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III.

Long-term renovation strategy to support the renovation of the national stock of both public and private residential and non-residential buildings

in accordance with Article 2a of Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings, as amended by Directive (EU) 2018/844 of the European Parliament and of the Council of 30 May 2018

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The Long-Term Renovation Strategy to Support the Renovation of the National Stock of Both Public and Private Residential and Non-Residential Buildings (hereinafter the 'Long-Term Strategy') was developed as required by Directive (EU) 2018/844 of the European Parliament and of the Council of 30 May 2018 amending Directive 2010/31/EU on the energy performance of buildings and Directive 2012/27/EU on energy efficiency (hereinafter 'revision of the Directive 2010/31/EU'). The Long-Term Strategy is one of the tools to achieve a sustainable, competitive, safe and decarbonised system for the building sector, which despite the policies already in place and investments already made to improve the energy performance of buildings still accounts for 40% of the EU's final energy consumption. A comprehensive framework should increase the number of renovations and their complexity, and thus help transform the building stock into a highly energy-efficient one.

The Long-Term Strategy is based on the Building Renovation Strategy of December 2016 prepared in accordance with Article 4 of Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC (hereinafter 'Directive 2012/27/EU'). However, it is more complex, for example, in terms of requirements for a policy proposal reflecting the identified barriers to the implementation of building renovations, market failures, etc. (for a comparison of the requirements for the Building Renovation Strategy and the Long-Term Strategy, see Annex 1). It aims to support the cost-effective transformation of existing buildings by setting up appropriate financial mechanisms that will mobilise private investment.

The output of the Long-Term Strategy is a proposal of a cost-effective scenario for the renovation of the Czech building stock comprising the residential, public and private sectors with measurable indicators of progress and with relevant policies, as a result of which the milestones and objectives of building renovation in the Czech Republic will be achieved.

The optimal scenario is reflected in the National Energy and Climate Plan of the Czech Republic, with the required milestones expressed in the specific energy consumption for heating based on Regulation (EU) 2018/1999 of the European Parliament and of the Council of 11 December 2018 on the Governance of the Energy Union and Climate Action, amending Regulations (EC) No 663/2009 and (EC) No 715/2009 of the European Parliament and of the Council, Directives 94/22/EC, 98/70/EC, 2009/31/EC, 2009/73/EC, 2010/31/EU, 2012/27/EU and 2013/30/EU of the European Parliament and of the Council, Council Directives 2009/119/EC and (EU) 2015/652 and repealing Regulation (EU) No 525/2013 of the European Parliament and of the Council.

Optimal	**2020**	**2030**	**2040**	**2050**
final energy consumption in the given year [PJ]	373	345	316	289
single-family houses	161	149	136	123
apartment buildings	88	83	78	73
public and commercial buildings	124	113	102	93
energy savings compared to baseline 378 PJ [PJ]	-5	-33	-62	-89
investment costs in the given year [CZK billion]	24	26	28	23
cumulative investment costs [CZK billion]	93	356	614	856
single-family houses	47	168	282	388
apartment buildings	13	45	76	105
public and commercial buildings	33	142	256	362
Specific heat required for space heating [MJ/(m2.year)]	**493**	**426**	**368**	**325**

To support the implementation of the optimal scenario, the State will introduce legislative measures (transposition of European requirements), fiscal measures (support programmes in the field of both investment and soft measures) and other measures, especially of an educational and informational nature. Fiscal measures are also the State's instruments for fulfilling the commitment to increase energy efficiency in accordance with Article 7 of Directive 2012/27/EU. However, it is not possible to precisely identify the contribution of this commitment of the Czech Republic, which is set at 462 PJ of cumulative final energy consumption savings in the period 2021–2030, because Article 7 of Directive 2012/27/EU concerns calculated energy savings, whereas the document uses real development of final energy consumption, which is influenced by many factors.

The Long-Term Renovation Strategy was to be submitted as an annex to the National Energy and Climate Plan of the Czech Republic. Due to a timing disharmony of the requirements of European regulations, this requirement has not been met and it will be met subsequently. At the same time, the approval of the submitted material will fulfil the preconditions, the fulfilment of which is a prerequisite for the effective drawing of funds from the European Structural and Investment Funds (hereinafter the 'ESI Funds').

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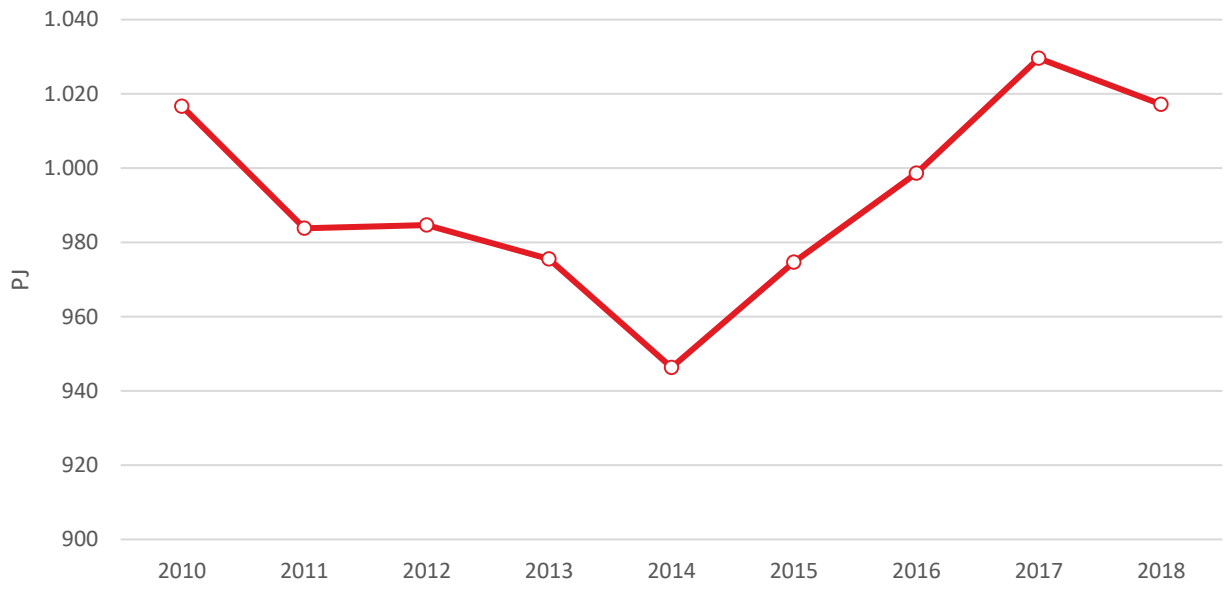
Contents

1 Final energy consumption trend in the Czech Republic

The analysis of energy consumption showed a year-on-year increase in final energy consumption in 2014–2017. Consumption in 2018 disrupted this trend, falling by 1.2% year-on-year, which in absolute terms was a decrease of 12 PJ[1]. According to the updated aggregate energy balance of the Czech Republic prepared according to the revised Eurostat methodology, the final energy consumption in 2018 was 1 017 PJ[2]. The previous year-on-year increase in final energy consumption caused an increase in consumption in all sectors of the economy.

Chart 1: *Development of final energy consumption, 2010–2018*

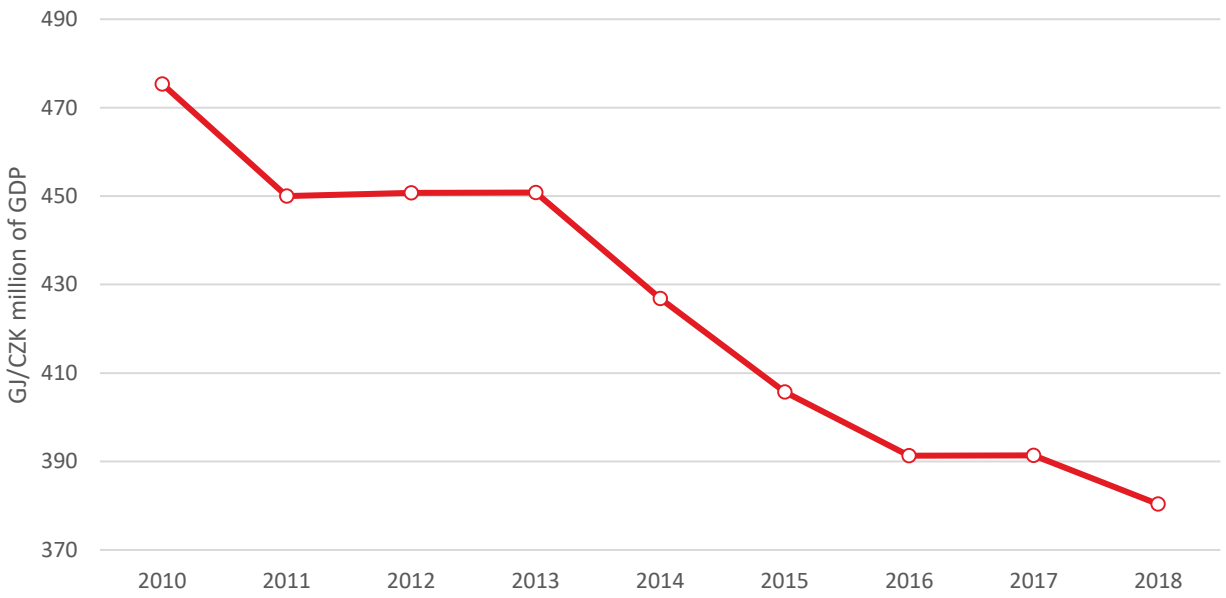


Source: Ministry of Industry and Trade

However, the fundamental fact is that, despite the prevailing growth trend, final energy consumption has been declining in the long-term. In 2018, the level of energy intensity decreased by 2.8%, reaching 380 GJ/CZK million of GDP[3].

[1]A detailed analysis of the causes of the decline in final energy consumption has yet to be carried out.
[2] The level of final energy consumption corresponds to the aggregate energy balance of the Ministry of Industry and Trade, which was prepared on the basis of the new Eurostat methodology.
[3] Gross domestic product at 2010 market prices (source: Eurostat).

***Chart 2**: Developments in the energy intensity, 2010–2018*



Source: Ministry of Industry and Trade

***Table 1:** Current primary and final energy consumption in the economy and by sector*

	unit	2015	2016	2017	2018
Consumption of primary energy sources	TJ	1,747,169	1,726,589	1,801,855	1,801,091
Total final energy consumption	TJ	974,675	998,603	1,029,584	1,017,197
Final energy consumption by sector:					
industry	TJ	272,283	268,682	281,257	279,536
transport	TJ	259,388	268,680	277,019	278,836
households	TJ	289,716	302,989	308,160	300,081
services	TJ	124,740	129,546	133,349	131,031
Final energy consumption according to Europe 2020–2030 methodology	TJ	1,013,075	1,039,286	1,067,029	1,060,034
Gross value added by sector – 2005 prices:					
Industry	CZK million	1,451,040	1,467,826	1,577,095	1,598,643
Services	CZK million	2,142,527	2,210,852	2,273,216	2,366,217
Gross value added by sector – current prices:					

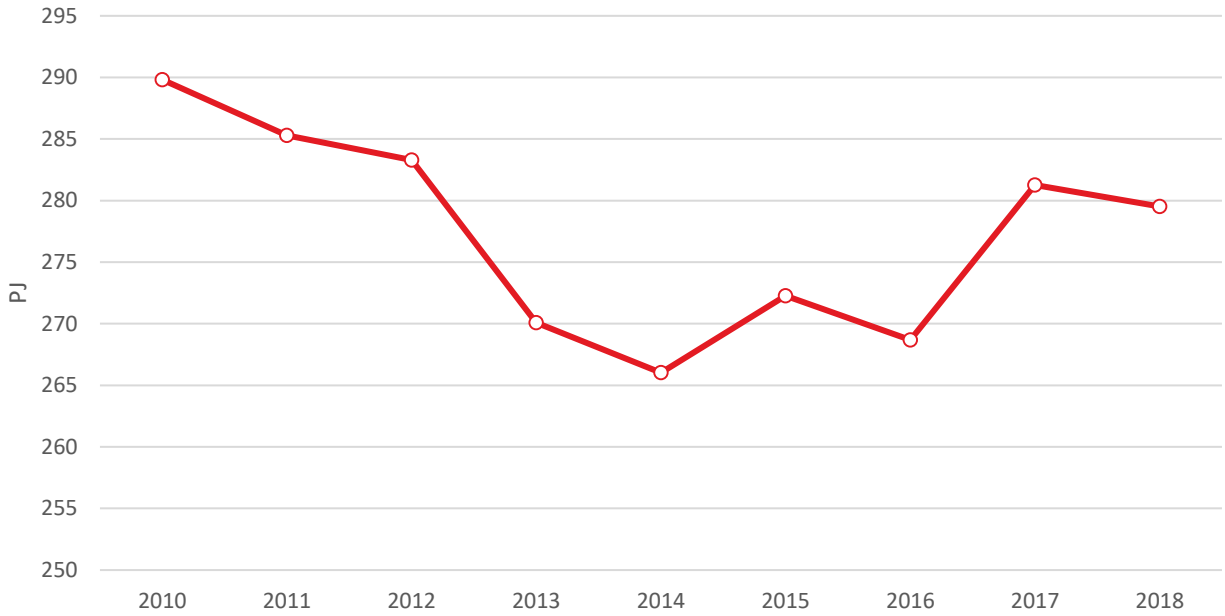
Industry	CZK million	1 562 192	1 600 393	1 676 537	1 715 166
Services	CZK million	2 470 997	2 586 987	2 748 756	2 969 060
Available household income	CZK million	2 383 321	2 474 370	2 575 885	2 761 123
Gross domestic product (GDP) – 2005 prices	CZK million	4 002 966	4 101 060	4 279 563	4 401 362
Gross domestic product (GDP) – current prices	CZK million	4 595 783	4 767 990	5 047 267	5 323 556
Production of electricity from heat power plants	GWh	77 984	77 479	81 226	82 384
Production of electricity from cogeneration	GWh	42 424	42 904	43 849	43 484
Production of heat from heat energy sources	TJ	121 233	127 519	122 851	118 123
Production of heat from cogeneration incl. waste heat from industrial processes	TJ	95 794	99 906	95 618	91 085
Consumption of fuel for the energy production from heat energy sources	TJ	904 638	889 375	924 494	933 186
Passenger-kilometres	pkm million	113 814	118 957	124 165	129 967
Tonne-kilometres	tkm million	76 613	68 172	62 936	60 327
Population (mean)	person	10 542 942	10 565 284	10 589 526	10 625 695

Source: 7. Progress report on meeting national energy efficiency targets in the Czech Republic

Table 1 shows the share of the most energy-intensive sectors; industry, transport, households and services. The largest share, namely 30% of the total final consumption in the Czech Republic, is consumed by households[4], i.e. single-family houses and apartment buildings. A household's final consumption represents the amount of energy needed to cover the energy needs associated with the use of the building, in particular for heating, cooling, ventilation, air humidity control, hot water production and lighting, but it also includes consumption by household appliances. The primary share of final consumption in households is used for heating, which accounts for more than 69% of final energy consumption.

[4] According to the CZSO, a household is a residential household consisting of persons living in one apartment. An apartment is generally understood to be a room or a set of rooms and their accessories that serve or are intended for permanent living and usually form one building and technical unit. The representation of apartments in the residential sector is presented in more detail in Chapter 2.1. 'Residential *sector'*.

Chart 3: *Development of final energy consumption in industry, 2010–2018*



Source: Ministry of Industry and Trade

The second most energy-intensive sector is industry, where production and technological processes are also included in addition to the amount of energy needed to cover the energy needs associated with the use of the building. The same is true for the service sector, where final consumption includes energy consumption associated with the use of the building and the technological processes. However, neither for services nor for industry can it be statistically separated whether it is the final energy consumption in buildings or in technological processes.

From the above it can be concluded that buildings in the Czech Republic represent one of the sectors with significant potential for energy savings, especially due to the substantial share of energy consumption in the residential sector. The objective of this document is to determine the real potential for reducing energy consumption in the building sector and the possibilities of its use.

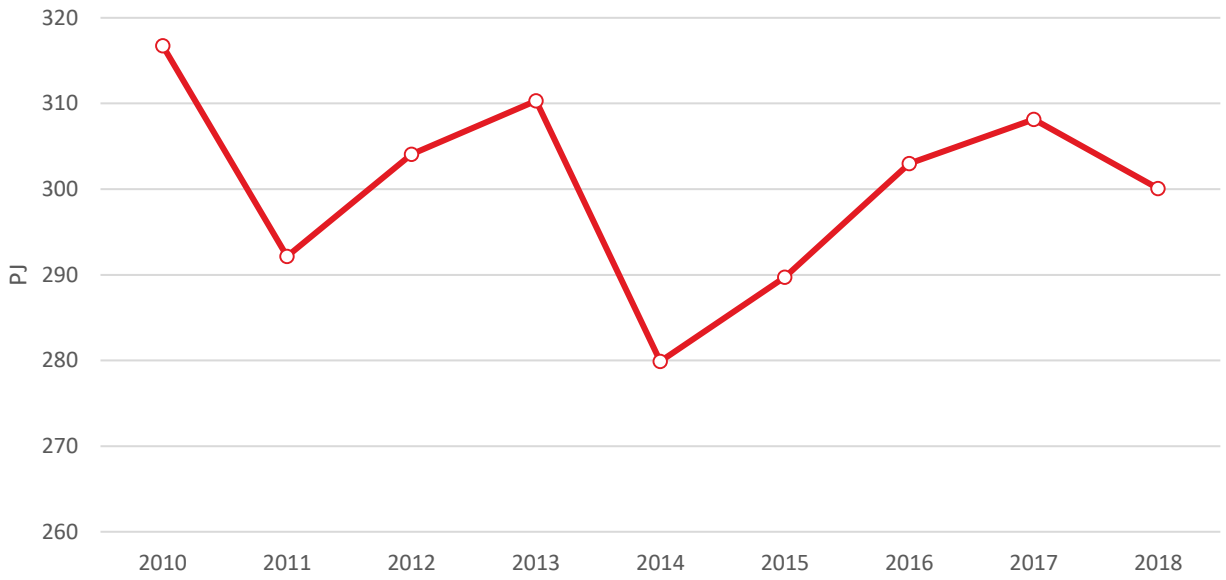
1.1 Final energy consumption of the residential sector

In the area of the residential sector, the Czech Republic has information on final energy consumption in households[5], energy consumption for heating[6], construction of individual housing units and other data that affect the trend of final energy consumption in this sector.

[5] Based on statistical information, a household's final consumption represents the amount of energy needed to cover the energy needs associated with the use of the building, in particular for heating, cooling, ventilation, air humidity control, hot water preparation and lighting, including the consumption of household appliances.

[6] Ministry of Industry and Trade data collection for EUROSTAT report 'Questionnaire for statistics on final energy consumption in households'

Chart 4: *Final energy consumption in the household sector, 2010–2018*

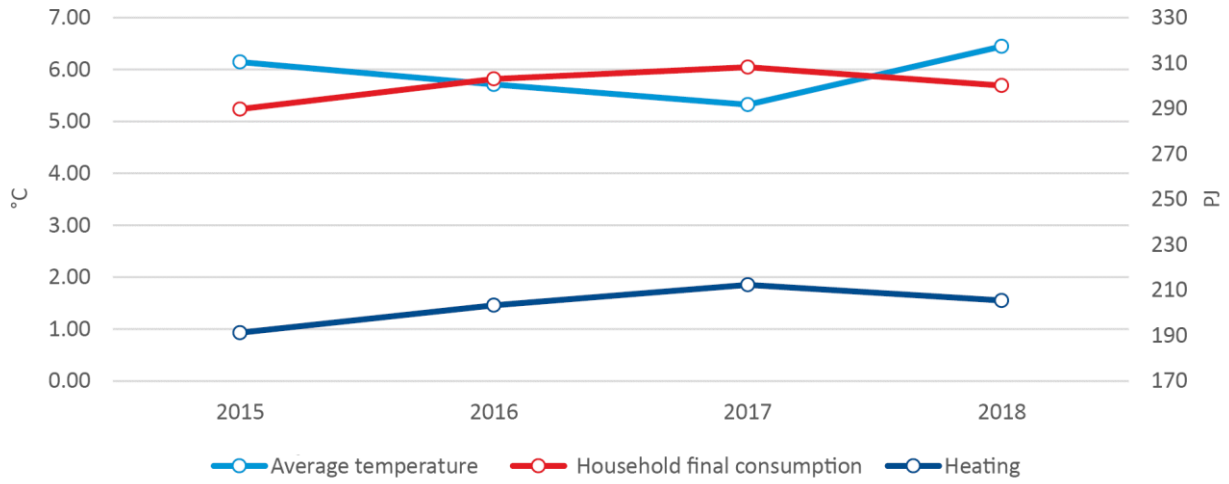


Source: Ministry of Industry and Trade – State Energy Balance

Energy consumption in the household sector decreased by 2.6 % year-on-year in 2018, reaching around 300 PJ. The energy intensity of households expressed per housing unit has also decreased. In 2018, it decreased by 3% year-on-year and reached 70.9 GJ/apartment.

Energy consumption in the household sector is mainly affected by climatic conditions. The link between the development of the average temperature during the heating months for a given year, the amount of final energy consumption of households or the energy consumption for heating can be seen in Chart 5 below.

Chart 5: *Influence of the average temperature in the heating months[7] on the final energy consumption for household heating*



Source: Own processing based on MIT and CHMI data

Households in the Czech Republic as a whole in the years 1994–2018 consistently accounted for more than a quarter of the total final energy consumption of the Czech Republic with an average of 28.3%[8]. The overall trend during this period was an increasing one, with an average of 288 PJ. The fact that their final energy consumption was not *de facto* reduced, despite the support from public funds for measures to improve the energy performance of houses, was caused by the high annual share, consistently more than half since 2010, of single-family houses, which are the most energy-intensive form of housing, among newly-completed dwellings in. In contrast, only 30% of newly-completed dwellings in the past twenty years were in apartment buildings, which are a more environmentally friendly and economical form of housing. Other factors that influence the development of energy consumption in the residential sector are the decline in the number of people living in any given housing unit. In terms of demography, consumption is influenced by an increase in population and in disposable household incomes, which leads to an increasing standard of living and influences consumer behaviour with an impact on energy consumption.

2 Evaluation of the national building stock

The primary source of statistical data for the evaluation of the building stock is the Czech Statistical Office (hereinafter the 'CZSO'). For single-family houses and apartment buildings, data was in particular obtained from the 2011 Population and Housing Census. For non-residential buildings, data from the 2018 survey of Buildings 1-99 were used. Additional data sources were other CZSO surveys (e.g. Energo 2015), statistics of

[7]The heating season begins on September 1 and ends on May 31 of the following year. With regard to the annual energy balance statistics, the average temperature was calculated for January to May and September to December of the given year.

[8] *Data source: Eurostat (last update on 24 February 2020) for the years 1994–2009, MIT (Aggregate Energy Balance of the Czech Republic) for the years 2010–2018.*

building authorities or the ENEX database managed by the MIT (a database containing records of documents processed by energy specialists). For the needs of the Long-Term Strategy, information from energy performance certificates of buildings (hereinafter the 'EPC') was used.

Another factor entering the evaluation of the building stock of the Czech Republic is the development of new additions to the building stock. With regard to the obligation arising from Section 7 of Act No 406/2000, on energy management, as amended (hereinafter 'Act No 406/2000'), which requires the builder to demonstrate compliance with energy performance requirements of buildings at a cost-optimal level from 1 January 2013, or with a general obligation to meet the requirements for a building with almost zero energy consumption from 1 January 2020, new construction does not enter into the input data of the model for setting building renovation scenarios. In the case of newly built buildings, it is assumed that the obligations on the energy performance of buildings will be met, i.e. that at the time of setting a long-term renovation strategy, they will have no significant impact on the modelling of building renovation scenarios.

2.1 Residential sector

2.1.1 Overview of building stock

2.1.1.1 Single-family houses

The following tables show the numbers of houses, apartments and the floor area of occupied single-family houses in the Czech Republic based on data from the 2011 Housing and Population Census (hereinafter the '2011 Census').

Table 2: *Total number of single-family houses in each category*

Number of floors	Total number of buildings [-]	single-family house individual [-]	single-family house semi-detached [-]	single-family house terraced [-]
Total	**1,554,794**	1,163,655	133,877	257,262
	100.0%	74.8%	8.6%	16.5%
1	**584,075**	456,426	38,885	88,764
2	**861,774**	630,737	86,757	144,280
3	**45,995**	24,753	4,783	16,459
not determined	**62,950**	51,739	3,452	7,759

Table 3: *Total number of apartments in single-family buildings in each category*

Number of floors	Total number of apartments [-]	single-family house individual [-]	single-family house semi-detached [-]	single-family house terraced [-]
Total	**1,896,931**	1,417,272	170,847	308,812
	100.0%	74.7%	9.0%	16.3%
1	**638,573**	496,998	45,605	95,970

2	**1,115,606**	823,789	113,086	178,731
3	**72,404**	39,216	7,918	25,270
not determined	**70,348**	57,269	4,238	8,841

Table 4: *Total internal floor area of single-family houses in individual categories*

Number of floors	Total internal area of single-family houses [m^2]	single-family house individual [m^2]	single-family house semi-detached [m^2]	single-family house terraced [m^2]
Total	**194,957,505**	146,673,210	16,405,534	31,878,760
	100.0%	75.2%	8.4%	16.4%
1	**59,426,442**	46,791,207	3,843,967	8,791,268
2	**122,834,323**	91,633,017	11,428,145	19,773,160
3	**7,941,825**	4,398,222	831,822	2,711,781
not determined	**4,754,915**	3,850,763	301,600	602,551

Source: 2011 Census

According to its terminology, the CZSO distinguishes the total area as the sum of the areas of all rooms in the apartment measured inside the perimeter walls. Therefore, in relation to the total internal floor area used as a matter of standard in calculations of the energy performance of buildings, the total area indicated in the statistics on the Czech Republic's housing stock is always smaller. In single-family buildings, the difference is the floor area taken up by partitions or shafts, and in apartment buildings this difference also includes communal areas (corridors and staircases). The total internal floor area given in the tables is obtained for family houses by adding 10% to the total area of occupied apartments in order to approximate the size of the area to the energy reference area defined by Act No 406/2000, which affects the energy performance of buildings in accordance with Decree No 78/2013, on the energy performance of buildings, as amended (hereinafter 'Decree No 78/2013').

