The challenges, dynamics and activities in the building sector and its energy demand in the Czech Republic

D2.1 of WP2 from Entranze Project

Written by:

Petr Zahradník, Jiří Karásek and Zuzana Šestáková
SEVEn

Carine Sebi

Enerdata

Reviewed by:

Diana Paunova and 'Zdravko Georgiev

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	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
	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.

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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 building stock area in the Czech Republic is almost 400 Mm2 from which more than 75% is related to residential building stock and the rest relates to service sector (about 25%, see Figure 1 and Table 1). In the residential buildings live about 10,2 million inhabitants. In total there are about 4 million flats, from which about 60% are in multi family buildings and 40% in single family houses. In terms of residential floor area, multi family buildings have about 45% and remaining 55% comes to single family ones. This difference logically comes from average floor area of flats in multi family buildings and single family houses. In case of single family houses, detached houses are most typical (about 80%), semi-detached houses (5%) and row houses (15%) are not typical.

The housing stock in the Czech Republic was constructed gradually in approximately 6 500 cities and villages. About 1.2 million flats are situated in panel buildings (pre-cast concrete structure) constructed after 1950. Almost 70% of them were built in 1960´s and 1970´s. This type of housing is typical for the country.

Quite important advantage in standardized, repeatedly built apartment buildings, made of pre-cast concrete panels can be found. Those building systems are typical for multi-story blocks of flats in Eastern Europe and former Soviet Union countries. The relevant energy efficient measures can be designed once and used repeatedly for number of similar construction systems.

Figure 1: Decomposition of buildings by type (2008[1])
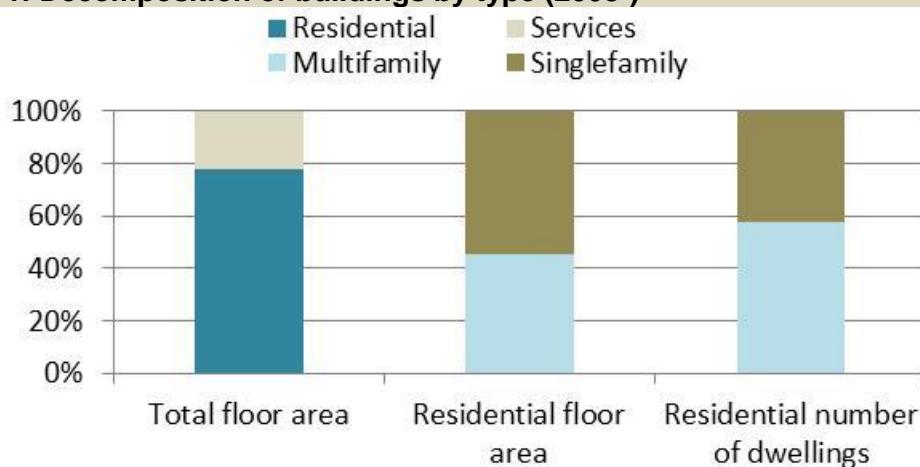
Source: Odyssee, estimations of SEVEn´s experts

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[1] 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 (M m2)
Total Residential	**3 993**	**305**
Multi-family	2 294	136
Single-family	1 699	170
Service		**89**

Source: Odyssee

Figure 2 represents the distribution of the total building floor area according to the status of occupation. Before services (about 24%), the main building stakeholders in the Czech Republic are owner occupants of single-family houses, with 37% of the total floor area and owner occupants of multi-family buildings with about 29%. Social rental housing is not common in the country and stays at last position (about 2% in total). Social housing in the Czech Republic is provided by some municipalities for poorer citizens. Private rental apartments make up 4% of total floor space. Rented single-family dwellings make up 4% as well.

