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Build up Skills (BUS) initiative in CZ and SK –

Rebooting the National qualification platforms and Roadmaps towards implementation of nearly Zero Energy Buildings and support for Renovation Wave

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Further information

More details on BUILD UP Skills can be found at www.build-up.ec.europa.eu

More details on the LIFE CET programme can be found at https://cinea.ec.europa.eu/programmes/life_en

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Summary

The construction industry has had a long-term significant impact on the state and development of the Czech economy as well as the social environment, including the related **environmental** and socio-cultural aspects of development, as:

- it steadily generates around **5 to 6 % gross domestic poduct**,
- it steadily employs approximately **7 to 8 % of people working in the civilian sector.** Currently (2021), the number of people employed in the construction sector reaches approximately 400 000 people. Yet, the construction sector in the Czech Republic has been facing a long-term **labour shortage** problem, which still continued in 2021 and 2022, both in skilled and unskilled labour.
- it steadily shows a substantial **multiplier effect** on a number of areas of the manufacturing sector, although this effect has been declining in recent years (the construction sector saw a multiplier effect with an index between **3.2 and 3.5** in 2010, but is now reported to be between **2.3 and 2.6**, both depending on the type of construction investment),
- construction projects **use a major share of raw materials and energy resources**:
  - **Extraction of construction raw materials** and minerals for the production of building materials represents more than **50% of total domestic extraction**, with some sources approaching their limits (aggregates, sand) and a growing share of imports.
  - **Buildings** are responsible for about **40% of total energy consumption** and about the same percentage of greenhouse gas emissions (mainly CO2) and solid waste production. This savings potential is addressed by the EED, RES and EPBD Directives, which aim to increase the energy efficiency of the building stock. The EPBD has been incorporated in Act No 406/2000 Coll. on Energy Management, which amends Act No 3/2020 Coll. and its implementing regulation, Decree 264/2020 Coll. on the energy performance of buildings. The EED and RES directives are also reflected in Act No 406/2000 Coll. and in the Czech Republic's National Energy and Climate Plan.
- Public procurement has a significant and irreplaceable impact on the development of building production within domestic procurement. The share in domestic procurement reached **58.8%** in 2021, when the value rose to CZK 131.9 billion.
- The Czech Republic is characterised by a high level of self help, which is reflected in a very dense network of specialized shops (Bauhaus, OBI, Baumax, Hornbach), building

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supplies, materials for garden architecture, bathroom and kitchen studios. Moreover, this area was significantly activated in the period of the Covid-19 pandemic.

- A very high level of responsibility is imposed on building contractors, which also predetermines a high **level of regulation and involvement on the part of the public administration.**

The pressure to improve the energy performance of buildings (both existing and newly constructed) has a major impact on both the production profile of the Czech construction sector and on the demands for the **qualifications of its workers** and this impact is going to be even greater in the future. The demand for energy-efficient construction, together with the general need to increase labour productivity, creates qualitatively new and quantitatively multiple demands for the development of the **education sector for the construction sector**.

Adult education will play a key role in this. This is due to the following factors:

- demographic trends, which will result in a slight increase in the number of people of secondary education age (15-19 years) by around 80, 000 by 2030, although this number will not reach the 2010 level,
- the lack of interest among young people in training for trade occupations in the building sector: the situation is currently slightly improving, but even so, only about **12,000 pupils** are being trained in all years of vocational schools (apprenticeships) focused on occupations within the construction sector. The number of graduates therefore barely covers the number of qualified construction workers retiring each year or moving to other sectors,
- It is true for construction apprenticeships and secondary vocational schools with a secondary school diploma that a significant number of their graduates leave upon graduation to work in another sector. Thus, around 40% of secondary school graduates work outside their field of study within a few years of graduation.

Primary education for the construction sector in the Czech Republic presently does not cover the balance of the needs of the construction sector with its capacities. A slight improvement of this situation by 2030 is possible from a quantitative point of view, given the current demographic development, however, primary education alone will hardly cover the new and growing qualification requirements of the Czech construction sector in the short term until 2030.

As far as adult education in the construction sector (and related professions) is concerned, it is still very fragmented in the Czech Republic with regard to content and organization. In terms of content, it promises methodological unification of the implementation of the

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National Qualifications System and the National System of Occupations. So far, however, these systems have not proved to be fully effective.

Currently, on average, only about **1/3 of all workers in the sector** receive some form of training each year, and this is often inconsistent, or only touching upon partial aspects of the profession.

The problem of adaptation of the construction sector in the Czech Republic to new challenges, including the growing demands for energy-efficient construction, is primarily related to the growth of the qualification of the skilled trades. In order to address this problem, it will be necessary to increase capacity in primary and adult education in these fields by 2030:

- Drywaller, dry installation (without wood);
- Carpenter and assembler of wooden structures;
- Carpenter (including wooden buildings);
- Bricklayer (completion works): thermal insulation, plastering, stucco;
- Low voltage electrician;
- Air conditioning technician.

In nearly all sectors, content innovation will be needed in education by 2030, and should be particularly strong in the following sectors:

- Bricklayer;
- Drywaller, dry installation (without wood);
- Plumber-heating engineer;
- Carpenter and assembler of wooden structures;
- (Builder) joiner (including wooden buildings);
- Bricklayer (completion works): thermal insulation, plastering, stucco;
- Air conditioning technician;
- Electrician;
- Building filler fitter;
- RES installer.

Although the issue of saturating the needs of the construction sector in the fields of craft work in the Czech Republic is topical and urgent, equally important, though difficult to quantify, is the issue of raising university-educated workers for (environmentally friendly)

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construction, responding to revolutionary technological changes in the field (digitalization, application of AI, etc.).

However, there are a number of **obstacles** on the way to the defined quantitative and qualitative goals of increasing the qualification profile of construction workers. The most important ones include:

- absence of a unified construction management system, including strategic management;
- poor labour productivity in the construction sector;
- pressure of companies to use unskilled workers due to labour cost savings;
- low level of management;
- low interest of young people in training in the field;
- low interest in adult education in the skilled trades (low motivation);
- unpredictability of the legislative environment.

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1. Introduction

1.1. Competences in the field of energy-efficient construction and education

In terms of competences, the area of construction, energy and energy-saving, construction sector is divided among several ministries at the level of the Government of the Czech Republic. The Ministry of Industry and Trade is responsible for building materials, construction sector, energy including energy legislation and regulation, and business environment. The Ministry of Regional Development is responsible for urban planning and building regulations, housing policy, regional development, European funds and public procurement legislation. The Ministry of the Environment provides environmental policy (including environmental impact assessments), water protection, environmental and ecological damage management, air protection, climate protection and waste issues. Its subsidy programmes most intensively support energy-saving solutions in civil and residential construction. In this context, the Ministry of Finance, which prepares draft state budgets and state fund budgets, is also important. The Ministry of the Interior then provides the education system for civil servants. The Ministry of Culture ensures the care of cultural heritage, of building monuments, which represent a significant proportion of the buildings in the historic cores of most Czech cities and towns. The Ministries of Transport and Agriculture then administer the construction of transport buildings and water management facilities. The Ministry of Education, Youth and Sports ensures the conditions for pre-school, primary, secondary and vocational education, as well as university education. The traditional education system is administered **separately from the construction industry itself and from the state's programmatic policies on construction**, which often causes the system to lag behind the needs of construction practice. The issue of lifelong learning is addressed separately. It is regulated only in the case of engineering and technical professions by Act 360/1992 Coll. on the exercise of the profession of authorized architects and on the exercise of authorized engineers and technicians active in construction, and for some vocational and trade professions including fire protection, energy audits, electrical installation work, gas installation, etc. In the case of trade professions, this issue is inconsistently ensured by the voluntary activity of professional guilds or by targeted promotion of some manufacturers of building materials and products for construction.

The practice gradually brings new requirements for knowledge and skills, especially the expected changes related to the quality requirements of work with new products, technologies, design solutions. To quantify these requirements and to define the requirements for the training of workers in the building and construction sector is one of the basic tasks of this SQA. 2.

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1.2. Ongoing and expected changes

Not only the Czech construction sector but also the European one is at a crossroads. The current lack of production capacity, the disruption of supply chains, the unaffordability of housing for the young and the generally slow response to technological and social change are just some of the trends that are creating pressure for an accelerated **transformation of the construction sector**. This sector, which directly employs more than 13 million workers in the EU, is also one of the key sectors in the fight against climate change. If the construction sector is to retain its important position in society and the economy, it must undergo structural change across the entire value chain, with a focus on increasing labour productivity, speeding up the construction process and making the sector more attractive to recruit new workers.

The sector has to deal with several challenges at the same moment. First, it needs to replace the missing workers in the industry and simultaneously improve the attractiveness of the sector. Furthermore, in the area of energy savings, the construction sector will implement comprehensive renovations of our housing stock – the key to increasing energy performance of buildings in the Czech Republic. In addtion, the construction sector must prepare for the increasingly rapid evolution of technology and a stronger perception of the carbon footprint of products, all the way through the manufacturing and supply chain to on-site installation.

The transformation will take place in the current and next decade and will lead to profound structural changes in the sector, to the decline of some trades and the creation of entirely new attractive positions. This will result in an increase in the share of industrial production and automation in the sector, as well as an increase in standardization and the use of the principles of typification of structural and functional parts of buildings using AI and robotics.

Apart from listed buildings and buildings of great cultural value, the renovation of existing buildings and especially new buildings will be subject to pressure to introduce new construction methods.