Table 5: *New construction and demolition of single-family houses*

	Until 95% of the total floor area of single-family houses is renovated
Rate of new construction	1.11%*
Rate of demolition	0.20%

Source: Own processing, using data of the CZSO[9]

The numbers of houses and apartments from the 2011 Census can be partially updated with the help of CZSO data on housing construction in the Czech Republic, i.e. statistics on newly completed dwellings. After conversion to single-family houses, we can monitor the approximate development of the single-family house stock (after including construction and the demolition rate) from 2011, including the trend until 2020.

[9] *Basic data on completed apartments* (Source: https://www.czso.cz/csu/czso/bvz_cr)

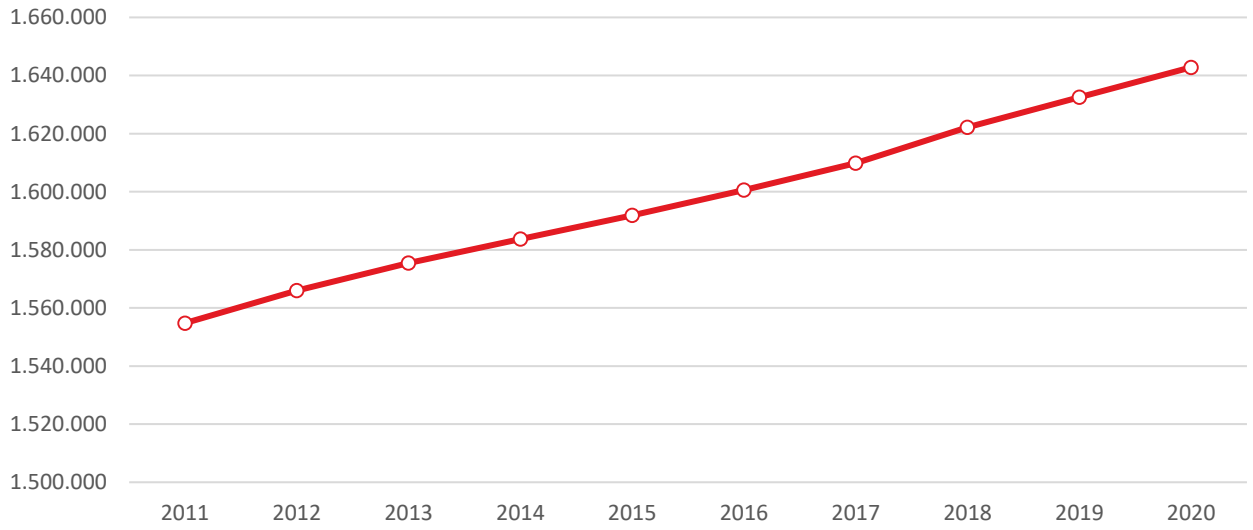
However, with regard to the above legislative requirements for the energy performance of buildings that new buildings must meet, new construction is not reflected in the input data of the model.

Table 6: *Housing construction in the Czech Republic*

Year	Completed dwellings										
	Total	of which according to the form of construction				Total per 1,000 inhabitants	Share of dwellings by form of construction in %				Living space of 1 completed dwelling in m²
		in cooperative ownership	in local authority ownership	individual	other		in cooperative ownership	in local authority ownership	individual	other	
2001	24,758	916	6,292	14,509	3,041	2.42	3.7	25.4	58.6	12.3	70.1
2002	27,291	1,528	7,019	15,611	3,133	2.68	5.6	25.7	57.2	11.5	68.5
2003	27,127	1,456	6,781	14,663	4,227	2.66	5.4	25.0	54.1	15.6	69.2
2004	32,268	1,739	6,538	16,867	7,124	3.16	5.4	20.3	52.3	22.1	68.5
2005	32,863	1,123	4,860	17,022	9,858	3.21	3.4	14.8	51.8	30.0	70.3
2006	30,190	476	4,470	15,368	9,876	2.94	1.6	14.8	50.9	32.7	71.8
2007	41,649	952	3,904	18,416	18,377	4.03	2.3	9.4	44.2	44.1	70.4
2008	38,380	689	1,852	20,812	15,027	3.68	1.8	4.8	54.2	39.2	76.0
2009	38,473	850	757	20,675	16,191	3.67	2.2	2.0	53.7	42.1	74.2
2010	36,442	873	850	21,848	12,871	3.46	2.4	2.3	60.0	35.3	76.8
2011	28,630	268	603	19,358	8,401	2.73	0.9	2.1	67.6	29.3	78.2
2012	29,467	298	1,073	19,621	8,475	2.80	1.0	3.6	66.6	28.8	76.3
2013	25,238	230	325	16,937	7,746	2.40	0.9	1.3	67.1	30.7	77.3
2014	23,954	566	363	15,606	7,419	2.28	2.4	1.5	65.1	31.0	75.3
2015	25,095	139	408	15,135	9,413	2.28	0.6	1.6	60.3	37.5	74.7
2016	27,322	236	230	15,680	11,176	2.59	0.9	0.8	57.4	40.9	72.8
2017	28,569	274	343	16,066	11,886	2.70	1.0	1.2	56.2	41.6	72.9
2018	33,868	.	.	.	.	.	.	.	.	.	.

Source: CZSO

Chart 6: *Construction of single-family houses in the Czech Republic*



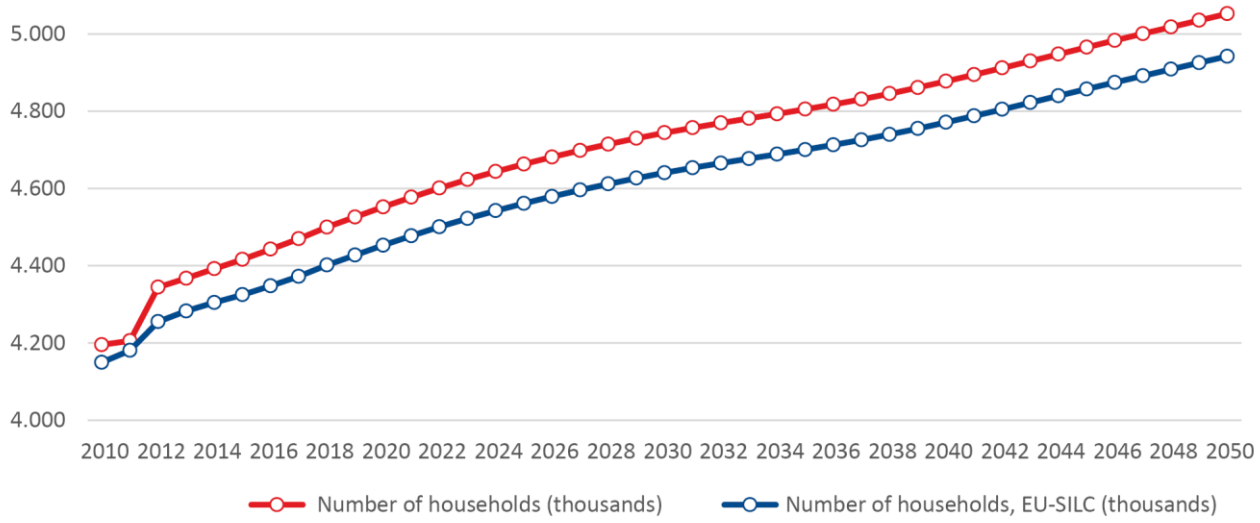
Source: Prepared by the MIT on the basis of CZSO data

Chart 6 shows the trend of housing construction in the form of single-family houses based on CZSO data on new construction and the expected rate of demolition. Data are extrapolated until 2020.

The growth trend or the reduction in floor space due to new construction and the rate of demolition plays an important role in determining and monitoring a measurable indicator of progress; see the following chapters.

From the point of view of future **development of building construction** according to the National Energy and Climate Plan of the Czech Republic, an increase in the number of households, i.e. dwellings, is expected. To a large extent, this trend is caused by demographic trends (population aging, increasing average age of first-time mothers) reflected in the number of inhabitants in one housing unit[10]. The average number of household members could thus fall from 2.37 in 2017 to 2.25 in 2030.

Chart 7: *Outlook of the number of households (thousands)* [11]



Source: Eurostat. Calculations of the Ministry of Finance of the Czech Republic

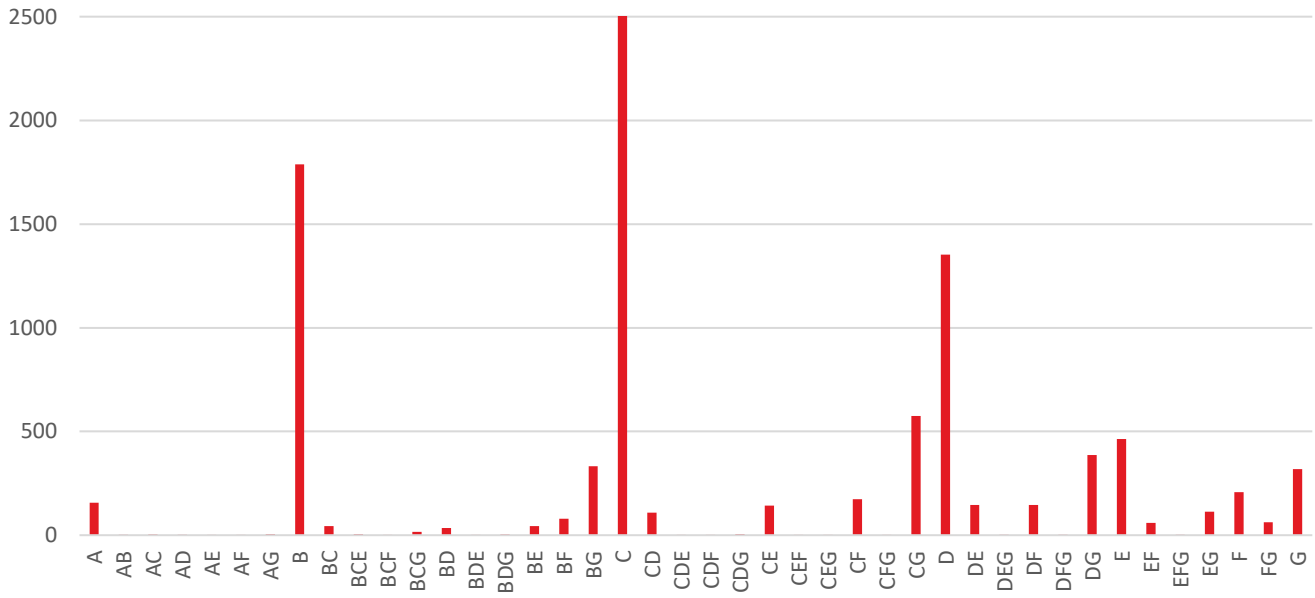
Renorate for single-family houses was determined using available information on single-family houses renovations from the New Green Savings support programme and data from the ENEX database. In view of the above data and a survey of awareness of energy savings among building owners and their motivations for and barriers to renovations[12], a renorate of 1.4% was determined.

[10] The decrease in the number of persons living in one apartment unit is due to the trend of independent living. The average number of persons in a flat decreased by 11 % between 2004 and 2015 (Source: CZSO – ENERGO 2015).

[11] The EU-SILC survey is carried out only in permanently occupied private apartments and does not include collective and institutional households (prisons, elderly homes, hostels, etc.) and homeless people.

[12] Main conclusions and recommendations from a survey of awareness of energy savings among building owners and their motivations for and barriers to renovations. 2019. Source: https://www.mpo.cz/assets/cz/rozcestnik/pro-media/tiskove-zpravy/2019/5/MPO_pruzkum-povedomi_uspory-energie_zavery-a-doporuceni_2021.pdf

Chart 8: *Number and depth of renovations of single-family houses according to the ENEX database for the years 2017 and 2018*



Source: Prepared by the MIT on the basis of the ENEX records

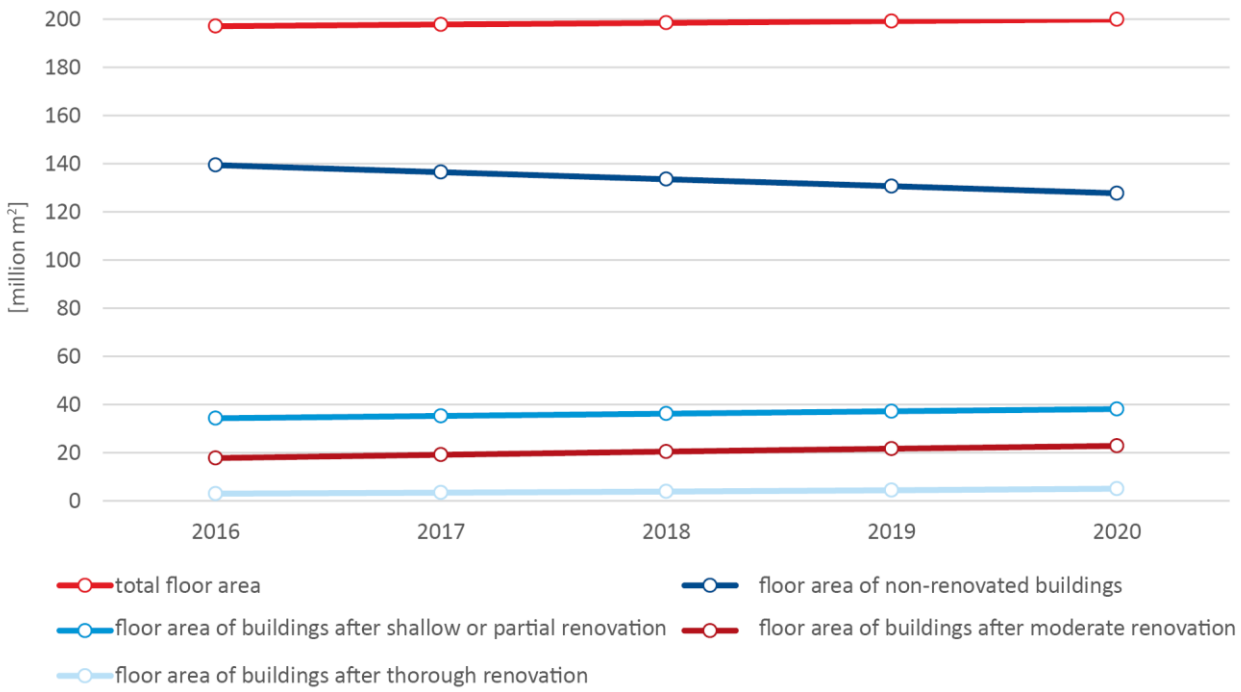
Chart 8 shows the depth of renovations for 2017 and 2018 for single-family houses monitored in the ENEX database. The depth of renovations was determined with the help of the energy performance class of the building, i.e. which class was achieved through the renovation of the building. **Building energy performance classes A and B were designated as thorough renovation depths, class C as moderate renovation depth and classes D, E, F and G were designated as shallow renovation depths.** According to the distribution of renovations in individual columns, the number of renovations of a given depth can be read from the chart, i.e. the measures were most often implemented where the building remained in energy efficiency class C before and after the measure, but very often it was a measure in class G, but thanks to the renovation it has moved to energy efficiency class C, as evidenced by the entries in column CG. In the case of a column with more than two letters, for example CDE, these are several successive renovations that have been carried out over two years, with the building initially in energy efficiency class E and after renovations moving to energy efficiency class building C.

Table 7: *Depths of single-family houses renovations carried out in the period 2014–2018*

Depth of renovation	Single-family houses
Shallow	35%
Moderate	45%
Thorough	20%

Source: Prepared by MIT for the purposes of the National Plan

Chart 9: *Development of renovation of the floor area of single-family houses from 2016 to 2020*



Source: Prepared by MIT for the purposes of the Building Renovation Strategy

2.1.1.2 Apartment buildings

The following tables present the numbers of buildings, apartments and floor area of occupied apartment buildings in the Czech Republic.

Table 8: *Total number of apartment buildings in each category*

NUMBER OF BUILDINGS [-]	period of construction							
number of floors	total	1919 and before	1920–1945	1946–1960	1961–1980	1981–2000	2001–2011	not determined
	211,252	**26,077**	**27,775**	**30,573**	**71,429**	**38,042**	**12,674**	**4,682**
1 floor	**3,910**	1,199	612	473	556	526	488	56
2 floors	**37,708**	7,939	5,700	6,867	9,734	4,892	2,350	226
3 floors	**49,888**	7,714	8,909	11,226	12,154	6,209	3,420	256
4 floors	**48,000**	4,777	5,360	7,313	19,079	8,154	3,084	233
5 floors	**23,354**	3,175	3,905	2,916	8,573	3,203	1,452	130
6 floors	**10,192**	598	1,351	827	4,100	2,570	712	34
7 floors	**5,716**	138	838	272	2,780	1,337	330	21
8 floors	**15,259**	32	160	81	7,394	7,163	390	39
9 floors	**3,216**	0	16	12	1,852	1,226	101	9
10 floors	**700**	0	1	8	504	155	32	0

11 or more floors	**3,660**	0	15	21	2,397	1,134	88	5
not determined	**9,649**	505	908	557	2,306	1,473	227	3,673

Table 9: *Total number of apartments in apartment buildings in each category*

NUMBER OF APARTMENTS [-]	period of construction							
number of floors	total	1919 and before	1920–1945	1946–1960	1961–1980	1981–2000	2001–2011	not determined
	2,416,033	**166,271**	**230,420**	**250,141**	**989,462**	**569,804**	**153,527**	**56,408**
1 floor	**18,466**	4,887	2,570	1,937	3,165	2,820	2,788	299
2 floors	**174,915**	34,391	25,014	31,127	45,086	24,281	13,697	1,319
3 floors	**324,604**	41,925	50,146	75,511	85,448	40,571	29,445	1,558
4 floors	**489,745**	37,579	46,586	70,586	204,713	89,104	39,189	1,988
5 floors	**310,593**	32,943	50,087	40,176	116,594	44,050	24,975	1,768
6 floors	**174,383**	7,365	22,427	14,894	69,256	44,733	15,209	499
7 floors	**115,119**	1,847	16,118	5,441	55,718	27,738	7,833	424
8 floors	**358,531**	468	3,279	1,671	174,960	167,842	9,475	836
9 floors	**81,354**	0	252	268	46,468	31,505	2,649	212
10 floors	**23,602**	0	8	276	16,536	5,570	1,212	0
11 or more floors	**183,950**	0	311	1,035	120,563	57,790	4,129	122
not determined	**160,771**	4,866	13,622	7,219	50,955	33,800	2,926	47,383

Table 10: *Total interior floor area of apartment buildings in each category*

FLOOR AREA [thousand m^2]	period of construction							
number of floors	total	1919 and before	1920–1945	1946–1960	1961–1980	1981–2000	2001–2011	not determined
	156,226	**10,161**	**14,202**	**15,657**	**64,518**	**38,943**	**9,435**	**3,310**
1 floor	**869**	227	112	90	159	132	138	11
2 floors	**10,516**	1,904	1,388	1,899	3,009	1,510	759	49
3 floors	**20,365**	2,495	3,080	4,636	5,723	2,639	1,716	76
4 floors	**31,535**	2,356	2,838	4,391	13,393	6,004	2,442	112
5 floors	**20,276**	2,191	3,146	2,649	7,627	2,961	1,613	90
6 floors	**11,691**	521	1,471	977	4,589	3,117	983	33
7 floors	**7,682**	136	1,121	362	3,587	1,940	508	28
8 floors	**24,517**	29	225	114	11,590	11,881	623	56
9 floors	**5,494**	0	17	18	3,046	2,238	161	13
10 floors	**1,534**	0	0	20	1,069	364	81	0
11 or more floors	**11,698**	0	20	62	7,492	3,877	240	8
not determined	**10,051**	303	783	441	3,236	2,282	172	2,834

Source: 2011 Census

The total internal floor area for apartment buildings has been determined by adding 15 % to the total area of occupied apartments in apartment buildings.

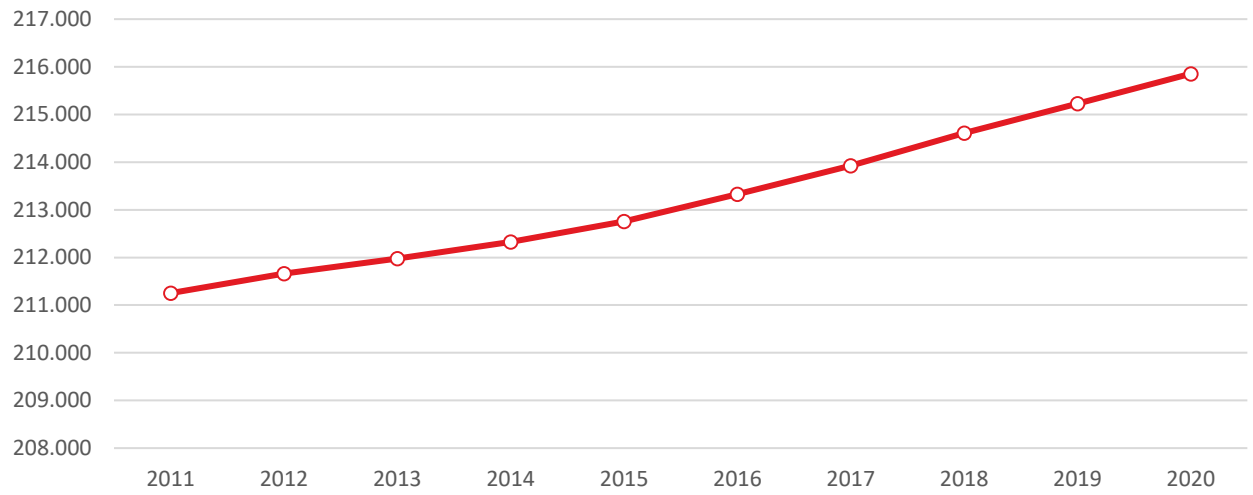
Table 11: *New construction and demolition of apartment buildings*

	Until 95% of the total floor area of apartment buildings is renovated
Rate of new construction	**0.46%**
Rate of demolition	**0.10%**

Source: Own processing, using data of the CZSO[13]

Data from the 2011 Census may be partially updated with the help of CZSO data on housing construction in the Czech Republic on completed dwellings also in the case of apartment buildings. However, with regard to the above legislative demands for the energy performance of buildings that new buildings must meet, new construction is not reflected in the input data of the model.

Chart 10: *Development of the apartment buildings stock in the Czech Republic*



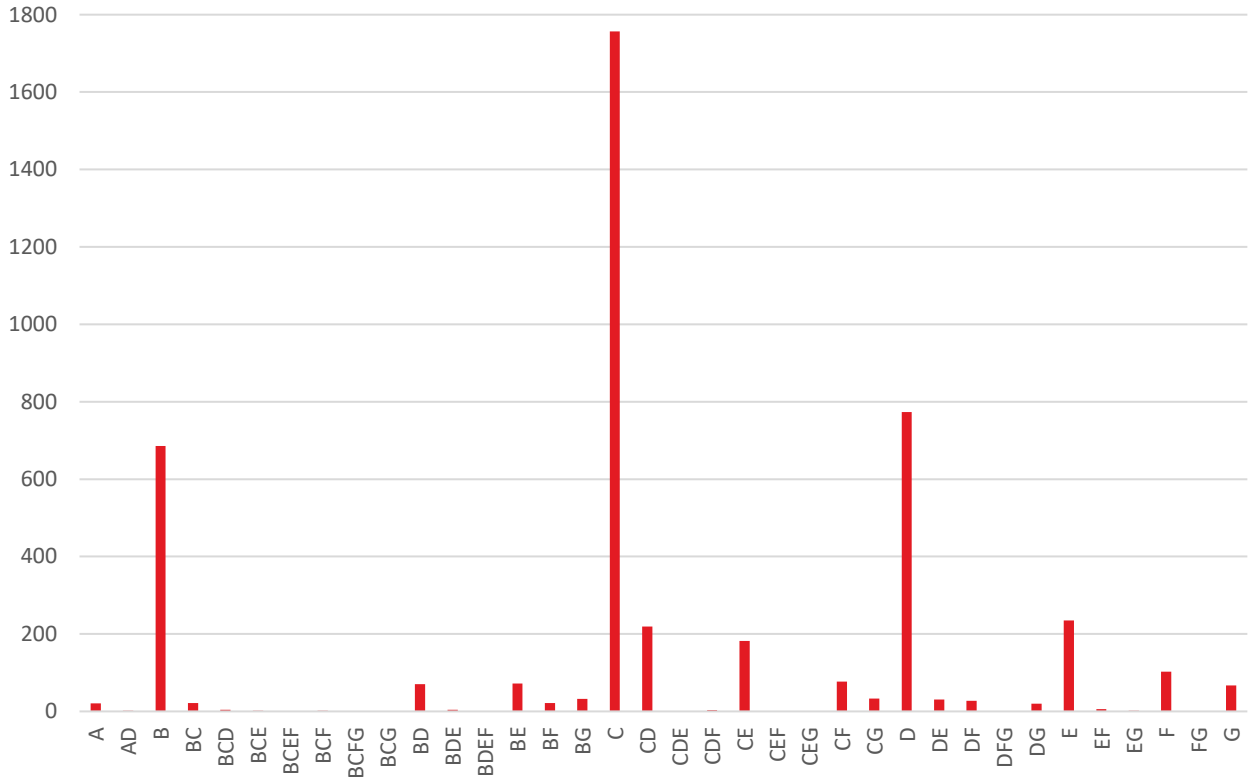
Source: Prepared by the MIT on the basis of CZSO data

Chart 10 shows the trend of housing construction in the form of apartment buildings based on CZSO data on new construction and the expected rate of demolition. Data are extrapolated until 2020.

