i> .....	9
<i>Figure 4: Residential dwellings according to construction date (2008)</i> .....	10
<i>Figure 5: Breakdown of ownership &amp; tenure (2008)</i> .....	10
<i>Figure 6: U-values by construction period (multifamily and single family, 2008)</i> .....	11
<i>Figure 7: Decomposition of service building areas by type (2008)</i> .....	11
<i>Figure 8: Dwelling stock according to space heating systems by energy (2008)</i> .....	12
<i>Figure 9: Dwellings according to centralisation of heat supply (2008)</i> .....	12
<i>Figure 10: Sales of energy efficient and renewable systems in recent years</i> .....	13
<i>Figure 11: Penetration of air conditioning in residential stock</i> .....	14
<i>Figure 12: Total energy consumption of the building sector (2008)</i> .....	14
<i>Figure 13: Total energy consumption by end-use (2008, real climate)</i> .....	15

## List of tables

<i>Table 1: Decomposition of buildings by type (stock and floor area, 2008)</i> .....	8
<i>Table 2: Total energy consumption by sector (2008)</i> .....	17

## 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.

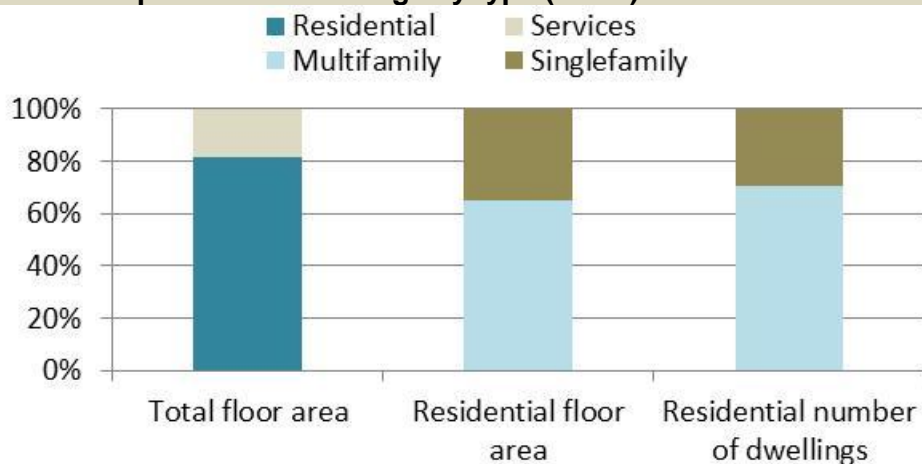
## 1. Building characteristics

### 1.1 Building sector

The total Spanish building area is around 1 917 Mm<sup>2</sup>: it is composed for about 82% by residential dwellings and the rest by services buildings (18%) (Figure 1 and Table1). The floor area associated to multi-family dwellings represents the 65% of the total, compared to 35% of single-family houses. The total Spanish dwelling stock is 25 million<sup>1</sup>: it is composed for about 68% by main homes and the rest (32%) by secondary homes. This analyse is mainly focused on the first category which represents around 17 million.

Multi-family dwellings are on average 22% smaller than single-family dwelling, with an average size of 86 m<sup>2</sup>, compared to 111 m<sup>2</sup> for single-family dwellings. However, the stock of multi-family dwellings in Spain is much more than single-family dwellings (70% of the total stock). As a consequence, the share of multi-family dwellings is dominant in the total floor area, with 65%. 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 single-family house consumes on average 27% (depending on each climatic zone) more per m<sup>2</sup> than a multi-family dwelling<sup>2</sup>.

**Figure 1: Decomposition of buildings by type (2008<sup>3</sup>)**



Source: Odyssee

<sup>1</sup> Ministry of Public works

<sup>2</sup> Framework of Spanish energy certification in buildings (energy need of reference for 12 climatic zones)

<sup>3</sup> The reference year chosen for this report is 2008, in order to get as much as possible available data among European countries.