The most crucial starting point for the transformation of the construction sector will be digitalization, “industrialization“ of the sector and adaptation to a changing ecosystem. Modularization, reinforced capacities for the production of construction products, artificial intelligence in production planning and logistics, which we already know from the automotive industry, for example, will change the construction sector in several aspects. The need for **digital literacy** in the construction professions with regard to working within a digital model of construction and its blending with reality will increase significantly. Increasingly, specializations of workers within the creation and use of the digital construction model are emerging. From these, as yet non-existent professions will be recruited to preserve and disseminate information throughout the construction lifecycle.

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The construction sector will see the rise of very high value-added positions related to the digital transformation in the sector and the repeatability of the outputs produced. At the same time, the appropriate adaptation of construction legislation and permitting processes will be a prerequisite and necessity.

2. Objectives and methodology

The aim of the present National Analysis of the current state of the art was to document the legislative conditions, the management environment of the entire construction sector (including human resources management), to evaluate the effectiveness of the individual education systems and levels, based on the assessment of the statistical data available and available forecasts and studies addressing particular partial issues, to synthesize this knowledge and formulate theses and requirements and then to verify these conclusions at a meeting with representatives of the sector (national qualification platform).

As the team of authors consisted of experts from several organizations, it was possible on the one hand to cover a relatively broad view of the addressed issue, on the other hand, it was necessary to unify the starting positions, methods of evaluation and comparison of sometimes inconsistent input data in a series of steps. An important aspect was to compare the information obtained with the knowledge and state of construction practice (through the Czech Construction Needs Survey) and with the prediction of its economic and technological development until 2030, or for a longer period of time.

The evaluation of the fulfilment of the 1st National Roadmap of Build Up Skills (2013) was also a rich source of knowledge, both in terms of the substantive fulfilment of the set objectives and the effectiveness of their implementation.

The current state and education of individual construction participants and construction professions ensuring the implementation of construction is ensured in the Czech Republic by a number of traditional tools, legislative regulations, practices and a number of organizations are involved in it. Nevertheless, there is no unified system, nor is there a clearly defined responsibility for its implementation, which would allow to provide the necessary preparation for practical implementation of knowledge and skills needed for the implementation of Directive 2010/31/EU of 19 May 2010 on the energy performance of buildings in the construction practice in the Czech Republic in the time and quality required.

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This situation is particularly difficult in the preparation and retraining of the persons who carry out and secure the construction. Therefore, the team of authors focused on the following issues:

1) Analysis of individual roles, functions on the construction site defining their responsibilities and existing requirements for their training and lifelong learning,

2) Analysis of individual construction professions, trades that provide the actual construction, installation of products and technologies in relation to energy-efficient construction,

3) An analysis of the capacity of existing facilities providing basic vocational training and the requirements for its verification and their capacity and readiness to provide new training requirements

4) Analysis of the capacities of existing facilities for holistic vocational training, providing both the updating of professional knowledge and the necessary retraining, the level of their equipment to ensure the new requirements resulting from the implementation of energy-efficient building directives,

5) Analysis of the construction market in terms of its size and perspective and the need for human resources to ensure the required transition to new technologies and new products needed for the construction, but also to ensure the operation of energy-efficient buildings.

The authors based this work on their own experience and previous studies. In addition, analytical materials on the development of the construction sector prepared mainly by the Ministry of Industry and Trade were used. The analysis also benefited from available information sources on the Internet, outputs of the Czech Statistical Office, printed materials and interviews with relevant staff of professional associations, chambers and central authorities of the Czech Republic. At the same time, it should be noted that in a number of areas (e.g. secondary and apprenticeship education for the construction sector) the availability of data for a reliable analysis of the above-mentioned issues has significantly deteriorated in the Czech Republic.

Another example (among many) is the virtual absence of data on renovation rates, which is alarming, especially for the housing stock (where we otherwise have a wide range of information). The commonly quoted rate of renovation of the housing stock of more than 1% per year is therefore only an educated guess.

The work on the analysis itself was conducted in the form of teamwork, in several gradually specifying steps. After the initial definition of the work procedure and the objectives to be

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achieved, the selection of background material, documents and papers was carried out by the individual authors and the partial sectoral theses were established, after which this material was consolidated in successive steps into the present form of the SQA draft. Emphasis was placed on gaining inspiration for the subsequent work on the new national Roadmap. A significant role was played here by defining the barriers (both material and systemic) to the successful adaptation of the qualification structure of the construction sector and the education system to the new economic and especially energy and environmental conditions.

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3. National policies and strategies to contribute to the EU's 2030 energy targets in buildings

3.1. A basic strategic framework for energy-efficient buildings

The Czech Republic does not have a separate sectoral strategy for the development of the building sector. However, tasks for the (green) construction sector are contained in a number of other official documents.

The National Energy and Climate Plan of the Czech Republic is the basis for the energy policy of the Czech Republic and the outline for the implementation of the objectives of the Green Deal in the field of energy savings, use of RES and environmental protection. The National Plan of the Czech Republic was developed on the basis of the requirements of Regulation (EU) 2018/1999 of the European Parliament and of the Council on the governance of the Energy Union and climate action.

On 13 January 2020, the document was approved by the Government of the Czech Republic. The document contains objectives and main policies in all five dimensions of the so-called Energy Union. Through this document, Member States are obliged, among other things, to inform the European Commission of their national contribution to the approved European targets in the areas of greenhouse gas emissions, renewable energy sources, energy efficiency and electricity and transmission system interconnectivity.[1]

State Energy Policy – on 18 May 2015, the Government of the Czech Republic approved the updated State Energy Policy for the next 25 years. The State Energy Policy identifies five strategic priorities to contribute to the fulfilment of the key objectives. These priorities include: A balanced mix of primary energy sources and sources of electricity production based on their broad portfolio, efficient use of all available domestic energy sources, maintaining the EC's surplus power balance with sufficient reserves and maintaining available strategic reserves of domestic forms of energy; increasing the energy efficiency of the national economy; developing the Czech Republic's network infrastructure in the context of Central European countries, enhancing international cooperation and integration of the electricity and gas markets in the region, including support for the creation of an effective and operational common EU energy policy; support of research, development and innovation to ensure the competitiveness of the Czech energy sector and support of education, with the aim of the need for generational change and improving the quality of technical intelligence in the energy sector; and, last but not least, enhancing the energy

[1] https://www.mpo.cz/cz/energetika/strategicke-a-koncepcni-dokumenty/vnitrostatni-plan-ceske-republiky-v-oblasti-energetiky-a-klimatu--252016/

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security and resilience of the Czech Republic and strengthening the ability to ensure the necessary energy supply in cases of cumulative failures, multiple attacks against critical infrastructure and in cases of prolonged fuel supply crises.[2]

The Ministry of Industry and Trade evaluates the implementation of the State Energy Policy (SEP) at least once in every 5 years. The aim of the evaluation is to assess the degree of implementation and the validity of the SEP of the Czech Republic on the basis of quantitative and qualitative information. The evaluation is then also the foundation for a possible update of the State Energy Policy.

The overarching strategic document of environmental protection is the **State Environmental Policy of the Czech Republic 2030** with a view to 2050 (SEP 2030)[3]. It addresses the issue of environmental protection in its full scope and sets the strategic direction, i.e. objectives, until 2030. Cross-cutting measures to increase energy efficiency are integrated in this context. Key measures include increasing the energy performance of buildings, achieving energy savings in heating, promoting an increase in the share of high-efficiency combined heat and power and efficient heat supply systems, increasing energy performance and enhancing the share of energy-efficient street lighting.

The climate protection policy in the Czech Republic [4] defines the main objectives and measures in the field of climate protection at the national level to ensure that the targets for reducing greenhouse gas emissions are met in relation to the obligations arising from international agreements (the UN Framework Convention on Climate Change and its Kyoto Protocol, the Paris Agreement and obligations arising from EU legislation). This climate protection strategy focuses on the period 2017 to 2030, with a view to 2050, and should thus contribute to the long-term transition to a sustainable low-emission economy in the Czech Republic.

The Climate Change Policy contains a total of 41 measures, ranging from cross-cutting themes and policies, to sectoral measures, research and development, monitoring and actions on international climate protection and development cooperation.

To implement the above strategies, the **Long-term Building Renovation Strategy**[5] to support the renovation of the national stock of residential and non-residential buildings, both public and private, has been developed based on the requirements of Directive 2010/31/EU of the

[2] https://www.mpo.cz/assets/dokumenty/52841/60959/636207/priloha006.pdf

[3] https://www.mzp.cz/C1257458002F0DC7/cz/statni_politika_zivotniho_prostredi/$FILE/OPZPUR-statni_politika_zp_2030_s_vyhledem_2050-20220615.pdf

[4] https://www.mzp.cz/cz/politika_ochrany_klimatu_2017

[5] https://www.mpo.cz/assets/cz/energetika/energeticka-ucinnost/strategicke-dokumenty/2020/6/_20_III_dlouhodoba_strategie_renovaci_20200520_schvalene.pdf

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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.

The strategy includes an assessment of the building stock in the Czech Republic in the residential and non-residential sectors, a methodology for determining energy savings for modelling building renovation scenarios, scenarios of possible development of building stock renovation with indicative milestones for 2030, 2040 and 2050, the choice of a building renovation development scenario to be implemented by the Czech Republic in the following period, an assessment of barriers in the residential, private and public sectors and the Czech Republic's strategy to support the implementation of the optimal scenario. For the practical application of this strategy, see Section 3.6.

3.2. Predicted contribution of the construction sector to the 2030 targets

As part of the National Energy and Climate Plan, scenarios for setting building renovation milestones by 2050 have been proposed, based on an analysis of the current state of the building stock, building renovation policy and its effect on increasing the energy performance of the Czech building stock.