For apartment buildings, there is more accurate information on renovations. Details on implemented savings measures can be read from the ENEX database and from information from support programmes used for the renovation of apartment buildings such as New Green Savings, Panel 2013+ or the Integrated Regional Operational Programme (IROP). The ENEX database will continue to provide relatively accurate information on the extent and depth of renovations. Renorate for apartment buildings is 0.79%, while the renorate and the depth of renovation for individual representatives of the owners vary.

[13] *Basic data on completed apartments* (Source: https://www.czso.cz/csu/czso/bvz_cr)

Chart 11: *Number and depth of renovations of apartment buildings according to the ENEX database for the years 2017 and 2018*



Source: Prepared by the MIT on the basis of the ENEX records

The depth of renovation in the case of apartment buildings is defined in the same way as in the case of single-family houses. Chart 11 shows the depth of renovations for the years 2017 and 2018 for apartment buildings monitored in the ENEX database across ownership ties. According to the distribution of renovations in individual columns, the number of renovations of a given depth can be read from the chart, i.e. the measures were most often implemented where the building remained in energy efficiency class C before and after the measure, but very often it was a measure in class D, but thanks to the renovation it has moved to energy efficiency class C, as evidenced by the entries in column CD. In the case of a column with more than two letters, for example CDE, these are several successive renovations that have been carried out over two years, with the building initially in energy efficiency class E and after renovations moving to energy efficiency class building C.

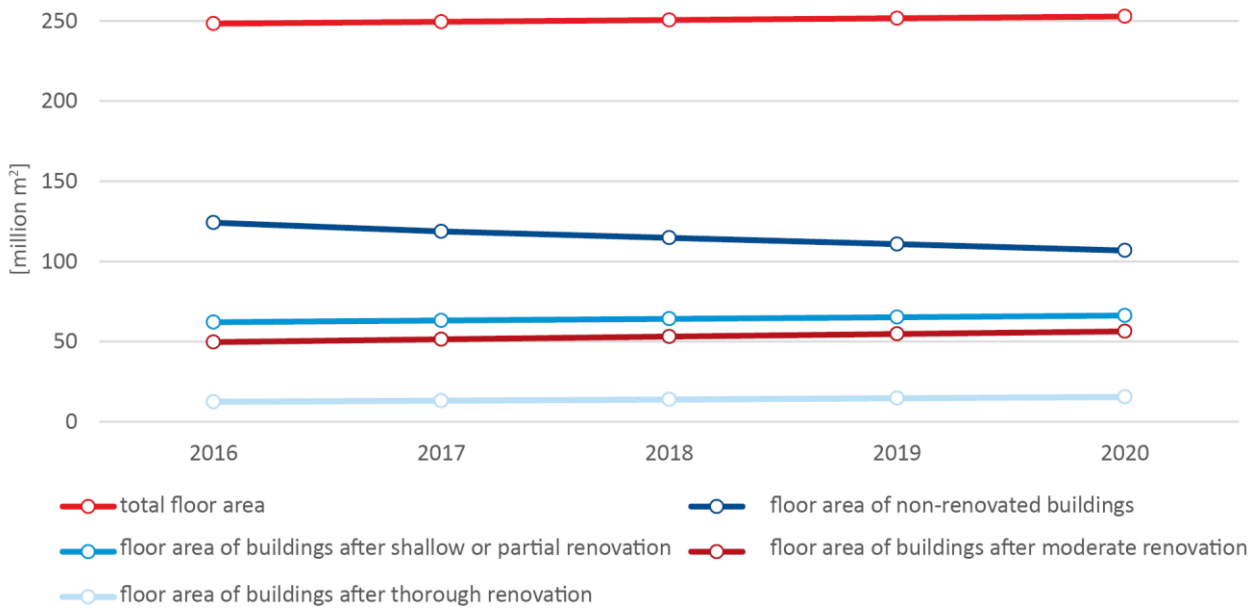
Table 12: *Depths of apartment buildings renovations carried out in the period 2014–2018 according to ownership relations*

Depth of renovation	Cooperative	Natural and legal persons	Associations of unit owners	Municipality/ State	Weighted average for apartment buildings

Shallow	28%	34%	30%	33%	31.1%
Moderate	57%	35%	58%	41%	49.6%
Thorough	15%	31%	12%	27%	19.3%

Source: Prepared by MIT for the purposes of the National Plan

Chart 12: *Development of renovation of the floor area of apartment buildings from 2016 to 2020*



Source: Prepared by MIT for the purposes of the Building Renovation Strategy

2.1.2 Methodology for determining energy savings for modelling building renovation scenarios

A detailed description of the procedure is given in the residential building stock survey[14]. The following steps have been taken:

a) For a matrix of 72 categories of buildings by age and size, the thermal insulation properties of the building envelope were estimated (the thermal transmittance coefficient for the main structures). The baseline document was the Tabula[15] project study, and the values were verified and clarified by reference to information from experts and companies based on experience. The percentage-based distribution of individual structures on the building envelope was estimated based on the author's survey of approximately 50 residential buildings. Certain efficiency of heat sources, by fuel type, was also considered in the calculations, again on the basis of expert estimates.

[14]Survey of the residential buildings stock in the Czech Republic and the possibilities of savings in them, Chance for Buildings for the MIT, December 2016; http://sanceprobudovy.cz/wp-content/uploads/2018/04/pruzkum-rezidencnich-budov-v-cr.pdf

[15]Guide to the typology of habitable buildings, Tabula project output, STÚ-K, 2011

b) The proportion of buildings already renovated was also estimated. For single-family buildings, this is 25 %; for apartment buildings it is 40 % (concerning prefabricated apartment buildings, 55 % of them have been renovated). This was based on the author's own survey, estimates by consulting companies, the statistics of support programmes, the quantity of ETICS (external thermal insulation composite system) sold, and, for apartment buildings, the PanelScan study[16]. Most of the renovated buildings have been considered in relation to the required values of thermal transmittance coefficients; for a minority, the recommended values under ČSN 730540 (2011) were considered.

c) In the next step, the study author's own unique model[17] based on the stochastic principle was used. For each of the 72 categories, he creates 1000 hypothetical buildings differing, within a set range, in their geometry, orientation, size and the thermal insulation properties of the building envelope. This method of modelling reduces the degree of deviation in the result compared to a process where there would only be one representative building for each category.

   The model was calibrated for the calculation so that the resultant values of final energy consumption (at the level of energy supplied to buildings) were consistent with the actual statistics kept by the Ministry of Industry and Trade.

d) Two standards were defined as cost-effective standards for the renovation of buildings. The first one is based on the recommended values of the thermal transmittance for structures under ČSN 730540 (2011) and the slightly improved efficiency of sources. Put simply, this entails a moderate energy-saving renovation to a standard approaching the low-energy standard.

   The second one is based on the lower threshold of the range of 'passive values' of thermal transmittance according to the same standard; it achieves peak efficiency of heat sources and uses mechanical ventilation with waste heat recovery. Put simply, this entails the deep general renovation of a building to a standard approaching the passive standard.

e) These two defined standards are also based on calculations when setting the cost-optimal level of requirements under the Energy Performance of Buildings Directive.
   For reference purposes, a shallow standard of renovation was also taken into consideration, for 'required values' of thermal transmittance with no improvement in the efficiency of sources.
   For the calculation of the potential to save energy on heating, the above-mentioned model was applied.

[16] A study into the condition of the housing stock of prefabricated concrete buildings in the Czech Republic, CERPAD for the Ministry of Regional Development, 2009
[17] http://optimalizacebudovy.fsv.cvut.cz

2.1.2.1 Outputs of modelling for heating

The resultant energy consumption and potential savings compared to the original consumption of the residential building stock that enter the building model can be found in the following tables.[18]

Table 13: *Model states of building stock (current and after renovation), energy consumed on heating*[19]

State of buildings	Indoor temperature considered	single-family house	apartment building	Total
	[°C]	[GWh]	[GWh]	[GWh]
original state of buildings – model	temperature estimate	38,492	20,023	**58,516**
consumption on heating – statistics from the Ministry of Industry and Trade	n/a			**47,798**
new state/standard of renovation considered:				
shallow renovation, required U values	18	30,836	13,666	**44,503**
moderate renovation, recommended U values	19	18,334	8,168	**26,502**
deep renovation, passive U values	20	6,083	2,812	**8,895**

Source: Prepared by Chance for Buildings for the purposes of the Building Renovation Strategy

For buildings in their original state, a lower average indoor temperature at the time of space heating is taken into account compared to the 20 °C considered as standard. The indoor design temperature is considered differently for each age category and increases as the insulation standard rises. For buildings in the 'required values' standard, a temperature of 18 °C is taken into consideration, for buildings in the 'recommended values' standard, the temperature is 19 °C, and in the 'passive standard', the temperature is 20 °C. Therefore, if anything, the estimates of opportunities to make energy savings are approached conservatively.

Table 14: *Model conditions of building stock (current and after renovation), energy consumed on heating, saving*

		MIT data[20]	Renovation to recommended values	Renovation to passive values
Energy required for heating	[GWh]	38,189	23,852	8,450
Total efficiency (production, distribution, sharing)	[%]	80%	90%	95%
Energy consumed on heating	[GWh]	47,798	26,502	8,895
	[PJ]	172.1	95.4	32.0
Saving in the energy consumed on heating	[GWh]		21,296	38,903
	[PJ]		76.7	140.1

[18]Detailed calculations for the following tables and modelling outputs can be found in the study *Survey of the residential buildings stock in the Czech Republic and the possibilities of savings in them*, Chance for Buildings for the MIT, December 2016; http://sanceprobudovy.cz/wp-content/uploads/2018/04/pruzkum-rezidencnich-budov-v-cr.pdf

[19]The input data to the model are based on the situation in 2011 and are continuously approximated with respect to current developments.

[20]The input data to the model are based on the situation in 2011 and are continuously approximated with respect to current developments.

Saving on actual consumption – percentage	[%]		45%	81%

Source: Prepared by Chance for Buildings for the purposes of the Building Renovation Strategy

Therefore, the potential heating energy savings for apartment buildings are 77 PJ for moderate energy-saving renovation (45% of the original consumption) and 140 PJ for the deep renovation of the entire building stock to a passive standard (81% of the original consumption). **This is the technical energy-saving potential.** The relevant part of this technical potential that can be implemented on buildings that have not yet undergone energy-saving renovation is the economic potential. However, the full harnessing of this potential is hampered by numerous factors (the initial high investment costs, lack of information about suitable measures for the different types of buildings, etc.). In other words, it is not the market potential.

2.1.2.2 Energy savings on the production of hot water and on lighting

Much less information is available about the systems designed for the production of hot water and artificial lighting in residential buildings. However, as consumption here is lower in absolute terms than consumption on space heating, we can work with a lower level of accuracy.

Further to expert estimates based on the procedure set out in the background study[21], the following summary can be made:

The estimated potential savings in energy on the production of hot water are 12 PJ, i.e. approximately 30% of the current consumption that entered the model. Nevertheless, we can assume that less of this potential will be exploited if reconstructions are carried out to a poorer quality. In contrast, this potential may actually be exceeded following deep energy-saving renovation. It is then included in the calculation of investment costs together with the cost of replacing the source of heat used for space heating.

The estimated potential savings in energy on the artificial lighting are 3,4 PJ, i.e. approximately 60% of the current consumption that entered the model. The whole of this potential is related to electricity consumption. The replacement of lighting is not included in the calculation of investment costs because this is treated as routine maintenance of apartments and, furthermore, the price of the most efficient lighting is rapidly falling.

2.1.2.3 Consumption and total potential energy savings in the residential sector

For 2011, final consumption in households (the residential sector) was between 246 and 252 PJ (depending on the methodology), of which approximately 40 PJ was energy consumed on household appliances. In 2017, the final energy consumption in households was already at the level of 307 PJ[22], of which approximately 25 PJ was the consumption of household appliances.

[21] Survey of the residential buildings stock in the Czech Republic and the possibilities of savings in them, Chance for Buildings for the MIT, December 2016; http://sanceprobudovy.cz/wp-content/uploads/2018/04/pruzkum-rezidencnich-budov-v-cr.pdf

[22] According to the Aggregate Energy Balance of the Czech Republic for the years 2010–2017

Based on the input data of the model, the total possible technical potential for energy savings in residential buildings was calculated at 92 PJ for moderately energy-efficient renovation of the building stock and 155 PJ for a thorough renovation of buildings. This estimate works with the types of energy consumption that are included in the calculation of energy performance of buildings in accordance with Act No 406/2000 and Decree No 78/2013. Therefore, this does not include energy consumed on household appliances.

It should be noted, again, that this is the economic rather than the market potential and, as such, it is only the hypothetically achievable potential of energy savings, which is evolving with respect to the implemented renovations.

The need to adjust the initial energy consumption due to differences between the input data occurred in 2019, when the statistics on reporting energy consumption in the Czech Republic changed. The multiplication of the model outputs by a suitable coefficient seems to be an effective approach to accounting for this change. The coefficient was created by comparing the output data of the model and new statistical data.

Table 15: *Coefficient of multiplication of model output data with respect to the change in energy consumption reporting statistics*

	Model input data [PJ]	Ratio	MIT's control data on consumption[23] [PJ]	
Total consumption	250.7		284.3	
Entering the model	223.8	89.3%	253.7	Coefficient
Single-family houses	144.3	64%	163.6	**1.13**
Apartment buildings	79.5	36%	90.1	**1.13**

Source: Prepared by Chance for Buildings for the purposes of the Building Renovation Strategy

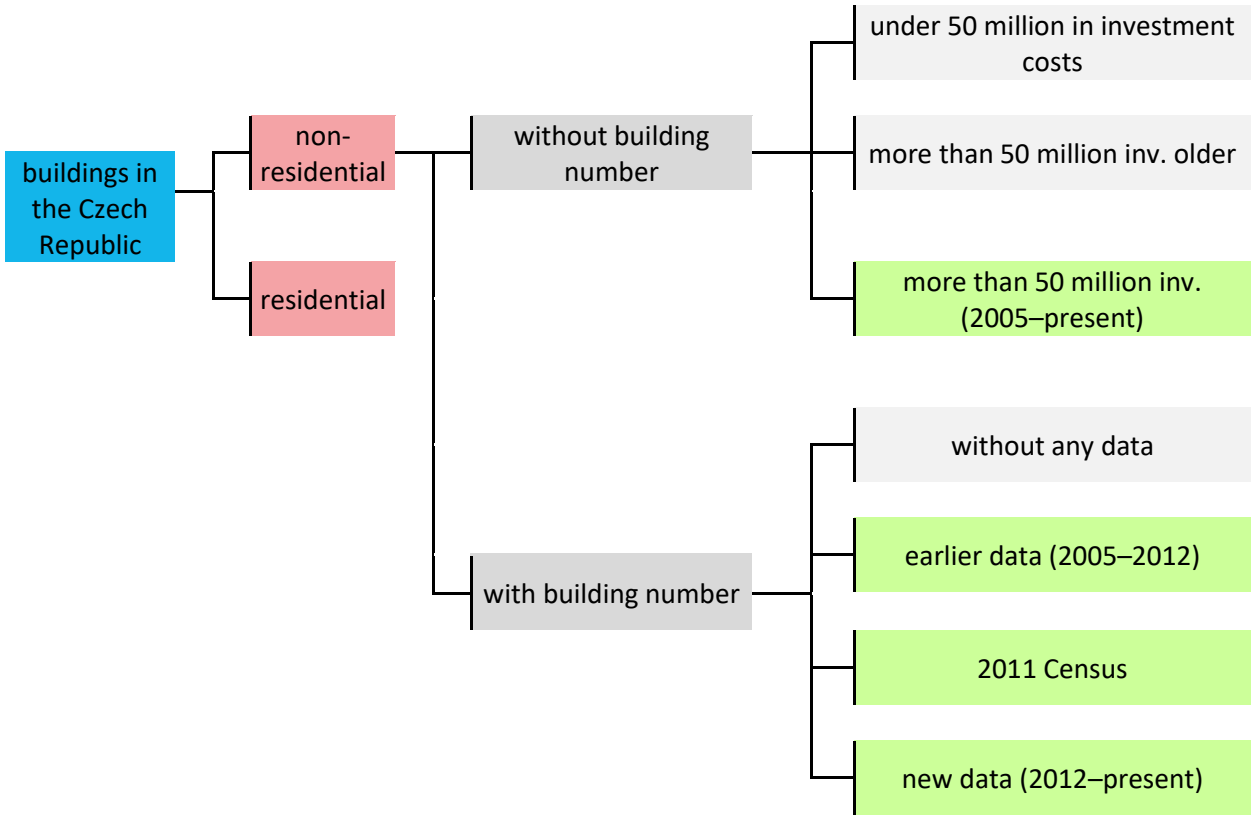
The mentioned coefficient of 1.13 is used only in the final phase of modelling the scenarios of final consumption and energy savings in single-family buildings and apartment houses.

2.2 Non-residential buildings

When determining the stock of buildings in the non-residential sector, significant approximations (or estimates) were made due to low availability and inconsistency of data (see Chart 13). The principal of collecting statistical data on public- and commercial-sector buildings is given in the diagram below. For this reason, it should be noted that the data presented below in this sector show a significantly higher deviation than the data for the residential sector.

[23] Data after the change in energy consumption reporting statistics in the Czech Republic

Chart 13: *Scheme for the collection of statistical data on buildings*



Source: Prepared by Chance for Buildings for the purposes of the Building Renovation Strategy based on CZSO data

Buildings can primarily be divided into those with a building number (street or registration number) and those without. Street number is typically used for buildings for permanent use. Registration number is used for buildings that are not for permanent use. Furthermore, certain data are available in some cases for buildings that do not have a building number. These are data collected since 2005 for new buildings with investment costs exceeding CZK 50 million. Since about 1999/2000, the building offices keep records of buildings by type. Since 2012, identification has been carried out on the basis of the Register of Territorial Identification, Addresses and Real Estate (RUIAN). It has only been for the last 10 years that all buildings that have been assigned a building number have been registered.

For buildings with a building number (that is, buildings that are expected to be used permanently), in the case of the Czech Statistical Office data given below, data are available from the three following sources:

- Housing and Population Census 2011
  - conducted for every building containing at least one apartment (designated for permanent use)
  - contains the following data, for example:
    - type of building
    - type of owner
    - period of construction or reconstruction

        - number of floors above ground
- 'Older data' (for buildings built between 2005 and 2012)
    - contain the following data:
        - apartment floor space
        - number of floors
        - type of building
- 'New data' (for buildings built from 2012 to date)
    - data aggregated from several sources
        - RUIAN (Register of territorial identification, addresses and real estate)
        - Building authorities (code 3041, state 7-99)
        - 'Buildings 1-99 Survey of non-residential buildings and selected residential buildings.'
    - Contains the following data:
        - ground coverage area
        - floor area
        - number of floors
        - type of building
    - approximately 20 % of non-residential buildings have yet to be registered

The Czech Statistical Office keeps records of buildings in the services, industry and agriculture sectors only if they have been assigned a building number. The numbers of such buildings are presented in the following table. The percentage of buildings in each category which are heated is also estimated. Based on the average floor area of buildings, where this is known, the total floor area of all buildings and the total floor area of heated buildings is estimated.

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Table 16: *Method of use of other buildings, estimated number of heated buildings and floor area*

		[pcs]		known floor area [pcs]	known floor area [m²]	[m²/building]
ENTIAL BUILDINGS		**613,134**		**24,816**	**16,639,423**	**671**
ition	ADM	18,922	3%	1,109	2,698,403	2,433
	TRD	14,999	3%	2,101	3,414,115	1,625

Source: Chance for Buildings[24]

The above overview of available records on non-residential buildings (please note that it is not clear whether a complex of buildings may be kept under one record) shows that the total area of non-residential buildings is 251.2 million m^2. By subtracting the categories of buildings that are considered unheated (garages, castles and chateaux and the 'no energy consumption' category) and subtracting 50% of the area of buildings from the storage, recreation and 'unspecified' categories (this is an estimate of the percentage of unheated buildings in this category), we get an estimated floor area of heated buildings of 215.9 million m^2. In the next step, a 15%correction was made between the floor area given by the statistical data and the actual (estimated) energy reference area. Therefore, the total area of heated buildings to determine the potential savings for non-residential buildings is considered to be **248.3 million m^2**.

[24]Survey of the non-residential buildings stock in the Czech Republic and possibilities of savings in them; 2016; http://sanceprobudovy.cz/wp-content/uploads/2018/04/pruzkum-nerezidencnich-budov-v-cr.pdf

2.2.1 Overview of building stock

2.2.1.1 Public sector

Data from the CZSO survey '*Buildings 1-99 Survey of non-residential buildings and selected residential buildings*' helped to divide the floor area of the public sector according to individual categories.

Table 17: *Representation of the public sector in the non-residential building stock (Chapter 2. 2.)*

Floor area of non-residential buildings [m^2]	248,300,000				
Number of non-residential buildings	613,134				
	Small municipalities (0–1,999)	Larger municipalities (2,000–49,999)	Towns (cities) and regions (more than 50,000)	State	**Total public buildings**
Share in the area	6.2%	11.1%	7.0%	4.4%	**28.7%**
Share in the number	8.6%	6.4%	2.3%	1.8%	**19.2%**
Floor area [m^2]	15,429,679	27,568,870	17,295,158	11,007,909	**71,301,617**
Number of buildings	52,975	39,069	14,376	11,332	**117,753**

Source: Survey 1-99, own processing.

The records for public sector buildings also include the category 'Other residential buildings' – in total they account for 3.6% (2 million m^2) of the total floor area of public buildings. It is not clear here whether these buildings figure in the category of apartment buildings owned by municipalities / the State. However, due to the small number of buildings, these buildings were left as part of public buildings.

2.2.1.2 Private sector

The buildings of the business sector represent the rest of non-residential buildings. This is the difference between the total number of non-residential buildings (their floor area) and the number of public buildings. It represents **495,381 buildings with a total floor area of 177 million m^2.**

2.2.2 Basis of entry for modelling – non-residential buildings

Table 188: *New construction and demolition of non-residential buildings*

	Until 95% of the total floor area is renovated
Rate of new construction	**0.96%**[25]
Rate of demolition	**0.20%**

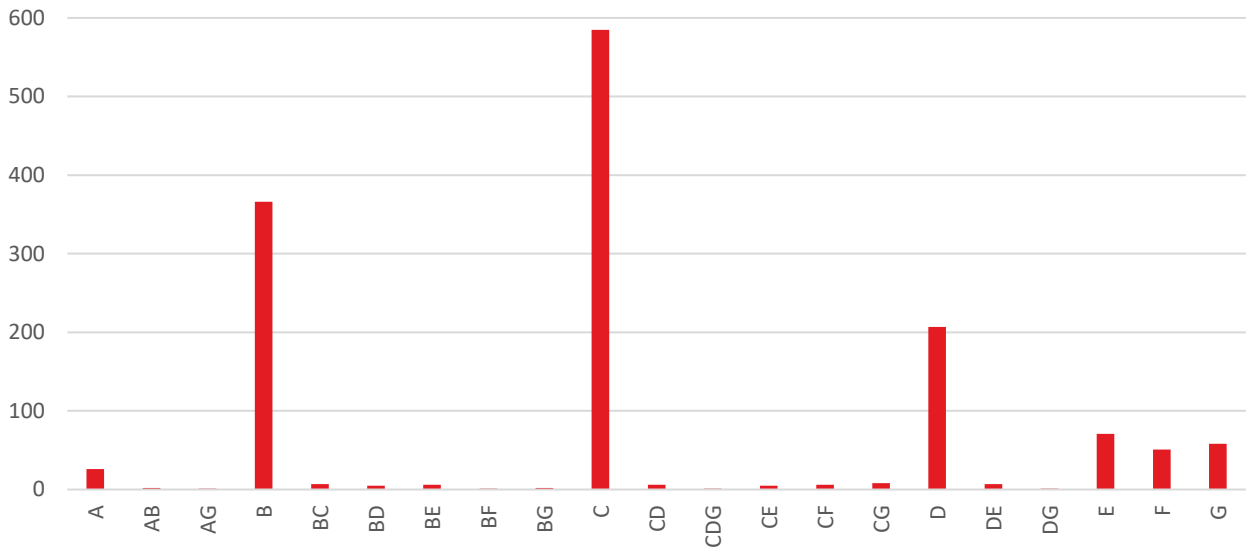
Source: Use of CZSO data[26]

[25] Reduced by 15% (based on data from the Survey of Non-Residential Buildings) due to the deduction of unheated areas such as warehouses and garages.

[26] Table 6 Number of issued building permits (monthly), Table 13 New floor area in m^2: residential and non-residential buildings (quarterly). (Source: https://www.czso.cz/csu/czso/bvz_cr)

To calculate the renorate of 1.4%, CZSO data on building permits for major alterations to buildings were used, which, however, also include renovations that do not have the character of energy savings measures, which is reflected in the affected floor area. The data kept in the ENEX records were also partially used for the calculation; they were primarily useful in terms of insight into the depth of the implemented renovations.