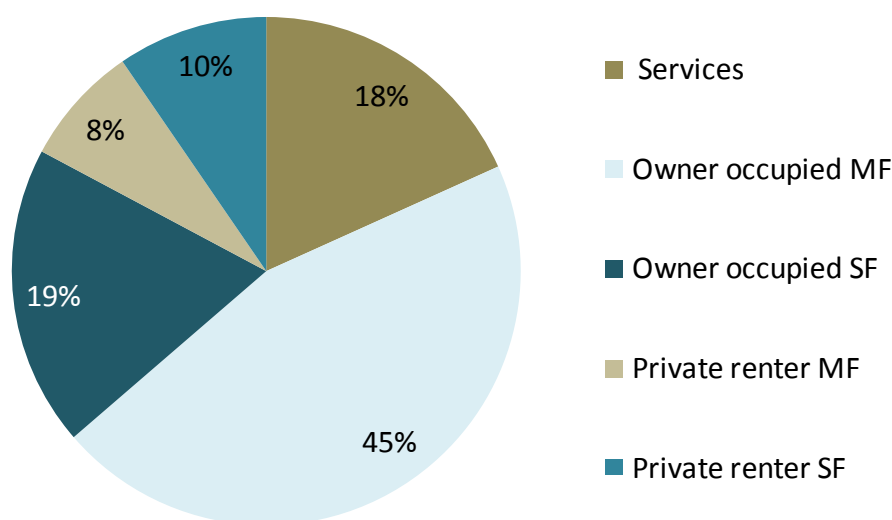
**Table 1: Decomposition of buildings by type (stock and floor area, 2008)**

	Stock (k)	Floor area (Mm2)
<b>Total Residential</b>	16 741	<b>1 567</b>
<b>Multi-family</b>	11 781	1 017
<b>Single-family</b>	4 961	550
<b>Service</b>		<b>350</b>

Source: Odyssee

Figure 2 represents the distribution of the total building floor area according to the status of occupation. The main building stakeholders in Spain are owner occupant of multi-family dwellings, with 45% of the total floor area. Owner occupied single-family dwellings arrives in second position and accounts for 19% of total floor area. Services sector represents 18% and finally, renter of multi-family and renter of single family dwellings represents 8% and 10%, respectively.

**Figure 2: Breakdown of floor area by ownership structure (2008)<sup>4</sup>**



Source: Eurostat and Odyssee

Between 2000 and 2010, around 4 million of main dwellings have been constructed, i.e. 340 000 per year on average. In 2008, main dwellings built after 2000 represents

<sup>4</sup> MF: Multi-family dwellings; SF: single family dwellings.



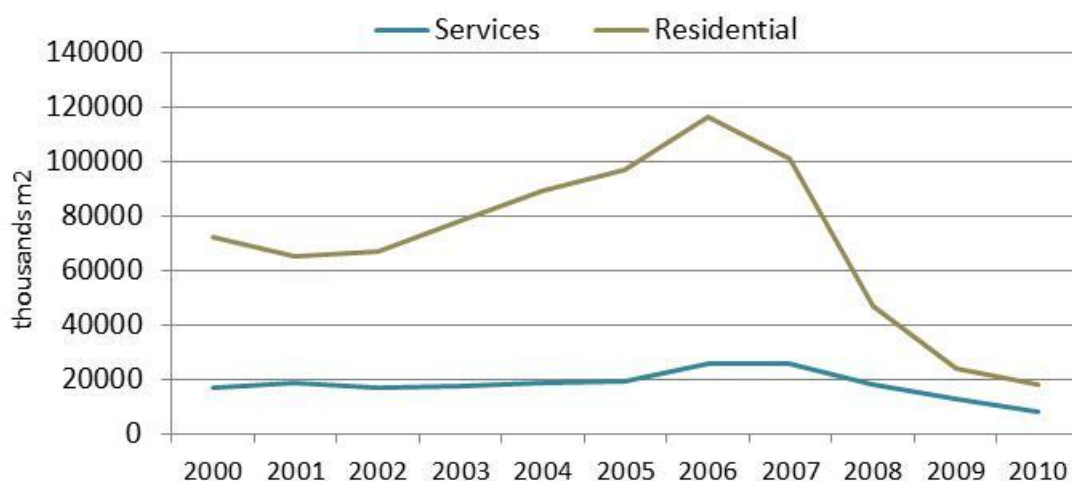
20% of total main dwellings stock (17 million). This value is very huge due to the large expansion that the building sector suffered at that moment.

While construction increased on average by 12%/year between 2002 and 2006, it has been significantly affected by the crisis since 2007. Since this year it has decrease on average by 40%/year until 2010.

