Czech-Austrian Spring and Summer School
The effects of policy frameworks in achieving energy savings in the building sector in Austria and Czech Republic.

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Co-operating Universities

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CONTENT

INTRODUCTION

The fight against climate change is unifying most of the countries around the world. In fact, the document promoted by the United Nations Climate Change (UNCC), the Paris Agreement (United Nations, 2015), has been signed by almost 200 countries.

In this context, European Union (EU) is one of the leading players. To ensure climate neutrality EU developed plans that later have been adopted by the majority of Member States (MSs). The first attempt to reduce greenhouse gases (GHG) emissions was made in 2007 with the development of the *"2020 EU climate and energy package"* (European Commission, 2007). This plan is based on three main pillars: 20% energy efficiency increase, 20% reduction of GHG emissions (compared to 1990 levels) and 20% renewable energy in the total energy consumption target by 2020. Later in 2013 EU adopted the *"2030 Climate and Energy Framework"* (European Commission, 2013) which set new targets to be achieved by 2030. Among these, it set a minimum growth of 32.5% in terms of energy efficiency and a reduction of GHG gases of 40% (compared to 1990 levels).

Lastly, the European Green Deal (European Commission, 2019) built on the 2030 plan to create a roadmap to achieve climate neutrality by 2050. With this step each MSs had to review the targets to develop new national energy plans.

Following these evolutions, energy efficiency and hence energy savings has always been one of the major areas of interest. Energy savings is an extensive topic which consists of a variety of directions regarding, among the others, policy and technical aspects, economy, sustainable development, environment etc. It is widely defined, that energy saving refers to save a money and at the same time contribute to better security in a matter of energy supply. In response to the EU's energy efficiency targets, it should be noted that this is a reduction in energy consumption compared to the model business as usual from the first package. Every member state has its own target in each pillar calculated based on geographical, economical and many other factors. The EU energy savings targets are supported in law, but much weaker than the other pillars of EU climate package. Maybe it is the main reason why the current evidence suggest that target will not be met, maybe not even close.

Core Objective

With this paper the authors would like to analyze past, present, and future situation in European Union in matter of energy savings. To be able to evaluate present results, previous targets must be considered. Applying former targets on current data will give us good perspective how the states have been able to fulfill their commitments and what is their perspective to the future.

As abovementioned, energy savings is an extensive topic that covers many areas of the energy world. Among these, the household sectors is one of the most important accounting for almost 27% of the final energy consumption in EU in 2019 (Eurostat, 2019b). Thus, addressing the issue of energy savings can have a large impact on the overall picture.

In light of this, the paper will analyze how different policy frameworks in the building sector affects energy savings in Czech Republic and Austria. That includes data analysis, policy, and market behavior. The building sector will be analyzed making a distinction in two major areas. The one linked to the electricity side (i.e. appliances, lighting etc…) and the one

related to the heating demand (i.e. heating equipment, preparation of domestic hot water). Particular focus will be give into identifying how legislations such as labelling policies, eco-design as well as standards in building regulations affect the implementation of energy savings in the two countries in exam.

Additionally the paper will investigate building regulations to understand how the two countries are moving in implementing the Energy Performance of Building directive (EPBD) (European Commission, 2010). This analysis will not only aim at seeing the level implementation of it but also which are the interventions and programs that the two countries planned to achieve the respective countries. This also translates in finding similarities and differences in the approach of the two countries.

Finally, respective national strategies will be analyzed and discussed to evaluate also what are the costs planned for these intervention and place and compare the two countries with respect also of the overall plans of the EU.

Work Structure

The structure of the work will be as follow:

In the introduction we will explain the motivation behind this paper and the research questions will be presented as well. In section 2 the European context in terms of laws, directives and targets will be presented and analyzed. Then the two countries will be analyzed separately trying to focus on policies, historical evolution of energy consumption and strategy for the future.

In the conclusion we will compare the two countries trying to point out factors in common as well as differences in terms of intervention but also strategies and results achieved.

METHODOLOGY

Energy Efficiency in the EU

As already mentioned in the introduction energy efficiency has been considered an important aspect by the European Commission since many years.

The 2012 energy efficiency directive set a target of 20% for energy efficiency by 2020 (European Commission, 2012). In this context, a series of measures have been implemented with regards to the building stock. Among these measures, EU Member States (MBs) committed to reach a renovation rate of 3% for all buildings owned or used by central government as well as planned a long-term renovation strategy for the building stock. Additionally, a series of informative measures such as labelling and energy efficiency certificates have been established by each MS. Alongside, every MS committed to prepare a national energy efficiency action plan every three year.

In 2018 the previous energy efficiency directive was amended including new targets (32.5%) but also separated the energy efficiency of the building stock from the main document merging it in the amended EU 2018/844 directive also known as the Energy Performance of Building Directive (EPBD)(European Commission, 2018). With this

development the EPBD – which originally was developed in 2010 (European Commission, 2010) – embraced a series of new elements to tighten and make the political sign stronger. Thus, the ultimate goal of this directive is to achieve a highly efficiency and fully decarbonized building stock by 2050 as well as to enable consumers and businesses to make more informed choices to save both energy and money.

In order to achieve these goals the EPBD covers a range of policies and supportive measures to support and help the national governments. Among these:

- MSs must establish long-term renovation strategies and these strategies should contribute at reaching the energy efficiency targets of each MS as mentioned in the respective national energy and climate plans (NECPs)
- MSs must set a minimum energy performance requirement for new buildings as well as for major renovations, and substitution of heating and cooling systems.
- From the 31st of December 2020 all new buildings must be nearly zero-energy buildings (NZEB)
- Every time a building is sold or rented energy performance certificates must be issued.
- Promotion of smart technologies and electro mobility (minimum requirements for car park)
- Renovation rate of 3% on buildings owned/used by central governments

Figure 1 shows the evolution of the share of the household sector in the final energy consumption in the EU27 as well as in Austria and Czech Republic. As one can see since 2008 the share has been pretty much stable. Looking at the percentage change since 2008 the average of the EU27 countries shows a decrease around 7% but both Czech Republic and Austria experienced an increase of 7.6% and 4.7% respectively. This shows how while overall there has been energy savings in the EU27 both Austria and Czech Republic in the last 12 years actually increased consumption of the household sector.

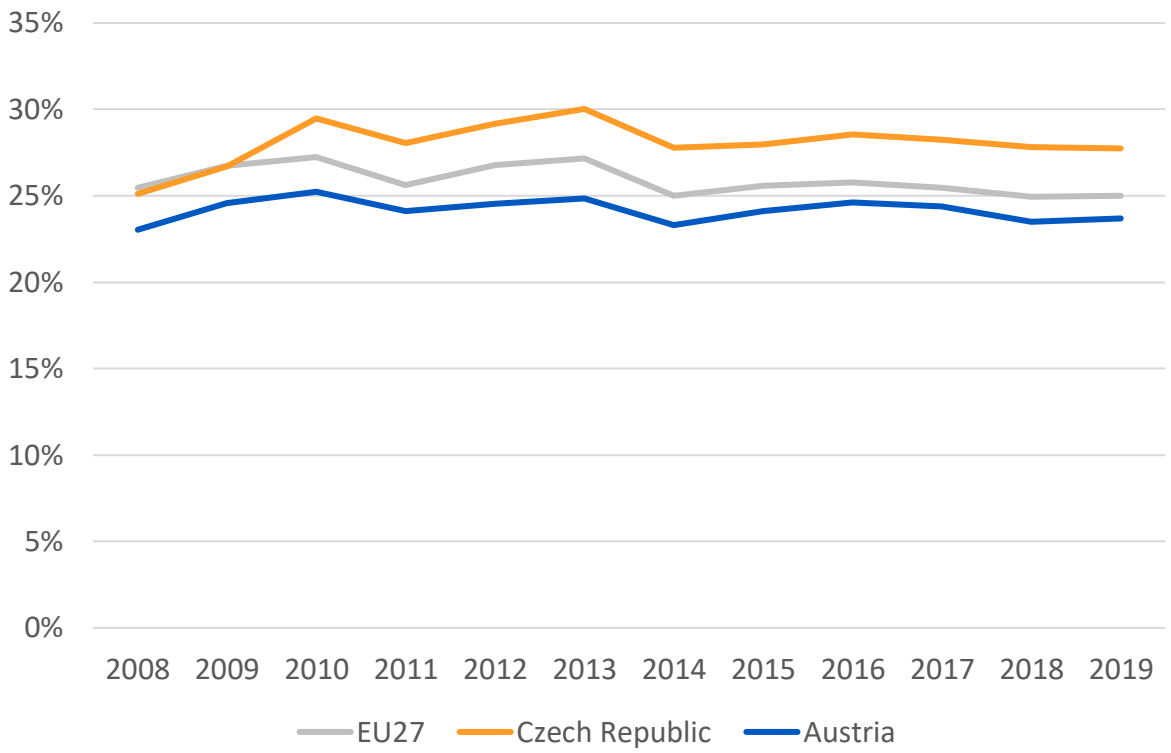

Figure 1 Share of household sector in final energy consumption. (Eurostat, 2019b, 2019a)

If we consider all sectors and compare the final energy consumption with the targets it is possible to see that overall, in the EU27 there has been a decrease since 2005 but 2020 targets have not been met yet. Figure 2 shows this distance in more detail.