Chart 14: *Number and depth of renovations of non-residential buildings according to the ENEX database for 2017 and 2018*



Source: Prepared by the MIT on the basis of the ENEX database

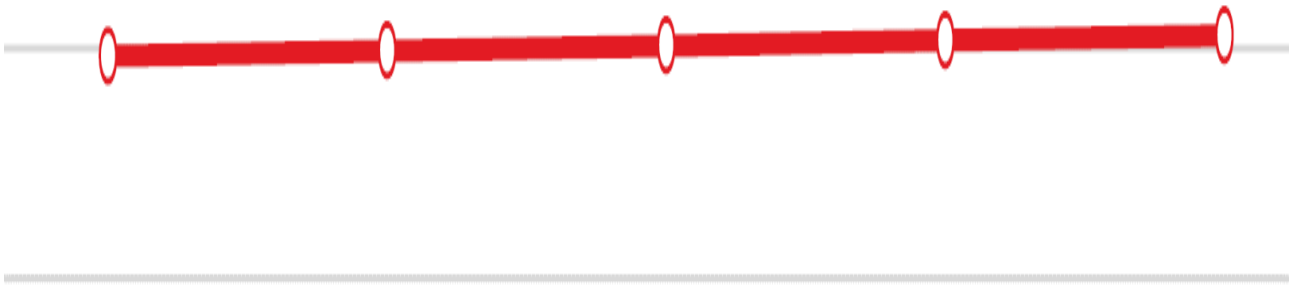
The depth of renovation in the case of the non-residential sector is defined in the same way as in the case of the residential sector. Chart 14 shows the depth of renovations for the years 2017 and 2018 for non-residential buildings monitored in the ENEX database across ownership ties. As in the residential sector, the largest number of renovations in the non-residential sector took place in buildings in energy performance class C, however, there were examples of renovations where the building was renovated in energy class E at the beginning and reached energy class B after renovation, as evidenced in the column marked BE.

Table 19: *Depth of renovation for the baseline scenario for non-residential buildings by the sector*

	Public buildings	Commercial building	Weighted average
shallow (D, E, F, G)	**28.08%**	**26.13%**	**26.7%**
moderate (C)	**41.03%**	**44.67%**	**43.6%**
thorough (A, B)	**30.90%**	**29.21%**	**29.7%**

Source: Prepared by Chance for Buildings for the purposes of the Building Renovation Strategy

Chart 15: *Development of renovation of the floor area of non-residential buildings from 2016 to 2020*



Source: Prepared by MIT for the purposes of the Building Renovation Strategy

2.2.3 Methodology for determining energy savings for modelling building renovation scenarios in the non-residential sector

A detailed description of the procedure is given in the non-residential building stock survey[27]. The following steps have been taken:

a) A detailed analysis of potential energy savings and their investment demands was made on a sample of 100 well-described buildings of varying size, age and type of use. Four variants of savings measures concerning the building envelope and savings measures concerning energy sources were then evaluated on the sample.
b) Also evaluated was a subset of 20 buildings for which actual energy consumption was available (for heating in particular) in addition to the energy model on the basis of utility invoices. From this, a comparison is then given of the calculation values according to the EPC and the actual building consumption, and a correction factor is derived between calculated and actual consumption values depending on the building parameters selected. The background study (Survey of the Non-Residential Building Stock in the Czech Republic) thus provides key information on the future use of the whole EPC data collection database to determine the real potential for energy savings. This correction is then applied retrospectively to the sample of 100 buildings.
c) Finally, statistical data from the non-residential building stock were collected in cooperation with the MIT and CZSO. Based on the data and an analysis of the sample of buildings, corrected to be closer to the real values, the conclusion of the study determined the potential energy savings for the non-

[27]Survey of the non-residential buildings stock in the Czech Republic and possibilities of savings in them; Chance for Buildings for the MIT; December 2016; http://sanceprobudovy.cz/wp-content/uploads/2018/04/pruzkum-nerezidencnich-budov-v-cr.pdf

residential building sector in the Czech Republic using several different variants of savings measures and scenarios. It also contains an estimate of the investment demands of the implemented measures and the energy savings achieved.

2.2.3.1 Modelling outputs for energy savings through envelope renovation

Given the nature of the proposed savings measures concerning, as a first step, building envelopes and the installation of forced ventilation with recovery, the energy savings options below relate only to the heating component, that is, the supply of energy for heating.

Chart 16: *Percentage savings of specific energy supplied for heating with a correction – by floor area*

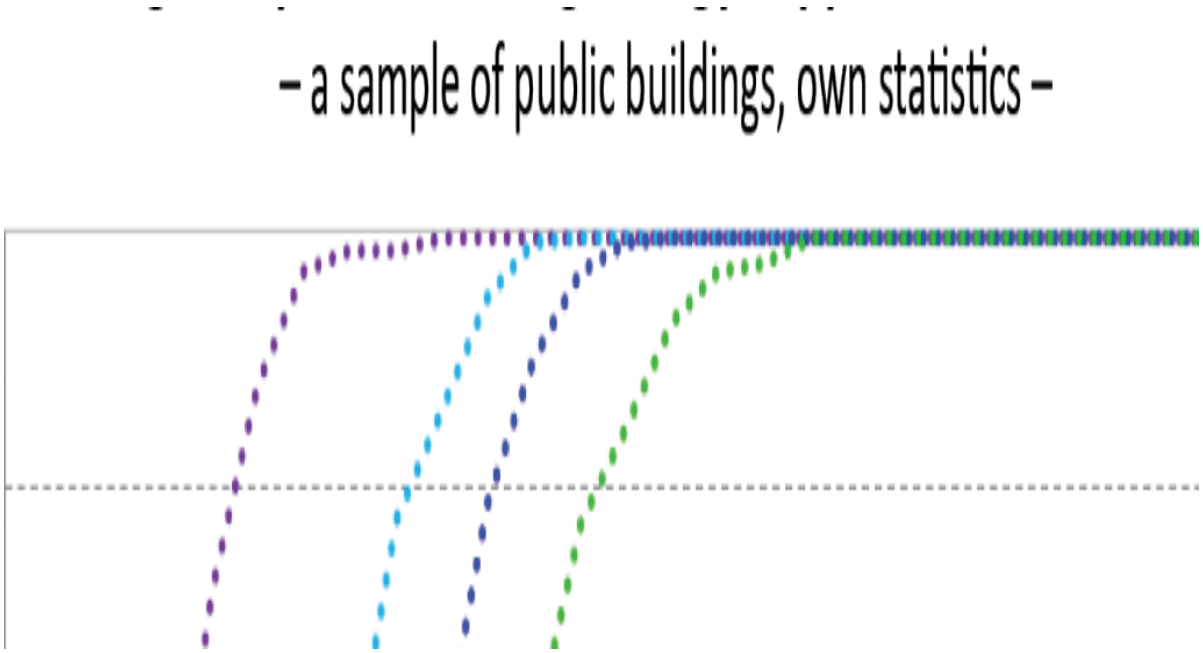


Table 200: *Percentage savings of specific energy supplied for heating with a correction – by floor area*[28]

savings of specific heating energy supplied – with correction						
	[kWh/(m²a)]			[kWh/(m²a)]		
status	min	average	max	min	average	max
1 – partial renovation	0	16	67	0%	15%	43%
2 – values required	2	30	132	1%	28%	56%
3 – recommended values	5	39	166	3%	36%	65%
4 – passive v. + recovery	13	53	189	20%	49%	84%

Source: Prepared by Chance for Buildings for the purposes of the Building Renovation Strategy

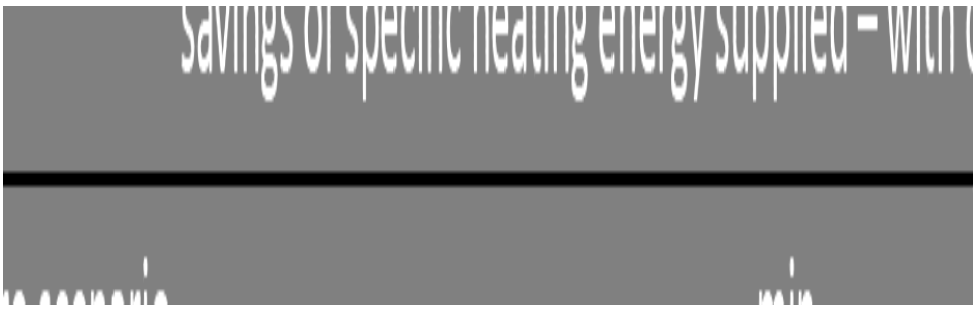
[28]Renovation status 1 – 4, corresponds to the values S1 – S4 in Chart 16. The exact definition of individual renovation states is based on the Survey of the non-residential buildings stock in the Czech Republic and possibilities of savings in them; Chance for Buildings for the MIT; December 2016; http://sanceprobudovy.cz/wp-content/uploads/2018/04/pruzkum-nerezidencnich-budov-v-cr.pdf

For the determination of possible savings, the total building area is estimated at **248,3 million m²**. If we assume that buildings have the same structure as those in the evaluated sample of 100 buildings, including their initial state (that is, assuming that some of them have already undergone some renovation), savings that are economically interesting can be achieved in 50% of the energy reference area of buildings. The potential for energy savings from heating with complex and high-quality renovations is **32.6 PJ**. Another **10.5 PJ** can be saved through more expensive renovations of a further 30% of the energy reference area.

2.2.3.2 Modelling outputs for energy savings through changing source

Using a sample of buildings, an analysis was performed of installed outputs and individual types of heat sources for heating and hot water preparation, broken down by fuel. The analysis is based on the determined design heat loss of buildings, while the distribution of heat sources is made by estimating the percentage coverage of energy needs for heating, based on the EPC. At the same time, the individual components of annual energy consumption are determined with the distribution of consumption per fuel type. The decrease in the required output of sources due to envelope renovation and the installation of ventilation with recovery is about half (to 53%).

Table 211: *Heat source output for a sample of 100 buildings related to floor area*



Source: Prepared by Chance for Buildings for the purposes of the Building Renovation Strategy

Two variants for the replacement of sources are also considered. In the case of district heating, it is considered that the existing source is maintained. In the case of a natural gas boiler room, the replacement of the boilers with new condensing boilers is envisaged, but, naturally, only where condensing boilers are not already installed. The replacement with new gas boilers will then account for approximately half of the total installed output of the existing gas boilers. If the existing source of heat for heating uses electricity (unless it is a heat pump, i.e. electric boilers in most cases and, in a small number of cases, a direct heating or storage appliance), variant A envisages a transition to a heat pump. Due to limitations of earth-water pumps (especially in urban areas), replacement is envisaged with air-water heat pumps. Variant B then envisages a hypothetical case in which heat pumps replace all types of sources.

The total possible savings in variant A are set at **7.0 PJ** and, in variant B, at **34.3 PJ**.

2.2.3.3 Consumption and total potential energy savings in non-residential sector

For 2011, final energy consumption was roughly 126 PJ in the service sector and 23 PJ in agriculture. In 2017, the development of energy consumption can be seen at the level of 133 PJ in the services sector and 26 PJ in the agricultural sector, so the development of energy consumption in these segments is not as dynamic as, for example, in the household sector. Based on an analysis of consumption statistics, consumption outside buildings (e.g. the internal consumption requirement of heat plants and incineration plants, as well as agricultural machinery) was deducted from these values, as were types of consumption not specified in the evaluation of the energy performance of buildings pursuant to the Energy Management Act (e.g. data centres and servers or the technological equipment of shops). **The final energy consumption from the operation of buildings in both of these sectors is estimated at 124 PJ.**

The potential for energy savings is the sum of the potential for savings using predominantly construction measures in appropriate parts of the building stock (cheaper energy savings, often in yet-to-be-renovated or only partly renovated buildings, making up half of the floor area of existing buildings) of 32.6 PJ, the potential for savings in already-renovated parts of the building stock (another 30% of floor area, more expensive energy savings) of 10.5 PJ, and the potential for savings using technological measures in the range 7.0 PJ (better efficiency of sources while keeping the fuel mix) to 34.3 PJ (better efficiency and a hypothetical transition to heat pumps). The overall potential for savings can therefore be set at 50.1 PJ to 77.4 PJ.

Adequately to the new finding about the distribution of floor area of public and commercial buildings, their consumption would be divided. There are no more precise data on its distribution.

3 Indicative milestones of the Long-Term Renovation Strategy according to modelling outputs in individual scenarios for the years 2030, 2040 and 2050

3.1 Scenarios of possible development of renovation of the building stock

The Chances for Buildings projected scenarios for the renovation of the building stock in the Czech Republic via its own model based on the outputs and findings of previous chapters of this report. This chapter aims to assess the energy and economic impacts of the different scenarios for the renovation of the building stock on the economy in the Czech Republic.

As mentioned in the previous chapters, the input data used to calculate the Long-Term Strategy scenario model are based on the 2011 Census, which provides the most detailed information on the building stock (number of dwellings, ownership structures, age of buildings, floor area of dwellings in m^2 and more). Data from the 2011 Census were used to map the building stock in the residential sector. For the non-residential sector, the survey 'Buildings 1-99 Survey of non-residential buildings and selected residential buildings' was used and supplemented with data from the Register of Territorial Identification, Addresses and Real Estate and Building Offices.

Another of the input data for modelling scenarios was the determination of the amount of investment per renovated m^2. To achieve the most accurate result, this investment was determined according to the cost per m^2 and graded according to the depth of renovation to shallow, medium and thorough and according to the type of building to single-family house, apartment building or non-residential building, see the table below.

Table 22: *Cost of renovations by type of building and depth of renovation*

Depth of renovation	Single-family houses CZK/m^2	Apartment buildings CZK/m^2	Non-residential buildings CZK/m^2
Shallow	3,175	2,025	1,525
Moderate	4,525	2,525	2,250
Thorough	6,100	3,850	3,250

Source: *Prepared by Chance for Buildings for the purposes of the Building Renovation Strategy*

The modelling of scenarios for the elaboration of the building renovation strategy is based on the input data as of 2013 and on the approximation of developments in the building sector as of 2019. Detailed update of the state of the building stock in the residential sector, i.e. the inclusion of new construction in the input data of the model, will be carried out on the basis of new statistical surveys, in particular the Census of Population, Houses and Dwellings, which will take place in 2021.

3.1.1 Defining possible scenarios

Three basic scenarios were defined:

Scenario 1: **Basic** (Business as Usual, current developments after the introduction of policies and measures based on Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings and Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency)

Scenario 2: **Optimal** (expected development of renovations of the building stock after the introduction of additional measures aimed mainly at changing the approach (complexity) of renovations and increasing their number in the public sector)

Scenario 3: **Hypothetical** (ideal scenario based on rapid and thorough renovations of the building stock, the implementation of which, however, is limited by the identified barriers and the possibility of implementing various measures, see Chapter 4)

The following table shows, in a simplified form, the parameters of the individual scenarios.

Table 23: *Table of basic parameters of scenarios*

Category	Depth of renovation	Basic	Optimal	Hypothetical
New construction				
single-family houses		1.11%	1.11%	1.11%
apartment buildings		0.46%	0.46%	0.46%
public and commercial buildings		0.96%	0.96%	0.96%
Annual rate of renovations				
single-family houses		1.40%	1.40%	3.00%
apartment buildings		0.79%	0.79%	2.00%
public and commercial buildings		1.40%	2.00%	2.50%
Depth of renovations (DR)		**Maintaining existing DR**	**DR increase by 2025**	**DR increase by 2030**
single-family houses	*shallow*	35%	20%	5%
	moderate	38%	40%	10%
	thorough	27%	40%	85%
apartment buildings	*shallow*	31%	20%	5%
	moderate	50%	40%	10%
	thorough	19%	40%	85%
public and commercial buildings	*shallow*	27%	20%	5%
	moderate	44%	40%	10%
	thorough	30%	40%	85%

Source: Prepared by Chance for Buildings for the Building Renovation Strategy

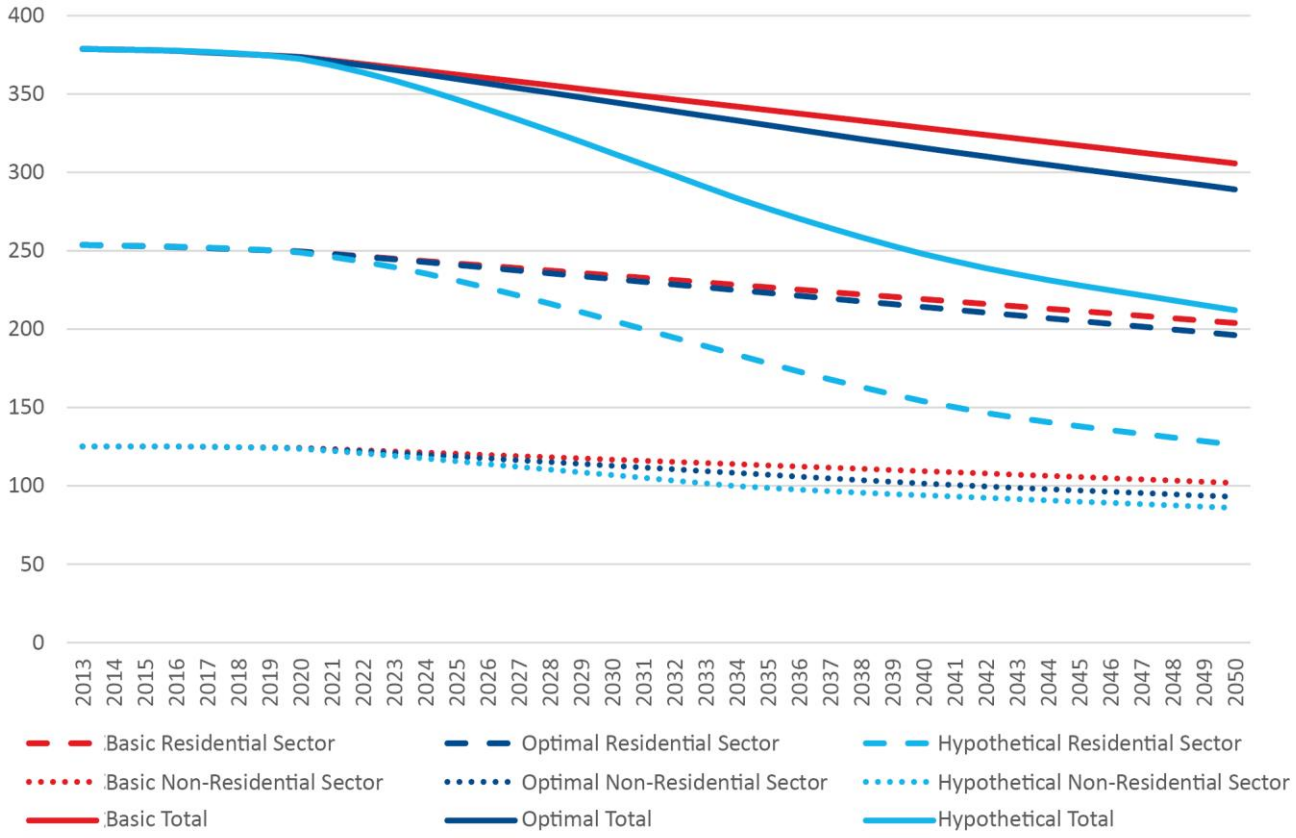
The entry depth of the renovation for all three scenarios corresponds to the state of the depth of the implemented renovations for 2020. Therefore, the values shown in the basic scenario are the same as the starting point for all three scenarios. In the basic scenario, the current depth of renovation is expected to be maintained for the entire period under review. In the optimal scenario, the depth of renovations is expected to increase by 2025, and this depth should then be maintained throughout the period under review. The

hypothetical scenario represents an ideal development based on rapid and thorough renovations, and from 2030 onwards, the depth of renovations should be at the above values.

3.1.2 Modelling outputs

The main output of the modelling can be seen in the following chart. Trends in energy consumption in the buildings sector for the types of consumption assumed in the evaluation of the energy performance of buildings in accordance with the Energy Management Act (i.e. excluding appliances). The starting point is 378 PJ. The residential sector accounts for 253 PJ, and the non-residential sector accounts for 125 PJ.

Chart 17: *Model final energy consumption in buildings [PJ]*



Source: Prepared by Chance for Buildings for the Building Renovation Strategy

Chart 18: *Development of the building stock structure according to the level of renovation – basic scenario [m²]*

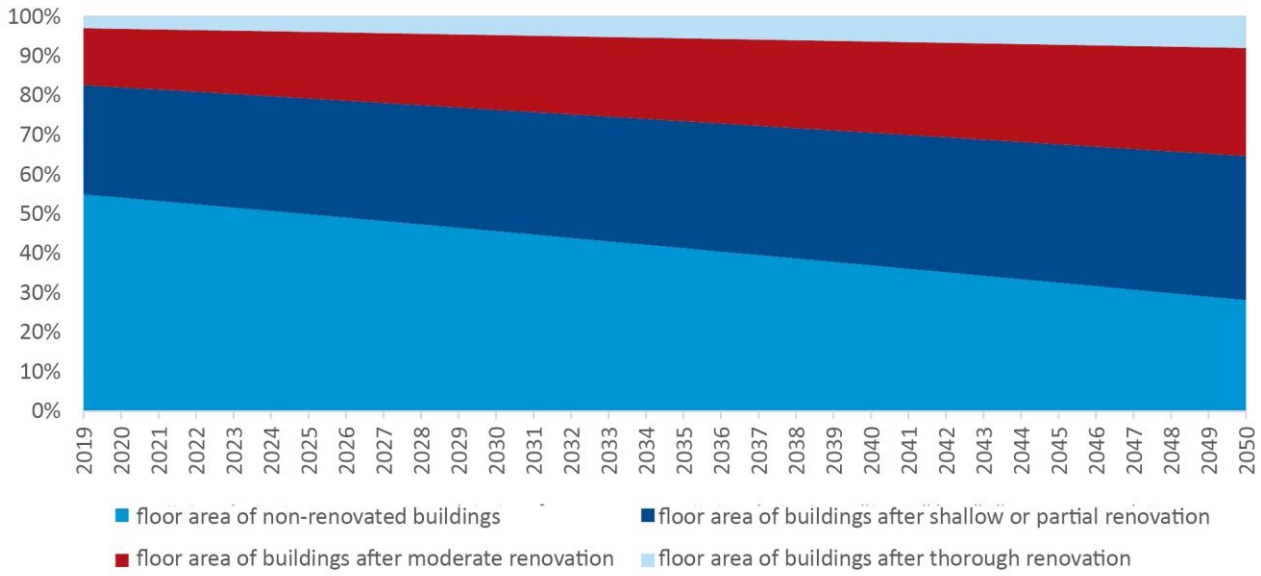


Chart 19: *Development of the building stock structure according to the level of renovation – optimal scenario [m²]*

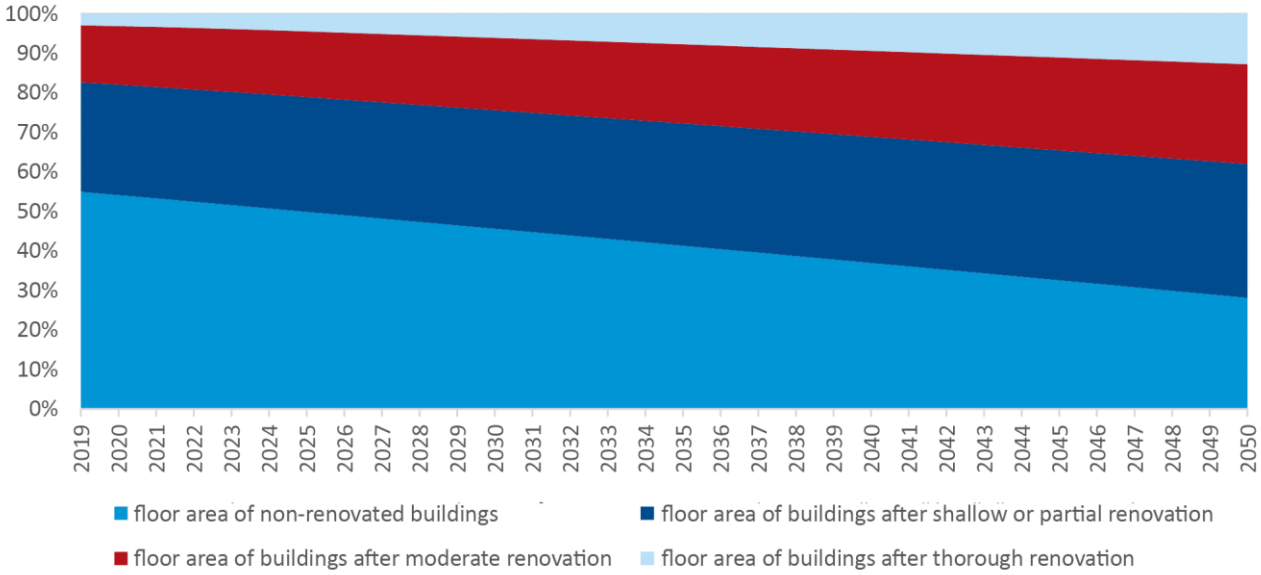
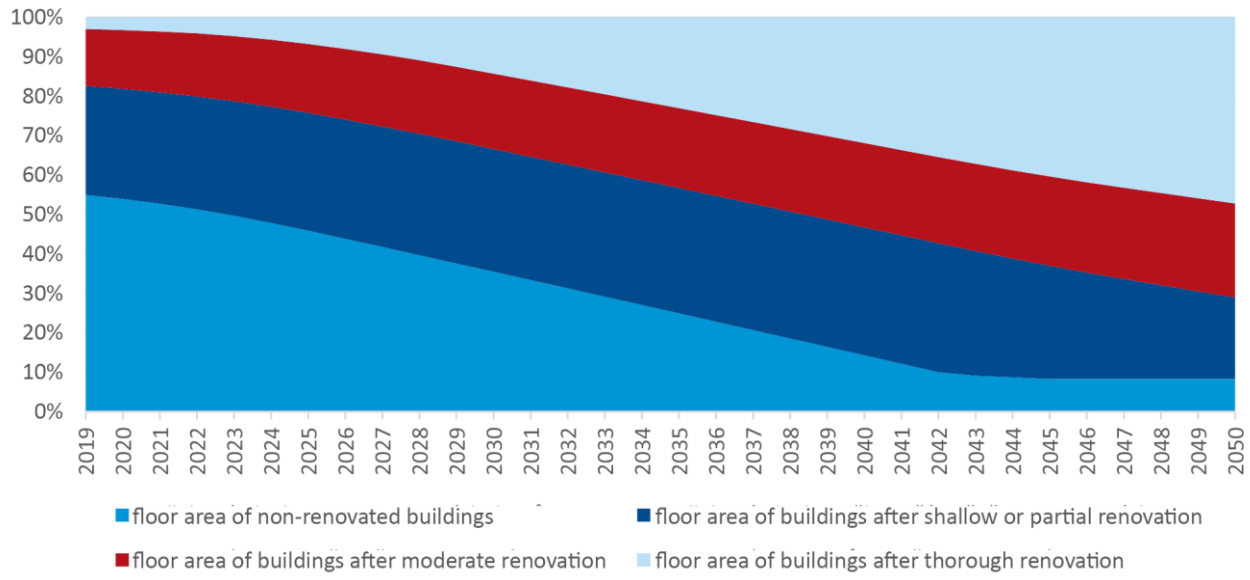


Chart 20: *Development of the building stock structure according to the level of renovation – hypothetical scenario [m²]*



Source: Prepared by Chance for Buildings for the Building Renovation Strategy

The renovation of buildings that have yet to undergo energy-saving renovation (75% of single-family buildings, 60% of apartment buildings and 50% of public and commercial buildings, see chapter 2) enters the scenarios first. Once this area of renovation (always moderate or deep) has been exhausted, attention turns to buildings that have already been renovated (for example, for single-family houses, this will be in about 2060 in the basic scenario, and in about 2040 in the hypothetical scenario).