During this last decade, the share of multi-family dwellings in annual construction has been constant, representing on average by 75% of total construction compare to 25% of single-family dwellings.

Over the period 2000-2010, a 22% of the new floor area constructed has been in the service sector. Construction has been as well affected by the crisis since 2007, but not in the so strong way than in residential sector.

**Figure 3: Dynamics of building construction**

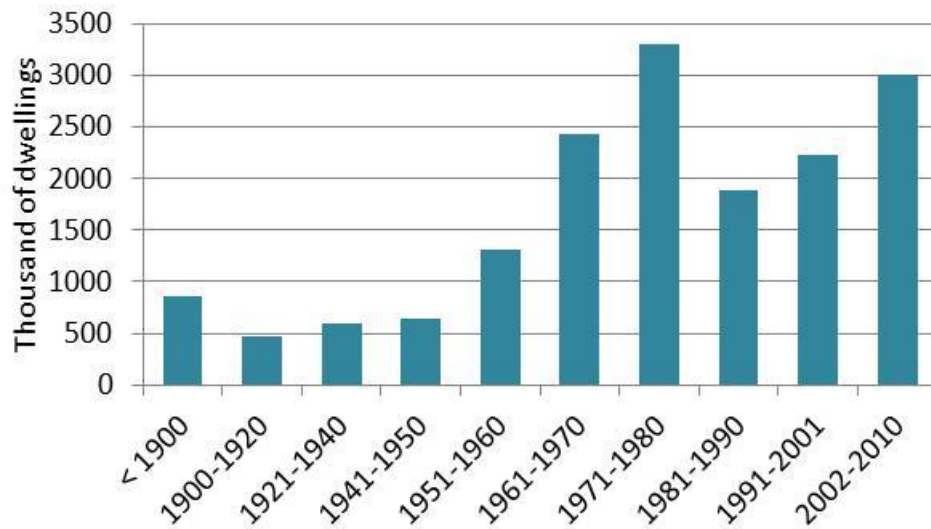


Source: Ministry of Public Works (Spain)

## 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 Spain, 58% of the dwelling stock existing in 2008 was built after 1980, date of the first thermal regulation (Figure 4).

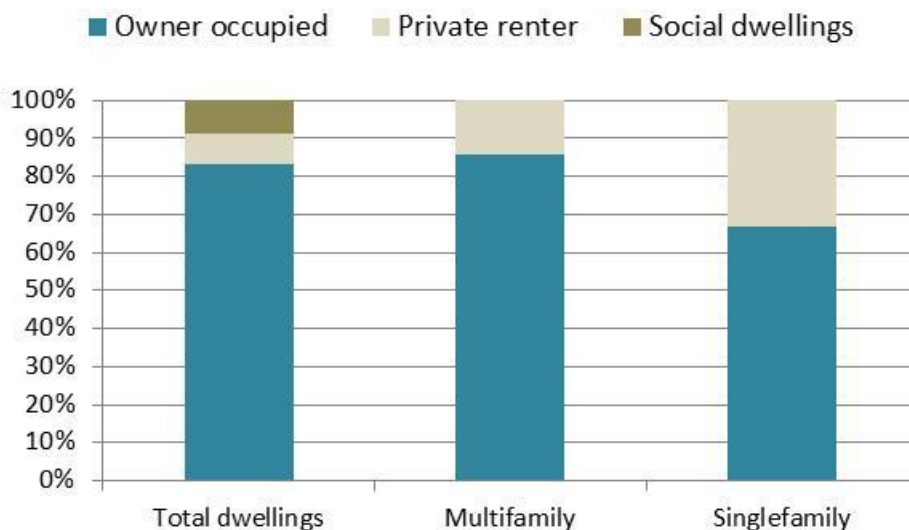
**Figure 4: Residential dwellings according to construction date (2008)**



Source: Tabula and Odyssee

Owner occupants are dominant in residential buildings, around 80% of total stock. (Figure 5).