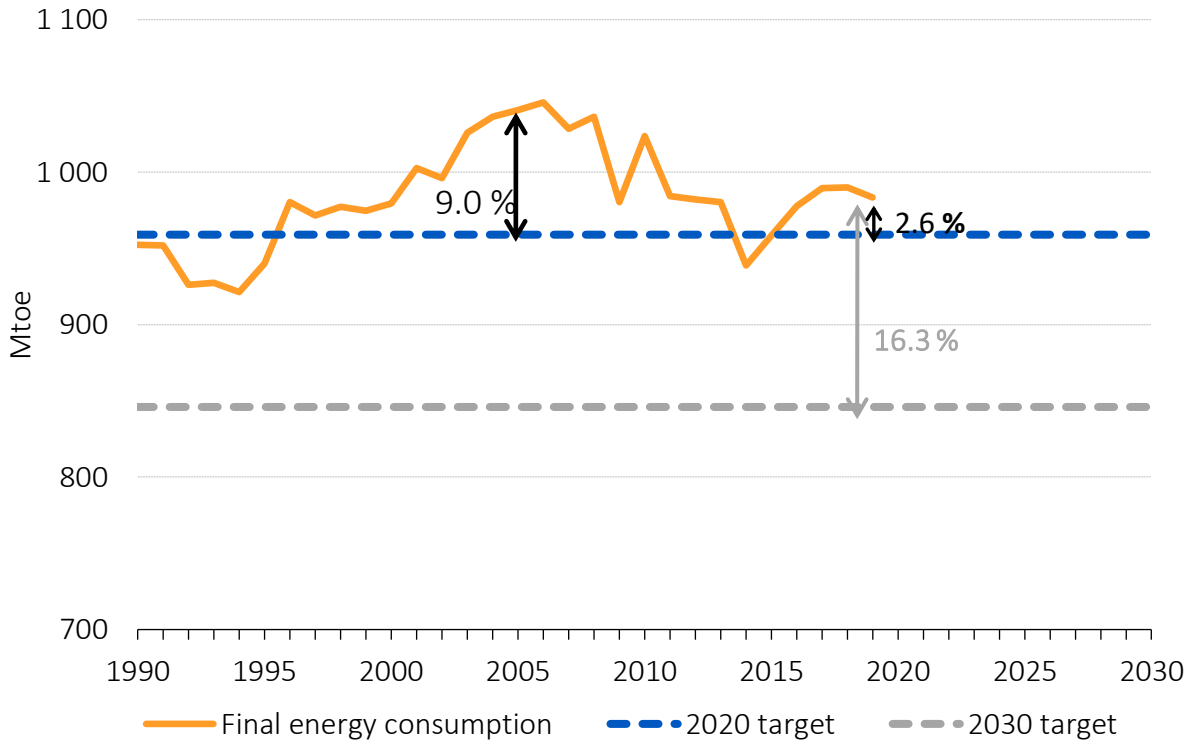

Figure 2 Distance to 2020 and 2030 targets for final energy consumption in EU27. (Eurostat, 2021b)

As one can see there is still plenty to do in order to achieve 2030 targets and is important that alla the counties do their part. In order to see how Austria and Czech Republic responded and are responding to the EU directives the next sections shows in details the overview of the two countries in exam.

Obligations and evaluation of energy efficiency targets for 2020

European Union Directive 2012/27 / EU requires Member States to:

- under Article 3, set a non-binding national target to contribute to a 20% reduction in EU final and primary energy by 2020,
- under Article 5, the obligation to renovate buildings owned and used by central institutions (there is a possibility to fulfill them retroactively, up to three years - 2020 + 3),
- under the article 7, obligation to generate cumulative energy savings corresponding to an annual reduction in final energy consumption of 1.5% by 2020.

In the following section we will evaluate how the two countries in exam, Austria and Czech Republic, acted following the European directives.

ENERGY SAVINGS IN AUSTRIA

In Austria the implementation of the 2012/27 directive happened in 2014 with the so called Federal Act on Increasing energy efficiency within the industry and the Federal State (Republic of Austria, 2014b) and later amended by the Federal Act amending the Environment Promotion Act and repealing the Federal Energy Efficiency Act in 2017 (Republic of Austria, 2017).

The implementation of these laws happened through the Energy Efficiency Guidelines Ordinance in 2015 (Republic of Austria, 2015) and the Federal Act providing additional funding for energy efficiency in 2014 (Republic of Austria, 2014a).

Article 3

Looking at the third article of the 2012/27/EC Directive Austria aimed at a final energy consumption of 1050 PJ by 2020. According to the IEA these targets should have been reached by the use of an obligation scheme for energy distributors and by strategic measures implemented by public authorities such as energy taxes, subsidy schemes, refurbishment activities and housing subsidies (IEA, 2017).

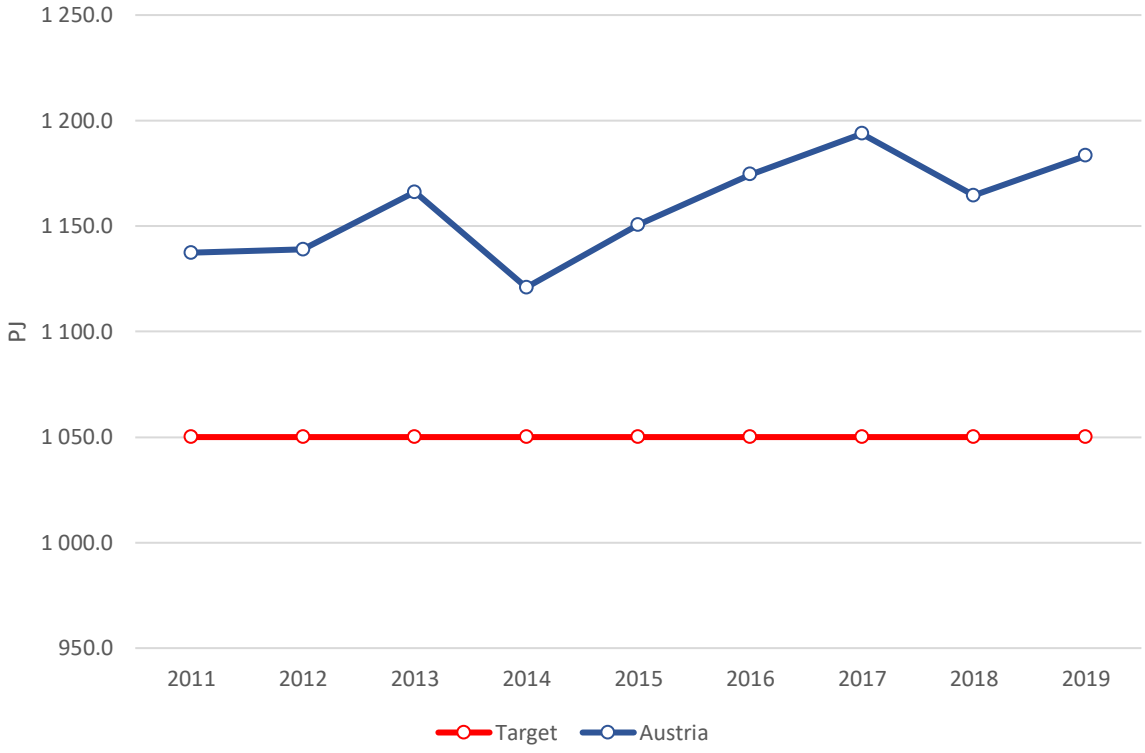

Figure 3 Final Energy Consumption 2008-2019 in Austria compared to target. (Eurostat, 2019a)

It can be seen that in 2014 there is a decrease on final energy consumption in Austria but this was followed by an almost constant year to year increase making Austria not complying with the target set. However, it is interesting to see how energy intensity (GJ/GDP) evolved in the same period. This indicator is a measure that is normally used to evaluate the energy efficiency of a particular economy.