The current development of building stock renovation (BAU scenario) reflects the current situation on the market. The modelling of this scenario is based on data available from the Czech Statistical Office and the Ministry of Industry and Trade. It is a scenario that takes into account the effect of the state's policy on increasing the energy performance of buildings.

The BAU scenario is based on the already implemented measures that contributed to the renovation of the building stock in the period 2014-2020 and to the assumption that the set renovation rate and depth of renovation, including other input factors, will continue in line with the current trend.

The set values for the renovation rate, final energy consumption and renovation "depth" determine the setting of the Real Scenario, assuming greater government intervention by 2030 and targeting fiscal and legislative measures to shift the renovation "depth".

Based on data from the National Energy and Climate Plan, the following developments in the building stock renovation up to 2030 can be assumed in a simplified way, taking into account the contribution of the building sector in achieving the 2030 climate and energy targets:

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Table 1: Final energy consumption savings in a given year and cumulative investment costs

For the period 2021-2030	Basic	Realistic scenario
Savings in final energy consumption over the period [PJ]	-23	-29
Family houses	*-11*	*-13*
Apartment buildings	*-5*	*-5*
Public and commercial buildings	*-7*	*-11*
Cumulative investment costs [CZK billion]	*218*	*262*
Family houses	*113*	*120*
Apartment buildings	*30*	*33*
Public and commercial buildings	*75*	*109*

Source: MIT for the purposes of the National plan

4. Key data on construction and energy

4.1. Overall performance of the construction sector

Gross value added (GVA) of the construction sector at current prices, i.e. the value newly created beyond input costs (reflecting the capacity of the sector), after a slight decrease in 2020, has returned to growth in 2021, increasing by 5.9% in year-on-year comparison at current prices. The share of construction in the GVA of the whole national economy has been between 5% and 6% over the long term, and in 2021 this share was 5.59%. This value is practically in line with the EU average (27 countries).

However, gross value added in constant 2015 prices in the construction sector continued to decline in 2021, well below the level of 2018. In fact, it has declined every year since then, most notably in 2020. In this respect, the construction sector has confirmed its characteristic of high sensitivity to economic and socio-political developments: over the 15 years between 2007 and 2021 (inclusive), 7 years of year-on-year decline, 7 years of growth and 1 year of stagnation were recorded.

The structural problem of lack of capacities in the construction sector is well illustrated by its macroeconomic position. Between 2011 and 2013, the construction sector suffered a deep crisis. In a delayed response to the shock of the so-called Great Recession of 2009, the

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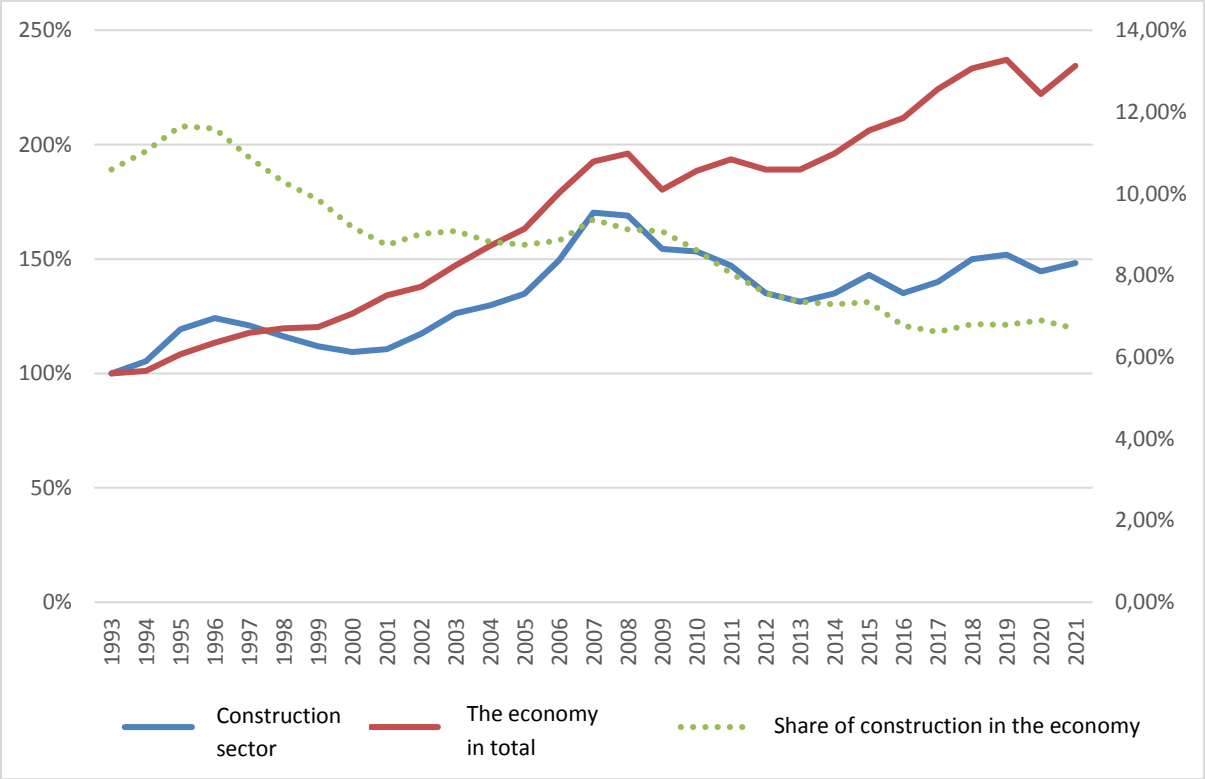
construction sector declined by 10% between 2011 and 2013. The plunge in the construction sector was relatively larger than that of the economy as a whole and, unlike the overall performance, the sector failed to return to the performance of the boom peak in 2007 and 2008. **As a result, the capacity of the construction sector has been irreversibly reduced.** A number of workers and firms have left the sector and have not returned, and its capital position has similarly weakened.

Figure 1: GDP of the economy and construction sector in constant prices 2015, year 2008 = 100%



Source: CZSO, National Accounts Database, GDP Production Method, available at: https://apl.czso.cz/pll/rocenka/rocenkavyber.makroek_prod

Main construction works (according to the supply contracts) express the total value of its own construction activities performed by the reporting unit on the basis of a supply contract for the end user (the builder), including the value of any subcontracting of construction work[6]. In 2021, companies carried out construction works worth CZK 580 billion,

[6] The indicator is statistically monitored in the CZ-CPA commodity classification and differs from the sales of services as these are classified according to the predominant economic CZ-NACE activity. Companies classified in section F of the construction sector according to CZNACE include in their services also activities that fall outside construction work, e.g. developer activities, transport, etc. In contrast, main construction works according to the CZ-CPA commodity breakdown is monitored for all enterprises, i.e. also for enterprises

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representing a year-on-year growth by 8.3% (in current prices). After 2021, when the construction sector was adversely affected by the coronavirus pandemic, construction companies are finding it difficult to return to a normal course, as they have been hampered in particular by a sharp rise in prices – on average, construction prices rose by 5.1% in 2021. However, material price rises have also been accompanied by material shortages, leaving the construction sector to cope with extended delivery times and ongoing labour shortages.

In domestic construction works, civil engineering occupies the largest section of new construction, with a total investment of CZK 170 billion in 2021. Thus, civil engineering construction accounted for roughly one third of domestic new construction and was up by 2.3% year-on-year. The fastest year-on-year growth in 2021 was achieved by the construction of residential buildings driven by high demand, when they increased by 36.3% year-on-year, thus increasing their share in domestic new construction. Construction of non-residential manufacturing buildings also achieved significant growth, as construction work on non-residential non-manufacturing buildings and water management structures declined year-on-year. **Approximately one-quarter of the construction work in the long term is on repair and maintenance.** The share of repair and maintenance was highest in 2016 (28.8% of domestic construction work) and has declined since then (to a 23.1% share in 2021). Year-on-year, it increased by 2.4% in 2021.

Table 2: Domestic main construction works in current prices (CZK million)

	2013	2014	2015	2016	2017	2018	2019	2020	2021
Residential buildings	43 690	46 344	51 603	57 574	59 791	73 689	78 971	73 835	100 662
Non-residential non-manufacturing buildings	55 079	59 811	56 185	42 645	48 462	73 143	78 006	74 586	73 000
Non-residential manufacturing buildings	58 630	60 615	62 155	71 171	88 662	88 428	91 860	76 139	88 180
Civil engineering buildings	119 423	130 563	151 693	117 927	114 584	123 517	145 921	166 219	170 097
Water management buildings	6 928	5 242	4 704	2 980	2 937	3 881	4 810	4 466	4 274
Repairs and maintenance	103 838	114 438	119 764	118 422	123 105	124 867	125 315	127 919	131 004
Domestic total	387 588	417 013	446 104	410 719	437 542	487 526	524 883	523 164	567 217

Source: CSO data

classified in CZ-NACE other than construction, e.g. agricultural enterprises have construction production but the predominant economic activity is agriculture. The values of sales of services and main construction works cannot coincide given the above. Both sets (sales of services CZ-NACE F and main construction works CZ-CPA construction manufacturing) are for enterprises with 0 employees and more.