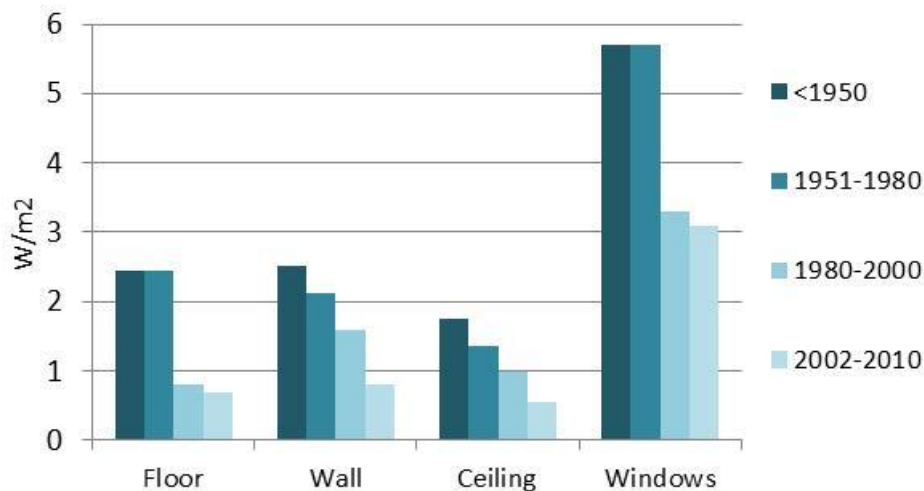
**Figure 5: Breakdown of ownership & tenure (2008)**



Source: Eurostat

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 Spain, U-values have decreased, and thus insulation improved, by minimum 60% in 30 years.

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

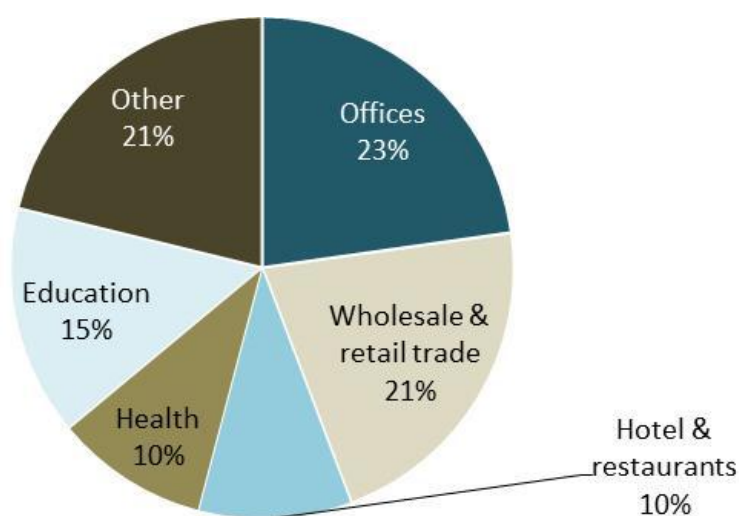


Source: Tabula

### 1.3 Service sector

Offices represent the highest share of total service sector floor area in 2008 (23%). It is followed by wholesale and retail trade (21%), education buildings (15%), health (10%) and hotel & restaurants (10%).

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

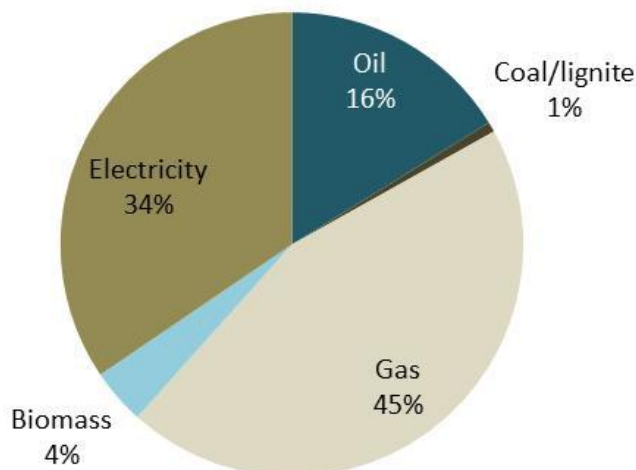


Source: Odyssee

## 2. Space heating and cooling systems

Gas is the main source of energy for household space heating: 45% of residential dwelling are heated with gas, 34% with electricity and 16% with oil; other energy sources are marginal such as biomass and coal (4% and 1% respectively).

