



EXPERT ANALYSIS

TRANSFORMATION OF THE CONSTRUCTION SECTOR IN SLOVAKIA TOWARDS CARBON NEUTRALITY

IDENTIFICATION OF PROBLEMS, BARRIERS AND RECOMMENDATIONS

ARCHITECTS DESIGN PRO-CLIMATE INNOVATIONS FOR BUILDINGS



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CLIM  **ARCHI** **NET**

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Acronyms used

CO ₂	Carbon dioxide
CND	Climate Neutral Districts
DH	District heating
EPC	Energy Performance Certificates
EPB	Energy Performance of Buildings
EUKI	European Climate Initiative
GHG	Greenhouse gasses
LCA	Life Cycle Assessment
MEPS	Minimum energy performance standard
MoF SR	Ministry of Finance of the Slovak republic
MoE SR	Ministry of Economy of the Slovak republic
MoEn SR	Ministry of Environment of the Slovak republic
MTC SR	Ministry of Transport and Construction of the Slovak republic
NGO	Non-governmental organisation
PPA	Power purchase agreement
RCUE	Regional centres for sustainable energy system
SIEA	Slovak Innovation and Energy Agency
SRI	Smart readiness indicator
RES	Renewable energy sources

1 Introduction

1.1 About ClimArchiNet

The ClimArchiNet project is funded by the European Climate Initiative (EUKI) programme, supported by the German Federal Ministry of the Environment and Nuclear Safety. The project implementation is ensured through the cooperation between Inštitút pre pasívne domy (SK) and Centrum pasivního domu (CZ).

The aim of the project is to describe the current situation and support development of innovative processes, materials and technologies for the preparation and implementation of buildings with very low energy demand throughout their life cycle, as well as to support transformation of the building sector towards carbon neutrality, building adaptation to climate change and social and energy security. For more information about the project and its activities in Slovakia see www.climarchi.net and www.iepd.sk.

In 2020-2022, the project focused on discussions with experts and on sharing of examples of good practices in sustainable architecture:

- 2 round-tables with experts and invited guests
- 4 discussion workshops with experts and invited guests
- 1-day international conference „A0 Buildings – back to the values“
- 3-day excursion around examples of good practices in sustainable architecture in Austria
- development of the information platform on sustainable architecture www.climarchi.net.

1.2 Expert team of the project ClimArchiNet



Ing. arch. Pavol Pokorný – architect, Pokorny architekti, platform "We build from wood"

After 15 years of architectural practice, Pavol Pokorný decided to radically change his approach to creation. Since 2009, he has been designing his projects exclusively in the energy-efficient standard. A wide range of buildings can be found in the portfolio of his architectural office, from interiors to industrial factories; from exhibition displays to office buildings. He is an enthusiastic ambassador of timber buildings, which have been awarded on the national and international scene (Weekend House in Nosice - winner of BEFFA 2012, ARCH 2012 nomination; Passive House in Stupava - winner of BEFFA 2014, ARCH 2014 nomination; Villa in Záhorské sady - Building of the Year 2018).

Mgr. arch. Nora Vranová - architect, vice-president of the Slovak Chamber of Architects

Nora Vranová is an architect and currently serves as Vice-Chairwoman of the Slovak Chamber of Architects, where she leads the agenda of professional education of architects. Her interest in sustainable architecture led her to the association Manifest 2020, the official partner of the New European Bauhaus in Slovakia. She sees architecture as an organisation of the environment in which we live. Quality architecture is a prerequisite for a quality life.

Ing.arch. Martin Stohl - architect, expert on carbon-neutral neighbourhoods, HB Reavis

Martin Stohl worked for 11 years as an architect in Canada, in several large design firms. In 2008 he started working for HB Reavis in Bratislava, where he is currently a Sustainability Specialist, overseeing BREEAM certifications for projects in the V4 countries, Germany and the UK. He has

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been instrumental in integrating sustainability principles and international certification into HB Reavis' ESG standards. He is a board member of SK GBC and vice-president of the Manifest 2020 initiative.

Ing. Ján Karaba, Msc. - Director of the Slovak Association of Photovoltaic and RES Industry (SAPI)

Ján Karaba is an expert on RES and since 2019 he is also the director of SAPI, the largest association of the renewable energy industry in Slovakia. Professionally, he has been involved in the development, implementation and operation of renewable energy projects for over 12 years and his work experience includes successful implementation of energy efficiency projects in the public sector. He is interested in innovative technologies and global trends especially in the energy sector.