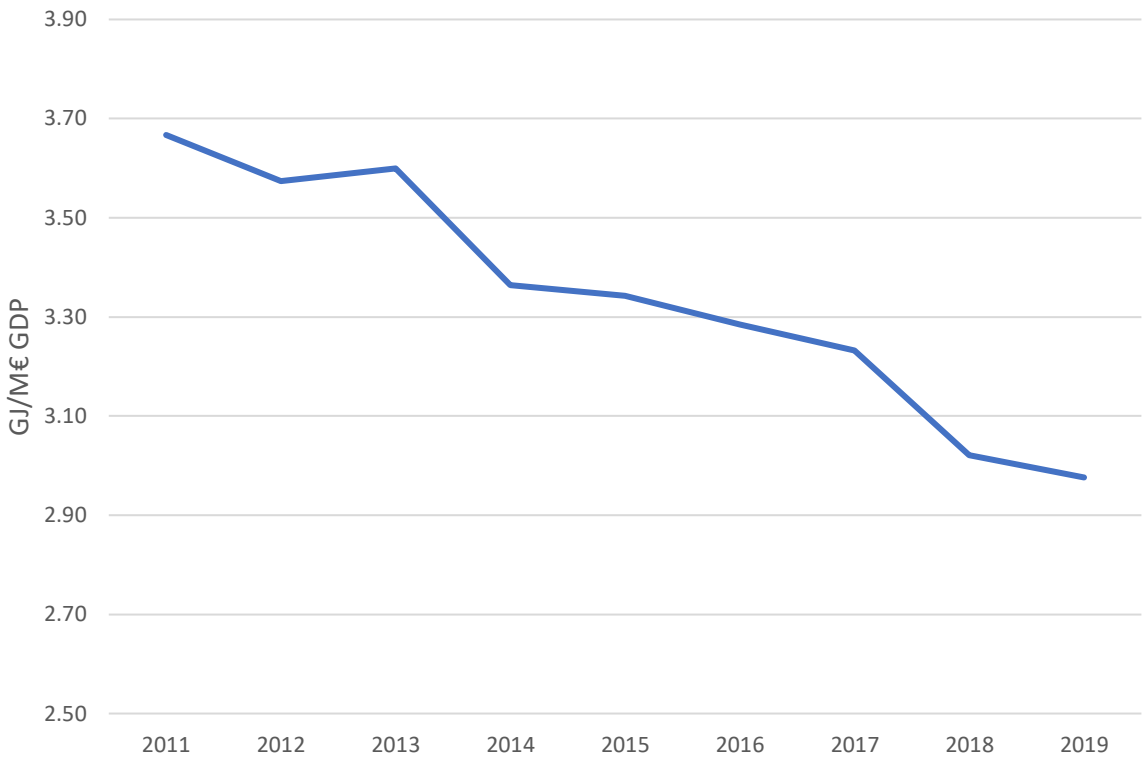

Figure 4 Energy Intensity 2011-2019 as GJ of Final Energy Consumption over GDP in Million Euro for Austria (Eurostat, 2019a, 2020)

As one see from Figure 4 energy intensity decreased. But this is still not enough to make Austria meeting the predefined targets.

It is also important to see what the overall contribution of all the sectors to the final energy consumption is to see whether a decrease occurred in one or not.

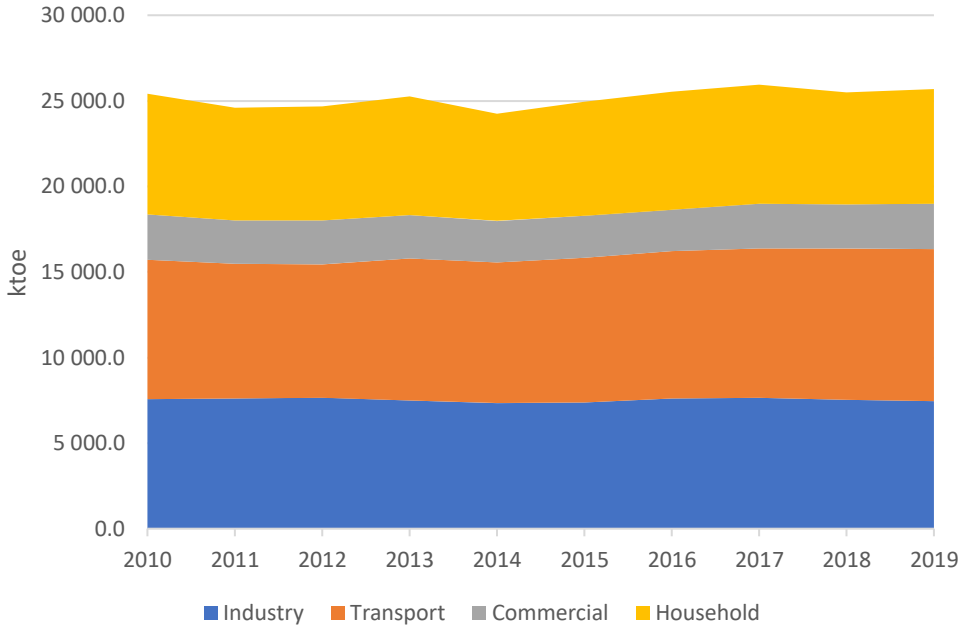

Figure 5 Final Energy Consumption by Sector in Austria(Eurostat, 2019b)

Also in this case it is possible to depict that consumption in Austria has been almost constant in the last 10 years in all the major sectors.

Article 5

In terms of renovation of government buildings there is not a lot of public information. However, according to (Firends of the Earth, 2020) Austria is going to faces complaints for not meeting the requirements of 3% renovation rate. This is also supported by the Integrated National Energy and Climate Plan for Austria (Republic of Austria, 2019) were it is mentioned that a new target will be set by the government for the period 2021-2030.

Article 7

In the Integrated National Energy And Climate Plan for Austria (Republic of Austria, 2019) the cumulative annual savings from 2014-2017 that have been notified are presented. Table 1 shows this savings.

Table 1 Energy Savings from policy instruments in PJ. (Republic of Austria, 2019)

Measure	**Cumulative Saving in TJ (2014-2017)**
Energy efficiency obligation scheme for energy suppliers	64.6
Provincial support for housing construction, energy and environment	28.26
Domestic Environmental Support ([Umweltförderung im Inland] UFI)	22.87
Federal support for green electricity	1.8
Energy taxation	39.21
Motorway tolls for HGVs	0.84
Austrian Federal Government's 'renovation initiative'	3.35
klimaaktiv mobil	0.18
Climate and Energy Fund	7.06
Federal Government property	0.12
Rounded Total	**168.29**

It should be recalled that article 7 required the achievement of 1.5% of annual saving until 2020. In the case of Austria this translated into a binding target of 310 PJ (as cumulative

savings) in the period 2014-2020. As seen in Table 1, up to 2017 more than 50% of the target for 2020 was met that led the Austrian government affirm that the target will likely to be met up to 2020.

Energy consumption in the residential sector

As already seen above, the residential sector is a relevant one in terms of energy consumption. Looking at the evolution of the consumption of the household sector it is possible to see how since 2014 it increased almost constantly.

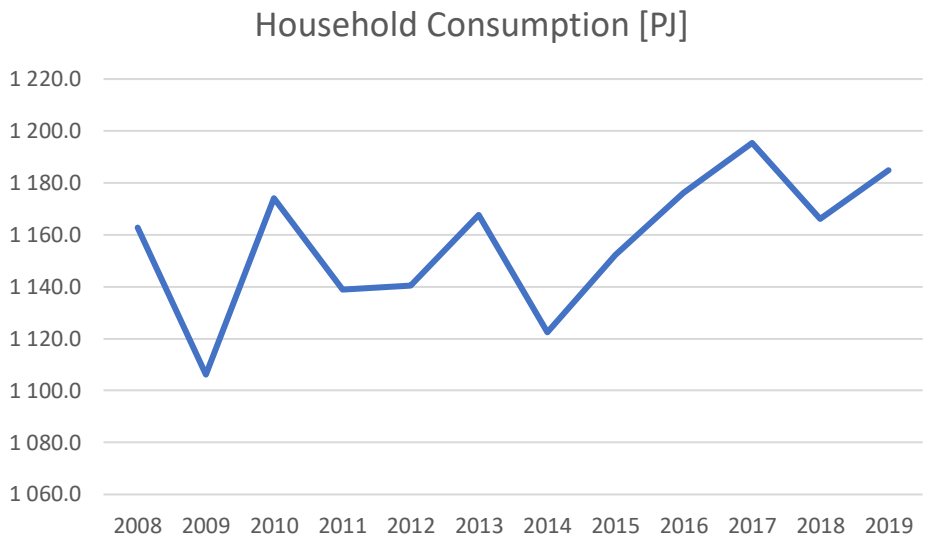

Figure 6 Final Energy Consumption of Household Sector in Austria 2008-2019.(Eurostat, 2019b)

The reasons of this increase are various and understanding them is crucial to been able to evaluate the strategies for energy efficiency. Looking at building permits can help on depicting the number of new buildings that have been built. Next figure shows the number of building permits in Austria having since 2010. Thus, 2010 is set to having an index of 100.