Details of each possible scenario are given below. The basic scenario reflects the current market situation. The scenario thus considers all existing policies and measures to support energy efficiency by the State, but does not consider their change (nor the introduction of new policies, but also their end, for example, with a new programming period). By 2050, it reduces consumption by about 72 PJ (19%) compared to the current state. The cumulative investment costs until 2050 for the implementation of this scenario are CZK 722 billion.

MIT's optimal scenario goes beyond existing policies. It envisages the introduction of new measures, especially in the area of public and commercial buildings. In the area of residential buildings, it counts with increased depth of renovations, but without increasing the number of renovations itself. By 2050, it reduces consumption by about 89 PJ (24%) compared to the current state. The cumulative investment costs until 2050 for the implementation of this scenario were calculated at CZK 856 billion. Investment costs will consist of funds from both the State budget and other public budgets, as well as EU and private funds; the volume of funds allocated for national subsidy titles will depend on the possibilities of the State budget for the relevant periods.

The hypothetical scenario assumes that the vast majority of buildings (85%) will undergo thorough renovation from 2025 or 2030; only buildings where this is not technically possible will stick with shallow or moderate renovations. This will not be possible without significant State interventions. Furthermore, it

counts with an approximately doubled renovation rate, which would mean the renovation of every building in less than 30 years. This increase in the depth and rate of renovations will lead to a reduction in energy consumption of 166 PJ (44%) by 2050, with a total investment need of CZK 1,419 billion.

Table 24: *Table of baseline scenarios*

Basic	**2020**	**2030**	**2040**	**2050**
final energy consumption in the given year [PJ][29]	374	351	328	306
single-family houses	161	151	140	129
apartment buildings	88	84	79	75
public and commercial buildings	124	117	109	102
energy savings compared to baseline 378 PJ [PJ]	-4	-27	-50	-72
investment costs in the given year [CZK billion]	23	21	20	21
cumulative investment costs [CZK billion]	91	309	514	722
single-family houses	47	160	266	366
apartment buildings	13	43	71	97
public and commercial buildings	32	107	177	259
Specific heat required for space heating [MJ/(m^2.year)]	**493**	**434**	**382**	**339**

Optimal	**2020**	**2030**	**2040**	**2050**
final energy consumption in the given year [PJ]	373	345	316	289
single-family houses	*161*	*149*	*136*	*123*
apartment buildings	*88*	*83*	*78*	*73*
public and commercial buildings	124	113	102	93
energy savings compared to baseline 378 PJ [PJ]	-5	-33	-62	-89
investment costs in the given year [CZK billion]	24	26	28	23
cumulative investment costs [CZK billion]	93	356	614	856
single-family houses	47	168	282	388
apartment buildings	13	45	76	105
public and commercial buildings	33	142	256	362
Specific heat required for space heating [MJ/(m2.year)]	**493**	**426**	**368**	**325**

Hypothetical	**2020**	**2030**	**2040**	**2050**
final energy consumption in the given year [PJ]	372	312	248	212
single-family houses	161	130	94	76
apartment buildings	88	76	60	50
public and commercial buildings	124	107	94	86
energy savings compared to baseline 378 PJ [PJ]	-6	-66	-130	-166
investment costs in the given year [CZK billion]	32	55	40	28
cumulative investment costs [CZK billion]	104	605	1,102	1,419
single-family houses	53	311	570	713
apartment buildings	13	94	188	263

[29] Scenarios are based on the assumption that the operation of the building is optimised along with their renovation, and the rebound effect is neglected. The scenarios will be updated in the coming years with regard to current developments in the building segment.

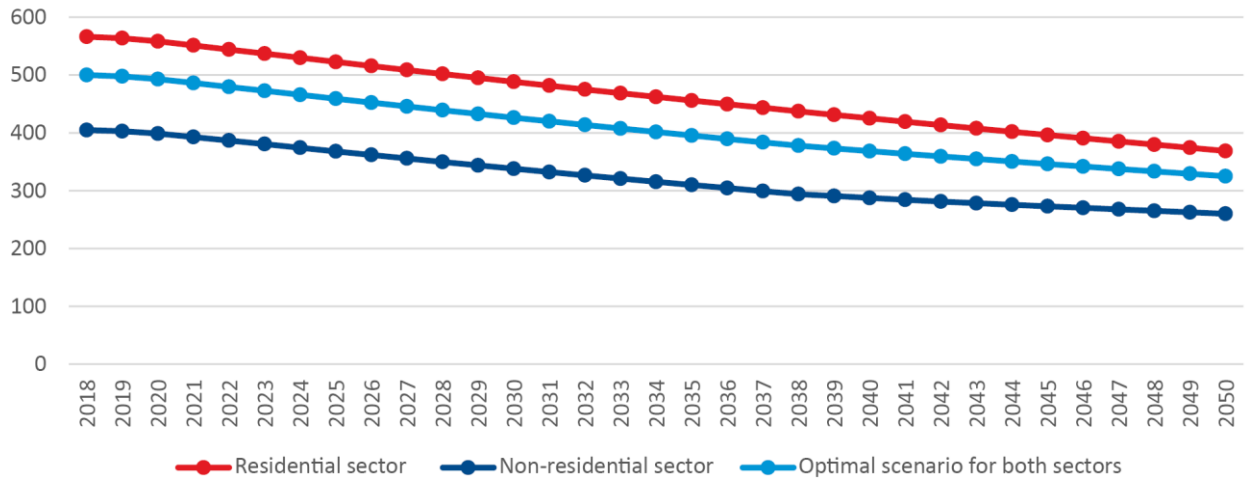
public and commercial buildings	37	199	344	443
Specific heat required for space heating [MJ/(m².year)]	**491**	**386**	**292**	**246**

Source: Prepared by Chance for Buildings for the Building Renovation Strategy

3.2 Choice of building renovation development scenario fulfilled by the Czech Republic in the following period

In the period 2020–2050, the Czech Republic expects developments in the area of building renovation according to the 'Optimal Scenario'. Although this is a scenario that does not use the maximum potential for decarbonisation of the Czech building stock, it is a scenario that is realistic to implement in the Czech Republic after modifying the existing policies, which could be evaluated over time, and after introducing other policies to improve energy efficiency of buildings. Given the fact that a number of measures motivating a higher number of building renovations beyond market development are already implemented in the basic scenario, without them the implementation of other available measures will focus mainly on the quality of renovations than on increasing the renovate.

Chart 21: *Development of specific consumption for heating in MJ per m²/year – optimal scenario*



Source: Prepared by the MIT based on the data from Chance for Buildings for the Building Renovation Strategy

For reporting of the impact, i.e. the fulfilment of the long-term strategy of building renovation, the indicator of specific heat required for heating in MJ per m² per year for individual sectors was selected. This indicator was chosen with regard to the availability of data (annual reporting of final consumption in households, specifically in the heating segment, knowledge of the size of the total floor area of the building stock (annual update of CZSO data on new construction)). The variable that is identified and does not have a detailed number of updates to it is the demolition rate. For this reason, the Census of People, Houses and Dwellings will always provide accurate information every 10 years, which can be used to refine the input data of the model.

Table 25: *Indicative milestones of the optimal scenario of the building renovation strategy for 2030, 2040 and 2050*

[MJ/(m^2.year)]	2020	2030	2040	2050
Specific heat required for heating	493	426	368	325
Residential sector	558	488	425	369
Non-residential sector	399	338	287	260

Source: Prepared by the MIT based on the data from Chance for Buildings for the Building Renovation Strategy

3.3 Contribution of the optimal scenario implementation to the reduction of greenhouse gas emissions

The adaptation model is taken from the Building Renovation Strategy prepared in 2016. It is recalculated for the aggregated outputs of the current model, i.e. it does not work with a breakdown by type of building owner, however, it gives a good idea of the extent of possible reductions in carbon dioxide emissions under different scenarios according to the rate and depth of building renovation.

Alongside the adaptation measure, the energy renovation of buildings is also a mitigation measure, that is, a measure that reduces greenhouse gas emissions. These are generated by the operation of buildings and their share of total anthropogenic emissions is not at all negligible.

To quantify this potential, the study 'Potential for greenhouse gas emissions savings in the Czech Republic through the reconstruction of buildings'[30] was therefore drawn up as part of the project of the preparation of the National Strategy for Adapting Buildings to Climate Change. The following text is based on this study, unless otherwise stated.

According to the National Greenhouse Gas Inventory[31], which was prepared for the Ministry of the Environment by the Czech Hydrometeorological Institute in June 2016, 101.15 Mt of CO^2 were generated in the Czech Republic in 2014.

The input values were obtained from the table of outputs from the complex model created by the Chance for Buildings in the up-to-date version. The final energy consumption figures are calculated for individual years on the basis of forecast of Czech building stock trends, as well as final energy consumption savings in heating and the increase in final energy consumption for cooling. It was also necessary to assign an energy mix to these final consumption values. Its development has been modelled for individual years, separately for residential buildings and for non-residential buildings. Current energy mixes were taken as the starting point, and energy mixes were predicted for 2060; both are based on studies of residential building[32] and non-

[30] Lupíšek, Antonín. 2016. *Potential for greenhouse gas emissions savings in the Czech Republic through the reconstruction of buildings.* University Centre for Energy Efficient Buildings of the Czech Technical University.

[31] KRTKOVÁ, Eva, Denitsa TROEVA GROZEVA a Martin BECK, 2016. National Greenhouse Gas Inventory Report of the Czech Republic (reported inventories 1990–2014) [online]. Obtained from: http://portal.chmi.cz/files/portal/docs/uoco/oez/nis/NIR/CZE_NIR-2016-2014_UNFCCC.pdf

[32] Survey of the residential buildings stock in the Czech Republic and the possibilities of savings in them, Chance for buildings for the MIT, December 2016

residential building stocks[33]. Simplifications were made for the sake of clarity, where current values and those for 2060 were linearly interpolated by discrete values for each year. Due to the large uncertainties of further forecasts for the purposes of this study, the energy mix in 2060 remains constant.

Table 26: *Energy mixes considered for residential buildings (according to final energy consumption)*

Energy carrier	Baseline (based on 2011 data from the MIT)	2060		
		Basic	*Optimal*	*Hypothetical*
Fuel oils	0.07%	0.07%	0%	0%
Natural gas	33.17%	33.17%	36.2%	24.9%
Coal	10.54%	10.54%	2.7%	0%
Biomass	18.34%	18.34%	18.6%	17.6%
District heating	17.46%	17.46%	24.6%	24.0%
Electricity	20.28%	20.28%	7.0%	6.3%
Other (solar, heat pumps)	0.13%	0.13%	10.9%	27.1%

Table 27: *Energy mixes considered for non-residential buildings (according to final energy consumption)*

Energy carrier	Baseline	2060	
		Basic scenario	*Optimal any hypothetical*
Electricity	42.1%	42.1%	34.9%
District heating	28.7%	28.7%	31.3%
Natural gas	27.1%	27.1%	27.0%
Gas cogeneration unit	1.5%	1.5%	1.6%
Other (solar, heat pumps)	0.4%	0.4%	4.8%
Solid fuels	0.2%	0.2%	0.2%

To calculate energy savings from CO^2 emissions, the emission factors were then used from Decree No 425/2004 and Decree No 480/2012, which are used for energy audits:

Table 28: *Emission factors in accordance with Decree No 480/2012*

Type of fuel	**Emission factor t CO_2/MWh, fuel efficiency[34]**
Lignite	0.36
Black coal	0.33
Heavy fuel oil	0.27
Light fuel oil	0.26

[33]Survey of the non-residential buildings stock in the Czech Republic and possibilities of savings in them; Chance for Buildings for the MIT; December 2016

[34] the district heating emission factor was assumed identical to that for natural gas, 0.2 t CO^2/MWh of fuel efficiency; for gas cogeneration units the emission factor was assumed to be half that for natural gas, i.e. 0.1 t CO^2/MWh of fuel efficiency; if the type of coal is not differentiated, the mean value of 0.345 t CO^2/MWh of fuel efficiency was used; for other fuels (solar energy, heat pumps), an emission factor of 0 will be used for this study

Natural gas	0.20
Biomass	0
Electricity	1.17

For the sake of clarity of the entire calculation, as no forecast of the future development of emission factors in the Czech Republic is available, they were considered to be constant over the whole evaluated period (we can expect a decrease in the emission factors of individual fuels with the advent of new technologies and a significant reduction in the emission factor of electricity with an increasing share of RES, cogeneration or nuclear power in the distribution network). Therefore, this simplification will lead to higher calculated emission production values than will actually be the case. Electricity was considered as a source of energy for changing the consumption of energy for cooling.

Based on the calculations made, it can be stated that the **operation of buildings with their 44.57 Mt of CO_2 contributes about 44[35]% to the total production of emissions in the Czech Republic.** The model scenarios also show that in the case of **CO_2 emissions from the operation of buildings, it is possible to reduce it from the current 44.6 Mt to 26 Mt per year by 2050 in the case of the Optimal Scenario, i.e. by about 40%.** Therefore, buildings can make a significant contribution to the emission reduction targets in the Czech Republic.

3.4 Influence of the Long-Term Strategy on the quality of the indoor environment of buildings

It is a well-known fact that people spend approximately 80–90% of their time inside buildings and therefore the quality of the indoor environment of buildings significantly affects their life and its quality. Therefore, it is necessary to look at buildings and their renovations comprehensively, i.e. in terms of energy performance of buildings, the quality of the indoor environment and their adaptation to climate change. When improving energy performance of buildings, it is thus important to implement a solution that ensures an improvement of energy performance, but also an optimal environment for life and work, i.e. an indoor environment that will not have a negative health impact on the users of the buildings. From this point of view, it is necessary to deal with the following parameters defining a healthy indoor environment:

- thermal comfort;
- indoor air quality (fresh air supply, moisture removal, removal of microorganisms, etc.);
- ensuring sufficient daylight as well as artificial light;
- acoustics;
- construction materials used.

Ensuring the optimal level of the above parameters, and thus creating conditions for a quality indoor environment, is achieved in the Czech Republic on the basis of legislative requirements and technical

[35] Based on 2014 data.

standards. The setting of legislative requirements ensures that when buildings are renovated, the requirements for the quality of the indoor environment are also ensured. Therefore, it can be said that as the renovated energy reference area increases, there will be a proportionate improvement in the area meeting the criteria for a healthy indoor environment. This assumption is based on the fact that the aim of the Long-Term Strategy is to increase the number of comprehensive renovations.

Legislative measures to achieve a quality indoor environment in new and existing buildings

Any building that is constructed or undergoes a major modification must meet the minimum requirements for energy efficiency. These requirements are set by Decree No 78/2013, which, in addition to the minimum requirements for the quality of the building envelope, also lays down, in accordance with the requirements of Directive (EU) 2018/844 of the European Parliament and of the Council of 30 May 2018 amending Directive 2010/31/EU on the energy performance of buildings and Directive 2012/27/EU on energy efficiency, the requirements for achieving a quality indoor environment in the form of quality technical equipment of buildings.

Another important legal regulation is Decree No 268/2009, on technical requirements for buildings, which is applicable nationwide with the exception of the City of Prague (where Regulation No 10/2016 of the City of Prague applies). The provisions of this Decree apply to both residential and non-residential premises of the building in terms of construction and technical equipment, alterations to completed buildings, maintenance work, changes in the use of buildings, temporary constructions of construction site equipment, as well as to constructions that are cultural monuments or are in heritage zones or conservation areas, unless compelling territorial or constructional reasons preclude its application. These are, in particular, the requirements for ventilation, lighting levels, fire safety, protection against noise and vibration, mechanical resistance, protection of human health and safety of use.

The conditions relating to a quality indoor environment and the protection of health while inside buildings are determined by Decree No 6/2003, which sets public health standards for chemical, physical and biological indicators for the indoor environment of occupied rooms in certain buildings. Specifically, these are public health standards for chemical, physical and biological indicators for the indoor environment of occupied rooms in facilities for education and training, universities, green schools, buildings for convalescence, buildings of medical facilities for medical and preventive care, social care institutions, accommodation facilities, retail premises and buildings for gatherings of large numbers of people.

Non legislative measures to achieve a quality indoor environment in new and existing buildings

In addition to the EPC assessment of buildings, buildings can be assessed more comprehensively through certification. This is a comprehensive assessment of the sustainability of buildings in terms of standards from various areas, such as technology and use of materials, environmental protection, energy, water management, transport (connection to surrounding areas). These certifications are voluntary for the commercial sphere in the Czech Republic and function as a transparent proof of the quality of buildings. In some countries, such as Germany or the USA, these are mandatory for buildings financed from public budgets.

WELL certification is currently being promoted in the Czech Republic. The WELL certification system, as the first certification focused on a healthy indoor environment of buildings, was created on the basis of the awareness that a healthy indoor environment significantly reduces staff costs and at the same time increases staff productivity. It is an international certification system complementing the LEED and BREEAM certification systems, which are focused on the sustainability of buildings. WELL is mutually compatible with these systems; it simply complements them. It is the result of a new form of sustainability, which, in addition to minimising the impact of buildings on the environment, also addresses the impact of buildings on people – their health and comfort. We spend 90% of our time inside buildings, and buildings have a major impact on us[36]. The Czech Republic currently counts three certified buildings and another four aspiring projects. The development of this certification system is expected to continue.

In addition to the development of building certification, other projects focusing on thermal comfort, quality indoor environment, etc. are currently being implemented in the Czech Republic. These projects are mostly implemented from support programmes financed from both European and national funds.

Ventilation concept

The Ministry, in cooperation with the Czech Lightweight Cladding Chamber, has prepared a 'Ventilation Concept' with support from the EFEKT program. The document is a methodological aid for ventilation design while respecting the main aspects (hygiene, health, construction, energy) and it is intended for all persons involved in construction whose activities affect the creation of the indoor environment in buildings – future builders, users, developers, architects, designers, suppliers, operators and employees of building authorities and public health authorities. The material is based on binding legal regulations (laws, government regulations, decrees), binding and recommended technical standards (CSN EN, CSN), recommended technical normative information TNI and technical rules (e.g. TPG), always in their current versions. Some recommendations are based on foreign data and experience. The ventilation concept is available for free at:

https://www.mpo.cz/cz/stavebnictvi-a-suroviny/stavebni-vyrobky/koncept-vetrani-_-pravidlo-spravne-praxe--232516/

Part of this methodology was used to provide support under the Operational Programme Environment, specifically in the case of support for the renovation of buildings used for the education and training of children. If one of the measures of such a project is to improve the thermal technical properties of peripheral structures, a ventilation system meeting the legislative requirements must be designed within the project (Decree No 410/2005, on hygienic requirements for premises and operation of facilities and establishments for education and training of children and juveniles, as amended) and be prepared in accordance with the methodological guideline for the design of school ventilation, which is based on the Ventilation Concept.

Healthy Building

[36] WELL Healthy Indoor Environment Certification. *Healthy building* [online]. 2020. Available at: http://www.zdravabudova.cz/cs/certifikace

The EFEKT programme also supported the 'Healthy Building' project, which was prepared by the Czech Green Building Council. It is a website that deals with individual aspects of achieving a healthy indoor environment, even in terms of mental well-being, which is no less important. Case studies of achieving a healthy indoor environment in buildings with different types of use are available free of charge on the website. More information can be found at http://www.zdravabudova.cz/.

Healthy school

Another project dealing with the quality of the indoor environment is the 'Healthy School' project, which was prepared by the Czech Green Building Council. Measurements were performed in two selected schools as part of the project. Based on the results, a solution was designed and implemented in two model classes leading to an increase in the quality of the indoor environment. More information can be found at http://www.zdravaskola.cz/.

Achieving a healthy indoor environment in existing buildings is supported by the State not only in the form of support for various studies and projects. Table 29 provides an overview of programmes to support the renovation of buildings available in the Czech Republic, which support activities such as insulation of building facades, better materials for hole fillings, installation of quality ventilation systems with recuperation and other technical equipment, support for building construction in the passive standard, outdoor shielding elements, etc. All these supported activities have a direct impact on quality of the indoor environment in the building, and thus a direct impact on human health and mental well-being.

4 Evaluation of the barrier for building renovations in the period until 2020

In the Czech Republic, a scheme based mainly on investment subsidies has been introduced to support the implementation of savings measures, including the renovation of buildings. In building sector area, investment subsidies are provided within the framework of programmes that differ according to the focus on the type of applicant, i.e. owner of the building, the type of building or the region where the building is located; see Table 29 *Overview of programmes to support the renovation of buildings available in the Czech Republic as of 2020.* The total allocation of funds to this area in the period 2014–2020 amounts to CZK 78.3 billion.

Table 29: *Overview of programmes to support the renovation of buildings available in the Czech Republic as of 2020*

Support programme	Type of applicant	Type of building	Scope	Measure
New Green Savings (subsidy) https://www.novazelenausporam.cz/	owners or builders (natural and legal persons, central institutions): • of single-family houses; • of apartment buildings; • of State buildings.	• single-family houses • apartment buildings • State buildings	The whole Czech Republic – single-family houses City of Prague – apartment buildings	**Construction:** • support for achieving the passive standard; • use of heat from wastewater; • construction of green roofs (apartment buildings).
				Renovation of single-family houses: • improving the energy performance of buildings (building envelope, technical equipment); • reconstruction and replacement of energy production equipment for own consumption; • reconstruction of electricity, gas and heat distribution; • construction of buildings in the passive standard; • replacement of electric heating systems with heat pump systems, replacement of local heaters; • support for photovoltaic and solar systems. Controlled ventilation system with recovery. • Outdoor shading elements. **Renovation of apartment and State buildings:**

Support programme	Type of applicant	Type of building	Scope	Measure
				• insulation of facades, roofs, ceilings, replacement of windows and doors, replacement of heat sources for heating with solid fossil fuels with efficient environmentally friendly sources; • replacement of electric heating systems with heat pump systems; replacement of gas heating with a gas heat pump system or for a cogeneration unit using natural gas as fuel; • support for photovoltaic and solar systems. Controlled ventilation system with recovery.
IROP (subsidy) https://irop.mmr.cz/cs/vyzvy/detaily-temat/zateplovani http://www.sfrb.cz/programy-a-podpory/program-zateplovani/	• owners of apartment buildings and associations of unit owners (excl. natural persons not engaged in business). • housing cooperatives; apartment building managers	apartment buildings	The whole Czech Republic outside the territory of the City of Prague	• Reducing energy consumption by improving the thermal properties of buildings (insulation, cladding, roof and ceiling and floor structures); • heating or hot water installations (replacement of fossil fuel sources with environmentally friendly sources); • transition to environmentally friendly, ecological sources (biomass or natural gas boilers, heat pumps, or cogeneration units; water and heat distribution).
OP EIC (subsidy / financial instrument) https://www.oppik.cz/dotacni-	Entrepreneurs	buildings for business	The whole Czech Republic outside the territory of the City of Prague	• Insulation, replacement and renovation of hole fillings, other construction measures with a demonstrable impact on the energy performance of the building; • installation of air conditioning with waste heat recovery; • modernisation of lighting systems, installation of renewable energy sources.

Support programme	Type of applicant	Type of building	Scope	Measure
programy/uspory-energie https://www.cmzrb.cz/podnikatele/uvery/uspory-energie/				
PANEL 2013+ (financial instrument) http://www.sfrb.cz/programy-a-podpory/program-panel-2013/	Owners of residential buildings • housing cooperatives • associations of owners of apartment units • natural and legal persons • towns (cities) • municipalities	apartment buildings	The whole Czech Republic	• Improving the energy performance of the building, repairing building's faults; • repairs and modernisation of common areas; • modernisation of residential cores.
JESSICA II (financial instrument)	municipalities and associations of municipalities	• residential buildings • sports facilities • start-up workshops and offices • community centres	Moravian-Silesian Region	• reconstruction; • construction realisation.