Juraj Zamkovský - regional energy expert, Executive Director of Friends of the Earth – CEPA

After founding the Centre for the Promotion of Local Activism (CEPA) in 1993, he led programmes supporting i. capacity building of civil society organisations, ii. assistance to communities threatened by commercial interests and iii. exposure of corruption in the administration of EU funds. Since 2005, he has been coordinating preparation of the conditions for the development of energy autonomy in the Polana region. As part of the Plenipotentiary Expert Group for the Support of Least Developed Districts, he supported the development of sustainable regional energy system. Currently he is involved in building expert capacities for planning of the decarbonisation of the regions.

Ing. Jana Bendžalová, PhD. - expert on implementation of the Energy Performance of Buildings Directive, energy certification of buildings, Executive Director of ENBEE

Jana Bendžalová worked as a Head of the Department of Thermal Protection and Energy of Buildings at the Technical Building Testing Institute, where she participated in national and international projects aimed at the implementation of the Energy Performance of Buildings Directive 2010/31/EU. She is involved in several studies for the European Commission and international projects on energy certification, indoor environment and cost optimality of building renovation. She is an active member of the technical standardisation committees TK 58 Thermal protection of buildings, TK 92 Heating systems in buildings and is a member of the CEN and ISO working groups for standards development.

Mgr. Šimon Hudák - legal expert on Energy Performance of Buildings, law firm Poláček and partners

Šimon Hudák is a legal expert in litigation and administrative proceedings. He focuses on environmental law, construction law as well as advisory services to clients in the electricity and heating industry. As part of his legal practice, he also provides free legal assistance to a number of non-profit organizations in the protection and compliance of human rights in the Slovak Republic.

1.3 The Aim of the Analysis

The primary aim of the analysis is to point out the problems and challenges in the area of sustainable construction in the Slovak Republic and present recommendations as well as innovative solutions in order to help the construction sector contribute in a significant way towards the Slovak goal of carbon neutrality by 2050.

The analysis summarises the findings and experience gained in the course of ClimArchiNet project, which set out to raise the awareness among architects on how much buildings impact our

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energy use and production of CO₂ emissions, and to support the process of construction industry transformation towards the green economy as proposed by the European Green Deal (EU 2019). The project involves, motivates and inspires the cooperation among the main stakeholders and experts.

The document is intended for these target groups:

- Ministry of Transport and Construction of the Slovak Republic (MTC SR)
- Ministry of Environment of the Slovak Republic (MoEn SR)
- Ministry of Economy of the Slovak Republic (MoE SR)
- Slovak Innovation and Energy Agency (SIEA)
- The Capital City of Slovakia, Bratislava - Office of the Chief Architect
- Slovak Chamber of Architects
- Faculty of Architecture STU
- Buildings for the Future
- Slovak Green Building Council (SKGBC)
- Slovak Chamber of Civil Engineers
- Union of Towns and Municipalities of Slovakia
- Cities and Municipalities

1.4 Climate Change and Long-term Goals of the Slovak Republic

According to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), the current climate change is a result of unsustainable use of energy and land, our lifestyle and consumption/production patterns, which has lasted for more than a century (IPCC 2022). During 2010 – 2019, the average annual global greenhouse gas (GHG) emissions reached the highest level in human history. As part of The Paris Agreement, Slovakia made a commitment to become carbon neutral by 2050 and lower the GHG emissions by 55% by 2030 (as compared to 1990 levels), so that rate of the global warming remains below 1.5 °C (UN 2016). According to the IPCC, this goal will be unattainable without an immediate and rapid reduction of GHG emissions across all sectors. In addition, as a member state of the European Union, Slovakia pledged to achieve carbon neutrality by 2050 (EU 2019). Moreover, similar goal was approved at the national level by the Slovak government within the Low Carbon Strategy of the Slovak Republic Until 2030 With a View to 2050 (MoEn SR 2019).

The construction industry accounts for almost 40% of the global GHG emissions (UN 2017) and contributes significantly to the consumption of materials as well as waste production. Changes in the construction sector are therefore considered a deciding factor on the path towards carbon neutrality as well as recovery after the COVID19 pandemic, which should lead to environmental sustainability. The current situation has also highlighted the immediate need to significantly improve energy security of Slovakia.