Figure 2: Breakdown of floor area by ownership structure (2008)[2]
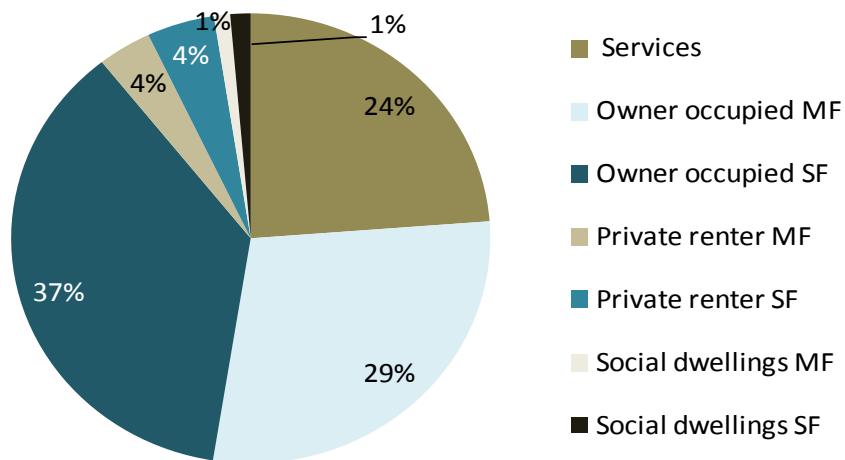
Source: Eurostat, Odyssee, Czech Statistical Office, estimations of SEVEn´s experts

Between 2000 and 2010, 30 000 of residential buildings have been constructed, i.e. 38 Mm[2] of floor area. In 2007 and 2008, huge boom in building sector was conscious.

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[2] explanation for the figure MF: Multi-family dwellings ; SF: single family dwellings.

After that, because of the global economic crisis, the statistical data show recession in construction sector, i.e. both in residential and service one (Figure 3). Over the period 2006-2010, one third of the new floor area constructed has been in the service sector. Data for service sector before year 2006 are not available, estimation would be extremely rough and inappropriate.

Figure 3: Dynamics of building construction
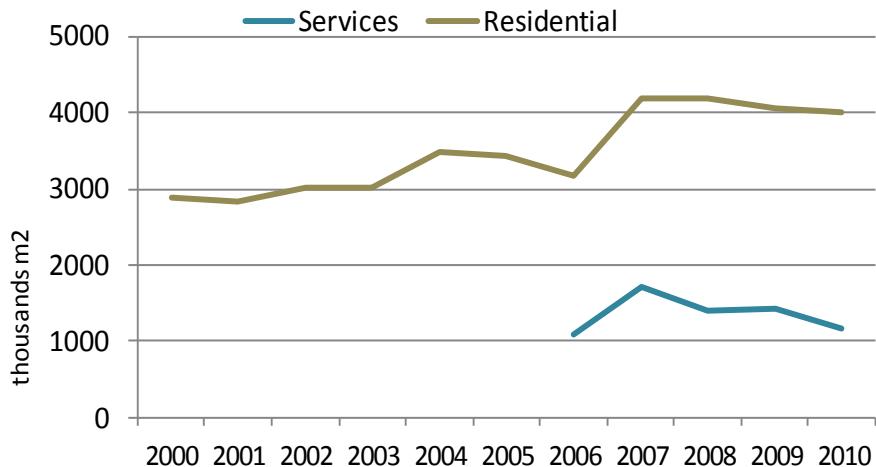
Source: ODYSSEE, Czech Statistical Office, estimations of SEVEn´s experts

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 with one exception (multi family buildings built especially in 1970´s were usually built in bad quality in terms of energy efficiency – concrete panel structure with low amount of insulation). But in general, the higher the share of recent dwelling, i.e. built with more efficient standards, the higher the energy performance of the stock. In the Czech Republic, 71% of the dwelling stock existing in 2008 was built till 1970´s, when the first thermal regulation was fully working (Figure 4).

Figure 4: Residential dwellings according to construction date (2008)[3]
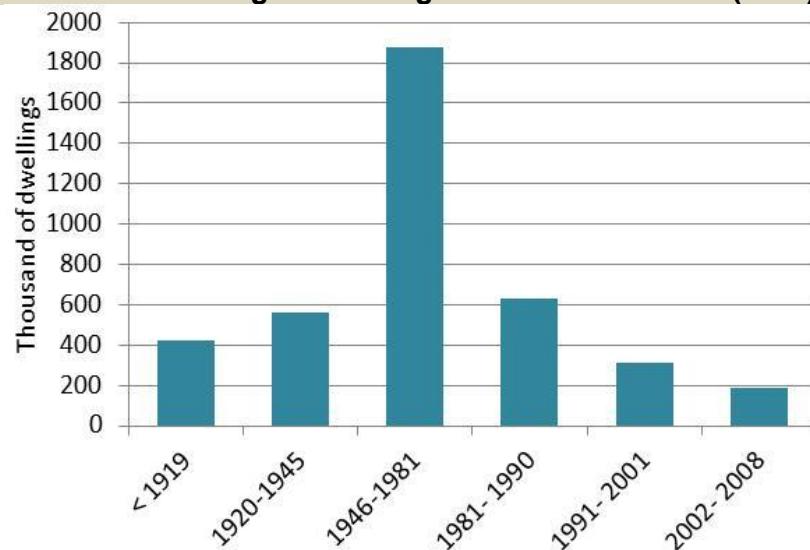
Source: BPIE, TABULA (No of buildings) , Czech Public Census 2001, Czech Statistical Office