Support programme	Type of applicant	Type of building	Scope	Measure
OP E https://www.opzp.cz/o-programu/podporovane-oblasti/prioritni-osa-5/	regions, municipalities, voluntary associations of municipalities, organisational units of the State, State organisations, public research institutions and research organisations, if they are public entities, public institutions, districts of the City of Prague, universities, schools and school facilities and school legal entities, non-state non-profit organisations, contributory organisations, churches and religious societies and their associations, business companies owned 100% by a public entity except for supported beneficiaries within the OP EIC;	Public buildings	The whole Czech Republic	**Renovation:** • thermal insulation of the building envelope, replacement and renovation (overhaul) of hole fillings; • implementation of measures having a demonstrated influence on the energy performance of buildings or improvements in the quality of the indoor climate; • implementation of mechanical ventilation systems with waste heat recuperation; • implementation of systems reusing waste heat, replacement the heating, cooling or domestic hot water source. **Construction:** • new public buildings in the passive energy standard.
	Building owners	Residential buildings (households)	The whole Czech Republic	• Replacement of a solid fuel boiler with manual loading, which do not meet the requirements of classes 3, 4 or 5 according to CSN EN 303-5, with a new, ecological heat source.
	regions, municipalities, voluntary associations of municipalities, organisational units of the State, State enterprises	Public buildings, business buildings	The whole Czech Republic	• Expansion and reconstruction of district heating systems, including the implementation of new systems; • replacement or reconstruction of stationary combustion sources

Support programme	Type of applicant	Type of building	Scope	Measure
	public research institutions and research organisations in accordance with Act No 130/2002, if they are public entities, public institutions, districts of the City of Prague, contributory organisations, universities, schools and school facilities, non-state non-profit organisations, churches and religious societies and their associations, business entities, business companies and cooperatives; natural persons engaged in business.			
EFEKT https://www.mpo-efekt.cz/cz/programy-podpory/efekt	Regions, municipalities and city districts with more than 5,000 inhabitants, voluntary associations of municipalities, business entities	Public buildings	The whole Czech Republic	• Introduction of an energy management system
	Building owners	Single-family houses, apartment buildings, public buildings, business buildings	The whole Czech Republic	• Preparation for the implementation of quality energy savings projects with good practice principles.

Support programme	Type of applicant	Type of building	Scope	Measure
	Regions, municipalities, city districts, State enterprises, companies owned 100% by municipalities or city districts, public non-profit institutional health care facilities, school legal entities, contributory organisations, organisational units of the State, business entities	Public buildings, buildings for business	The whole Czech Republic	• Processing of documents for the preparation of an energy savings project solved with the EPC method.
ENERG https://www.cmzrb.cz/podnikatele/uvery/energ/	Small, medium and large enterprises	Buildings for business	City of Prague	• Insulation of buildings for business and window replacement; • reconstruction of electricity and gas distribution; • replacement of air conditioning with more energy efficient types; • illumination of buildings and industrial areas; • modernisation of energy generation plants for own consumption; • installation of renewable energy power-generating facilities and heat pumps.
Operational Programme Prague – Growth Pole of the Czech Republic	City of Prague, Districts of the City of Prague, Organisations founded by the City of Prague and its districts, Prague Public Transport Company, Prague Technical Road Administration, Organisation for Research and Dissemination of Knowledge	Transport buildings, public buildings	City of Prague	• improving energy performance of buildings and technical equipment; • conversion of energy-intensive public buildings into near-zero energy buildings (or buildings in the passive energy standard) with integrated intelligent systems; • supporting the transition to smart buildings.

However, these programmes are not fully used, see *Table 30 Evaluation of the use of funds to support energy savings measures*, from which it can be concluded that there are other, non-financial barriers on the market to implement a higher rate of renovation. In order to find these barriers and map the attitude of the general public to the renovation of buildings, *a survey of awareness of energy savings and barriers to / motivations for their implementation among various types of building owners in the Czech Republic (hereinafter the 'survey')* was conducted[37]. The results of the market survey helped to determine the real rate of renovations in the Czech Republic (see Chapter 4), but in particular they provide a basis for more effective policy settings to increase the number of renovations and the quality of their implementation in the coming period (after 2020).

Table 30: *Evaluation of the use of funds to support energy savings measures (source data from 1 May 2019)*

Programme	Number of approved projects	Energy savings from approved projects (TJ)	Amount of subsidy (CZK million)	Current specific subsidy (CZK/GJ)	Current allocation 2014–2020 (CZK million)	Current status of allocation utilisation
OP EIC SO 3.2	1,215	3,186	6,651	2,087	17,300	38%
OP E SO 2.1	56,939	1,811	5,733	3,165	9,600	60%
OP E SO 5.1 and SO 5.3	1,433	800	5,464	6,833	13,614	40%
IROP	1,453	928	3,096	3,335	9,600	32%
NGS	32,257	4,017	8,810	2,193	17,200	38%
PANEL[38]	488	144	1894	13,141	4,500	42%
JESSICA[39]	150	74	175	2,363	600	29%
ENERG	1	0	3	9,112	130	2%

Source: Ministry of Industry and Trade

The following subchapters present the survey outputs according to the type of building owner and the type of buildings. The survey was conducted among representatives of individual types of owners or managers of the following categories of buildings:

A. Residential buildings
    a. Single-family houses
    b. Apartment buildings
        i. Owners of apartment units
        ii. Associations of unit owners
        iii. Housing cooperatives
        iv. Individual owners of apartment buildings
B. Public buildings
    a. Municipalities with up to 1,999 inhabitants
    b. Municipalities and towns with between 2,000 and 49,999 inhabitants

[37] https://www.mpo.cz/assets/cz/rozcestnik/pro-media/tiskove-zpravy/2019/5/MPO_pruzkum-povedomi_uspory-energie_zavery-a-doporuceni_2021.pdf
[38]This is a programme that provides funds in the form of a concessional loan.
[39]This is a programme that provides funds in the form of a concessional loan.

c. Cities and regions with more than 50,000 inhabitants

C. Business buildings

a. Businesses that use buildings for their own business

b. Businesses that manage buildings for other entities

A comprehensive understanding of barriers in a given sector requires knowledge of the ownership structure, especially in the case of apartment buildings and non-residential buildings, due to various motivational factors depending on the type of owner. The starting point for the assessment of ownership relations is data from the 2011 Census and the document *Housing in the Czech Republic in Figures 2019* prepared by the Ministry of Regional Development.

4.1 Barriers in the residential sector

4.1.1 Evaluation of ownership relations in the residential sector

In the residential sector category, the survey focused on two types of buildings and four types of ownership. In the Czech Republic, private ownership of dwellings predominates[40], with about 70% of the population living in their own housing[41]. Ownership housing is most widespread in the field of single-family houses.

Table 31: *Houses by type of house and persons in them and by occupancy and owner*

		Houses total	of which		Number of persons	
			single-family houses	apartment buildings	total	of which in single-family houses
Houses total		**2,158,119**	**1,901,126**	**214,760**	**10,304,041**	**5,043,384**
occupied houses		**1,800,075**	**1,554,794**	**211,252**	**10,304,041**	**5,043,384**
ownership by number of	natural person	1,499,512	1,455,367	36,763	5,224,455	4,729,644
	Municipality, State	48,948	9,580	31,531	887,773	32,749
	residential cooperative	31,509	1,037	30,404	1,023,035	3,116
	co-ownership of apartments owners	137,687	60,651	76,522	2,048,197	196,380

Source: Use of CZSO data[42]

The following Table 32 provides an overview of the occupancy of houses and at the same time gives an opportunity to look at housing in terms of the number of housing units.

[40] It also includes cooperative housing, which is close to ownership housing. This is approximately 9.5% of occupied dwellings.

[42] Table 117; MoRD, https://www.mmr.cz/getmedia/c7b6b3b8-267c-4a90-bd3c-07187f5d77cd/Bydleni-v-Ceske-republice-v-cislech-(zari-2016),-web.pdf

Table 32: *Houses for living by occupancy, number of dwellings in them, by type of house*

Houses for living by occupancy				Houses total	of which		
					single-family houses	apartment buildings	other buildings
Buildings with apartments	Occupied houses with apartments	number of houses		1 798 318	1 554 794	211 252	32,272
		number of apartments in houses	*total*	*4 371 661*	*1 896 931*	*2,416,033*	*58,697*
			occupied	*4 104 635*	*1 795 065*	*2,257,978*	*51,592*
			non-occupied	*267 026*	*101 866*	*158,055*	*7,105*
	Non-occupied houses with apartments	number of houses		356 933	346 332	3 508	7,093
		of which number of (unoccupied) apartments		*384 911*	*359 141*	*18 586*	*7,184*
	Total houses with apartments	number of houses		**2 155 251**	**1 901 126**	**214 760**	**39,365**
		number of apartments in houses	*total*	***4 756 572***	***2 256 072***	***2,434,619***	***65,881***
			occupied	***4 104 635***	***1 795 065***	***2,257,978***	***51,592***
			non-occupied	***651 937***	***461 007***	***176,641***	***14,289***
Buildings without apartments		occupied		4,023	x	x	4 023
		non-occupied		1,111	x	x	1 111

Source: Use of CZSO data[43]

The distribution of ownership in the residential sector is even clearer, if we look at it from the point of view of the use of housing units according to the above division (see Table 33).

Table 33: *Occupied dwellings by legal reason for using the dwelling and owner of the house*

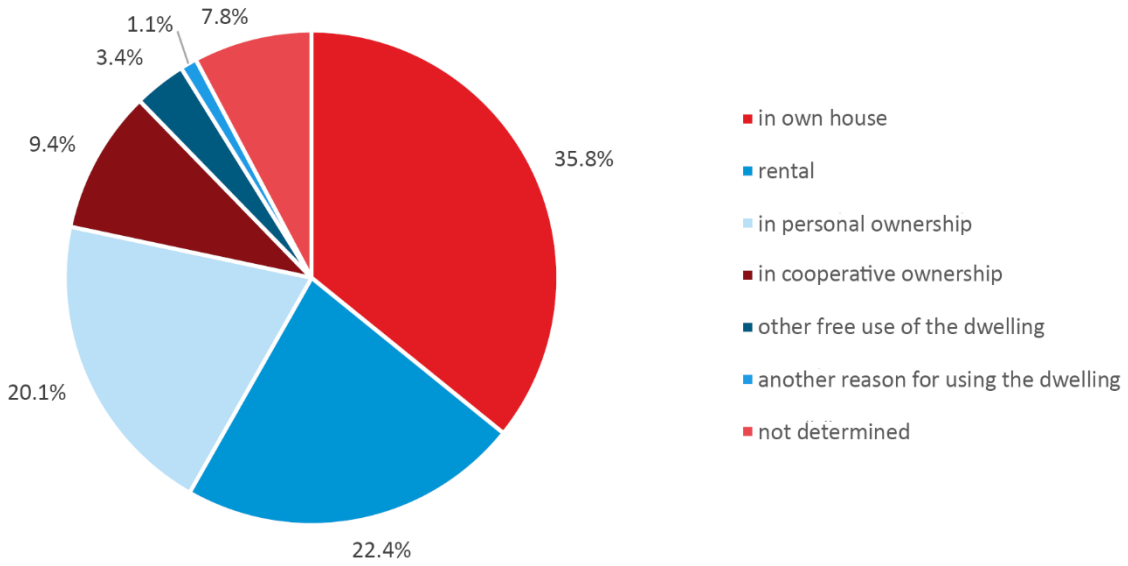
Owner of the house		Occupied apartments total	of which according to the legal reason for using the dwelling						
			in own house	in personal ownership	other free use	rental	in cooperative ownership	other reason for use	not determined
Total occupied apartments		4 104 635	1 470 174	824 076	140 348	920 405	385 601	44 645	319 386
of which by	natural person	1 894 868	1 407 789	-	140 348	183 856	-	24 485	138 390
	Municipality, State	372 214	-	-	-	342 468	-	-	29 746

[43] Table 253. MoRD, https://www.mmr.cz/getmedia/c7b6b3b8-267c-4a90-bd3c-07187f5d77cd/Bydleni-v-Ceske-republice-v-cislech-(zari-2016),-web.pdf

	residential cooperative	451 217	-	-	-	118 391	304 117	3 033	25 676
	other legal person	107 068	-	-	-	89 677	-	2 943	14 448
	co-ownership of apartments owners	908 997	61 344	665 155	-	118 609	-	9 632	54 257
	combination of owners	259 746	950	124 555	-	33 397	81 483	2 798	16 563
	not determined	110 525	91	34 366	-	34 007	1	1 754	40 306

Source: Use of CZSO data[44]

Chart 22: *Total occupied dwellings by tenure status in the Czech Republic*



Source: CZSO, MoRD's calculations

The above overviews clearly show that among occupied dwellings, rental housing is the most widespread after owner-occupied housing, which is in turn reflected in the interest in renovations; see below in the sections of the survey findings.

4.1.2 Findings from a survey of single-family house owners

In 94% of cases, the owner of single-family houses is a natural person (according to the 2011 Census), therefore only the owners of single-family houses were contacted in the survey.

More than half of the respondents have implemented 2 or more measures in their house in the last 5 years. However, owners of single-family most often renovate on their own, for their own money and gradually.

[44] Table 355 MoRD, https://www.mmr.cz/getmedia/c7b6b3b8-267c-4a90-bd3c-07187f5d77cd/Bydleni-v-Ceske-republice-v-cislech-(zari-2016),-web.pdf

Owners are not used to using the services of construction companies, borrowing money or applying for a subsidy. They renovate gradually, part by part, whenever they have enough money saved.

On the part of this group of owners, there is an effort to carry out the renovation with a minimal number of administrative tasks, i.e. they want to carry out renovations outside the approval regime of Act No 183/2006, on spatial planning and building code. Hence, it is problematic for the State to get an overview of the actual number of renovations.

The most important factor in deciding on the renovation was the increase in living comfort, energy cost savings and the technical condition of the house. The availability of a subsidy is not an important trigger for them to prepare and implement a renovation – only about 6% of respondents use it. The administrative procedure associated with processing the subsidy will be difficult for people in most cases.

When asked what would motivate the respondents to carry out a more thorough renovation, the respondents most often chose the possibility of a higher subsidy in the case of a more extensive and thorough renovation and an interest-free loan from a State institution. An interest-free loan from commercial banks and assistance with the preparation of documentation and energy optimisation seem a bit less motivating.

Based on the above outputs, the objective in this group is to increase the quality of renovations and their complexity.

The key to achieving the objective, same as with the other categories, is to achieve a change in the attitude of the general public towards the topic of energy efficiency and energy savings. Without a change in attitude, the application of other support mechanisms for the implementation of quality renovations will be ineffective or not used at all. Despite efforts to date to improve the energy performance of buildings and household consumption, the survey shows that the efforts are ineffective and that a change in the marketing approach is needed. A possible way to reach homeowners is through their motivational factors for renovation.

Therefore, for the period 2020–2030, the Czech Republic will focus on raising awareness of the topic of increasing energy efficiency[45] and adopting efficient energy management (regulation, ventilation, efficient use of energy-saving appliances, etc.) as part of everyday life.

Non-investment measures will be supplemented by investment support from the State. As appropriate tools to achieve the above objectives, the Czech Republic will adopt a modification of the existing support scheme with greater emphasis on the use of non-subsidy financial mechanisms, such as concessional loans and guarantees.

Last but not least, as the survey shows, it is necessary to focus on ensuring the 'administrative simplicity' of the renovation, both in terms of legislative requirements and preparation of the application for support.

[45]In 2019, a project entitled *Creating a Communication Campaign to Raise Awareness of Energy Savings in the Czech Republic* was implemented in the Czech Republic as part of the Structural Reform Support Service. One of the outputs of the project (a short-term, two-year communication campaign) will be implemented in the period 2021–2023.

4.1.3 Findings from a survey of apartment building owners

In the category of apartment buildings, both owners of individual apartments and representatives of the association of unit owners (SVJ), representatives of housing cooperatives and individual owners of entire apartment buildings were surveyed.

Since 2010, more than two thirds of apartment buildings have undergone at least some renovation of the common parts of the apartment building. The most common motivation for renovation was the need for house maintenance or an acute solution of an issue, i.e. the technical condition of the building, the improvement of the internal environment and the saving of energy costs. The availability of a subsidy was not a significant motivating factor.

Cooperative houses show a more comprehensive approach – more measures are more often implemented for them at once (complete building envelope – windows, cladding, roof). This is probably also one of the reasons why this category shows a higher financial demands of renovation, longer period of time needed for preparation and the actual implementation of the renovation, but also more frequent complications in approving the renovation and its project in case they wanted to use subsidies for financing. Unlike other categories, energy cost savings prevail here as the main motivation. In the case of cooperative ownership, it is possible to observe similar actions as in the case of municipalities.

In other categories, the renovations are more often gradual. The vast majority of buildings are renovated from their own resources from the repair fund. The subsidy was used only in 12–20% of cases. Less than half then use a commercial loan to co-finance the renovation.

The category of individual owners renovates the least often, has a significantly lower ratio of the use of commercial loans in its financing, and almost half of the renovations take place without a selection procedure for a supplier and without the presence of a construction manager, which is less than in other categories. It is in this category that the low motivation for renovations is so significant due to the purpose of using the building, which is often the rental of housing units. In such a case, the owner is not motivated to implement the measures even when there is an emergency situation or the need to reduce energy costs.

The survey showed that in the case of apartment buildings, the project preparation can take four times longer than its implementation. Owners or administrators of all categories of apartment buildings usually consult the form of renovation with the owners, tenants or members of the cooperative. Renovation is usually not blocked by anyone.

As in the case of single-family houses **the objective for this group is to increase the quality of renovations and their complexity, especially in the case of ownership by associations of owners and individual owners.** In the case of individual owners, it is necessary to find a motivating factor for renovations, which would increase their interest in carrying out a renovation. In these cases, it will be necessary to consider the introduction of appropriate instruments, especially at the municipal level.

As in the case of single-family houses, it will be key to execute a campaign for the period 2020–2030 to bring the topic of increasing energy efficiency to the general public. The owners will be reached out to via topics

that motivate them to carry out renovations in order to increase the number of implemented renovations. The technical condition of the building is crucial in this regard.

However, it is not possible to generally determine when the owner is carrying out the renovation due to the 'wear and tear'[46] of the building in order to optimally set up the incentive in the form of a financial instruments. In order to determine the above moment, a detailed analysis of wear depending on the nature of the maintenance would have to be carried out. Data for such an analysis are not publicly available and their collection and evaluation is not possible for the Long-Term Strategy due to time constraints. Hence, policies are set based on the building stock survey that was carried out on the basis of available data and a market survey.

4.2 Barriers in the public sector

4.2.1 Evaluation of ownership relations

This category includes buildings belonging to municipalities, towns or cities, the State and the organisations founded by them. The data provided by the CZSO from the survey *'Buildings 1-99 Survey of non-residential buildings and selected residential buildings'* were used to evaluate this category.

Basic division for the needs of the renovation strategy, i.e. the evaluation of the policy settings for the implementation of the Long-Term Strategy, was made by the number (and size) of buildings that fall into each category of public buildings:

- Small municipalities (0–1,999)
- Larger municipalities (2,000–49,999)
- Towns (cities) and regions (more than 50,000)
- State

The data analysis and subsequent extrapolation [47]revealed the number of public administration buildings listed in Table 34 *'Overview of owners / users of public sector buildings'*.

Table 34: *Overview of owners / users of public sector buildings*

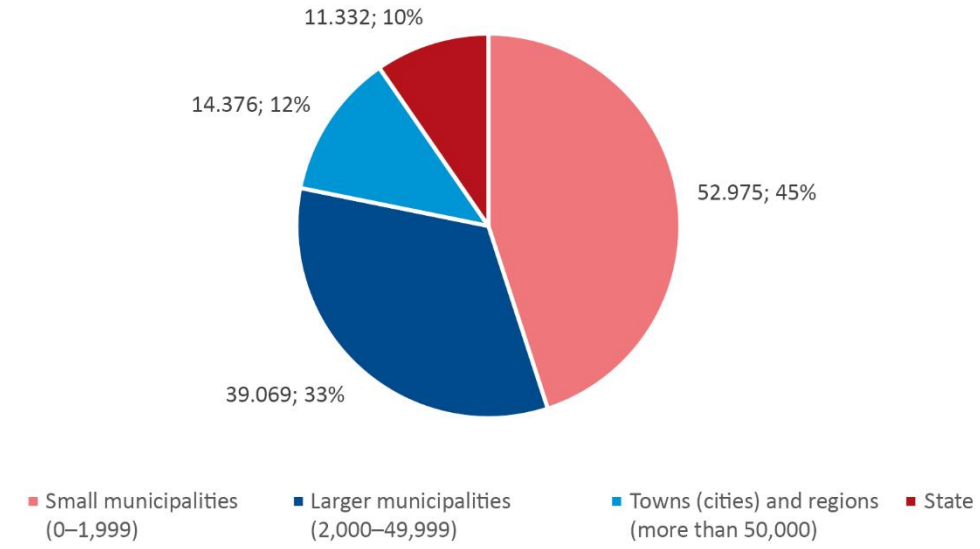
Code	Owner	Number of buildings	Surface area [m^2]
325	State organisational units / State	7,652	7,097,677
331–131	State contributory organisations	1,210	1,510,508
331–133	municipal contributory organisations	3,726	3,524,826
801–A	small municipalities	39,572	11,163,976
801–B	medium municipalities / towns	29,184	19,947,155
801–C	large cities / City of Prague districts	6,648	6,918,573
804	regions	4,091	5,595,150
	total	**92,083**	**55,757,865**

[46] 'Wear and tear' means the gradual degradation of a building due to aging and its use. It is given as a percentage of the value of a new building.

[47]The extrapolation was performed on the basis of the ratio of returned questionnaires, which was 78.2%.

Source: Survey 1-99, own processing.

Chart 23: *Distribution of ownership of public sector buildings according to the size of the municipality or town / city*



Source: Survey 1-99, own processing.

4.2.2 Findings from the public sector survey

For the purposes of the survey, public buildings were divided into 6 main typological groups: administrative (office), school, residential, cultural (incl. sports), medical and commercial buildings. Most buildings fall into the residential and school categories. The number of buildings in all categories increases significantly with the size of the municipality, which is the main differentiating factor between municipalities.

Smaller municipalities more often manage their own buildings themselves. Their administration is in the hands of the mayor, councillor or deputy, who is often the initiator of the renovation and, together with an external project designer, prepares the form of the renovation. Renovations in smaller municipalities are often rather *ad-hoc* without a long-term renovation plan. Subsidies are usually the main source of funding.

Larger municipalities more often use some form of external building management and the entities using the buildings are also more often involved in the building management. Instead of the municipality council, the departments of property management, investment activities, or other dedicated parts of the public authority, which have the capacity to initiate renovation and prepare its form, play a greater role here. There is more often a plan of investment activities and the importance of subsidies for securing financing is slightly lower.

The important finding relevant to setting additional policies to implement a long-term building renovation strategy is the fact that the motivation for implementing energy-saving projects is the saving of energy costs, increasing comfort and improving technical condition. At the same time, a certain degree of 'subsidy dependence' is evident in all municipalities. More than three quarters of municipalities use subsidies for

renovations, and waiting for an available subsidy is presented as the most common reason for delaying the implementation of energy savings projects.

The motivation for easier and more frequent renovations could have the form of higher subsidies for municipalities for more thorough or higher quality renovations and for smaller municipalities also of a support in the preparation of project documentation. On the contrary, interest-free loans seem rather uninteresting for municipalities.

The **objective** for this group is to **increase the number of renovations and increase their complexity** (i.e. a combination of reducing energy consumption and the use of renewables). Due to the fact that this group implements projects in cooperation with experts, it is not necessary to focus on the quality of project implementation for this group, which is, on the contrary, a problem in the residential sector.

The findings suggest that support for renovation in the public sector will require different instruments than in the case of building owners in the residential sector. It is necessary to maintain the current financial scheme for this sector, i.e. the subsidy scheme. However, it is necessary to modify its settings to more specifically meet the needs and requirements of municipalities. However, for such a scheme to work, it is necessary to focus on technical assistance, including both in project preparation phase and with the administrative side of the application for financial support. Seeing as it turns out that the motivating factor is cost savings, it is necessary to help municipalities to be able to identify the potential for reducing energy consumption (i.e. operating costs) in the implementation of energy management.

4.3 Barriers in the private sector – business buildings

For the private sector, data are not available for the evaluation of ownership relations to buildings, i.e. it is not possible to assess the extent to which ownership or use of the building affects the motivation for its renovation. However, it should be noted that ownership relations determine the attitude of entrepreneurs to the implementation of energy savings measures. The survey focused on two categories; entrepreneurs who own and use buildings for their own activities and those who rent buildings to third parties.

The private sector, in contrast to the residential sector, is characterised by significant diversification, both in the type of buildings and their size.

4.3.1 Findings from the business sector survey

Entrepreneurs who use the building for their own business

Businesses most often use office buildings, followed by warehouses and commercial buildings. These entrepreneurs most often manage their own buildings themselves. They use energy audits and energy management certified according to ISO 50001 to monitor energy consumption; in some case, ongoing energy management is utilised. A quarter of companies have their own energy manager. However, it must be emphasised that one third of the surveyed entrepreneurs do keep a summary of their energy consumption.

The main motivation for the implementation of energy-saving projects is to reduce operating costs, improve the technical condition and increase comfort. Only a minimum of respondents used the State financial

scheme to implement the measures. The main reason is the need to modify the project to meet the criteria and the administrative requirements for the provision of the subsidy.

Entrepreneurs would welcome support from the State, especially in the form of tax benefits and the provision of technical assistance, including the administration of the application for support.