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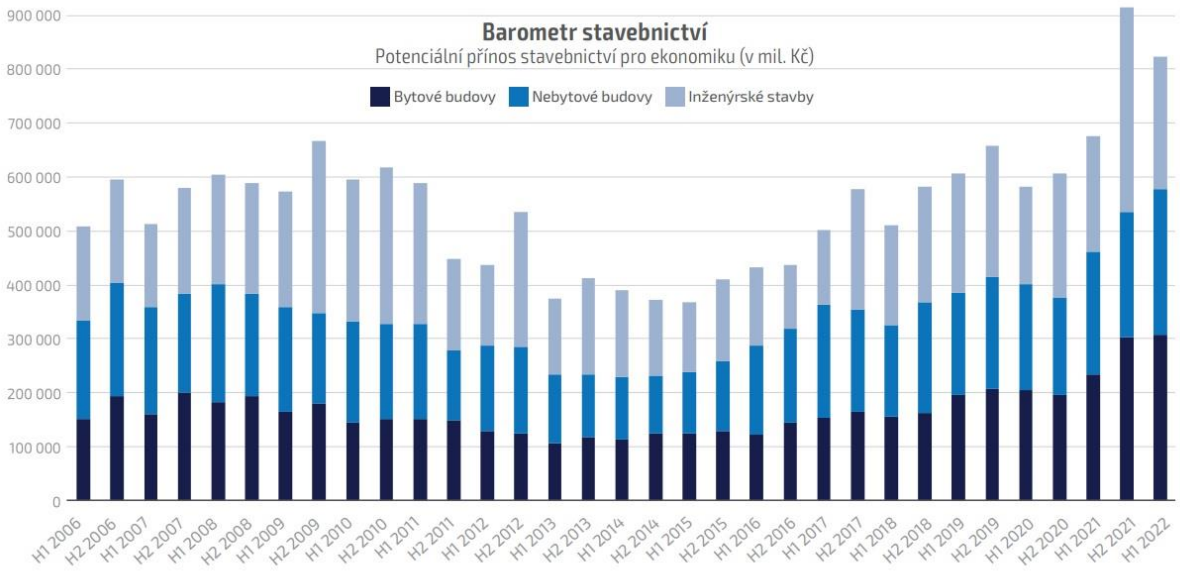
4.2. 4.2. Current state and forecast of the construction market

The construction works permitted in the second half of 2022 have the potential to bring more than CZK 823 billion to the Czech economy. Compared to the previous half-year with a possible contribution of CZK 916 billion, this is a roughly 10% decrease. The "driving force" of the construction sector is now becoming residential construction. In the previous period, the largest potential contribution to the economy was – as mentioned – civil engineering.

The decline in value compared to the second half of 2021 is mainly due to a decline in the value of building permits for civil engineering constructions. This has fallen by 35% compared to the record value in the second half of 2021, mainly due to transport construction, where the value of building permits fell by more than half compared to the previous half-year (-53.5%). Even so, the estimated total contribution of civil engineering is still above the average of previous years.

Figure 2: Construction Barometer

(Graph: Potential contribution of the construction sector to the economy (in CZK mil); Residential buildings, Non-residential buildings; Civil engineering constructions)



The construction sector continues to face huge uncertainty due to unprecedented rises in the price of building materials, labour shortages and, more recently, rocketing energy prices. These circumstances are further exacerbated by very expensive loans (the CNB base rate has increased from 0.25% to the current 7% in one year), which fundamentally complicate financing for most companies and the use of mortgages.

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Construction prices are rising significantly and often the implementation period is extended. A number of constructions (public and private) are now being suspended or postponed.

Home building costs are rising, but at the same time, sales are slowing and sales price growth is slowing. This is mainly due to the postponement of purchases of flats by those interested in mortgages, whose interest rates are roughly three times higher than last year. Rents, on the other hand, continue to rise.

As for the prospects for the near future, the situation in the construction sector will continue to be very uncertain and the whole sector is very likely to experience a significant downturn. This will be in terms of reduced investment by both the public and private sectors. The key to future developments not only in the construction sector but also in other sectors will be the extent to which the problem of rocketing energy prices and the risk of supply constraints can be resolved.

4.3. Housing stock and its energy performance

New housing construction is only very slowly changing the overall volume and quality structure of the existing residential and housing stock. Its extent is monitored by the Czech Statistical Office as part of the statistical survey 'Census of Population, Houses and Flats' (CPHF). The census is carried out every ten years. The last two were carried out in 2011 and 2021.

Table 3: Comparison of the increase in the number of houses between 2011 and 2021

Source	Number of houses	Number of Occupied Houses	Family houses	Apartment houses	Other buildings
CPHF **2011**	2 158 119	1 800 075	1 554 794	211 252	34 029
CPHF 2021	2 317 276	1 952 668	1 709 845	207 540	35 283
Increase in number	159 157	152 593	155 051	-3 712	1 254
Increase in %	6,87%	7,81%	9,07%	-1,79%	3,55%

Sources: (CSO, 2022)

It is all the more important to monitor the growth of the energy standard of buildings in new constructions (including renovations). Statistics on completed houses and flats categorized

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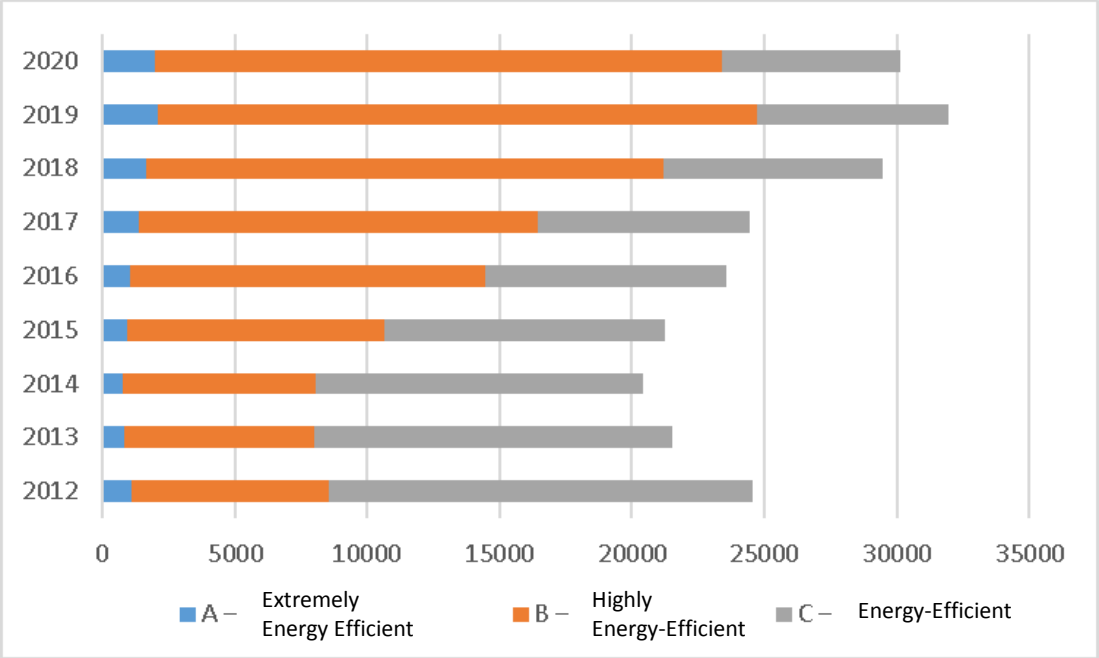
according to the energy standard achieved on the basis of certification according to Decree 78/2013 Coll. on the energy performance of buildings is a useful indicator.

Graph 6: Development of house construction in terms of energy efficiency



Source: SEVEn, based on CSO data

The presented graph clearly shows that a minimum number of apartment and family houses in energy class A are being built so far (on average 145 flats/year in the period 2012-2020).

Most houses, both apartment and family houses, are now being built in category B, while at the same time a significant shift from worse to better energy categories can be seen over the years. The trend towards better energy categories can be expected to continue in the coming years, especially in response to gradually increasing energy efficiency requirements and technological advances.

Table 4: Annual rate and depth of renovation in the Czech Republic in the period 2014–2018

	Residential sector		Non-residential sector	
	Family houses	Apartment houses	Public buildings	Commercial buildings
Renorate	1.40%	0.79%	1.40%	
Renovation depth*				
Shallow (D, E, F, G)	35.0%	31.1%	28.08%	26.13%
Medium (C)	45.0%	49.6%	41.03%	44.67%
Thorough (A, B)	20.0%	19.3%	30.90%	29.21%

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* Weighted average for apartment buildings

Source: (MIT, 2020)

The definition of thorough renovation is not entirely consistent with the EC's use of the term deep energy renovation. A thorough renovation represents an achieved standard rather than a level of improvement.

4.4. Energy consumption and renewable energy in buildings

Table 5: Final energy consumption in households between 2014–2020, PJ

Year	2014	2015	2016	2017	2018	2019
PJ	274.41	283.43	296.85	301.57	294.86	293.36

Source: (Eurostat, 2021)

The largest share, 30% of the total final energy consumption in the Czech Republic, is consumed by households, i.e. family houses and apartment buildings. Household final consumption represents the amount of energy needed to meet the energy needs associated with the use of the building, mainly for heating, cooling, ventilation, humidity control, hot water and lighting, but also includes the consumption of household appliances. The primary share of final consumption in households is used for heating, which accounts for more than 69% of final energy consumption (MIT, 2020).

Between 2010 and 2019, total annual household final energy consumption fell by 'only' 6%. This is due to an increase in household living standards and an increase in the number of households. On the other hand, the average annual final energy consumption per individual household has decreased by 12%, which means that there is an overall improvement in the energy efficiency of housing. The average annual final energy consumption per person decreased by 6.3% from 30.35 GJ to 28.45 GJ.