Owner occupants are absolutely dominant in residential buildings, with a bit more than 80% in case of single family houses and slightly less than 80% in case of multi family single-family dwellings. Other categories are minor (Figure 5).

Figure 5: Breakdown of ownership & tenure (2008)
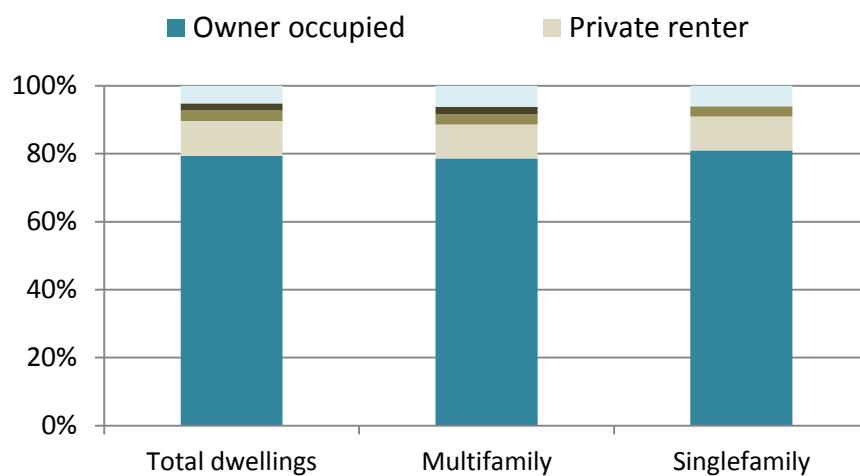
Source: Eurostat, calculations according to Czech Statistical Office data

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[3] The age categories correspond to typical construction eras in the Czech Republic

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 the Czech Republic, U-values have decreased in several periods. At the end of 1970´s, first standard related to U-value requirements was introduced.

Figure 6: U-values by construction period (multifamily and single family, 2008)
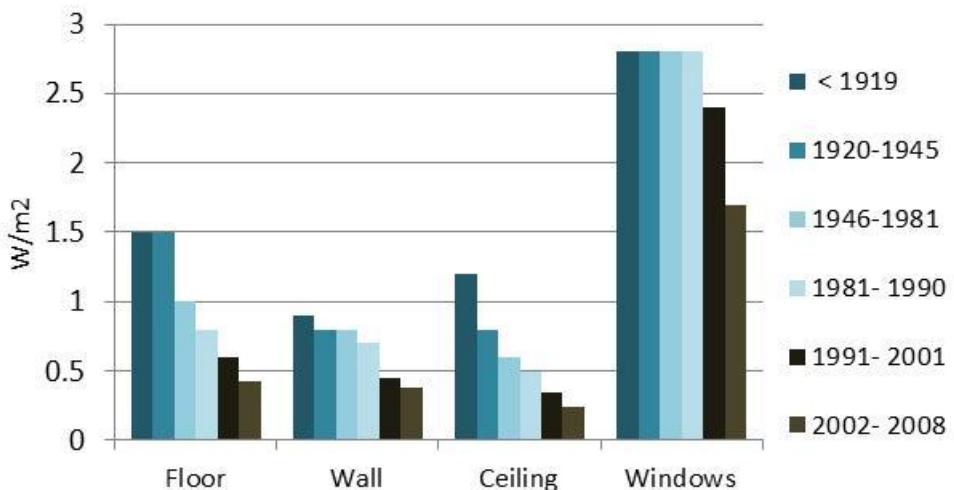
Source: BPIE, Czech technical standard ČSN 73 0540 Thermal protection of buildings

1.3   Service sector

Offices (about 40%) and wholesale and retail trade (about 18%) represent the highest share of total service sector floor area in 2008. Education buildings (14%) and health (6%) follow. Other types of buildings have about 21% share.