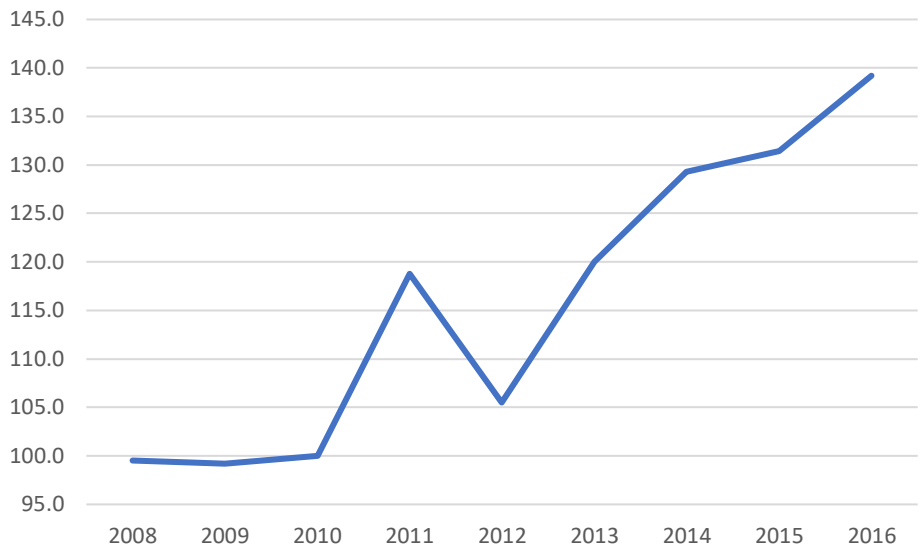

Figure 7 Building Permits in Austria compared to 2010 (index=100).(Eurostat, 2021a)

As one can see, it is possible to see how since 2012 there was an important increase. Even though new buildings are likely to be efficient this could be one of the reasons of why final energy consumption of the household sector has increased. Another relevant aspect that could explain this increase is the increase of population that happened in Austria in the last 20 years with an increase of more than 11% ('Demographics of Austria', 2021). This is also confirmed by the analysis of the Austrian Institute of Construction Engineering (OIB) made in the long term renovation strategy of Austria. Comparing data of 1993 and 2017 in terms of energy consumption in the household sectors they found the following:

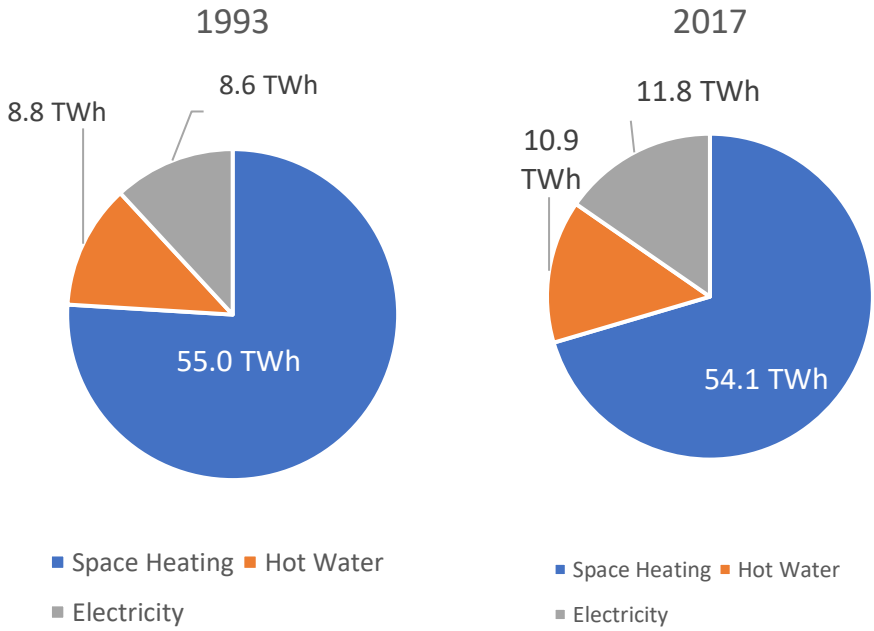

Figure 8 Energy consumption in the housing sector 1993-2017 in Austria. Adapted from(OIB, 2020)

They point out how while it was possible to maintain the amount of space heating constant, Hot Water consumption and electricity experienced an increase of 25% and 37.5% respectively. (OIB, 2020)

One of the reasons that allows to maintain constant the consumption of space heating despite the rise in the population and the increase in specific useful of floor area, can be attributed to various factors. Among them, the increased efficiency in building technology, and setting the requirements for new build.

Implementation of the EPBD directive

In Austria, all the nine landers have completed the implementation of the EPBD directive. In order to harmonize the process of implementation among the nine landers the Austrian Institute of Construction Engineering (OIB) was assigned to manage the process. Both new residential and non-residential buildings has minimum requirements in terms of energy performance. As presented by (Naghmeh Altmann-Mavaddat et al., 2016) these requirements are the following:

New buildings		[kWh/m².year)]
Space Heating Demand$_{Ref,RC}$	from entry into force until 31.12.2016	16 x (1+3.0/l_c)
	from 01.01.2017	14 x (1+3.0/l_c)
Space Heating Demand$_{max,Ref,RC}$	from entry into force until 31.12.2016	54.4
	from 01.01.2017	47.6
Space Cooling Demand$_{max,RC}$	from entry into force until 31.12.2016	1.0
	from 01.01.2017	
Heating Energy Demand$_{RC}$	from entry into force until 31.12.2016	Heating Energy Demand$_{max,NRB,RC}$
	from 01.01.2017	
Final Energy Demand$_{RC}$	from entry into force until 31.12.2016	Final Energy Demand$_{max,NRB,RC}$
	from 01.01.2017	

Ref: Reference space heating demand for reference climate

RC: Reference climate

NRB: Non-residential building

f_{GEE}: Total energy efficiency factor

l_c: Building shape factor

Figure 9 Maximum requirements for the energy performance of new residential buildings by heating energy (Naghmeh Altmann-Mavaddat et al., 2016)

New buildings		[kWh/m².year)]
Space Heating Demand $_{Ref,RC}$	from entry into force until 31.12.2016	16 x (1+3.0/l_c)
	from 01.01.2017	14 x (1+3.0/l_c)
Space Heating Demand $_{max,Ref,RC}$	from entry into force until 31.12.2016	54.4
	from 01.01.2017	47.6
Heating Energy Demand $_{RC}$	from entry into force until 31.12.2016	Heating Energy Demand $_{max,RB,RC}$
	from 01.01.2017	
Final Energy Demand $_{RC}$	from entry into force until 31.12.2016	Final Energy Demand $_{max,RB,RC}$
	from 01.01.2017	

Ref: Reference space heating demand for reference climate

RB: Residential building

RC: Reference climate

f_{GEE}: Total energy efficiency factor

l_c: Building shape factor

Figure 10 Maximum requirements for the energy performance of new non-residential buildings by heating (Naghmeh Altmann-Mavaddat et al., 2016)

Plans for the future

The main program for fighting climate change in Austria is currently the so called “mission2030”. The goal of this program is to reduce GHG emission by 36% in 2030 comapred to 2005 and t increase the ratio of RES in gross final energy consumption to 46-50%. To achieve this goal the strategy consist of 8 tasks and 12 flagship projects. Among them there is the increase the thermal building renovation in order to lower the consumption in the household sector. (IEA, 2020)

ENERGY SAVINGS IN CZECH REPUBLIC

Within the framework of Czech legislation, changes were implemented to achieve the objectives of the 2012/27 directive in 2015. This concerns the amendment to Act No. 458/2000 Coll. (energetic law), more precisely on the conditions of business conditions and the performance of state administration in the energy sectors, as amended, Act No. 406/2000 Coll., on energy management and Act No. 165/2012 Coll., on supported resources.

Among the latest regulations, we can mention Decree No. 264/2020 Coll., On the energy performance of buildings, replaced Decree No. 78/2013 Coll. The new regulation greatly tightens the requirements for buildings with almost zero energy consumption from 2022. At the same time, the regulation considers some updated directives of the European Parliament and the EU Council 844/2018, which aim at a healthier indoor environment and changes in energy performance indicators. There is also an adjustment of some calculations, but also an equivalent approach in considering the renewable sources installed in the building and the central network regarding the factors of primary energy from non-renewable sources. (*Zprava o Pokroku Plneni Cilu Energeticke Ucinnosti v CR-2021,* n.d.)

Article 3

With respect to Article 3 of Directive 20212/27 / EEC, a national indicative target has been set for the overall national contribution from the 20% savings target. According to this article, each state can choose its own energy efficiency target based on primary energy consumption or final consumption. 20% savings are savings from final energy consumption compared to the reference scenario from 2007. The target for final energy consumption for 2020 was set at 1060 PJ, which corresponds to 25.315 Mtoe. Target is not only for final energy consumption but also for primary energy consumption. Based on the primary energy coefficient for Czech Republic, target corresponds to 1 855 PJ, which is 44.305 Mtoe. This target was set with the original "Eurostat Europe 2020" methodology, which was revised in 2017, but is still authoritative in demonstrating compliance with the national 2020 target.