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5. Current situation in the field of education and training

5.1. Labour market –- workforce and its qualifications

The construction sector differs significantly from other manufacturing sectors in terms of the nature of the work, the technologies used, the changing conditions of the site and the type of construction. In a number of aspects it is not comparable to any other industrial activity. Although new technologies, machines, materials and processes reduce the physical demands of work and increase its productivity, the basic nature of the activities, and thus the requirements for the professional structure of the staff, remain essentially unchanged or change slowly. The construction sector will continue to be (at least for the foreseeable future) a sector heavily dependent on skilled manual labour.

As regards the requirements of the construction sector in terms of securing the workforce, **the situation is** steadily **deteriorating**. The average age of the employees is constantly and disturbingly increasing (now about 45 years). In the manual worker occupational group (craft trades), the situation is downright alarming. The first prerequisite for changing the unfavourable trend in the development of the age structure is an increase in the number of **young people entering the profession**. It is therefore a matter of adapting primary education institutions, from apprenticeships to universities, to the demands of the construction sector. The second prerequisite is the development of a **lifelong learning** system, where the growth or change of qualifications among adult employees is at stake – again in relation to the changing demand of construction companies.

5.2. Primary education

After many years of a decline in interest in construction disciplines, related not only to their low attractiveness but also to negative demographic development, interest in construction fields in secondary schools has increased over the past four years. Between 2018 and 2021, the number of new enrolments in them grew from 4,324 to 5,344, and their share rose from 5.6 to 6.2 per cent of all secondary school enrolments. The increase even exceeds population growth. Statistics from the Ministry of Education show that the number of entrants to the first year of secondary school rose by about 10 per cent between 2018 and 2021. The construction trades are up by about 24 percent!

The growth in interest in construction is particularly true for apprenticeship courses! The proportion of new apprentices in them has risen from 7.5 per cent since 2017 to 9.4 per cent of pupils entering their first year last year. By contrast, the proportion of new entrants in school-leaving certificate programmes rose as early as 2016 to 2018 and has rather stagnated in recent years. New entrants in the high-school-leaving certificate construction majors accounted for about 5.1 percent of all freshmen last year.

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The relatively significant increase in pupils entering construction training courses is not only influenced by long-term support and promotion, but also in the last two years by a drop in the availability of jobs in the gastronomy sector, in which a long-term decline in interest has been reinforced due to the Covid-19 pandemic. The impact of the pandemic can probably explain the spike in 2020, when the proportion of new entrants in secondary school-leaving exam construction courses rose from 5.1 to 5.5 per cent.

Building apprenticeship courses are taught in 140 schools in the Czech Republic and school-leaving certificate courses in 51 schools. The most popular apprenticeship courses include mechanic of gas equipment, plumber, floor layer and bricklayer, while the most favourite school-leaving certificate courses are construction, geodesy, and land registry. On the other hand, there is little interest in the glazier, roofing and tiling apprenticeships. In recent years, tinsmith, water supply and sewerage installer, or pipe fitter have not even opened due to a lack of applicants. There is also very little interest in the school-leaving certificate course focused on building materials.

Table 6: Development of the number of new enrolments in construction fields in secondary schools:

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Number of new entrants to the construction courses	5788	5417	4741	4309	4283	4114	4324	4687	5126	5344
Proportion of all secondary school enrolments	7,3%	6,9%	6,1%	5,6%	5,6%	5,4%	5,6%	5,9%	6,3%	6,2%

Source: NPI

Table 7: Development of the number of new enrolments in the construction apprenticeship courses:

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Number of entrants to the construction apprenticeship courses	3577	3327	2773	2443	2371	2198	2259	2496	2656	2830
Percentage of total enrolments in apprenticeship courses	10,8%	10,5%	8,9%	8,1%	8,1%	7,5%	7,7%	8,1%	8,7%	9,4%

Source: NPI

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Table 8: Development of the number of new enrolments to secondary construction schools with school leaving examination courses:

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
The number of entrants to secondary construction schools with school leaving examination courses	2211	2090	1968	1866	1912	1916	2065	2191	2470	2514
Percentage of all students enrolled in school leaving examination courses	5,5%	5,2%	4,9%	4,6%	4,7%	4,7%	5,0%	5,1%	5,5%	5,1%

Source: NPI

As far as education for (modern) construction is concerned, the situation is differentiated according to the different levels of the education system. This can be summarised in the following brief characteristics:

University graduates

In this case, it can be stated that in terms of the demand-supply ratio for the labour force of the construction sector, university graduates represent relatively the least problematic group. Nevertheless, the impact of the long-standing shortage of candidates for studies at construction faculties is increasingly being felt. This is a result of the overall low popularity of technical disciplines and the low prestige of construction as a field of practical employment. There is also a problem in terms of the qualification profile of graduates. To ensure comprehensive education of students, it will be necessary to increase the proportion of training in economic disciplines, the minimum foundations of legal thinking (especially in the fields of administrative and commercial law), staff management skills, construction organization, project management, etc.

Graduates of secondary vocational (technical) schools

For this group of graduates, likewise, quality, not quantity, is the key issue. Here, too, it is necessary to focus more on the acquiring of theoretical (ICT) as well as practical skills (that can be both used in future practice) with greater depth of knowledge, and at the same time to increase knowledge in the area of working with people. As the acquisition of practical experience must be an essential part of the training in this field of secondary education, this requires a greater involvement of specialists from the field and the related active participation of business entities. As for the numbers of graduates of these schools per se, they are nominally sufficient; the problem is that about 40% of them seek employment outside their field of study within a few years of entering practice.

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Graduates of vocational schools

Securing of craft occupations for the construction sector is perceived as a major long-term (yet acute) problem of the construction labour market. Despite positive changes over the past 5 years or so, there is no reason for optimism.

There are currently 140 vocational schools teaching the construction trades. The network of vocational schools and their territorial distribution is sufficient. However, the total number of applicants for apprenticeships is so low that the capacity of the schools is mostly not used, classes of pupils with different qualifications are combined and some courses are not open at all in the year concerned. Funding is also a problem for the operation of schools, both in terms of methodology and volume. There are no funds left for the measures that need to be taken, especially for the technical equipment of vocational classrooms. Not renewing the equipment for a long time affects the quality of teaching, and it also has an effect on parents and children at open day events.

In addition, construction apprenticeships are often taken up by pupils with low study skills and low motivation to work. Therefore, the apprenticeship system can be reformed by intensively involving construction entrepreneurs in the training of apprentices by improving the quality of teaching, which, in addition to professional readiness, will also stimulate a lasting interest in working in the construction sector.

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6. Relevant construction skills projects

6.1. National Plan 2013

In 2013, the National plan for education in the construction sector towards Nearly Zero Energy Buildings[7] was developed, which included a proposal for measures to increase the number of qualified construction workers.

The document of the first National Plan contained specific activities that were intended to lead to the desired state of knowledge and skills of construction workers of different occupations. The measures adopted in the National Plan were aimed at ensuring an increase in the number of skilled workers who would be prepared and trained to carry out the conversion of completed buildings with poor energy performance into energy-efficient buildings, as well as for the construction of new buildings with almost zero energy consumption. **The projects included in the 1st National Plan can therefore rightly be considered relevant and have been assessed as such.**

For this analysis, the evaluation criteria for each measure were first established: relevance, coherence, effectiveness, efficiency, impact, and sustainability. According to these criteria, both the measures of the Action Plan and the financial instruments were evaluated, and the comparison resulted in recommendations for the development of the new National Plan of the Czech Republic.

During the implementation of the measures of the first National Plan, **the target for the number of educated staff and presentations/trainings was not sufficiently met.** For the new Action Plan, there is a need to focus more not only on the development of study materials but to use more financial resources to conduct training courses and trainings. There is also a need to focus more on awareness raising on the issue of construction of nZEB buildings and to try to involve not only public and educational institutions more, but also to involve private construction companies in education, which employ a significant proportion of the workers who will be active in the construction process in the next ten years.

6.2. Recommendations for the development of the new National Plan

- Expand the topics of the National Plan for Education in Construction to include the current goals and areas of the Green Deal and the EU Taxonomy: **Climate Change**

[7] http://archiv.sps.cz/RDS/_PDFDoc_2013/BUILD-UP-Skills-roadmap-V14-12-7-2013.pdf

Adaptation, Water, Circular Economy, Pollution Prevention, Biodiversity, Social Sustainability and Just Transition

- In addition, include the following target groups: **vocational schools, universities of civil engineering, public investors, corporate investors and private investors, architects, planners, universities of architecture.**
- Like the first national plan, the new one should **incorporate specified measures** that reflect the focus of its action plan. Their selection should be determined on the basis of the outcome of the project team´s discussion. Each measure should specify a detailed description of the measure and the identification of its objectives; the objectives should ideally be specified using the **S.M.A.R.T. method**.
- **Setting the measure of the target number of educated persons in each target group,** as well as **the courses in which these numbers of persons will be educated** and the institution responsible for achieving the number of educated persons**.** It is also appropriate to establish **criteria for monitoring the behavioural change of these people.**
- **For the financial instruments, the new National Plan should include specific recommendations for the institutions coordinating the operational programmes** to ensure that the programmes are attractive to the relevant target groups and at the same time meet the objectives of the National Plan**.**
- It is necessary to focus on **graphic quality, clarity and resourcing** to make the document attractive and understandable.
- Once completed, the National Plan for Education in Construction needs to be further **disseminated and promoted**, both among partner institutions, ministries and public institutions, and among the wider professional community: companies, consulting organizations, NGOs, universities, schools and others.