Figure 7: Decomposition of service building areas by type (2008)
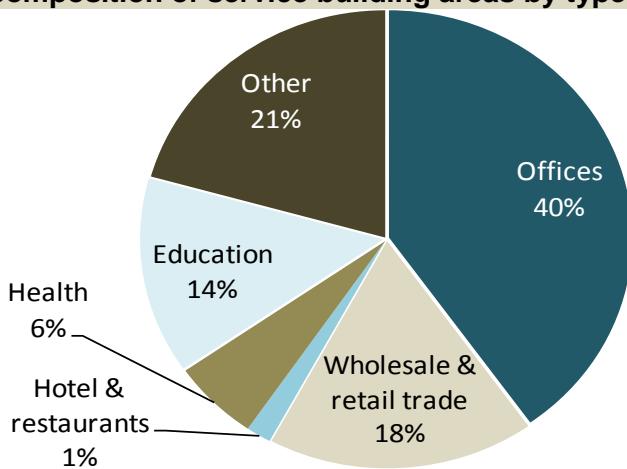
Source: Odyssee, national Public Census 2001, Czech Statistical Office

2. Space heating and cooling systems

District heating is the most widespread (about 55%) system of heating in multi family buildings, followed by natural gas heating (35%). In case of single family houses, majority is on natural gas heating (about 40%) followed by coal and district heating.

In service sector, the most important energy source is gas (about 50%) and also district heating (about 35%).

Figure 8: Dwelling stock according to space heating systems by energy (2008)
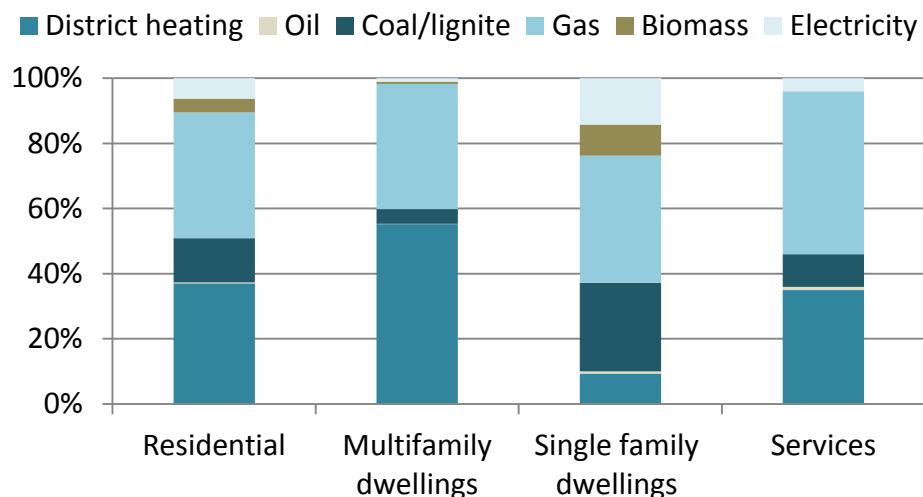
Source: SEVEn´s experts estimations and calculations based on experience

Figure 9 shows the penetration of heating systems. In the Czech Republic almost the entire housing stock is heated by central heating systems[4]: room heating has almost disappeared, except in rural areas in single family dwellings. Collective heating systems[5] represent around 75% of multi-family dwellings. Altogether, about 50% of all dwellings have an individual central heating system.

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

Figure 9: Dwellings according to centralisation of heat supply (2008)
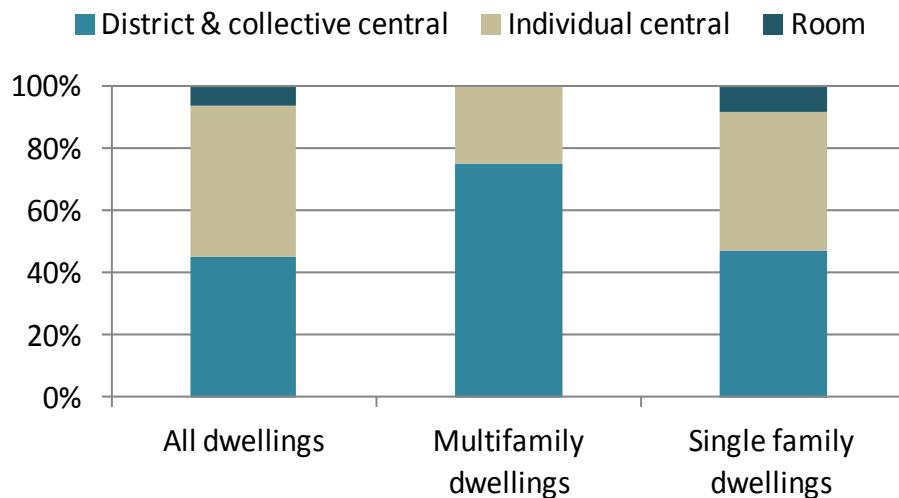
Source: Odyssee, SEVEn´s experts estimations and calculations based on experience