Entrepreneurs who manage buildings for other entities

The surveyed companies most often manage office buildings, then commercial and storage buildings, with production buildings sitting in the last place. Even in the case of this group, the impact of the obligation to perform an energy audit, which is performed by less than half of entrepreneurs, was evident. This is followed by the use of ongoing energy management and the introduction and certification of energy management in accordance with ISO 50001. These tools are more commonly used in larger companies.

The main motivation for the implementation of energy savings projects is similar to the above group. It is about reducing operating costs, improving the technical condition and increasing comfort.

For this group, there is a barrier to the implementation of cost-saving measures on the part of building users – both for the renovations carried out and as the main factor for renovations that have not yet been carried out. On the other hand, this group more frequently uses the possibility of subsidies from the State for the implementation of savings measures.

Similar to the public sector, the **objective** for this group **is to increase the number of renovations and increase their complexity** (i.e. a combination of reducing energy consumption and the use of renewables).

The state of energy management in companies is proving to be a key consideration for other instruments to support the renovation of buildings in the private sector. Even though they meet the legal obligations in the field of energy audit or the introduction of energy management, entrepreneurs have no idea about energy costs. At the same time, saving operating costs is a big motivation for implementation of savings measures. In the following period, it is necessary to the available instruments on improving the energy management in the business sector. Given that most projects are prepared by external entities, the availability of these services (in terms of finances and quality) should provide greater motivation to implement building renovation projects.

For this group, the success in the form of increased number of building renovations will depend on whether, thanks to financial support, it will be possible to achieve a reduction in the payback period of projects to a period acceptable to entrepreneurs, i.e. about 5 years. It is this requirement that can be a barrier to the implementation of measures for buildings (long-term return for projects aimed at improving the quality of the building envelope), which do not require renovation, or the technical condition of which does not require immediate investment.

Although entrepreneurs state that they would welcome tax measures instead of subsidies, it is not possible to use this instrument because of the State's tax policy under the current government's programme

statement. If the future government(s) decide otherwise, then it will be possible to reconsider the non-use of this instrument at the government level.

5 Strategy of the Czech Republic to support the implementation of the optimal scenario

5.1 Existing scheme to support the renovation of the building stock of the Czech Republic

In the Czech Republic (for the period up to 2020), a scheme and policies (especially financial, see Chapter 4) to support the implementation of building renovations across sectors already exist. In particular, these are the following measures:

- **fiscal**

  High initial investment costs for energy-efficient renovations of buildings are addressed through a financial support scheme, which is focused mainly on providing subsidies. The Czech Republic has more than ten years of experience in offering support programmes that help different groups of property owners to achieve energy savings in the operation of their properties, see Table 29: *Overview of programmes to support the renovation of buildings available in the Czech Republic as of 2020.*

- **legislative**

  The basic legislative acts to support energy-efficient construction and renovation of buildings in the Czech legal system are Act No 406/2000, on energy management, as amended, with its implementing legal regulations[48] and Act No 183/2006, on spatial planning and building code, as amended, and in particular its Implementing Decrees No 268/2009, on technical requirements for buildings, as amended, and No 499/2006, on building documentation, as amended.

- **in the field of education and consultancy**
  In the conditions of the Czech Republic, there has long been a low awareness across sectors about increasing energy efficiency and efficient energy management. Due to this situation, State measures to improve energy efficiency (i.e. to reduce energy consumption) are generally not positively adopted. Of course, this also applies to the buildings sector. For this reason, the activities of the State are already set to increase awareness about the possibilities of reducing energy consumption due to the improvements in energy performance of buildings and the implementation of effective energy management, even at the household level. The State Programme for the Support of Energy Savings (hereinafter the 'EFEKT Programme') plays an important role in this area.

[48] These are mainly Implementing Decree No 78/2013, on the energy performance of buildings, as amended, and Implementing Decree No 480/2012, on energy audit and energy assessment, as amended, and Implementing Decree No 4/2020, on energy specialists (which in 2020 replaced Implementing Decree No 118/2013, on energy specialists, as amended).

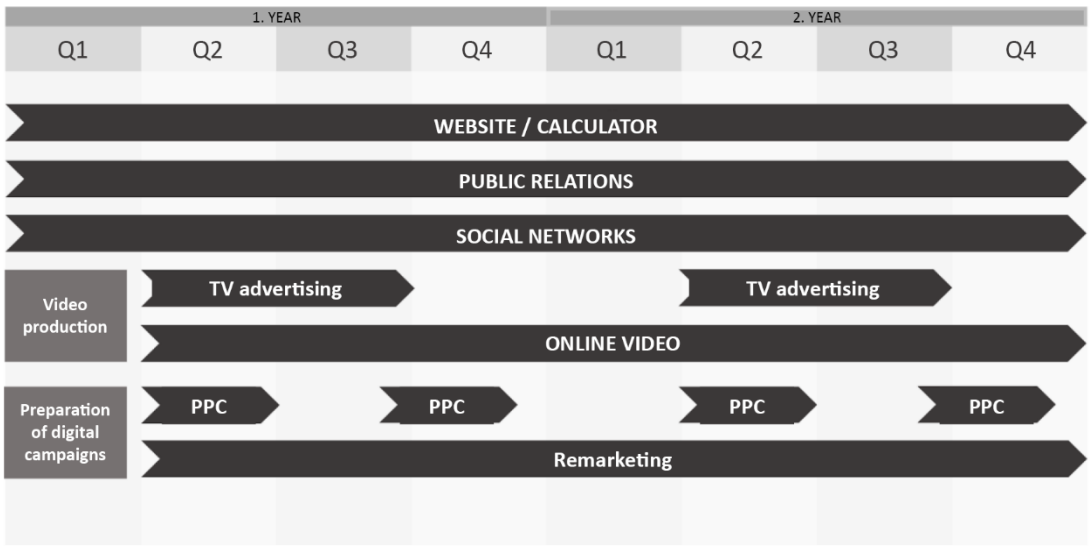
As already mentioned in the previous chapter, it turns out that the measures applied so far are not effectively set or are not sufficient to increase the motivation for building renovations across individual sectors (households, entrepreneurs, State and public administration). Based on the findings summarised in the previous chapter, the strategy of the Czech Republic in the area of buildings, policies and measures to support the implementation of the optimal scenario (see Chapter 4) and the achievement of objectives according in the individual groups (described in the chapter *Barriers to building renovations*) was updated for the following periods until 2030 and 2050.

5.2 Scheme for fulfilling the optimal scenario of the Long-Term Strategy

The basis for the implementation of the Long-Term Strategy is a communication campaign at national level. Based on the outputs of the *draft Communication Strategy for Raising Awareness of Energy Efficiency in order to motivate target groups to reduce energy consumption and to implement efficient energy management*, the Ministry of Industry and Trade is seeking to launch a 'Short-term campaign aimed at the general target group'. The aim of this campaign is to quickly improve the awareness of the Czech public about energy savings. The campaign is timed to run for two years and the main target groups are the following:

- Households
    - Young people 18–35 years
    - Families 35–60 years
    - Older and elderly 60+
- Management of companies
    - With production
    - Without production
- Public administration
    - Mayors
    - Directors of investment and asset management departments

To achieve the campaign's objective, it is assumed that all the main communication channels will be involved throughout the campaign.



More detailed information on the concept and content of the campaign can be found in Annex 2.

In connection with this campaign, related services and products will be provided for all major and other target groups. In this context, the service means ensuring the actual and financial availability of Energy Consulting and Information Centres, feasibility studies of energy savings and adaptation measures on and in buildings, creating strategies for improving the energy performance of buildings in the region, technical assistance for submitting applications for financial support from the State. Information on services related to improving energy performance and a calculator will be available on a central website, which will be linked to other and partial specialised websites.

Products means the provision of a portfolio of financial instruments according to the specifics and needs of individual target groups. The financial support scheme will be based on the existing support scheme in the form of subsidies, which will be extended to support in the form of financial instruments. This change presupposes a more active involvement of the national bank, i.e. the Czech-Moravian Guarantee and Development Bank, as well as of the private banks and building societies.

The provision of the above services and their effective connection to the financial support scheme is intended to increase the number of quality, comprehensive renovations. The updated policy of the Czech Republic to support the renovation of the building stock is also aimed at the owners of the most energy-intensive building stock, where the involvement of municipalities will play an important role.

Details of individual services and products with a target group are given below.

5.2.1 Services

Energy Consultation and Information Centres ('EKIS') (https://www.mpo-efekt.cz/cz/programy-podpory/efekt/ekis)

EKIS Energy Consultation is a free service for the public that serves to support the introduction of energy savings and renewables.

Compared to the current setting, this service will be extended to better suit the needs of building owners. Specifically, the expansion will include the possibility of specific consultations in the place of possible implementation of savings measures.

Target group:

- citizens;
- public administration;
- business enterprise sector.

Source of funding:

State budget. Funds are provided through the EFEKT programme.

Support for the preparation for the implementation of quality energy savings projects with good practice principles

This is a subsidy for the preparation of a comprehensively processed energy savings project with a proposal for a combination of energy savings measures in the form of a feasibility study / energy assessment, where the prepared document must clearly show what solution variants (which combinations of energy savings measures) are possible for the building, what volume of investment funds will be needed for the implementation of individual measures and in particular, what benefits in future savings of operating costs related to energy consumption will be achieved as a result of individual measures.

The implementation of the proposed measures is a condition of the provided subsidy. In order to increase awareness about the possibilities of implementing savings measures, a change in the conditions for the provision of subsidies is being considered, specifically the cancellation of the need to implement the measures.

Target group:

- owners of single-family houses and their tenants;
- owners of apartments buildings and their tenants;
- owners of public sector buildings and their tenants;
- owners of buildings for business purposes and their tenants.

Source of funding:

State budget. Funds are provided through the EFEKT programme.

Elaboration of documents for the preparation of an energy savings project solved by the EPC method and advice to contracting entities in choosing a supplier

This is a subsidy for the elaboration of a detailed analysis of the state and potential savings in individual buildings and / or public lighting and a recommendation as to whether the buildings and / or public lighting are suitable for the implementation of an EPC project. If the analysis shows the objects are suitable for the

implementation of an EPC project, the applicant is then obliged to implement the project. Otherwise, they must return the subsidy.

Contracting entities from the State sector may also receive aid for the processing of tender documentation for the selection of a supplier, i.e. the implementer of its own project. Consideration could be given to extending this option to the whole public sector.

Target group:

- regions, municipalities, city districts, State enterprises;
- companies 100% owned by municipalities or city districts;
- public non-profit institutional health care facilities;
- school legal entities, contributory organisations;
- organisational units of the State, business entities.

Source of funding:

State budget. Funds are provided through the EFEKT programme.

Introduction of an energy management system

The subsidy is intended for the introduction of an energy management system in the form of the system itself and measures necessary to improve energy performance.

Target group:

- regions, municipalities and city districts with more than 5,000 inhabitants;
- voluntary associations of municipalities;
- business entities.

Source of funding:

State budget. Funds are provided through the EFEKT programme.

The need for a concept for the introduction of energy management at the level of municipalities, city districts and the business sector arose from the above market research. Without data from energy management, these entities are not able to evaluate the need for and benefits of renovation. For this reason, a project entitled **'Evaluation of Energy Management (EM) in the Municipalities of the Czech Republic and Proposal of Further Procedure for the Development of EM in the Czech Republic'** is being implemented. The objective here is to offer a concept for the introduction of energy management at the municipal level and a proposal for its implementation. In response to these outputs, optimisation in the setting of support for municipalities in this area is expected. In addition to the above aid measures, there are other aid measures within other projects, such as the Covenant of Mayors for Sustainable Energy and Climate (https://www.mzp.cz/cz/pakt_starostu_a_primatoru). It is important to avoid excessive fragmentation and reduced transparency.

The project 'Evaluation of Energy Management (EM) in the Municipalities of the Czech Republic and Proposal of Further Procedure for the Development of EM in the Czech Republic' is followed by a project entitled '**Regional Energy Planning and Technical Assistance in the Preparation and Implementation of Energy Savings Projects**'. It aims to create a methodology for the implementation of technical assistance in the preparation and implementation of energy savings projects in the field of housing, enterprises (especially small and medium-sized) and property of municipalities and towns of up to 25 thousand inhabitants. The methodology will be designed so that, according to its recommendations, a specific entity may receive technical assistance in the initial specification of all energy savings measures, in proposing the optimal combination of proposed measures that will have the best economic impact on the entity and in preparing the implementation of the project.

The combination of the implementation of the outputs of the above projects will ensure energy planning at the municipal level. This will enable even smaller municipalities to evaluate and implement cost-saving measures on their building stocks. It is once again envisaged that the EFEKT programme will be used for the actual implementation.

Technical assistance services – ensuring project management of the implementation of cost-saving measures in State buildings

This measure regards financial cover of all preparatory activities necessary for the actual implementation of savings measures. In buildings owned or used by State organisations, there is a significant potential for the implementation of complex renovations instead of partial measures aimed more at correcting the poor technical condition of buildings. Financial cover for the preparation of the complete renovation project and ensuring the preparation of documents necessary for the administrative provision of projects will ensure an increase in the number of renovations in this sector. At the same time, the absorption capacity for the use of products will increase, see the following chapter.

Target group:

State organisations

Source of funding:

Funds from the European Investment Bank's ELENA programme (https://www.eib.org/en/products/advising/elena/index.htm) in combination with State budget funds (10% co-financing).

5.2.2 Products

The setting of products for the following period will be based on already existing programmes (see Chapter 4), which are and will be updated in 2020 in response to the setting of the programming period 2021–2027, changes in legislation in the field of greenhouse gas emission allowance trading at European and national level and the European Green Deal investment plan and the Just Transition Mechanism.

From the information available as of March 2020, the Czech Republic expects to adopt the following product settings.

Operational Programme Technology and Applications for Competitiveness (OP TAC) 2021–2027: Specific Objective – Aid for energy-efficiency measures

The product focuses on investment aid for increasing the energy efficiency of technological and production processes in industry and on **improving the energy performance of buildings intended for business**. Its launch is expected in 2022.

In the area of buildings, aid measures will focus on:

- improving the energy performance of buildings (building envelope, technical equipment);
- reconstruction and replacement of energy production technical equipment for own consumption;
- reconstruction of electricity, gas and heat distribution;
- recovery of waste energy in production processes;
- construction of high (passive) energy standard buildings;
- implementation of monitoring, automation and energy management features in buildings;
- energy management;
- introduction of elements of adaptation of buildings to climate change.

Target group:

- business enterprise sector
    - sectors of industry outside the EU ETS
    - services
    - other non-residential buildings

Source of funding:

European Regional Development Fund (ERDF). Estimated allocation for the entire programme in the amount of CZK 8 000 million.

New Green Savings Programme and its successor programme

The product focuses on investment aid for improving energy performance of single-family houses and apartment buildings. Partial and comprehensive renovation of residential buildings are supported.

Specifically, the following is and will be supported:

- improving the energy performance of buildings (building envelope, technical equipment);
- reconstruction and replacement of energy production equipment for own consumption;
- reconstruction of electricity, gas and heat distribution;
- construction of buildings to the passive standard;
- implementation of monitoring, automation and energy management features in buildings;

- introduction of elements of adaptation of buildings to climate change.

Target group:

- residential sector
    - single-family houses
    - apartment buildings

Source of funding:

Revenues from emission trading until now (State budget). From 2021, a budget guaranteed by Act No 383/2012, on the conditions for trading in greenhouse gas emission allowances, as amended, in the amount of CZK 4,000 million per year. For 2020, the allocation of funds is expected in the amount of CZK 1,350 million.

Operational Programme Environment 2021–2027: Specific Objective – Aid for energy-efficiency measures

The product is primarily focused on investment aid to improve energy performance of non-residential public buildings and activities related to increasing the use of renewable energy sources.

Specifically, the following is and will be supported:

- improving the energy performance of buildings (building envelope, technical equipment);
- reconstruction and replacement of energy production equipment for own consumption;
- reconstruction of electricity, gas and heat distribution;
- construction of buildings in the passive standard;
- implementation of monitoring, automation and energy management features in buildings;
- introduction of elements of adaptation of buildings to climate change.

Target group:

non-residential public and State buildings

Source of funding:

For the public sector, funding will be provided by the ERDF and the Cohesion Fund (CF). An allocation in the amount of CZK 14,000 million is expected.

The use of the Modernisation Fund managed by the EIB is expected to support the renovation of buildings of State organisations. It is expected that CZK 15,000 million will be used from this fund for the renovation of these buildings for the entire 2021–2030 period.

PANEL Programme

The product focuses on investment aid for improving energy performance of single-family houses by concessional loans.

Specifically, the following is and will be supported:

- improving the energy performance of buildings (building envelope, technical equipment);
- reconstruction and replacement of energy production equipment for own consumption;
- reconstruction of electricity, gas and heat distribution.

Target group:

residential sector – apartment buildings

Source of funding:

The source of funding is the State budget. The amount of the allocation is the annual result of negotiations on the State budget. However, in order to achieve the development of building renovation according to the chosen scenario, it is necessary to allocate funds to the programme in the amount of CZK 15,000 million for the 2020–2030 period.

Development of models of financial instruments for financing energy efficiency projects after 2020

The current financial scheme to support the improvement of energy performance of buildings covers all sectors (residential, business, public and State). Investigations show that this scheme, which is mainly subsidy-based, has its limits.

For this reason, other options for mobilising private investment in building renovations initiated by a financial incentive from the State are being discussed. One of the most suitable solutions is to set up a set of suitable financial instruments for individual sectors, which will lead to an increase in the leverage of public funds on induced total investment. In principle, three basic types of financial instruments can be distinguished, namely guarantees, loans, and capital investments. Combinations of the above types may also be considered as financial instruments.

Banks, investment groups and the business sector are aware of the opportunity offered by the right setting of financial instruments with State or EU support. At the national level, the Czech-Moravian Guarantee and Development Bank (hereinafter also 'CMGDB') plays an important role in this respect, having experience with a wider portfolio of financial instruments and at the same time experience with cooperation with private banks and State administration bodies.

At EU level, the European Investment Bank is a major player, providing funding from a variety of sources. These include, for example, European programmes managed by the European Commission, but it can also provide national funds. These are funds provided through risk capital and risk financial instruments under the European Fund for Strategic Investments.

The range of prepared financial instruments will be expanded mainly by guarantee mechanisms. Guarantees from the State or the EU increase the credibility of a loan applicant when dealing with private banks, because it takes on part of the risk and thus allows for money to be invested in more risky projects. In the case of energy efficiency projects, the risk is also reduced in connection with the relatively fast return on investment, provided they are implemented in a correct and professional manner.

In order for the above mechanisms to function properly, support programmes be set up so that the content of financial instruments will emphasise the advantage for users of these instruments, not only in terms of administrative complexity, but also in terms of availability and cost of funds and return conditions. It must not be a competition to the banking market, and this must be sufficiently demonstrated by transparent targeting at specific target groups. On the contrary, there must be close cooperation with the entire private sector, including banks.

Business enterprise sector

After 2020, it would be appropriate to expand the portfolio of financial instruments with the following:

- deferred principal loans, including, for example, subordinated loans;
- use of guarantee mechanisms for business loans.

Guarantee mechanisms will make it easier for the applicant to obtain a bank loan because of the provided loan security. The banking sector evaluates the applicant in terms of ability to repay and the financial instrument allows to replace its own collateral (e.g. real estate, which the loan applicant may not always have and which makes it difficult to reach the required amount of financing) with an individual guarantee for a specific client or a comprehensive guarantee for created portfolio of loans from banks and other financial institutions (e.g. leasing companies, etc.).

The **objective** of these financial instruments should be to ensure the initiation of private capital and at the same time the return and re-use of funds available in the financial instrument.

Owners of single-family houses

Proposed financial instrument: form of guarantees for low-interest renovation loans financed from part of the funds allocated in the New Green Savings programme and its succession programme.

Loan guarantees would ensure the interest of commercial banks in providing loans for energy-efficient renovations without the need to use real estate as a collateral (for which homeowners may have a fundamental reluctance, or which may be already mortgaged as part of their acquisition), or to clients with already significant bank involvement and limited possibilities of securing other additional liability.

For this sector, a specific setting of the financial instrument is already being prepared in connection with the last change in the programme documentation of the New Green Savings Programme and its succession programme. The last change introduces a new **sub-programme NGS – FINANCIAL GUARANTEE (FG)**. The objective of this specific aim measure is to increase the availability of commercial loans intended mainly for the renovation or construction of single-family houses by providing guarantees, or guarantees with a financial contribution, to pay interest.

The guarantee scheme will be provided by CMGDB through the created guarantee fund. This fund will be used to cover the risk of the guarantee bank arising from portfolio guarantees issued in favour of building societies or banks financing projects of beneficiaries of the NGS programme and its succession programme and to pay financial contributions to pay interest on commercial loans for these energy savings measures.

The condition for including the financial intermediary's business in the guarantee portfolio is the acceptance of the application in the NGS programme; in the case of a financial contribution for interest payments, the provision of a subsidy from NGS (subsidy decision) from the NGS – SFH (single-family houses) sub-programme.

Owners / administrators of apartment buildings

In 2019, a financial instrument was set up, prepared and launched within the IROP. It is a combination of a subsidy and co-financing through an interest-free loan. If this combination proves successful for this sector, its extension will be discussed.

For apartment buildings owned by towns or cities, the proposals below shall apply.

State and public administration

In the 2014–2020 programming period, the use of an interest-free loan was considered. However, due to the low commercial interest rate (combined with a low administrative burden compared to obtaining State aid), there was no interest in this product. So far, no suitable financial instrument has been found.

However, there is significant potential for this sector to use the EPC method as a specific form of financial instrument, which would not at the same time crowd out private capital through government loans. Therefore, in order for energy service providers with a guaranteed result to be able to offer their EPC services to organisations established by the State, i.e. not self-governments, including financing, it is necessary to address the barrier in existing EUROSTAT accounting rules to offset public debt. In that case, there would be no need to further institutionalise this financial instrument or to address the source of funding. The latest revision of these rules in the conditions of the Czech Republic and the approach to EPC did not change the situation in the Czech Republic much.

5.2.3 Legislative measures to promote energy efficient construction

The above scheme assumes a clear legislative environment that supports more energy-efficient construction and renovation. In 2019, a complete revision of building law was launched with the aim of unifying, streamlining and improving the protection of public interests represented by the State and creating long-term conditions for unifying the performance of State administration and uniform implementation of e-Government tools. In the area of substantive law, some requirements for constructions are being transferred directly to the legal regulation. A special legal regulation of the Building Code is and will be Act No 406/2000. The correct setting of these two fundamental regulations in the field of energy performance of buildings will ensure the construction of buildings with good energy performance.

The amendment to Decree No 78/2013, which will become effective in the second half of 2020, also plays an important role. The amendment to this decree will introduce stricter requirements for buildings with almost zero energy consumption from 2022. Furthermore, the amendment responds to a certain shift in construction, development of building services engineering and it updates the parameters of the reference building from its effective date.

5.2.4 Smart Technology Initiatives

In recent years, the pressure has increased not only on the energy efficiency of construction, but especially on the effective management of consumption in buildings, both with the aim of ensuring the comfort of the indoor environment and reducing energy consumption. Effective management to ensure a productive and cost-effective environment can be achieved by unifying the building management, security and management system and optimising these components.

However, the 'smart building' requirements differ from the purpose and method of their use. Nevertheless, it is always necessary to meet the criteria of safety, reliability, economical operation and reasonable investment and operating costs. 'Smart buildings' are one of the elements of the broader 'smart city' concept. In recent years, many projects have been created in the Czech Republic with the aim of gaining practical knowledge and unifying the methodologies of approaches to solving the above concepts.

In this regard, mention should be made of the National Research and Innovation Strategy for Smart Specialisation (National RIS3 Strategy), which EU Member States were obliged to prepare in order to identify suitable promising areas of the economy, which should be subsequently supported by the European Structural and Investment Funds (ESIF). To this end, the Czech Republic has prepared its National RIS3 Strategy, which reflects the priorities of our economy, which should be targeted by ESIF programmes and selected research and development support programmes. One of the approved areas of research based on the National Research and Innovation Strategy is energy savings. The Strategy state that *in the field of energy savings, it is crucial to develop and demonstrate practically applicable solutions in the final consumption sectors – households, industry, services and agriculture. The preparation and demonstration of integral solutions for cities and agglomerations (smart cities and regions) in relation to European initiatives, but taking into account the specificities of the Czech Republic is also a complex area. The essence lies in synergistically integrating the generation and transmission of energy, the use of energy in buildings and the energy intensity of transport, all while applying ICT technologies. In the residential sector, the concept of smart homes and housing is to be developed, which is the intersection between construction, local energy production, smart appliances, but also other elements for a safe and happy life. Energy savings must focus not only on technical solutions, but also on business and financing models. It is also important to improve the energy performance of buildings, for example by insulation.*

One of the main instruments of support of applied research specifically in the energy sector is the THÉTA programme, administered by the Technological Agency of the Czech Republic[49]. In the medium and long term, the programme aims to contribute, through the outputs, results and impacts of the supported projects, to achieving the vision of transformation and modernisation of the energy sector in accordance with approved strategic documents. This will be achieved through the support for energy research, development and innovation with a focus on: (i) promoting public interest projects; (ii) new technologies and system

[49] This is an organisational unit of the State, which was established in 2009 by Act No 130/2002, on the promotion of research, experimental development, and innovation.

elements with high potential for rapid deployment in practice; (iii) support for long-term technological perspectives; the division to individual sub-programmes is reflective of this.

The State budget expenditures for THÉTA programme for 2018–2025 total CZK 4 000 million. Non-public funds should then amount to CZK 1 715 million. Thus, total expenditure amounts to CZK 5 715 million. The programme allocation is divided into sub-programmes as follows: sub-programme 1 – 15 %, sub-programme 2 – 50 % and sub-programme 3 – 35 %.