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7. Skills gaps between the current situation and needs by 2030

7.1. Predicting construction needs in 2030 and beyond

7.1.1. New roles for the workforce

Current changes in the Czech construction sector (among others due to the need for sustainable construction and the need to increase labour productivity) significantly complicate the possibility of **accurate estimation** of labour requirements in the construction sector, both in terms of numbers and qualification structure. It is true that the constant shortage of workforce in the Czech construction sector, due to the low attractiveness of this sector (in terms of remuneration and working environment) in competition with other sectors, can only be solved by digitalization of the construction sector, or the introduction of other modern technical and technological changes in the process of preparation, construction and management of buildings and networks. This modernization, which is also closely related to the requirement for energy-efficient construction, therefore places completely new demands on the number and qualification of the workforce, and therefore also on their training. It is, however, difficult to formulate (and quantify) these demands, as they are still rather theoretically suspected and are currently mentioned only marginally by construction companies and investors. The "pressure from below" is thus mainly in the demand for **traditional construction trades**, as can be seen from the Survey of Construction Needs (see Chapter 7.2.)

This call "from below" has a rational foundation. Indeed, in the Czech context, there is a long-term shortage of craft professions, ageing of the workers and a slow "inflow" of workers from primary education institutions. The solution may be to increase the proportion of retrained workers and those entering craft roles using sophisticated technologies and increasingly demanding equipment as technology advances. Meanwhile, secondary and further education has repeatedly noted less interest from applicants in technical fields.

The construction in the Czech Republic will not be possible by 2030 without additional sources of craft professions. Ensuring sufficient numbers of craftspeople has a strategic dimension: the requirements for increased renovation of the existing housing stock (including listed buildings), together with the requirements for increased energy efficiency of renovated buildings, will continue to place great demands on quality craftsmanship in the future, and thus on the number and especially the quality (or appropriate structure) of craftspeople in the construction sector.

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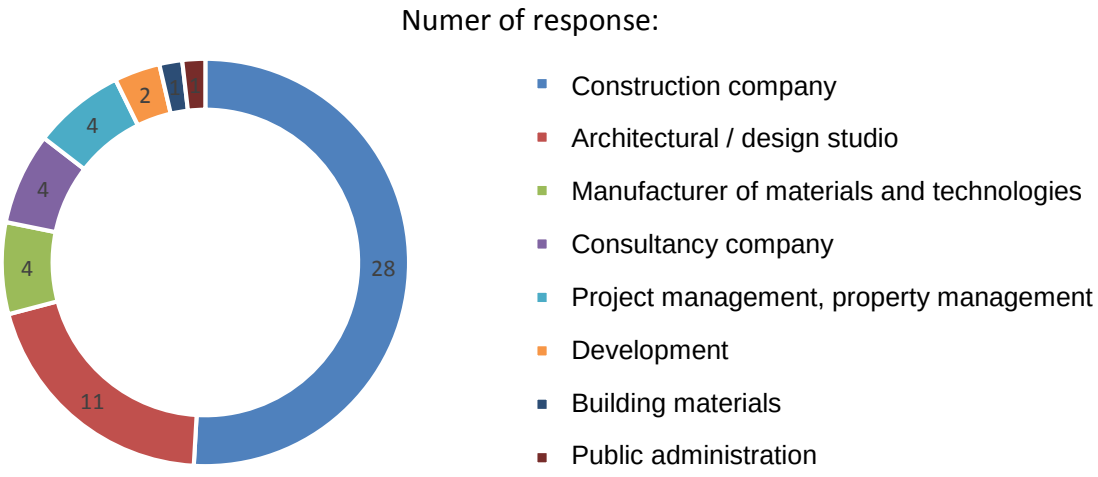
7.2. Evaluation of the survey Identification of companies' needs in terms of professional skills

Figure 3: Distribution of survey respondents



7.2.1. Questions and answers

1. **Do you sense a shortage of skilled workers in your company?**

Conclusion: the vast majority of respondents experience a shortage of skilled workers, with some stating that this is a long-term problem (5+ years) and see no sign of change in the near future.

2. **If so, is it more a lack of theoretical knowledge or practical skills?**

Conclusion: the vast majority of respondents, in line with question 1, see both a lack of theoretical knowledge and practical skills among workers. The demand for practical experience is slightly more prevalent. The depth of the problem is captured by the frequent mention of an overall shortage of workers, regardless of qualifications and experience.

3. **Which professions do you lack in your company/subcontractors?**

The most frequently mentioned absent positions are bricklayer (16x), carpenter (12x), construction manager (10x), electrician (9x), construction worker (8x), preparer (8x).

The positions of foreman, HVAC installer, tinsmith, budgeter, driver, heating engineer, locksmith, welder are mentioned several times (3 to 5 times).

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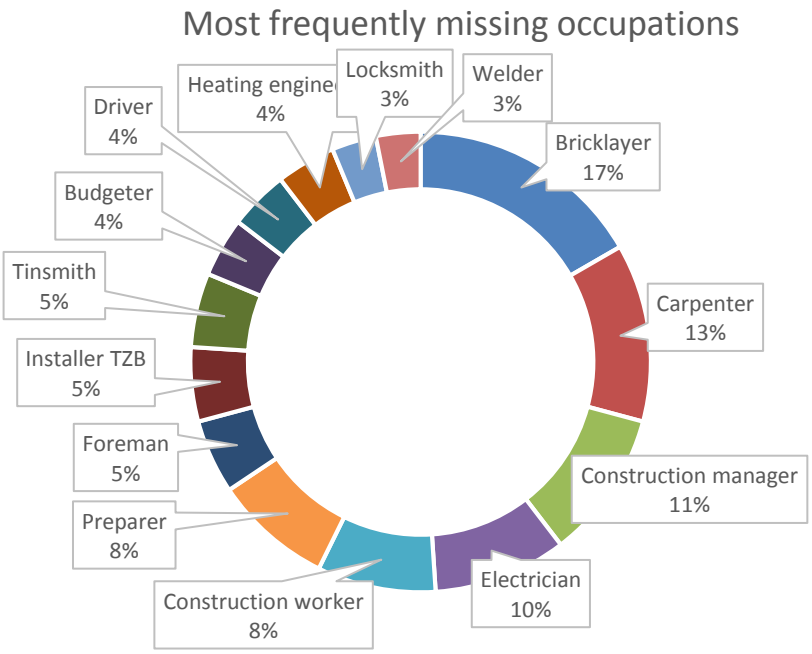
This is followed by the mention of many professions (at least 1 occurrence) that cover basically the whole range of construction activities, including drywallers, plasterers, facade builders, tile setters, insulators, roofers, plumbers.

Specific reference is made to the critical situation in the artistic trades covering the restoration of historical monuments, i.e. stonemasons, plasterers and metalworkers.

Figure 4: Missing occupations



4. How do you deal with the situation? I.e. what technologies, products, and methods do you use to improve efficiency?

Conclusion: The long-term nature of the problem is indicated by the considerable scepticism of several respondents. Subcontracting solutions prevail. As a result, this does not solve the lack of qualified people on the market, but only shifts the problem elsewhere (to other companies). This ultimately affects the customer both in terms of quality of work and meeting deadlines, and e.g. responses to warranties.

Minimum of respondents have their own systematic solution, they react to the situation by introducing more efficient technologies in production, BIM, they train employees internally and they teach them.

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5. Where do you see barriers to solving the shortage of skilled workers?

A number of barriers are identified by respondents, ranging from demotivation, a poorly set up schooling system, to financial barriers.

The barriers listed below are always mentioned several times, the most frequently mentioned barriers are underlined. The obsolete schooling system setup is regarded as the biggest barrier.

There are three basic categories of barriers:

Systemic barriers

- Poor educational set-up – graduates are not prepared for practice even in theory, let alone in practical skills; outdated way of preparing for practice
- Artificial support for generating a lot of university educated people at the expense of crafts – partly a political barrier; a significantly higher number of primary school pupils go to secondary schools like grammar school, lack of apprentices
- Lack of an overarching government strategy for educating apprentices and preparing them for employment
- The subcontracting system in practice means the creation of poor working conditions by the main contractor for subcontractors' workers (technical and hygienic facilities, unfavourable contractual conditions for subcontractors, poor organization among contractors leading to stressful work)
- Unpredictability of the schooling system – loss of opportunity to focus timely on new apprenticeship fields that are expected to increase in demand, while at the same time using modern technologies that could increase the profitability of studies (robotics, digitalization, sustainability, renewables)

Financial barriers

- General undervaluation of skilled labour in the construction sector (imbalance between adequate wages for skilled people and low contract prices)
- Outflow of skilled workers abroad (pendlers) in search of better earnings

Social barriers

- Low social prestige – a barrier especially for young people; the common perception that the apprentice – worker is a low-value job

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- Low unemployment
- Difficulty and strenuousness of technical professions does not correspond to the expectations of the current young generation (in the case of preparation of project documentation, the tediousness of the work is mentioned)
- Demanding physical work in adverse climatic conditions, overall society increasingly prefers comfortable work
- Time-consuming work, the changing location of work, separation
- Shift of society's interest from technical fields to the humanities

6. **How is the demand for specific occupations changing and will continue to change? (What development trends do you expect in terms of the shortage of specific skills, influenced by e.g. Green Deal principles)?**

Conclusion: the vast majority of construction companies, manufacturers and planners anticipate an increasing demand for both traditional tradespeople and specialists for "new" fields based on easier work with technology, robots and IT in general. These trades are expected to be more attractive and prestigious for young graduates than traditional trades.

7. **Who could help you with this and how?**

Conclusion: the lower number of responses to this question suggests a slight scepticism and helplessness on the part of respondents, as these are long-term problems. Yet, in many cases, companies are unsure how they will solve the problem. This can also be partly attributed to the fact that the respondents specialise in activities other than human resources in their companies.