The diffusion of efficient and renewable heating systems, such as condensing boilers and heat pumps, partly promoted by subsidy program *Greenlight to savings*, significantly improve the average heating energy efficiency. Especially the sales of heat pumps and biomass are on huge increase. Detailed data on concrete types of heat pumps, biomass boilers used are not available.

Figure 10: Sales of energy efficient and renewable systems in recent years
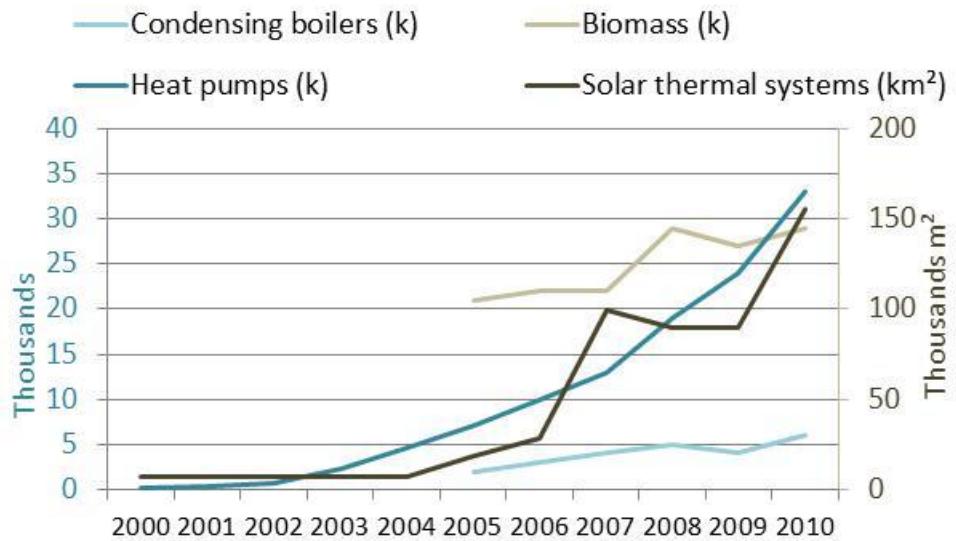
Source: Odyssee, Czech heat pump association, own calculations, http://vytapeni.tzb-info.cz/zdroje-tepla/7382-prodej-kotlu-o-vykonu-do-50-kw-v-cr-v-roce-2010

Diffusion of air conditioning is steadily increasing in the service sector with stable increase from 5% in 2000 to 20% in 2010. The share of dwellings with air conditioning increases as well, but very slowly and it could be said that the change is negligible (Figure 11). Detailed statistics is not available, the data are based on experts estimations.

Figure 11: Penetration of air conditioning[6]
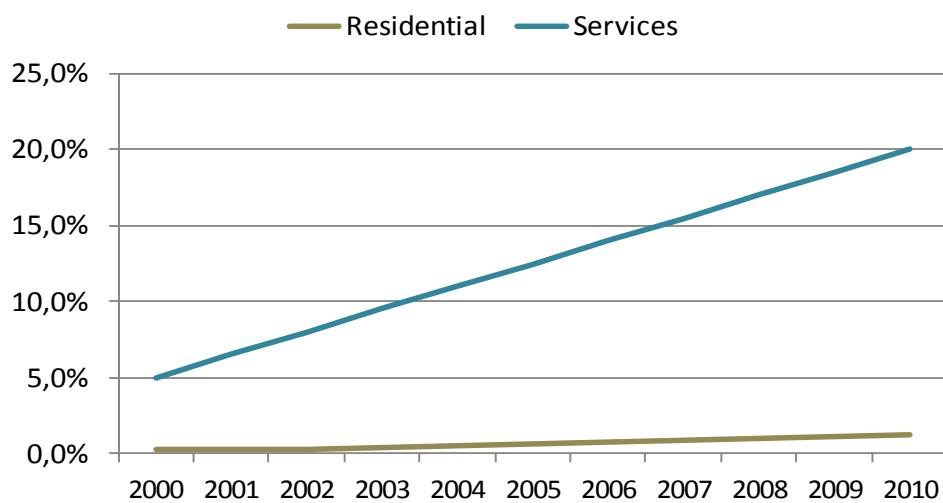
Source: estimation of SEVEn´s experts

3. Energy consumption

Natural gas (40%) and electricity (25%) are the dominant sources of energy in the Czech Republic (Figure 12). Third highest consumption can be identified by heat from district heating for both residential and service sectors. In residential sector, biomass and coal are identified as well.