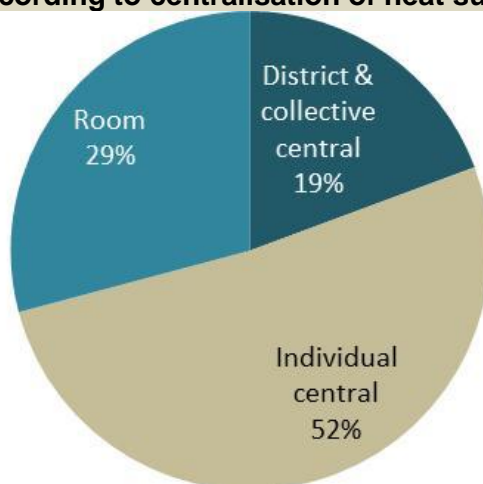
**Figure 8: Dwelling stock according to space heating systems by energy (2008)**



Source: Ministry of Public Works

Figure 9 shows the penetration of heating systems. In Spain the 52% of entire housing stock is heated by individual heating systems<sup>5</sup>: It is followed by room systems which represent the 29% of the total. Collective heating systems represent around 19% of total stock of dwellings.

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



Source: Odyssee

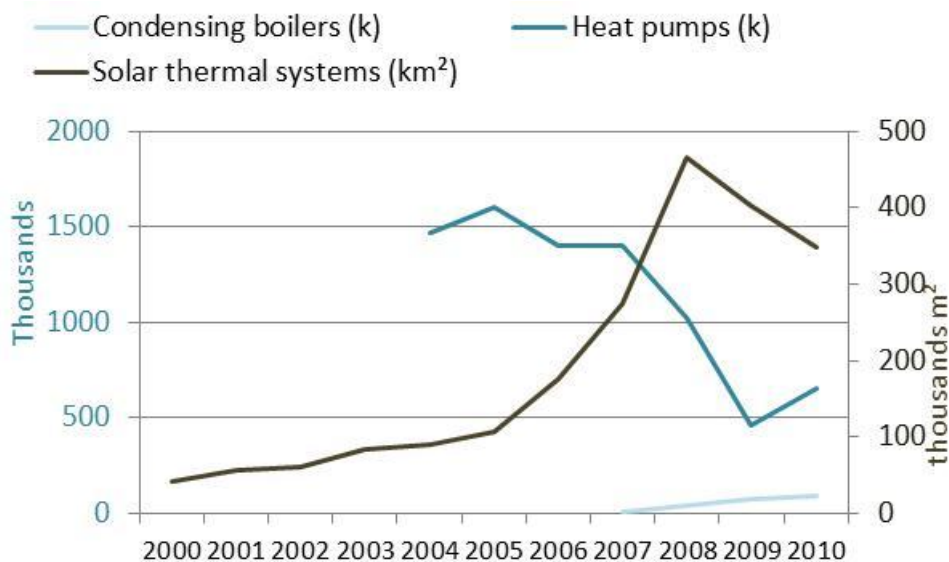
<sup>5</sup> Electric heating is considered as a central system as all the rooms have usually and electric convector.

The diffusion of efficient and renewable heating systems, such as condensing boilers and heat pumps of high efficiency, promoted by several subsidies or tax credits, significantly improve the average heating energy efficiency. The sales of condensing boilers and heat pumps are increasing over time (e.g. gas boilers sales share have increased by 32% between 2009 and 2010). Although the sales of equipments are affected by the crisis, the high efficiency equipments' sales are maintained because new buildings are increasing their energy efficiency.

The sales of heat pumps (Figure 10) include all typologies of equipment: air-air (e.g. residential air conditioning units, rooftops...), air-water (e.g. chillers) and water-water (e.g. ground source heat pumps). This is the reason why the sales number is so huge but all these units cannot be considered like high efficient systems or renewable energy sources.

The sales of solar thermal systems increased significantly since the enforcement of TBC 2006 (Technical Building Code) due to HE4 Section which specifies the minimum requirement of DHW that must be covered by RES. These sales have been affected by the crisis since 2007.