The main actor in solving the problem is the state, namely the government, the Ministry of Education, Youth and Sport and the Ministry of Industry and Trade, which should adjust the education system, especially the system of apprenticeships, secondary vocational education, lifelong learning and retraining.

8. **How are you (your company) prepared to deal with this future shortage of skilled workers?**

Conclusion: The answers are very similar to questions 4 and 7. If the company has a solution, it usually concerns internal and external training of employees or direct cooperation with schools.

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9. What form of education of your employees are you interested in?

Conclusion: There is clearly a prevailing demand and interest in all types of employee education both in the form of training and courses, mostly full-time. This applies both to the traditional trades and new innovative fields, IT and fields related to the transition to digitalization and robotization.

10. Do you use the National Qualifications Framework (NQF) where new work qualifications can be obtained?

38 responses in total.

Conclusion: the answer that the NQF is not used in the respondents' companies is clearly predominant.

11. What impact will digitalization of construction have on your company?

35 responses in total.

Conclusion: Only a small number of companies consider themselves ready for digitalization and use digital technologies themselves. In most cases, digitalization is associated with BIM (see Question 12). Digitalization is generally viewed as beneficial, leading to optimization of activities but not to a reduction of workload for human resources. On the contrary, the demands on staff will be higher given the need for IT qualifications.

12. Have you encountered a requirement to use BIM when performing tasks in your company?

Conclusion: Most respondents have already met the BIM requirement, however, only a small number of companies actually work with BIM. The question is what exactly they understand by the term BIM – whether only 3D modeling in the processing of project documentation or some higher form of "real" BIM. A positive opinion of BIM prevails in terms of optimising work both for the project documentation and for the execution of the work. However, even here exceptions were found with negative experience. The problem was in the required greater human resources to create the BIM model. This can be partly attributed to temporary inexperience with this type of work. No one mentioned the advantage of systematically bringing together large amounts of complex information on the building to be handed over by the building management for the current operational state.

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8. Barriers

The basic barrier to the development of the Czech construction and building sector is the utter **lack of a long-term strategy for the development of the sector**, which would be based on the generally accepted and acknowledged needs of settlement development and the formulation of technical, legislative and investment tools to achieve such a goal. Construction is significantly influenced particularly by the needs of the construction market, by short-term and campaign-like government measures, often reacting to EU-wide measures, without meaningful adaptation to our national needs. Therefore, we have seen the unmanaged development of municipalities around large cities causing a large increase in the need for automobiles, the campaigning gasification of many communities, the emergence of solar "barons" which caused the subsequent rejection of photovoltaics and, as a result, a lag in solar development. The state leaves the issue of raw material resources unaddressed. **The development of a comprehensive long-term strategy for the development of the construction sector, with the state's responsibility for the development of education for the construction sector and for the strategy of development of settlements is the biggest barrier and thus a condition for the effective development of the sector.**

The most frequently mentioned **barrier to the development of the construction sector is the lack of workers**. Complaints range from a shortage of manual workers, no ready replacements for the retiring generation of tradespeople, to a significant decline in the number of students in vocational and higher education construction schools over the past decade. The high employment rate, together with the unpopularity of the sector and especially manual work, resulted in the involvement of a large number of foreign workers. The conflict in Ukraine, a country from which a large number of foreign workers were recruited, highlights the risks of this situation. Moreover, the system of recruiting foreign workers faces formal and legislative barriers and is associated with "agency employment" and a black market in workers. The unbalanced sinusoid of the population curve in the past period marked a significant decline in the number of students entering vocational and university education. With the growth in absolute numbers in the upcoming generation of high school students, there seems to be an increase in interest in vocational training in general and hopefully in the construction field as well since last year. However, some reports suggest that there is insufficient capacity in vocational schools to take advantage of this increased interest in the construction sector. Demographic assumptions suggest about 4-5 years of demographic peaks. **There is a complete lack of systemic support for the study of construction, support for schools and support for students with scholarships and such.**

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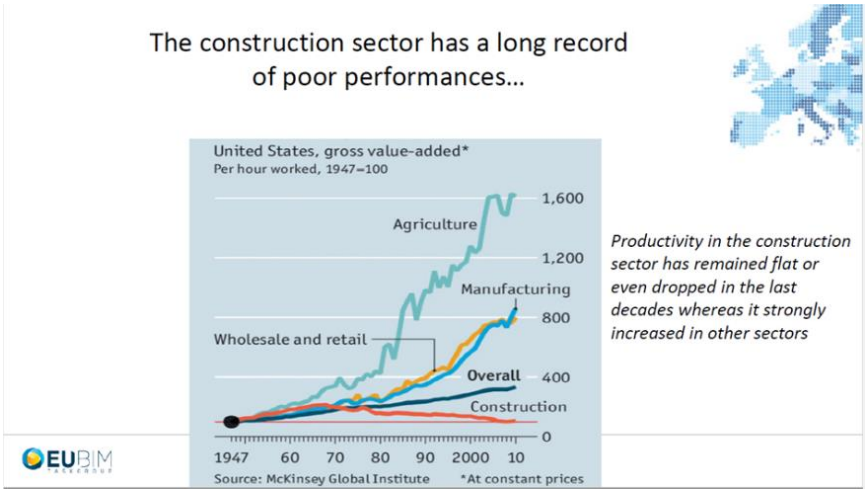
Construction as a sector is characterised globally by a low level of added value, and very slow digitalization of the field as a whole. This character is not specific to the Czech Republic, but as the attached graph indicates, it is European and American.

Figure 5: Labour productivity development in US national economy sectors



Source: From the material of EUROBIM, a conference on the development of BIM in the EU organized under the Czech Presidency in Prague 2022

The construction process, unlike in other fields, is very long (the period from the preparation of the investment and project, through its approval, subsequent construction and commissioning, usually takes 5 years or more), in which innovations and new developments are promoted in different phases separately, but the final implementation following the "weakest link" principle, often presents little progress. The result is always suboptimal, responsive to site conditions and is always unique. New efforts to perceive construction as including facility management, that is, the operation of the building and its lifetime, and even including the disposal costs and the return of materials from it (recyclability), so far hardly affect the quality and value of the implementation part. Buildings are still mainly assessed for the investment costs of the actual implementation. In an attempt to make the process cheaper (or to maximise profit), most contractors are continuously oriented towards cheap labour, wage labourers, often unskilled.

The construction sector therefore has a social role to play in how to employ such a labour force. It is hoped that **effective tools can be found to take the construction sector out of the search for minimum costs in the design and implementation phase, to focus on lifetime efficiency of buildings, and to stimulate involvement in technical and technological development and progress in the various stages of the preparation, construction and operation of buildings.**

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The property structure of the construction industry is very specific to the Czech Republic. Large companies are usually part of foreign construction and supplier concerns, which often have the nature of an "engineering" organization and subcontract a large part of their production to smaller specialized companies. Medium-sized and often specialized companies, acting as subcontractors (drywallers, chimney sweeps, heating engineers, electricians, installation organizations, construction foundations, etc.), focus on the maximum use of a particular technology, installation of specific products and have specific technical equipment. The largest part, however, are sole traders – individuals (they make more than 40% of the workforce), who are engaged by campaigners in larger contracts as a fixed-term workforce. They provide independently a large proportion of all reconstruction and renovation work for smaller private builders or are 'contractors' for their 'self-help' projects. **The orientation towards progress and the conditions for the use of vocational training and for lifelong learning are fundamentally different for each of this group, but this is not usually matched by educational practice or the outputs of educational projects.**

Legislative conditions do not favour progress and complicate the possibilities of promoting progressive trends in the construction sector. The most frequently reported obstacle is the length of building approvals, where the deadlines for construction procedures are influenced by many (more than 40) binding opinions based on often uncoordinated and contradictory legislation. These obstacles and undignified legal practices lead to construction approval and permitting deadlines of up to ten years, during which time the original technical concept becomes outdated, the functional specifications often change their content, and this further weakens the ambition for technical progress in the construction sector. The bureaucratic formalism in many opinions and objections often does not address the substance of the projects, but applies an alibi of the approving authorities, which often conceals ignorance, reluctance to innovate, incompetence or, yes, even the complete pointlessness of the opinions given. There is little hope for an improvement in the situation with the new Building Act under discussion due to the increasing number of sections and thus further complications in the approval process. The second issue is the form of procurement under the Public Procurement Act, which distorts more than half of the market that has to follow it when it comes to public procurement. Individual project stages and deliverables are often procured separately, usually either completely or with a strong emphasis on the lowest prices. A low-cost project may result in a more expensive construction with many changes and additional work. Moreover, a low-cost construction may have a more expensive operation or a shorter lifetime, etc. **Attempts to formally reform most of these regulations only bring clarification of the legal alibism, but do not increase the pressure for greater competence and accountability of the various participants, nor for higher quality constructions.**

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The education system constantly suffers from the remoteness of the demands of practice and the rigidity of classical schooling and academic practices, which are superior to the need to prepare and train new knowledge and skills for practice. There are a number of issues here, such as how to link school and top practice, the use of the ABF Rating to select companies from practice as partners of schools for top practice, enabling the participation of leading experts, practitioners, in the educational process, without the barriers of "pedagogical" attestations. Another issue is introduction of Masters craftsmen examinations, and their legalization as a condition for managing a professional firm, strengthening of professional guilds and communities and recognition of vocational Apprenticeship certificates. The ineffectiveness of the work on the NQS and NSP is a worrying issue, as more than 70% of the companies in the department do not use these materials, consider them irrelevant for the assignment of workers, or are not even aware of them. The fact that a large proportion of vocational and university graduates do not enter construction practice is also bad news. The task of transforming the education system for the future of digital and robotic construction is the most serious task, but it is also a way to attract the younger generation to the creative field and to popularize it. The situation requires gradual but substantial changes in apprenticeships, secondary vocational education and higher education, and each system is administered from a different centre (Ministry of Education, regions, MIT). Lifelong learning has neither a legislative administration nor a system of financing and, with the exception of Law 360/1992 (Authorisation Law) for CCA and ČKAIT, the requirements for training of officials under the responsibility of the Ministry of Interior and some other regulations (energy inspectors, chimney inspections, electrical inspections, etc.), is left entirely to the private sector without systemic support.