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[6] % of residential stock and service stock.

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Figure 12: Total energy consumption of the building sector (2008)
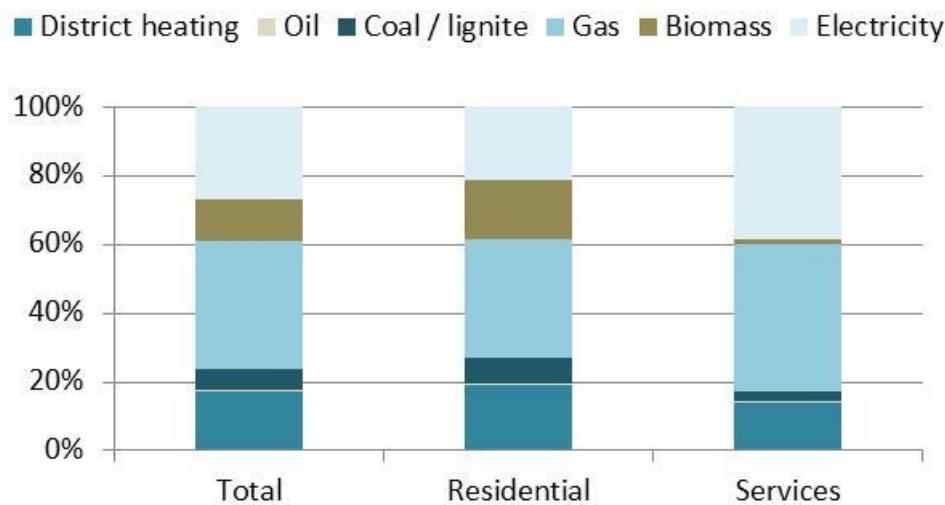
Source: estimation of SEVEn´s experts

Space heating represents the largest share of household energy use. It corresponds on average to almost 80% of total energy consumption. Water heating consumption equals to almost 20% of the residential buildings consumption respectively to 10% of service sector consumption. Air conditioning consumes about 8% in service sector. Lighting is minor in all cases.

Figure 13: Total energy consumption by end-use (2008, real climate)
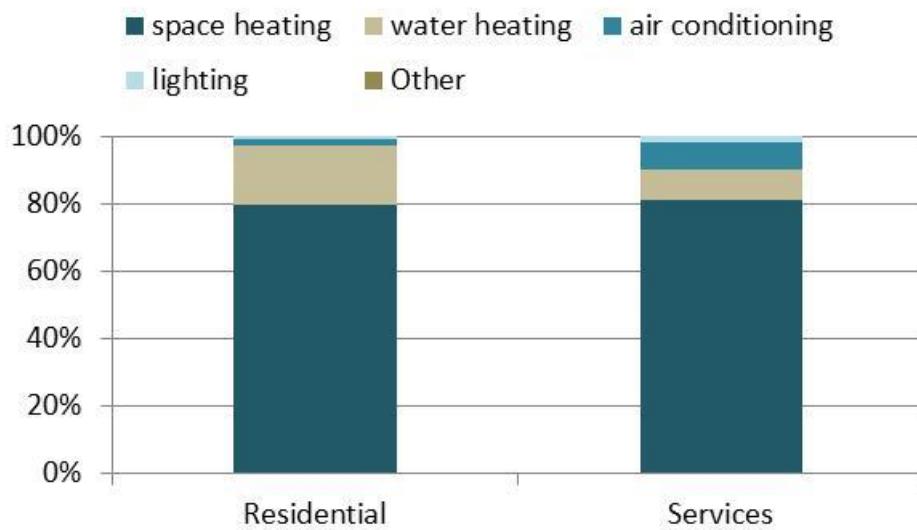
Source: estimation of SEVEn´s experts

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

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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 the Czech Republic, several thermal regulations were implemented and updated since the 1970's. The last thermal regulation implemented in the country in 2007 implies a specific consumption almost four times lower than the first thermal regulation implemented in the mid 70's. The regulation proposal that is being discussed in the Czech Republic nowadays should go further in the requirements.