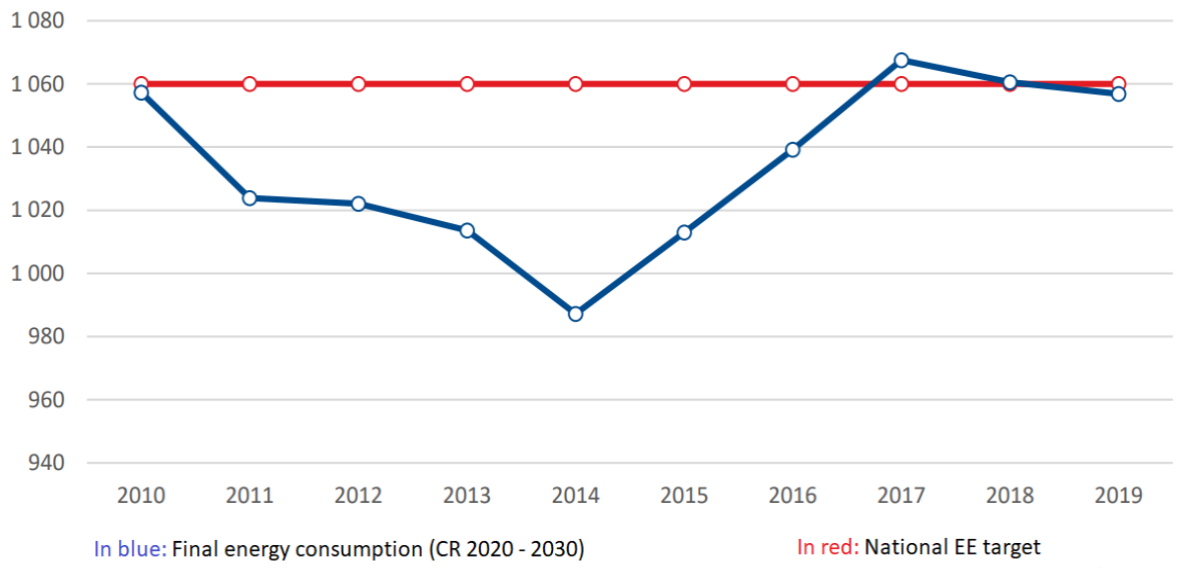

Figure 11 final energy consumption from 2010 to 2019, source Eurostat Europa 2020

The target was already met in 2010, however, since 2014 it has started to show a year-on-year increase. The maximum was then reached in 2017, after which there is a gradual slight decrease. In 2019, final primary energy consumption reached 1,057 PJ and 1,679.5 PJ of primary energy consumption. The final target value for energy consumption was thus met.

However, it is necessary to consider that individual fluctuations in consumption each year may be caused by various factors, such as variable temperature, change in total exports, etc. It is so good to look at the level of energy intensity. In 2019, it decreased by 3.4% year-on-year and reaches the value of 364 GJ / mil. CZK GDP.

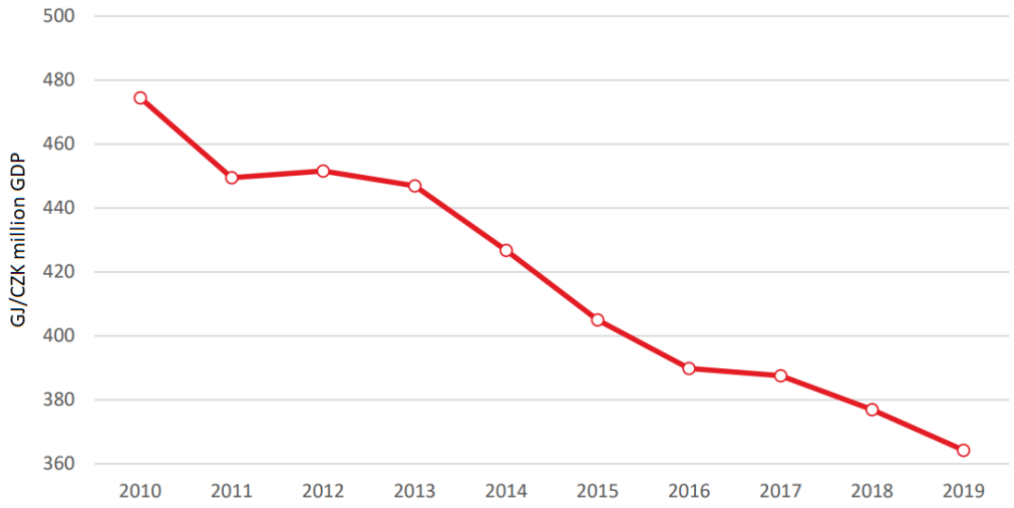

Figure 11 – Trend in energy performance in the Czech Republic, 2010 -2019, source MIT, Eurostat 2017

In the case of final energy consumption, it is necessary to look at the contributions of individual sectors. In this work, the analysis will focus mainly on the share of households, however, it is good to analyze at least briefly what is happening in other sectors.

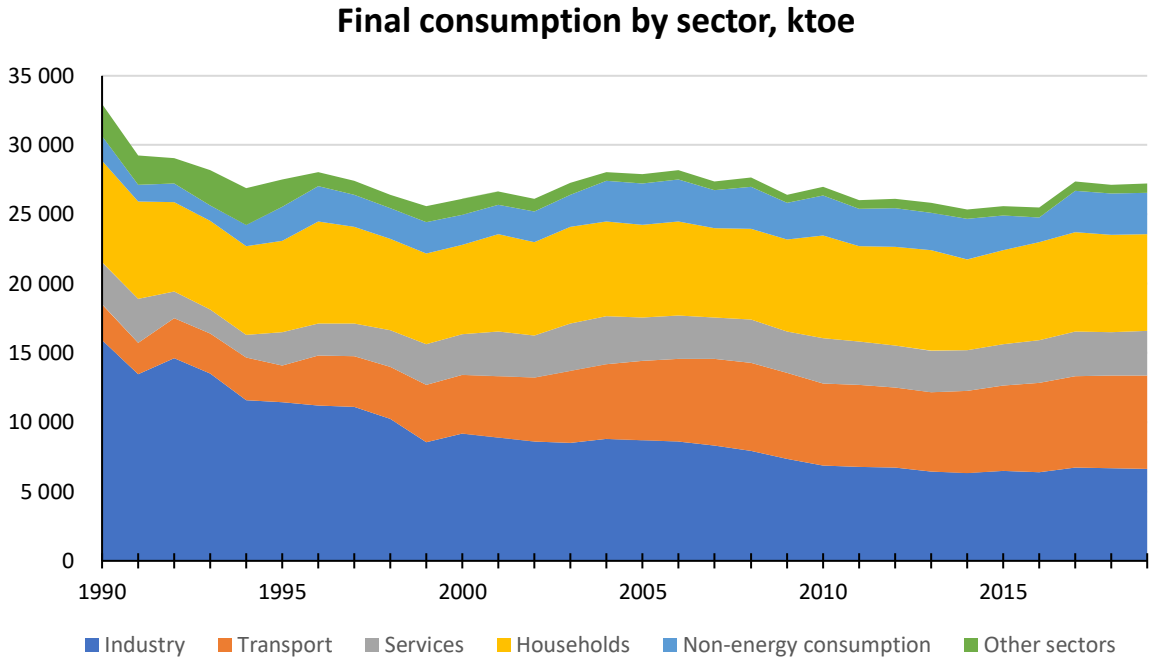

Figure 12 – final consumption by sector, ktoe for CR, source Eurostat (Energy Balances - Energy - Eurostat, 2021)

Industry in terms of energy consumption is declining year on year, by about 2%. The consequences of reducing the energy intensity of industry are fully felt in this sector. The trend is also declining for the ratio of energy consumption to industrial production. Technical efficiency is thus steadily increasing in this sector.

Transport has been growing for a long time. In 2018, it was already 1.8% year-on-year, so in the total amount the annual difference in 2019 is the total energy consumption of 4.9 PJ. The trend is closely related to the increase in passenger-kilometers and tones-kilometers. For 2019, this corresponds to a year-on-year growth of 2.3%. On the other hand, energy consumption per passenger-kilometer has decreased, and this also applies to one car. The efficiency has thus increased.

Services show a growing increase of about 2.1%, which in absolute numbers is about 2.7 PJ.

Households recorded a year-on-year decrease of 0.8%, so total consumption reached 297.6 PJ. In terms of absolute numbers, this is the largest share of all sectors. In 2019, the energy intensity per housing unit reached 69.7 GJ / apartment.

Article 5

Unlike the previous article, Article 5 of Directive 2012/27 / EU is binding. Failure to do so could result in EU sanctions against Member States. This binding target sets the obligation to renovate 3% of the energy reference area of owned and used buildings of central institutions that do not meet the energy performance requirements of buildings. The regulation was implemented into Czech legislation in 2015 into regulations. In connection

with this, an investment plan for the reconstruction of buildings owned by central institutions was presented. The number of buildings as of 2019 that did not meet the requirements for energy efficiency of buildings C (energy-efficient building) was a total of 585 units.

Nu. of institutions	Nu. of properties owned and used	Nu. of compliant properties	Energy reference area of compliant properties [m^2]	No of noncompliant properties	Energy reference area of noncompliant properties [m^2]	Annual commitment deriving from noncompliant reference area [TJ]
37	774	189	804 779	585	1 600 494	13.33

Table 2 – Status of the building stock of institutions with obligations under Article 5 of Directive 2012/27/EU for 2019

The commitment for 2020 was set at 20.7 TJ. Liabilities and annual savings can be seen in the following table.