Another barrier is material limits. The construction sector is generally dependent on a domestic material stock, as importing large volumes of material over longer distances adds to overall costs and denies the green Europe trend. At the same time, the production of most domestic materials is relatively energy-intensive (bricks, concrete – or cement, glass, metal structures, ceramics), or does not have sufficiently developed technologies in the Czech Republic (wood processing, plastic for window frames). The long-term prospects for domestic mining of aggregates and sand are not ensured either. The new sources that have been tested only on a pilot basis so far are recyclates, where a way of standardization and homogeneity of the products and the possibilities of their use are being sought. New modern advanced materials are still finding their way to wider application, which is very complicated in the long-term process of building preparation. **The application of new technical devices and IoT elements is encountering both the length of the construction process and a different understanding of the durability and application of high-end products with an often-shorter lifetime in the long-term operation of a building.**

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Financial resources and economic cycles and how they are projected into the construction sector are areas where the long construction process is also reflected. Therefore, the construction sector always reacts to recovery with a considerable time lag. Ensuring the continuity of public investment is therefore one of the critical issues. Another issue is bank loan financing, which will increasingly apply the European requirements for GreenDeal4Building, i.e. extensive documentation of the green approach. This approach risks putting medium and small companies at a significant disadvantage, as it will be much more difficult for them to document the requirements needed and this will make it more difficult for them to obtain credit financing. **The question is whether the additional bureaucratic conditions will lead to an increase in the quality of buildings or their acceleration or reduction in cost, or only to further growth of consultancy firms preying on the documentary process of construction financing and, as a result, to an overall increase in the cost of construction and stagnation of its productivity.**

The European requirement of the renovation wave is neither methodologically nor organizationally ready in the Czech Republic. Historic buildings can be divided into several relatively separate structures: the first group are the protected historic cores of municipalities and towns, often enjoying monument protection. This structure is made up of very individual buildings **requiring an individual approach and extensive historical but also traditional craftsmanship skills, and here the question of capacity (human and material) springs fully to the fore.** The second group is the built environment (from the second half of the 19th to the first half of the 20th century), which often represents a valuable building structure but requires significant adaptations in terms of energy and other facilities and an individual approach. A separate sub-group is rural development from this period. For this structure, mostly restituted or privatized, **there are no programmes to motivate their renovation.** The implemented forms of renovation are oriented either to above-standard housing or to the change of function to non-residential (office and other) premises, and thus the housing stock and housing function in often central parts of especially larger cities is impoverished. The third group is housing estates, which represent the largest amount of existing housing stock to date, their lifetime is approaching its limit, and their first phase of renovation (the Panel programme) is practically no longer functioning. **However, we are facing a decision whether to start the second phase of renovation or, on the contrary, to start demolishing the housing estates. This issue, which is the broadest in terms of volume, is not currently being systematically prepared and studied in a comprehensive way, and the professional knowledge from the time of the construction of housing estates is rapidly disappearing with the passing generation of their builders.** The question of renovation of the last era of housing development, which meant the development of mainly single-family houses and only complementary apartment buildings, raises issues other than renovation (questions of retrofitting new development communities, questions of their transport accessibility, questions of finding employment opportunities in the place of their

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construction, or questions of working from home). **The goal for affordable rental housing is completely new.** However, in order to meet this goal, it is necessary to design a very rational construction that will allow realistic prices that cannot be achieved through the way of individually designed housing today. This will require a return to typification and the rise of robotization. The aim is cost-effectiveness, the utility value of the new apartments and the complexity of the housing complexes: a new Bauhaus, new requirements for working on site, a reduction in transport demands, an emphasis on leisure facilities. **There is no strong politically supported effort to promote the aims and ideas outlined in the Architecture and Building Culture Policy, the preparation of modern building design systems for affordable rental housing, but also the spatial preparation of such developments and the philosophy of comprehensive financing.**

It seems that some issues related to building and construction have completely or considerably faded from the attention of Czech science. The Czech Republic dedicated a record 2% of GDP to science and research in 2021. However, construction and issues related to architecture and municipal development certainly do not receive support corresponding to 6-8% of GDP. The workplaces where construction research is developed are universities and their research institutes (UCEEB or CEITEC). The Academy of Sciences does not have a specialized institute dealing with construction, architecture or urban planning. Nor do the MIT and the MRD have any departmental research institutes whose outputs would help to find and solve construction issues. This is evident in comparison with the situation of 30 years ago, when several institutes were involved in the preparation of the concept of construction of housing estates: RIBA, CCBA (ČSVA), USI, Typization Institute, Research Institute of Construction and Earthmoving Machinery (RICEM) and others with a capacity of about 1,000 employees. Private research, conducted by building materials but also by software services manufacturers and large contractors, is not separately statistically tracked for the construction sector and is used for protected competitive advantage in the construction market. **The evidence of the lack of a research sector are the activities of a number of non-profit organizations and associations, which mediate the knowledge gained through conferences and training for members, or, like SEVEn and the ABF Foundation and others, organize ad hoc teams of external staff for the processing of specific grant tasks and the promotion of the knowledge gained in practice.**

The Czech Republic does not have a single central administrative institution responsible for construction and building issues. The MIT is responsible for energy policy, the construction of energy networks and resources, the production of building materials and the construction sector in general and for the introduction of BIM. The MRD is in charge of the construction law and spatial development, public procurement, housing and support from European funds, the MoE has the largest budget available to support energy savings, MoT deals separately with investments and legislation for transport constructions, the MoC has its own

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competences in the field of protection of cultural heritage, the MOI in the field of education and methodology of local governments, the MoE in the field of construction of university campuses, the MEYS in the field of physical education and youth care, and individual regions implement a number of regional or local investment programmes. Similarly, the issue of vocational education and training of professionals for the construction sector is not managed from one central authority. The affordable housing and renovation wave is also an unflattering example. Its framework is defined by the MRD and the MoLSA but it does not address construction technical issues and investment issues are left to local governments, which are not professionally prepared for such construction activity. The technical solution of affordable but quality construction is not addressed at all. This is also reflected in the number of flats being built, and even several dozen different financial support programmes do not provide sufficient incentive. However, investment money is only a small fraction of what the MoLSA spends to support housing costs for vulnerable groups. In doing so, these funds do not bring about a meaningful improvement in the situation, but only bridge the immediate need of the affected citizens and, ultimately, accelerate the inflationary spiral despite the profits of housing providers. **Repeated attempts to create a single central body responsible for and effective in implementing state investment policy and construction management, or at least a permanent government commission on building and construction to coordinate fragmented activities and fill in the missing elements, have failed to develop over the long term.**

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9. Conclusion

The above analysis of the state of the Czech construction reveals primarily that the sector as a whole is not currently in the best shape. Its performance, the number of workers and labour productivity are stagnating, and this situation has been going on for so long that part of the capacity seems to be irretrievably lost. The pressure to build cheaply ('cheap at all costs'), dictated partly by the market (private investors) but largely by public procurement law (public investors), brings with it pressure to reduce personnel costs, especially today, when the costs of materials and energy are rising. As a result, average wages in the sector are relatively lagging behind (from slightly above average 10 years ago to strongly below average today), making the construction sector less attractive, especially for qualified labour. This results in a situation where there has been a long-term outflow of skilled trades (either to other sectors or to retirement), which is not replaced even in balance by graduates of secondary vocational and apprenticeship schools. The attractiveness of the sector, especially for young people and women, is also declining. The labour shortage has thus already become a latent condition that severely limits the demands that construction companies can make on the workforce (including its motivation to further training), even within the 'traditional' construction business.

There are challenges posed to the construction industry by the demands for energy-efficient construction and the demands for revolutionary process changes in construction, such as digitalization and the application of IA, to which the Czech sector is able to respond only marginally and is not able to concentrate sensibly on strategies for coping with these technical and technological requirements.

Equally "conserved" is the shape of the education system, which is not able to ensure the education of workers corresponding to the technical and technological demands of modern construction 4.0.

The implementation of the international commitments (within the EU) that the Czech Republic has made in the field of sustainable construction cannot be left to the internal forces of the construction industry alone; strong state intervention will be necessary – especially in terms of removing barriers to progress. Of these, two appear to be crucial: a) the absence of a single administrative institution responsible for the development of the construction sector, and b) the absence of a long-term and binding strategy for the development of the construction sector at national level.

The new Roadmap will undoubtedly have to respond to all these issues. However, the draft SQA needs to be finalized before its formulation. The refinement will consist both in completing and updating the data base on which the analysis is based, and in discussing the draft in the boards of persons and institutions engaged in aligning the current and strategic

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needs of the construction sector (especially in terms of workforce in the optimal skill structure) with the current and strategic capacities in the field of primary and lifelong learning. In this context, we rely in particular on two upcoming seminars with representatives of universities and secondary schools. Their outputs will certainly enrich and consolidate the conclusions of the final SQA with a planned completion in June 2023.

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