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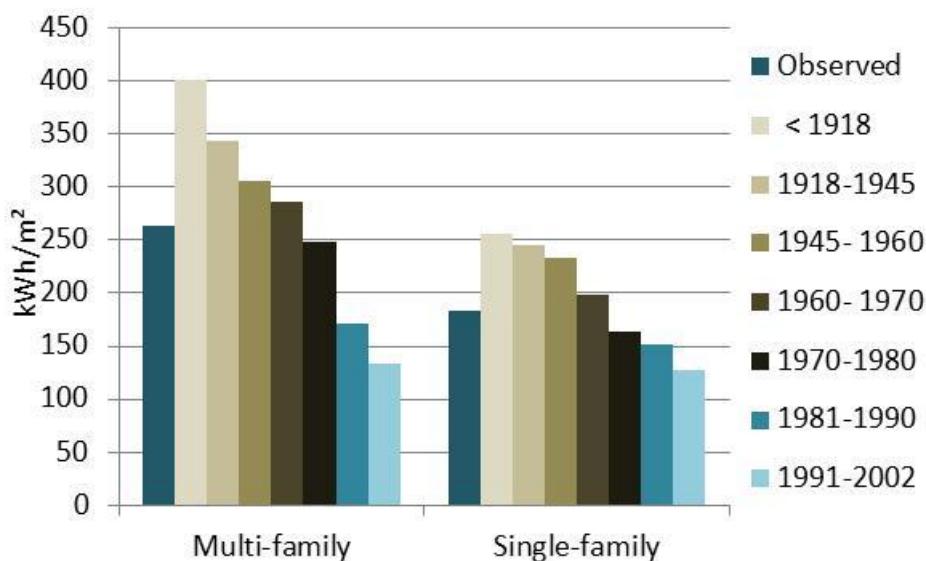

Source: SEVEn´s experts estimations and calculations

4. Conclusions

Residential buildings represent 76% of total floor area and the main stakeholders in the Czech Republic are owner occupants of single family dwellings with 37% and owner occupants of multi family dwellings with 29% of the total floor area.

In last decade, about 30 000 of residential dwellings have been constructed. Concrete panel multi family buildings are most typical for the Czech residential stock. They were built especially in periods of 1970´s and 1980´s.

U-values were decreased by implemented by several updated regulations since 1970´s. Especially wall, floor and ceiling (roof) insulation requirements were strengthened.

In the Czech Republic, almost the entire housing stock is heated by central heating systems. District heating is the most widespread (about 55%) system of heating in multi family buildings, followed by natural gas heating (35%). In case of single family houses, majority is on natural gas heating (about 40%) followed by coal and district heating.

Water heating consumption equals to almost 20% of the residential buildings consumption. Air conditioning still represents a marginal share of residential dwelling consumption. Diffusion of air conditioning is almost negligible in the residential sector. The sales of biomass boilers and heat pumps are increasing rapidly in recent years over time.

In the service sector, space heating and water heating represent 80% respectively 10% of total consumption. Air conditioning is more significant than in the residential sector, and reached about 8% of total consumption. Lighting is marginal.

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6. Appendix

Table 2: Total energy consumption by sector (2008)

Mtoe	District heating	Oil	Coal / lignite	Gas	Biomass	Electricity	Total
Residential	**1.15**	**0.02**	**0.46**	**2.05**	**1.06**	**1.26**	**5.99**
of which: space heating	0.74	0.01	0.43	1.69	1.01	0.13	4.00
of which: water heating	0.40	0.00	0.02	0.19	0.02	0.25	0.88
of which: air conditioning	0.00	0.00	0.00	0.00	0.00	0.00	0.10
of wich: lighting						0.04	0.04
Services	**0.43**	**0.02**	**0.08**	**1.33**	**0.05**	**1.20**	**3.10**
of which: space heating	0.27	0.01	0.05	0.83	0.03	0.75	2.16
of which: water heating	0.08	0.00	0.01	0.24	0.01	0.21	0.24
of which: air conditioning	0.00	0.00	0.00	0.00	0.00	0.08	0.21
of wich: lighting						0.05	0.05

Source: Odyssee

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