	2014	2015	2016	2017	2018	2019	2020	Total
Annual energy savings commitment [TJ]	5,3	5,3	5,3	20.7	20.7	20.7	20.7	**98.7**
	Actual							
Annual energy savings [TJ]	4.1	12.2	7.8	25.2	8.6	13.2	26.1	**97.1**
Progress towards the commitment (plan – commitment) [TJ]	-1.2	6.9	2.5	4.5	-12.1	-7.5	5.4	**-1.6**
Cost of renovations [CZK million]	31.2	172.7	117.2	173.1	136.3	395.9	1 391.6	**2 417.9**

Table 3 – Summary of annual commitment under Article 5 of the Directive and fulfilment as of 2020

In total, a deficit of 1.6 TJ arose compared to the value determined by the liability. However, regarding the possibility of fulfilling the commitment up to 3 years after the expiration of the 2020 deadline, it can be assumed that the commitment will eventually be fulfilled.

Article 7

This article reflects the obligation to implement energy saving projects that generate cumulative energy savings in the period 2014 to 2020. These savings must constitute an annual reduction in final energy consumption by 1.5% of purchased energy for final use. A binding target of 204.39 PJ of accumulated energy savings has been set for the Czech Republic, which corresponds to a saving of 7.3 PJ per year. The obligation is mandatory and in case of non-compliance, the Czech Republic risks sanction from the EU.

[TJ]	2014	2015	2016	2017	2018	2019	2020
Behavioral measures	147	221	101	139	214	119	8
Environmental tax	1 325	1 544	1 747	1 653	1 378	1 550	0
Investment measures - new	1 977	4 796	6 083	5 226	6 003	5 267	5 399
Investment measures - cumulative		1 977	6 773	12 856	18 082	24 085	29 352
Total	3 449	8 538	14 703	19 874	25 676	31 021	34 833

Table 4 – Overview of annual fulfilment for the calculation of compliance with the cumulative energy savings obligation

As of 2020, the total value of accumulated savings is 138.1 PJ, the deficit of accumulated savings is 66.3 PJ. This number is not completely final, as for some measures the savings are calculated only later the basis of the measured savings. The main deficit arose between 2014 and 2015, when the implementation of austerity measures was very slow. However, according to current data, the commitment has certainly not been fulfilled. The question is therefore whether the Czech Republic will face sanctions or not.

Energy consumption in the residential sector

In response to Directive (EU) 2018/844 of the European Parliament and of the Council amending Directive 2010 / 31EU on the energy performance of buildings and Directive 2012/27 / EU on energy efficiency, a long-term renovation strategy has been developed. It is one of the tools to achieve a system focused on the building sector, which so far accounts for 40% of final energy consumption in the European Union. The document aims to propose an effective scenario for the renovation of the building stock, including the residential, public and private sectors.

In the case of the Czech Republic, the share of households in final energy consumption is equal to 30%, which is the largest share of the possible sectors. This final consumption includes energy for cooling, heating, ventilation, humidity adjustment, hot water preparation, lighting, and household appliance consumption. Heating plays the biggest role, accounting for more than 69% of households' final energy consumption.

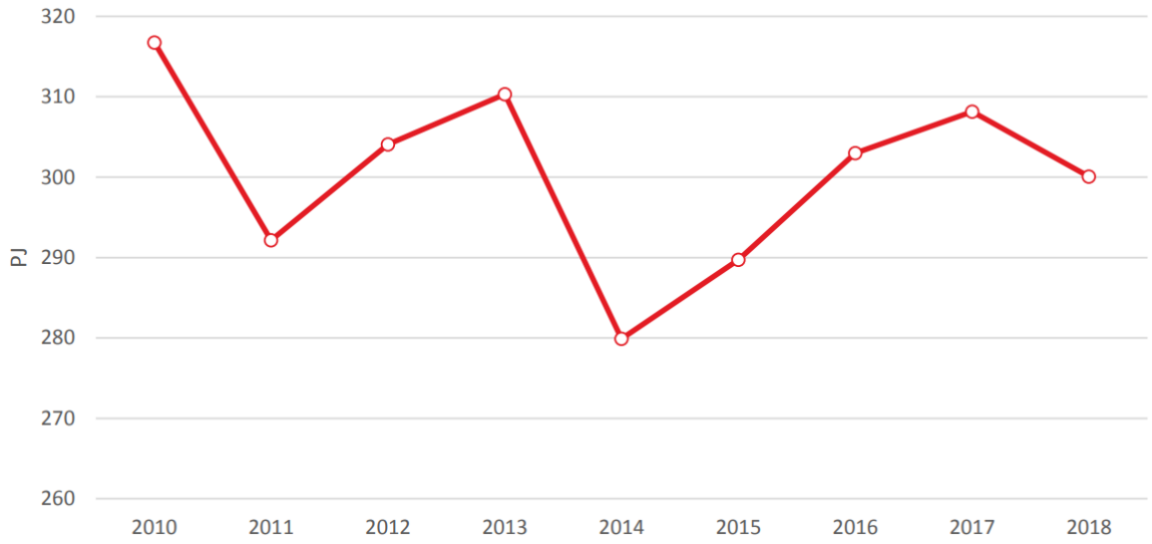

Figure 13 – Final energy consumption in the household sector, 2010–2018

However, the final consumption graph is affected by the average temperature of the heating months, so higher consumption depends on lower average temperatures in the heating season. The fact that, in principle, there has been no reduction in final consumption since 2010 is due to the construction of new family houses, which in terms of construction exceeded the percentage of more energy-efficient apartment buildings. In addition, there is an ever-increasing trend in increasing living standards and decreasing the number of people living in one housing unit. In Czech Republic increased living standards is definitely associated with air conditioning.

Family houses and housing units

The following data are made based on the 2011 census of population, houses and flats.

	Total number of Buildings [-]	single-family house individual [-]	single-family house semi-detached [-]	single-family house terraced [-]
Family Houses	1 554 794	74,8%	8,6%	16,5%
Apartments in family houses	1 896 931	74,7%	9,0%	16,3%
	[m^2]			
Interior floor area	194 957 505	75,2%	8,4%	16,4%

Table 5 – Total number of single-family houses in each category

It is obvious that the largest part of the family house sector consists of separate units. The construction of family houses is still rising. This also applies to housing units. The following data correspond to housing units. It is a single storey up to 11 or more storey units.

	Apartment buildings [-]	Apartments in apartment buildings [-]	Interior floor area of apartment buildings [thousand m^2]
Total from 1919 and before to 2011	211 252	2 416 033	156 226

Table 6 - Total number of apartment buildings, number of apartments in apartment buildings and interior floor area

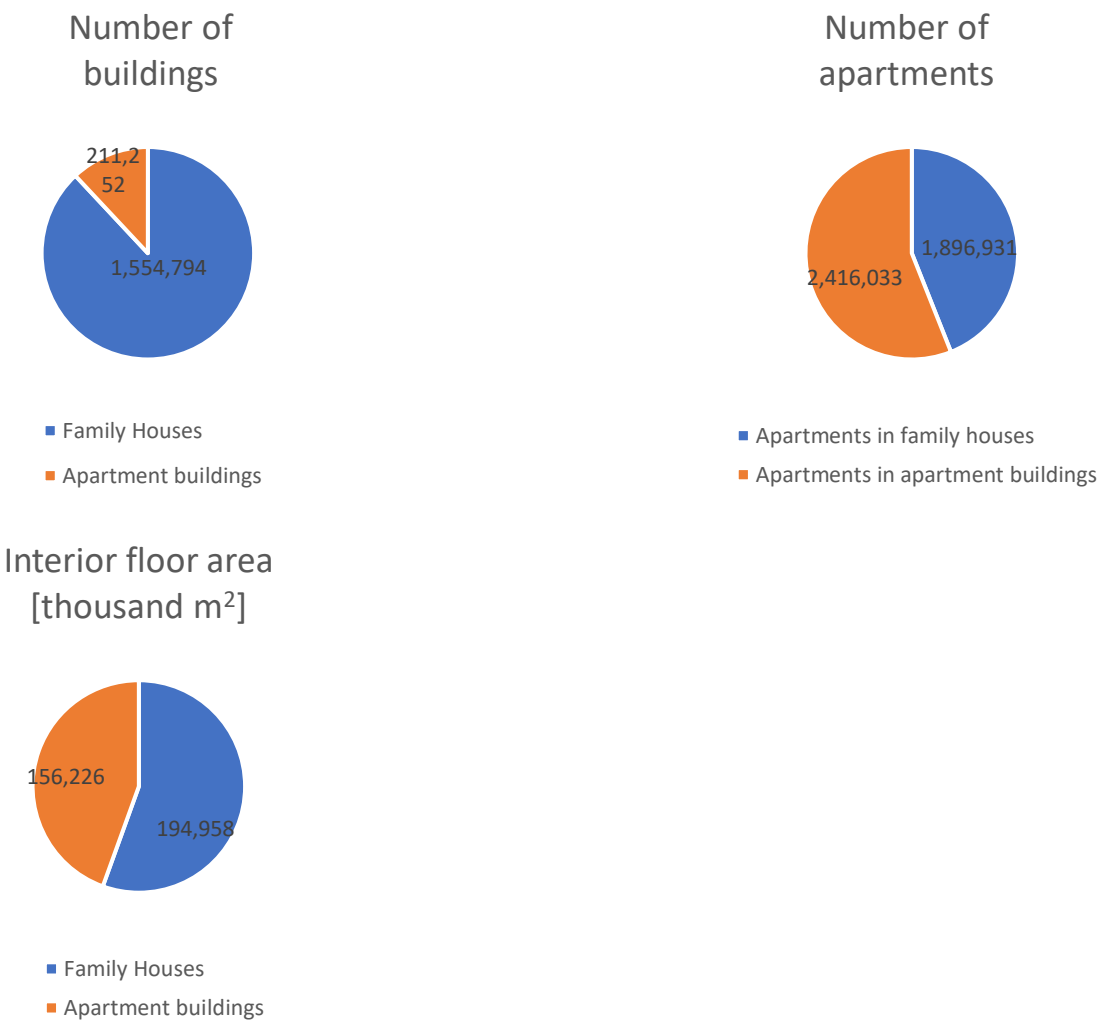

Figure 14 – Comparison between family houses and apartment buildings in counts, apartments, and interior floor area

Construction of a new family house

According to the national plan of the Czech Republic in the field of energy and climate, an increase in the number of households and flats is expected with regard to demographic trends.