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

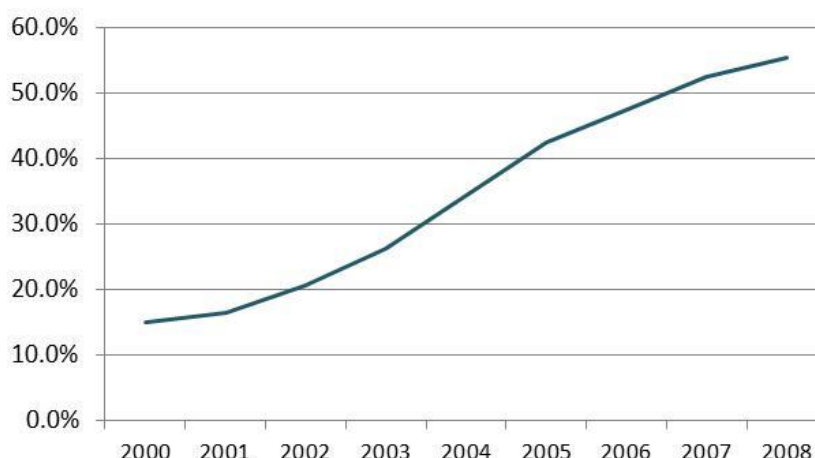


Source: Afec - Fegeca<sup>6</sup>

Diffusion of air conditioning is increasing in the residential sector: the share of dwellings with air conditioning increased from 14.9% to 55.3% in 2008 (Figure 11).

<sup>6</sup> Afec (Air Conditioning Equipment Manufacturers Association) – Fegeca (Manufacturers of Generators and Emission Systems by hot water)

**Figure 11: Penetration of air conditioning in residential stock**

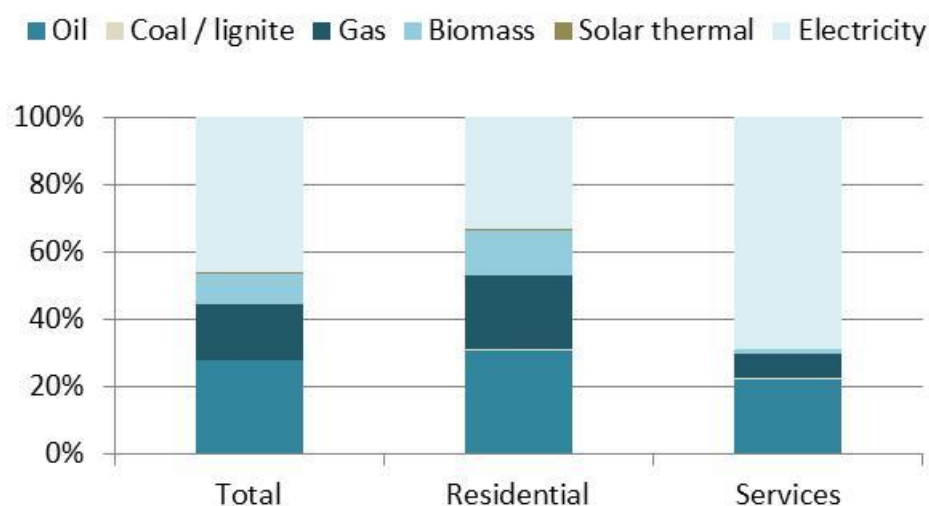


Source: Odyssee

### 3. Energy consumption

Electricity and Oil are the dominant source of energy in Spain buildings with around 46% and 28% (respectively) of the total market (Figure 12). Oil is slowly being phased out and is being substituted by natural gas but still represents 31% in 2008 in residential stock and 23% in services sector. In the service sector, electricity is the dominant source of energy with 69%; its share has increased a lot due to the greater use of electricity especially for information/communication technologies and air conditioning. Gas represents only 7% of total service sector energy consumption.