But it is not just the THÉTA programme that is involved in the development and practical application of the 'smart building' and 'smart city' concepts. For example, the project 'Intelligent Regions; Information Modelling of Buildings and Settlements, Technologies and Infrastructure for Sustainable Development' which is a part of TA CR Competence Centre programme. The aim of the project is to create a multidisciplinary and interdisciplinary system of cooperation between companies and research organisations for the development of energy-efficient and environmentally friendly technologies, systems, equipment, components, methodologies and strategies for intelligent buildings in the regions. More information about the project http://www.inteligentniregiony.cz/

Currently, the Ministry is the expert guarantor in a project implemented under the THÉTA programme entitled 'Development of Tools for Optimal Energy Response of Buildings to Smart Grid Requirements and their Impact on the Energy Market and the Environment', which aims to develop and test autonomous tools to maximise the energy flexibility of buildings by 2022. Specifically, the research will deal with the development of a superior management system for residential and office buildings. Its task will be to ensure the coordinated operation of all building systems (heating, cooling, ventilation, shielding, local production and storage of electricity, etc.) so as to achieve an optimal energy response to the future smart grid requirements. By incorporating these tools into the currently developed concept of integrated building management, its purpose is its natural dissemination among users and building operators, enabling them to play a more active role in the modern energy market (https://www.uceeb.cz/projekty/vyvoj-nastroju-pro-optimalni-energetickou-odezvu-budov-na-pozadavky-chytre-site-jejich).

5.2.5 Education in the field of construction and energy efficiency

If quality energy savings projects are to be implemented, qualified experts are needed in all phases of project implementation. The Czech Republic uses, and will continue to use, legislative and non-legislative instruments in this area.

Legislative education instruments

Energy intensity of buildings – energy specialist

An energy specialist is, in accordance with Section 10 of Act No 406/2000, a natural or legal person authorised by the Ministry to perform the following activities:

- process an energy audit and energy assessment;
- process an energy performance certificate;

- carry out inspections of heating systems and combined heating and ventilation systems in operation; or
- carry out inspections of air-conditioning systems and combined air-conditioning and ventilation systems in operation.

One of the conditions for obtaining the authorisation to perform the activity of an energy specialist is the fulfilment of the professional competence requirements. In the case of a natural person, professional competence is demonstrated by the following:

a) higher education in bachelor's, master's or doctoral study programmes in the field of technical sciences and their fields of energy, energy equipment, construction or in the field of electrical engineering, energy, construction according to legislation governing higher education or in fields similar to these areas, and 3 years of experience in the field;
b) secondary education with a school-leaving examination by completing an educational programme in the fields of energy, energy equipment or construction, and 6 years of experience in the field; or
c) vocational education by completing an accredited educational programme in fields focused on energy, energy equipment or construction, and 5 years of experience in the field.

In addition to these administrative requirements, the applicant proves his expertise in a professional examination, which forms another condition for obtaining the authorisation of an energy specialist. The exam consists of two parts, written and oral. The first of them focuses on the knowledge of legal regulations and standards; the oral part examines the technical knowledge of the applicant.

In order to ensure the expertise of an authorised energy specialist, Act No 406/2000 stipulates the obligation of the energy specialist to complete the continuing education, which consists of participation in educational events included in the continuing updating education (this is selected an expert commission in accordance with implementing legislation, i.e. Implementing Decree No 4/2000, on energy specialists) and obtaining the necessary number of credits in the period defined by law. The thematic scope of educational events is such as to cover as much as possible the area of performance of the activity of an energy specialist. Typically, it is most often a multidisciplinary seminar focusing on current legislation in the field and technological processes or on energy management. In the field of buildings, there are seminars focused on the construction and thermal properties of buildings, technical systems, lighting, cooling and air conditioning, ventilation, hot water preparation in the building, etc.

Installation of renewable energy sources – a person authorised to install selected installations generating energy from renewable sources

A person authorised to install selected installations generating energy from renewable sources (hereinafter the 'authorised person') is a natural or legal person who holds a trade licence in the following fields:

a) plumbing;
b) heating;
c) installation, repair and reconstruction of cooling equipment and heat pumps;

d) installation, repair, inspection and testing of electrical equipment;
e) installation, repair, inspection and testing of gas equipment and filling of gas containers;
f) installation, repair, inspection and testing of pressure equipment and gas receptacles; or
g) stove-building.

Expertise is ensured by the requirement for a certificate of professional qualification for the relevant activity in accordance with Act No 179/2006, on the verification and recognition of further education results and amending certain acts (Act on the Recognition of Further Education Results) not older than 5 years. The certification may only be obtained by passing a professional exam with an authorised person, repeatedly, every 5 years.

Building design – Authorised persons

In accordance with Act No 183/2006, on spatial planning and building code, as amended, certain activities that affect the public interest in construction require authorisation to perform activities under other legal regulations. These activities include project activities and professional construction management. This person – project designer is responsible for the accuracy, integrity, completeness and safety of the construction carried out according to the project documentation prepared by it and the feasibility of the construction according to this documentation, as well as for the technical and economic level of the technological equipment project, including environmental impacts. This person is obliged to observe legal regulations and general requirements for construction related to a specific construction project and to act in cooperation with the relevant authorities concerned. For this activity, it is necessary to obtain authorisation in accordance with Act of the Czech National Council No 360/1992, on practice of profession of authorised architects and authorised engineers and technicians working in the field of building constructions.

The conditions for obtaining authorisation are the following:

a) legal capacity;
b) integrity;
c) required education;
d) prescribed professional experience;
e) passing a professional competence test;
f) making a promise.

Relevant education for obtaining the authorisation of an engineer is a university education obtained in the field of civil engineering, transport construction, water management and landscape engineering, bridges and civil engineering, technological equipment of buildings, building environment technology, statics and dynamics of buildings, urban engineering, geotechnics, fire safety of buildings, buildings for the performance of forest functions; or a related field of study, in a bachelor's degree program or master's degree programme, or a secondary or vocational education in a similar field of study.

The length of the experience is set at a period of at least three years if the applicant is a graduate of a master's degree programme, and at least five years if the applicant is a graduate of a bachelor's degree programme or other similar education.

In accordance with the said Act, the authorised person is obliged to continue his or her professional education and keep up with the information necessary for the proper performance of his activities. Authorised persons (AP) are part of individual chambers. Within the Czech Chamber of Chartered Engineers and Technicians, education is conducted in the form of lifelong (credit-based) or individual education in the field of authorisation. When participating in the credit programme, the AP is obliged to obtain 12 credits during the running duration. At the same time, each AP must complete at least two educational events focused on legal regulations. When participating through an individual form of education, the AP chooses his/her own, individual form in order to ensure his/her professional growth. The situation is similar in the case of the obligation to study at the Czech Chamber of Architects.

Non-legislative education instruments

The State also participates in the system of education of persons in the construction industry in the form of State aid within the **EFEKT programme**. One of the supported areas of this programme is 'Actions aimed at active dissemination of information and education in the field of energy saving' and 'Publications, materials and tools for dissemination of information and education in the field of energy saving, including support for international cooperation'. The subject of the first of these areas is the organisation of courses and seminars and other educational and information events, e.g. to increase the qualifications of energy specialists and persons authorised to conduct professional activities consisting in the installation of equipment producing energy from RES, informing about legislative changes in energy management and increasing energy efficiency and support for forms of education that increase energy literacy at all levels of schools.

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Annex 1

Comparison of the requirements of Article 4 of Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC and Article 2a of Directive (EU) 2018/844 of the European Parliament and of the Council of 30 May 2018 amending Directive 2010/31/EU on the energy performance of buildings and Directive 2012/27/EU on energy efficiency

	Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency	Directive (EU) 2018/844 of the European Parliament and of the Council of 30 May 2018 amending Directive 2010/31/EU on the energy performance of buildings and Directive 2012/27/EU on energy efficiency
Required parts of the strategy	(a) an overview of the national building stock based, as appropriate, on statistical sampling	(a) an overview of the national building stock based, as appropriate, on a statistical sample and the expected share of renovated buildings in 2020;
	(b) identification of cost-effective approaches to renovations relevant to the building type and climatic zone	(b) identification of cost-effective approaches to renovations relevant to the building type and climatic zone, taking into account, where appropriate, potentially relevant activation moments over the life of the building
	(c) policies and measures to stimulate cost-effective deep renovations of buildings, including staged deep renovations	(c) policies and measures to stimulate cost-effective deep renovations of buildings, including staged deep renovations, and policies and measures to promote targeted cost-saving measures and renovations, for example through the introduction of a voluntary passport scheme for building renovations
	(d) a forward-looking perspective to guide investment decisions of individuals, the construction industry and financial institutions	(d) an overview of policies and measures targeting the most energy-intensive segments of the national building stock, the issue of differing incentives and market failures, as well as an outline of relevant

		national actions contributing to alleviating energy poverty
	-	(e) policies and measures targeted at all public buildings;
	-	(f) an overview of national initiatives to promote smart technologies and well-connected buildings and communities, as well as skills and training in the construction and energy efficiency sectors; and
	(e) an evidence-based estimate of expected energy savings and wider benefits	(g) an evidence-based estimate of expected energy savings and wider benefits, for example in the areas of health, safety and air quality
Milestones	None	Indicative milestones for 2030, 2040 and 2050
Indicators	None	Measures and national measurable progress indicators
Public consultation	Not required	Required
Submission	A first version of the strategy shall be published by 30 April 2014 and updated every three years thereafter and submitted to the Commission as part of the National Energy Efficiency Action Plans.	In accordance with Regulation (EU) 2018/1999 of the European Parliament and of the Council of 11 December 2018 on the Governance of the Energy Union and Climate Action, the first version must be submitted by 10 March 2020. Then as part of the final integrated national energy and climate plan (update in 5 years and new plan in 10 years)

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Annex 2

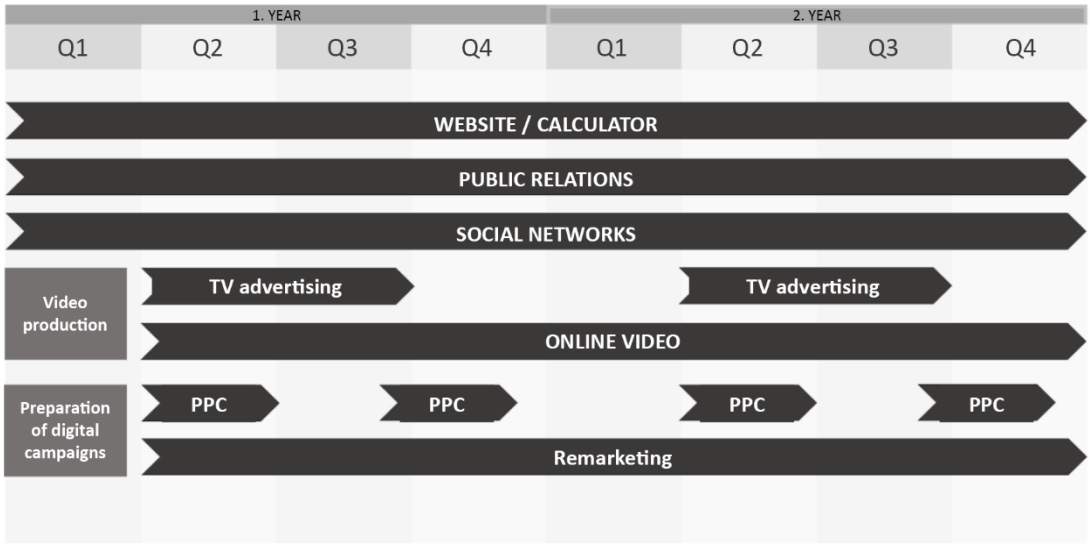
Variant 2 – Short-term campaign aimed at the general target group

The objective of this variant is to present a campaign seeking a rapid change in raising awareness about the topic of energy savings in general among the Czech public. The campaign is timed for two years. Due to the time scale, the range of target groups that such a short campaign should target has been reduced. The changes are mainly in the target group of households, when groups of children under 15 and children in secondary education were excluded. The main differences between Variants 1 and 2 are mainly the timing of the use of communication tools and the role that these tools play. **Target groups**

- Households
  - Young 18–35 years
  - Families 35–60 years
  - Older and elderly 60+
- Management of companies
  - With production
  - Without production
- Public administration
  - Mayors
  - Directors of investment and asset management departments

Campaign timing

The aim of this variant is to present a campaign for the general target group, with an effect ideally within two years. In order to achieve the goals of the campaign in a limited time and also for the widest possible target group, it is ideal to involve all the main communication tools throughout the campaign and create a comprehensive 360° approach across all involved media channels.



This variant differs from Variant 1 in that it involves the most important tools throughout the campaign – not only public relations and social networks, but also online video and remarketing. As with Variant 1, TV advertising
will be deployed on a regular basis. A continuous two-year TV campaign would be very expensive
and it would also become ineffective over time (gradually, it could start annoying the audience). In addition to TV advertising, PPC advertising will also be used on a regular basis.

The campaign timing is chosen so that the widest possible public is reached as quickly as possible. The tools used aim to show the public the possible savings opportunities and to provide general information
on energy savings and their benefits. As with Variant 1, the audience will be directed to the offices of the EKIS centres, which ensure direct contact with the public.

Given that the campaign is focused on short-term and quick achievement of the set objectives, it should promote quick-thinking and decision-making in the near future. Quick-thinking is a fast, emotional, unconscious and intuitive system of decision-making. The short-term campaign should promote this quick decision-making among the public, which also leads to rapid change.

Communication tools and communicated topics

Public relations

Households
Young (18–35 years)
• The predominance of online content over printed press – especially among younger people within this target group. • Long-term sustainability is important for representatives of the target group who live in large cities, and greater emphasis is also placed on 'green' topics. • Communication should preferably take place via social networks and digital campaigns.
Families (35–60)
• The largest target group for which the largest number of activities can be created. • The widest range of media should be utilised – from news to hobby or lifestyle media • A group that should come into regular contact with the campaign – there is the greatest potential for improvement not only in soft measures, but above all in specific, more costly measures. • The communication must be based on data and surveys – these can quite well show how Czech people stand, what they know about issues related to energy intensity, etc.

- How many people buy energy-saving appliances and for how many of them is it the main indicator?
- The most common mistakes that households make? Who airs their house incorrectly and who overheats unnecessarily?
- What are the trends in Czech households?
- What rumours and myths do you believe?

- Surveys can be very easily adapted to both soft and hard measures, as well as to the field of transport. Surveys are attractive to the media, but their potential attractiveness must be taken into account when creating them.

- Another topic that can be used for creative work and also for different channels are examples of good practice. This topic is ideal for the 'living' media, in which it is easy to show nice buildings and reconstructions of low-cost houses or the right and at the same time modern energy management solutions.

- Similar forms can also target hobby media; these can include even more technical information (such as data on household consumption)
  or have a more educational article format.

- In addition, media partnerships can be established with a wide range of media, in which campaign visuals, PR articles or, for example, counselling section can appear regularly.

- All communication should follow the campaign motto – opportunities are all around us. The communication can thus focus on two main areas – showing good practice and telling people about the opportunities around them, or drawing attention to mistakes and the potential for improvement.

Older and elderly (60+)

- While most of the communication for previous groups emphasises online media, the opposite is true for the elderly. Although more and more of them use the Internet, the main communication channel in this case should be the printed media.
- Communication to the elderly should focus primarily on soft measures that do not require large investments.

- The main motivations include a healthy environment that the elderly want to spend their time in. But for many of them, finances and their savings are also very important.

- The main types of media that the elderly follow are tabloids, crossword puzzle magazines and TV periodicals. From the news media, they prefer regional daily newspapers.

- They need a campaign ambassador or a celebrity, who are generally popular and who will add credibility and weight to the campaign.

Management of companies

Companies with / without production

- Communication focused on companies should generally appear in economic media, in which it is possible to use more comprehensive data on financial savings of companies, which are the main motivating factor for this target group.
- In the economic media, specific stories of companies and examples of good practice can be used.
- Regional media may be used in a similar manner.
- Mass-contacting companies may prove to be an issue – the channels of the Chamber of Commerce or the Association of Small and Medium-Sized Enterprises, or trade unions, may be used for this. It is advisable to cooperate with these entities
  and start some form of a partnership – for example, you can reach companies through their newsletters or internal media.
- A suitable form of cooperation is the establishment of a media partnership with a media such as Deník (local daily newspaper) – topics can be adapted to different company sizes. Thanks to this, we can also target small companies or sole traders that we will not reach via the associations.
- In general, either business owners / management or employees can be targeted.
- Communicated topics can be easily tailored to companies with or without production. However, the companies' objectives are in general very similar – everyone wants financial savings – and general communication to a wide target group does not need to be specifically divided and differentiated.
- The communication can refer to the existence of energy advisors and EKIS centres that will help with savings.

Public administration

Mayors of municipalities and directors of relevant departments

- The most important here are the specialised media – especially the Moderní obec (Modern Community) or Veřejná správa (Public Administration) magazines.
- One of the main motivations of mayors is to gain / maintain a good image with their constituents. It can be expected that some steps by mayors may be taken in order to gain political points during the pre-election period, which may help them in the next election. Therefore, in the context of communication to mayors, it can be emphasised that the changes made are to the benefit of citizens and the community in general and can thus be a source of these political points.
- Communication towards municipalities should be based on examples of good practice from surrounding municipalities, regions
  and from the Czech Republic in general. Such demonstrations can convince municipalities that it is not difficult to opt for the Smart Choice and implement measures to help save energy.

- In addition, we can also show examples of bad practice – when, on the contrary, the municipalities did not use the possibility of an energy advisors and made mistakes, due to which they had to modify the original project.
- For these purposes, a training program for municipal representatives can be set up to learn about the services of energy advisors and auditors.
- The peak of the communication would be the creation of a competition for the best reconstruction or construction carried out by a municipality, region or public administration in general. An award in a competition is a motivating factor for many municipalities and also an instrument that they can use to 'boast' in front of their constituents.
- Concluding a media partnership with the Modern Municipality – the possibility to advertise continuously or, for example, to create a special edition supplement on the occasion of a competition between municipalities.
- Cooperation with the Ministry of the Interior and organisations such as the Union of Towns and Municipalities of the Czech Republic, the Association of Local Authorities of the Czech Republic or the Association of Regions of the Czech Republic.

Social networks

Households
Young (18–35 years)
• Within this group, there will be a certain division into younger and older representatives. For the younger part of this group, involving an influencer would be an interesting option. However, there is a need to choose another representative with whom this group will be able to identify. • This group consumes social networks the most, especially Facebook. Its content must be adapted so that it can address this group effectively. • YouTube channel with tips and tricks, examples of good practice and DIY manuals for various home improvements. • Creating a series in cooperation with one of the online TVs (e.g. Stream.cz, Mall.tv, etc.), which can pass the necessary information to those who prefer online content in a simplified form.
Families (35–60)

• This group wants to see practical tips on social networks. Influencers and their videos are not important to them. • However, if the campaign uses with a popular ambassador / celebrity, it will provide an added value for this group as well. • YouTube channel with tips and tricks, examples of good practice and DIY manuals for various home improvements. • Creating a series in cooperation with one of the online TVs (e.g. Stream.cz, Mall.tv, etc.), which can pass the necessary information to those who prefer online content in a simplified form.
Older and elderly (60+)
• Communication on social networks will not be directly focused on this target group.
Companies
Companies with / without production
• Specific targeting of communication to business owners and sole traders, ideally through video, which simply introduces the benefits of Smart Choices for companies. • Using the LinkedIn network to target the target group. • In general, it is also possible to target employees.
Public administration
Mayors of municipalities
• The campaign is not expected to communicate with this target group through social networks. Other channels should be used for communication. • However, activities from the competition of municipalities for the most successful reconstruction can be shared on the campaign's social profile. Examples of good practice are certainly the right content to share on social networks – some active communities that own their social networks may share such contributions on their sites.

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TV

Households
• A set of television commercials from everyday family life. Children, parents and grandparents should perform here – the videos should be suitable for all ages. • Game principle of the spot (introduced at the beginning of this document). • Ongoing deployment of videos as part of a long-term campaign. • The TV spot can be broadcast in cinemas – for example before family films. • Product placement – Expert comments, examples of good practice or counselling during suitable shows – *Rady ptáka Loskutáka, Receptář, Hobby naší doby, Sama doma, Jak se staví sen* etc.). • It is also possible to target programmes from the transport segment – a topic for media such as *Autorevue* or *Garáž* can be, for example, a school of economical driving or types of new electric cars and smart vehicles. • Media partnerships can be established with such media. • Topic placement – brining up a topic in popular Czech TV series (*Ulice, Ordinace v růžové zahradě*). After an agreement with the screenwriters of the show, for example, a scene can be devoted to the topic of wasting energy in the household of the series characters.
Companies
• One of the TV spots from family life can be followed up on by a story from the employment of one of the parents. • The story can take place in a normal office, where tired and less active employees sit, the light is on unnecessarily, the room is poorly ventilated – the principle of opportunities around us should be use here as well. Such a spot is aimed more at the employees, who can realise that they should have a healthy working environment at their employment as well. • The second of the stories can focus on a manufacturing company with a hall that is cold in the winter, employees are frozen and sick, and even the funds for heating disappear right through the gaps in the poorly insulated building.
Public administration
• For the area of public administration, a TV spot is relatively irrelevant and inefficient – this target group communicates by completely different means.

Online videos

Households

• Similar to Variant 1 – Long-term campaigns – same tools and targeting.
• However, this variant puts much more pressure on faster results and conversions.
• We recommend running videos on different topics and with different focus in parallel and showing more videos to those who have already seen some others as part of your targeting.
• The digital video campaign is the first and main reach-out (along with TV commercials and PR) to a wide target group. It does not wait for the PR to prepare the ground; it goes straight to the point.
• At the same time, other digital tools (PPC banner campaign, remarketing) do not wait either and work in parallel with the videos.
 	
• Uploading the videos
  ○ on the campaign's own channels (web, Facebook, YouTube)
  ○ Paid views – YouTube, or other channels (Stream, Czech Television online, other video portals)
• It is advisable to have several versions of several lengths. Long version (approx. 60 sec), short version (15–30 sec), both with a skip-through option. On YouTube, you can only pay for a view that lasts more than 30 seconds, or when the entire video is watched (if shorter) or the desired action performed (click-through). These can be supplemented with a 'microspot' of up to 6 seconds for the 'unskippable' formats.
 	
• Game principle of the spot (introduced at the beginning of this document).
 	
• Deployment of videos across the board, from the beginning – show more videos to people who watch the first one.
 	
• Targeting by the topic of the clip (socio-demographic parameters, interests)
• The aim is to:
  ○ Watch the video (awareness about the topic, about opportunities for energy savings…)
  ○ 'Involvement in the game' – the user himself or herself is looking for possible savings in the videos (motivation with a prize – link to a website / social network)
  ○ Click-through to websites

Companies
• Some of the videos should also have a business theme, targeted at business owners or decision-makers in this area (energy, building management, etc.). • In addition to targeting YouTube (focus on higher revenues, business topics, etc.), it is a good idea to use other channels with a stronger audience. For example, a preroll on DVTV would be suitable.
Public administration
• This target group can encounter the video, for example, on the website or social network profiles of the campaign. Trying to hit this group with the video through paid channels will not be very effective. • However, video can be used in the presentation of a campaign for an event aimed at this target group – e.g. 'Den malých obcí' (small municipalities day) etc.

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Digital campaign

Households
Very similar to Variant 1, but with deployment from the beginning. The campaign is not waiting for the PR to reach out to households, it reaches out to the target group from the beginning. In an online environment, it is a mix of several tools, including online video (described above), that intertwine and build on each other. The digital campaign should be in full swing from the beginning and it should complement the video campaign in order to maximise the hit on target group. In a few waves with slightly modified creativity, the campaign should build awareness and then push for conversions: ● ONLINE VIDEO ○ building awareness about the topic, activating target groups ○ building behaviour patterns (learning to look for savings opportunities) ○ own channels + paid channels (YouTube, Facebook, video portals) ○ Show other videos from the series to those who saw the first one ● PPC – BANNER CAMPAIGN ○ Targeting to individual target groups according to socio-demographic parameters (first address) ○ Target those who watched the video(s) (second address) ○ Tools: AdWords (Google Display Network), Sklik, Facebook Ads ○ Banner content – based on the video and motivating to specific action: ■ Visit a website (I want to know more) ■ Visit calculator (calculate…) ● PPC – SEARCH ○ Search engine campaign for keywords and longtails (house insulation, how to insulate a house, energy savings, how to save energy, house renovation, etc.) ○ Bring people to the campaign website and give them information, or refer them to the EKIS centres ● REMARKETING ○ Subsequent address (second / third / x-th address) of those who have already interacted with the campaign ○ Banner content – following the last interaction and motivating for specific action: ■ Who saw the video but did not see the website – link to the website for more information ■ Who was on the website or in the calculator – motivation to visit the EKIS centre (click-through for the contact details of the nearest EKIS centre) ● FACEBOOK ADS ○ A community-building campaign to make FB profile management an effective tool ○ Gaining fans, such as those who saw the video, visited the website, etc.
Companies
● Similar to households ● Use of topics (videos and banners) from the corporate environment

- Narrow targeting in areas where relevant representation of the target group can be expected – business owners or people with decision-making powers in this area (energy, building management, etc.).
- Can be supplemented by direct purchase – a banner campaign focused on business titles
- In remarketing, targeting those who have visited the corporate section of the website

Public administration

- As with online video, the impact of digital campaigns on this target group will not be very effective.
- We recommend getting partners for the campaign (events, portals, media) whose websites are visited by the target group (mayors, heads of relevant departments) and agree with them to place campaign remarketing codes on their sites (ideally through Google Tag Manager). Then focus the public administration campaign on this target group in the form of remarketing.
- In the case of an available target group database, 'custom audience' on Facebook or 'Customer Match' on Google can also be used for targeting.