The latest regulation for the construction of new buildings is regulated by Decree No. 264/2020 Coll. on the energy performance of buildings, which responds to the new European Directive 2018/844. The decree describes the process of determining a reference building for planned construction. Such a building corresponds to the same type, the same orientation to the sides of the world, the geometric shape, ie the same sizes of glazed surfaces, floors, etc. The reference corresponds to the fact that it uses reference structures, properties, and technical systems.

The basic indicators of energy intensity include:

a) primary energy from non-renewable energy sources per square meter of energy reference area,
b) the total energy supplied per year per square meter of energy reference area,
c) average heat transfer coefficient,
d) heat transfer coefficients of individual structures at the system boundary,

e) efficiency of technical systems.

The requirements for the energy performance of a building are met during the construction of a new building, if the values of the energy performance indicators a), b) and c) are not higher than for a building with almost zero energy consumption. The standard of a building with almost zero consumption thus sets the maximum values of energy intensity and is calculated according to Czech technical standards, especially ČSN 73 0540-2. In the case of a major renovation, the requirements must be higher than for the reference building according to a) and c), or b) and c) or d) and e).

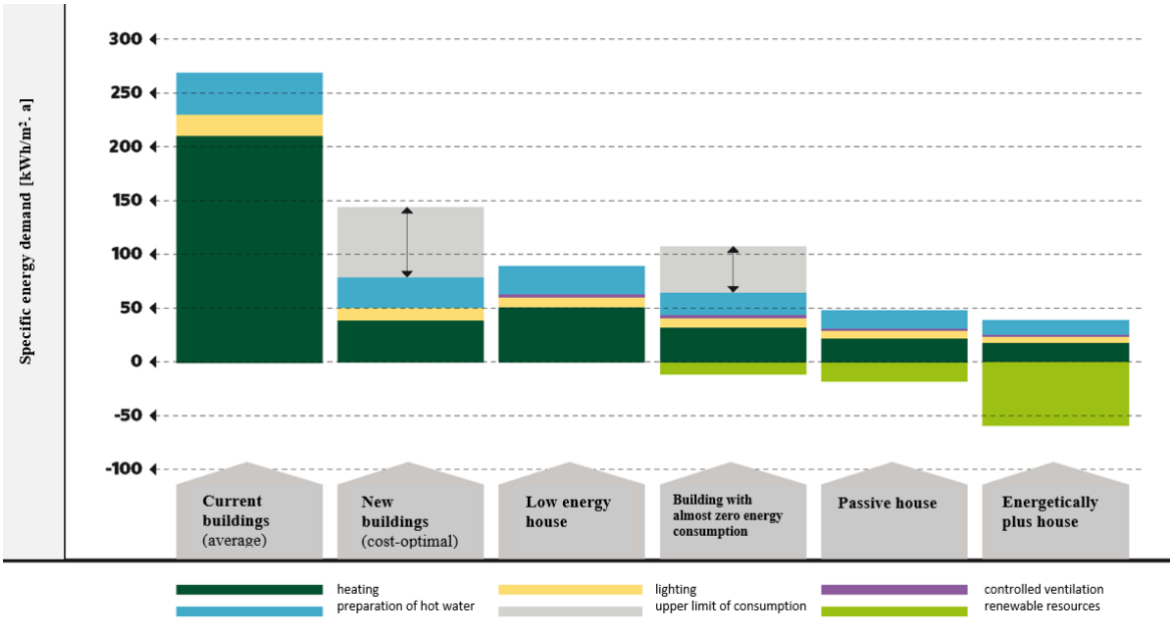

Figure 15 – Comparison between energy standards, source Šance pro budovy (Energetické standardy budov, n.d.)

The conditions include the values of the minimum efficiency of individual parts of the insulation system, heating, cooling, etc., however, it is not worth discussing them in detail here, the main requirement is the basic value of the average heat transfer coefficient, which is $f_r = 0.7$. Overall, this requirement places demands on the thermal insulation standards of the building envelope. The specific heat demand for heating for a standard building with almost zero consumption is based on approximately 30 - 70 kWh / (m^2.per year). Furthermore, the requirement for the consumption of primary energy from non-renewable sources is very fundamental. This is measured based on the primary energy consumption of the reference building, and according to the category, whether it is a house in a residential zone or another, a percentage reduction is determined. At present, the values are between (10 - 25) %. This roughly corresponds to the specific consumption of non-renewable primary energy at 100 - 160 kWh / m^2, however, from 2022 a new building standard with almost zero consumption will apply, which increases the percentage savings according to the specific heat demand for heating the reference building in the range of (20 - 60) %. This can be achieved either by reducing the total energy consumption, or by choosing heat sources with a lower primary energy factor or by installing renewable sources on the building, such as solar panels. In the energy certificate, it is mostly class B, but the conditions can also be met in category C.

Renovation

From the point of view of energy goals, it is crucial how the energy efficiency of a building is increased during renovation. If we look at the data between 2017 and 2018, it is possible to distinguish what depths of renovation the family houses achieved and what changes the building achieved after renovation in the system of evaluation of the energy performance class of the building. Classes A and B were designated as thorough renovation depths, class C as medium and classes D, E, F and G as shallow renovation depths. From the following graph it is possible to deduce the number of renovations of a given depth and what changes in energy performance the building achieved after the renovation. It can be read that the highest number of renovations was in class C, while the class was maintained. The highest number of renovations when the class was changed was when changing from class G to class C, which corresponds to the data from the CG column. More letters correspond to a gradual renovation.

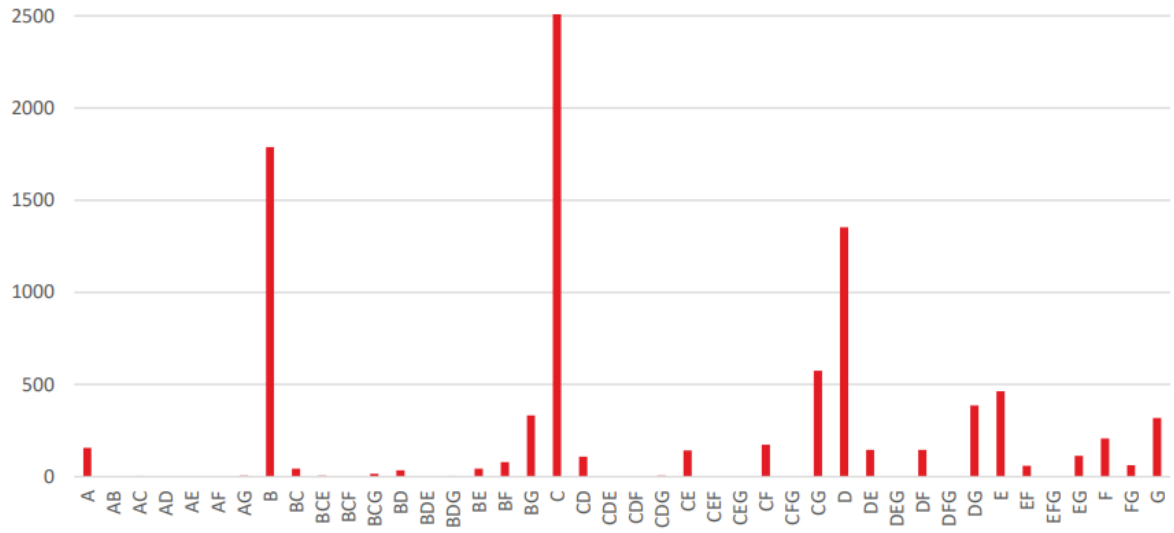

Figure 16 – Number and depth of renovations of single-family houses according to the ENEX database for the years 2017 and 2018

The trend is very similar in the renovation of apartment buildings. Class C renovations, which have been preserved, also dominate. The following order is class D and B. For renovations where the energy class is changed, there is a high number of CD and CE. Compared to family houses between 2017 and 2018, there was no such number of renovations in the DG category compared to family houses.