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

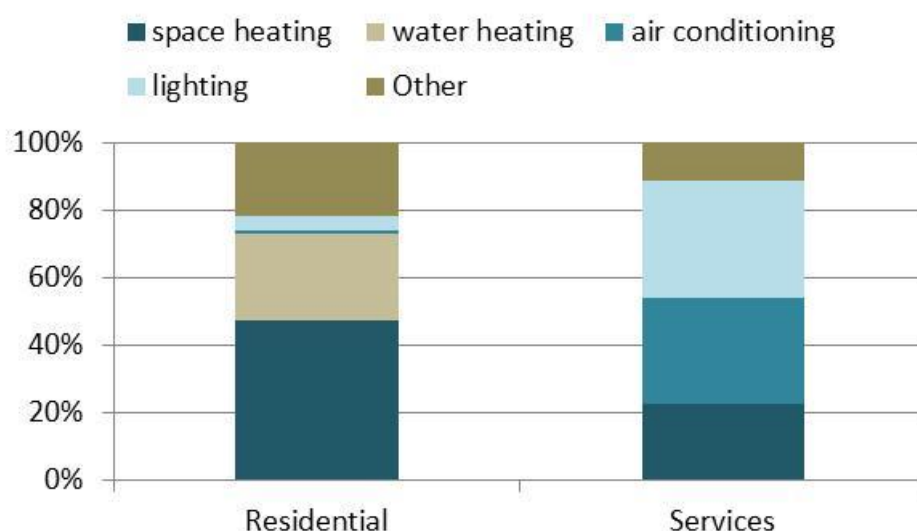


Source: Odyssee and IDAE (Institute for Energy Diversification and Savings. Ministry of Industry, Energy and Tourism of Spain)

Space heating represents the largest share of household energy use: it corresponds on average to almost 50% of total energy consumption. Water heating consumption equals 26% of the consumption. Lighting makes up 4% of household consumption. Air conditioning still represents a marginal share of residential consumption (1%).

In the service sector, space heating represents 23% of total consumption. Air conditioning is much more significant than in the residential sector, and reached 31% of total consumption. On the other hand, lighting represents the most important weight with 35% of the total energy consumption.

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



Source: Odyssee, IDAE (Spain) and University of Seville (Engineers)

## 4. Conclusions

Residential buildings represent 82% of total floor area and the main stakeholders in Spain are owner occupant of multi-family dwellings, with 45% of the total floor area. This last decade, around 5.5 M of residential dwellings have been constructed, i.e. 21% of 2008 total stock (and 31% of main dwellings stock, 17 M).

In Spain, 58% of the dwelling stock existing in 2008 was built after 1980, date of the first thermal regulation (NBE-79). U-values decreased by a minimum of 60% in 30 years, mainly thanks to the last thermal regulation implemented since 2006 (Technical Building Code – 2006).

In Spain almost the entire housing stock is heated by individual heating systems (around 52%). 45% of residential dwellings are heated with gas systems, 34% by electricity, and 16% by oil. Other energy systems are marginal such as biomass and coal (4% and 1% respectively).

Space heating represents the largest share of household energy use: it corresponds on average to almost 50% of total energy consumption. Water heating consumption equals 26% of the consumption. Lighting makes up 4% of household consumption. Air conditioning still represents a marginal share of residential consumption (1%).

In the service sector, space heating represents 23% of total consumption. Air conditioning is much more significant than in the residential sector, and reached 31% of total consumption. On the other hand, lighting represents the most important weight with 35% of the total energy consumption.

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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	Dis- trict heat- ing	Oil	Coal / lignite	Gas	Bio- mass	Solar Ther- mal	Elec- tricity	Total
<b>Residential</b>	0	5.117	0.017	3.639	2.155	0.124	5.414	16.34 1
of which: space heat- ing	0	2.476	0.013	1.785	2.058	0	1.4	7.732
of which: water heat- ing	0	2.152	0.003	1.461	0.101	0.124	0.475	4.192
of which: air condi- tioning	0	0	0	0	0	0	0.15	0.15
of which: lighting	0	0	0	0	0	0	0.703	0.69
of which: cooking	0	0.442	0	0.394	0	0	0.239	
of which: appliances	0	0	0	0	0	0	2.551	
<b>Services</b>	0	2.108	0.003	0.695	0.119	0.029	6.442	9.39
of which: space heat- ing	0	1.737	0.003	0.635	0.119	0	0.494	2.15
of which: water heat- ing	0	-	-	-	-	0.029	-	0
of which: air condi- tioning	0	-	-	-	-	-	-	2.90
of which: lighting	0	-	-	-	-	-	-	3.28
of which: equipments	0	-	-	-	-	-	-	1.03

Source: Odyssee, IDAE (Institute for Energy Diversification and Savings. Ministry of Industry, Energy and Tourism of Spain) and University of Seville (Engineers)