According to the latest survey conducted by the Alliance, the chances for buildings are most often renovated by the owners on their own for the money saved and gradually. Among the main motivations are energy savings and better comfort. Most respondents stated that renovations are taking place gradually due to a lack of immediate funding and they are not used to borrowing from it, the amount of the repair is usually up to EUR 7 840. Of the respondents, only 7% used a state subsidy, where it accounted for 30% of their total costs. However, according to the people contacted, the energy performance certificate of the building, which must be prepared by a state-certified person, pays off the least. One of the main reasons for not using subsidies is self-help construction, people are not used to using the professional services of architects and rather use the advice of craftsmen and builders.

For most people, the subsidy system is too complicated, and 16% did not even know that there was such a possibility.

The main problem is the high administrative burden, but also the fact that only a minimum of people has informed the authorities in some way about this change, so the state does not have the necessary information to report progress in reducing energy intensity. The state must raise awareness of these programs and offer free non-binding energy advice. (*Hlavní Závěry a Doporučení z Průzkumu Povědomí o Úsporách Energie Mezi Vlastníky Budov a Jejich Motivací a Bariér pro Renovace,* n.d.)

Future scenarios

The new energy efficiency targets are amended in the framework of 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.(*Long-Term Renovation Strategy to Support the Renovation of the National Stock of Both Public and Private Residential and Non-Residential Buildings,* n.d.)

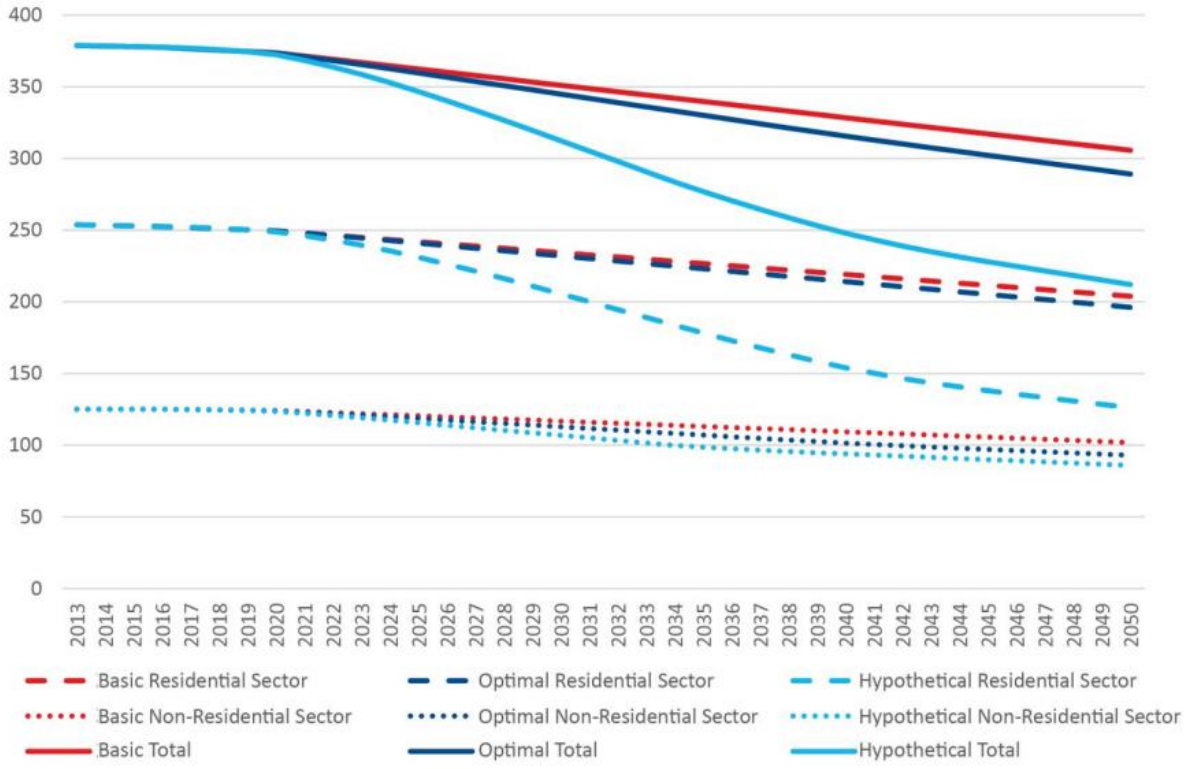

Figure 17 – Model final energy consumption in buildings [PJ]

First, it is planned to renovate non-energetically renovated buildings, where 75% are family houses, then the second phase of renovation of these now or already renovated houses is planned.

Basic scenario reflects the current assumption of developments following the implementation of policies and measures in response to Directive 2010/31 / EU of the European Parliament of 19 May 2010 on the energy performance of buildings and Directive 2012/27 / EU of the European Parliament of 25 October 2012 on energy efficiency. By 2050, consumption is reduced by 72 PJ compared to the present, while CZK 722 billion is expected for implementation.

Optimal scenario goes beyond new measures in public and commercial buildings. The savings amount to 89 PJ compared to the current situation, while the estimated costs amount to 856 billion CZK.

Hypothetical scenario assumes that most of the buildings will be renovated from 2025, only in the part where it will not be technically possible, shallow renovations will take place. The total reduction in consumption by 2050 is 166 PJ with a total investment of CZK 1,419 billion.

DISCUSSION: BARRIERS FOR ACHIEVING ENERGY EFFICIENCY TARGETS

Austria

There are various reasons why Austria is behind his targets in terms of energy efficiency. Some of them have already been mentioned as the increased in the population together with the increase of the specific heat floor needed. However, there are some other aspects that are important to be noted.

In fact, even though energy efficiency brings a set of advantages it is also a costly operation that, particularly in the household sector, may involve not only the tenants but also the landlord in case of rented apartment. This issue, known as split-incentive or tenant/owner dilemma, is clearly a barrier for the implementation of energy savings since neither the landlord or the tenant has sufficient motivation/incentives to invest in energy efficiency.

Additionally, even for private entities or for people living in and owning their house investing in energy efficiency measures usually means to have a pay back period of more than 6-10 years.

Another barrier is coming from the rebound effect. In this situation even though energy efficiency measures have been implemented, there is an increase in the use of the commodity that reduce the benefits of the implemented measures.

Additionally, there are also barriers in terms of regulatory aspects. More tailored and effective policies can in fact help on mitigating the abovementioned challenges making it possible for Austria to achieve the foreseen targets.

Czech Republic

The basic problem in the implementation of energy saving policy in the Czech Republic is in the very way of support and motivation. Although saving energy is in the interests of both the state and the owner, people are not sufficiently motivated for deep renovations that would lead to a significant transformation of the energy efficiency of a housing unit. Although the state offers active support in the form of subsidies, it does not sufficiently inform the public about the existence of these programs and offers a higher administrative burden rather than a helping hand. The Czech Republic is a big fan of accreditations, which means that if something is to be done officially, there must be an accredited company and an accredited person who will assess the result of the work. Renovations are no exception, so it is difficult to get a subsidy for self-help renovations. Of course, hiring an accredited company incurs additional expenses, and as a result, these increased costs and time spent

on administrative burdens discourage people from doing so, because in most cases, people want to make repairs themselves. The state should focus on the area of unpaid non-binding consultations, people would then be better informed about the right steps to take to save overall energy and help or improve the administrative flow of applications and grant processing.

CONCLUSIONS

The two countries in exam, Czech Republic and Austria, present some similar aspects one to each other. In fact, they share a similar size in terms of annual energy consumption of 25 Mtoe and 28 Mtoe Respectively in 2019. Similar is also the share of the household sector in the final energy consumption even though Czech Republic experience a slightly higher share than Austria. This could depict a higher inefficiency level of the building stock of Czech Republic or a larger demand for heating purposes.

Moreover, looking at the targets both the countries have for energy efficiency, it is possible to see how Czech Republic has been following them in a better way meeting the main targets and obligation set from the European commission. However, both the countries in the last year showed a tendency towards increasing the energy consumption in the household sector. Similarly, the two countries showed important decrease in terms of energy intensity in the last years showing a fairly good use of resources.

Table 7 Target achievement of the EU directive for Austria and Czech Republic

	Article 3	Article 5	Article 7
Austria	Not Met	Not Met	Met
Czech Republic	Met	Met	Not Met

Another important aspect is that both countries tried to implement the energy efficiency directives of EU. However, as already mentioned before, it seems that Austria has been less effective than Czech Republic in obtaining the desired results. In fact, Austria only met the requirements set by article 7 while Czech Republic met the target of article 3 and 5 but not the one for Article 7.

We can than conclude that even though European Directives are an important instrument to guide member states to reach some pre-defined targets. The results of the implementation of them strongly depend on the member states itself.

Additionally, there is still a lot to do in both countries in order to reduce the impact of the household sector and to have a more efficient building stock.

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