1.5 The Context and Status Quo

Although there are several support schemes available for building renovation and higher utilisation of renewable energy sources (e.g. support scheme for renovation of multi-family buildings by the State Housing Development Fund, support scheme for renovation of single-family houses by the Ministry of Transport and Construction of the Slovak Republic, support scheme for public buildings renovation within the European Structural and Investment Funds (2014-2020), within which there

are also separate calls to support increased use of renewable energy source in households), however these schemes are not interconnected nor coordinated. As a result, they subsidise installations of renewable energy sources (RES) without previously minimising the building's energy demand for heating and/or support ineffective solutions. It was discovered that the single-family houses renovation scheme has an insignificant impact on improving energy performance of the buildings. Moreover, there is a lack of effective systematic measures in the energy sector, municipal planning as well as in the legislation process.

Even though the European Directive on Energy Performance of Buildings (EU 2010) sets out considerably strict requirements for the energy performance of buildings, the results are still not satisfactory. Although several hundreds of passive single-family houses have been built, the development in the area of multi-family buildings, public and administrative buildings is insufficient. The contribution of buildings to mitigation of climate change is usually presented only in terms of their energy efficiency, but rarely in terms of their impact on social and health issues and the readiness of these buildings to adapt to the current climate change. The potential impact of energy use is only interpreted in terms of energy savings and reduction of CO₂ emissions, but not in terms of reduced use of other resources.

In general, majority of architects, designers and other specialists are not ready to comply with the increasing expectations of the energy performance of buildings and sustainable solutions, the level of their knowledge in this area is low. They rely on specialists in different areas, but are not aware of the considerable impact of the building design on the eventual energy performance of the building and they do not apply holistic approach within the process of building design.

Description of the division into chapters

The analysis is divided thematically into three chapters:

- Sustainable architecture (P. Pokorný, N. Vranová, M. Stohl)
- Sustainable energy system of buildings (J. Karaba, J. Zamkovský)
- Legislative and legal aspects of building sustainability (Š. Hudák, J. Bendžalová)

The chapters are divided into subchapters, which have been prepared by the individual experts.

The text of the analysis represents solely the views and experience of the authors.



CHAPTER

SUSTAINABLE ARCHITECTURE

PAVOL POKORNÝ
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CLIMARCHI NET

2 Sustainable architecture (P. Pokorný, N. Vranová, M. Stohl)

2.1. P. Pokorný: Let's build in a different way

2.1.2. Introduction

"Let's build differently!" - this is the current wording of the imperative for all professional fields that participate in the human activity collectively called architecture and construction. Given the respectable history of activities of civil associations in the field (IEPD, SKGBC, IUR, BPB and many others), it is no longer possible to ignore the vocabulary of environmentally empathetic and sustainable architecture, i.e. (in no particular order): intelligent design of buildings, their energy efficiency, energy self-sufficiency, increasing the share of renewable building materials, waste-free construction and operation of buildings, stormwater management, building living communities and creating an environment for the inclusion of urban habitats. The reality of the mainstream - skilfully manoeuvring our specific social and legislative level - handles the vocabulary of sustainability selectively.

2.1.2. Identifying challenges and barriers

There are not very many professions that can take pride in the adjective "free". Architecture is one of them. In the definition of the word, we can read that "the liberal profession includes intellectual and knowledge-based services, which, as scientific, literary, artistic, cultural, educational, teaching, medical, economic, engineering, legal, technical, and natural science activities, are carried out personally, on their own responsibility and independently, in the interest of their clients and the public, on the basis of specific professional-legal standards". If we want to talk responsibly about the identification of barriers on the subject, we must also identify the barriers that exist in our own heads. Architects and their clients. Not excluding the general public.

The duality of the approach to the topic is obvious (applicable in general to any human activity evolutionary towards higher quality). Professionals either pragmatically remain in the established (if already outdated) processes, or principally begin to integrate vocabulary of architecture sensitive to the environment into the design and implementation processes.

To an outside observer of what is happening in the house building sector, it may seem that, in the horizon of the last quarter of a century of tightening up of the standard requirements for energy efficiency of buildings, the current achievement of the A0 standard is actually not a topic. The rules are clearly set, just follow them. In this area, it is simple buildings with the simplest way of applying the standard requirement (or even going beyond it) and any (unwanted or ignored) 'deviations' are only a negligible proportion of the total volume/volume of building production, which is the main environmental burden on the country. In fact, the house building segment is the cradle where the fundamental battle of ideas about the nature of building culture in our region is played out and foreshadows future developments.

In none of the other segments (public, corporate) has this erupted a complex interval of the character of building production. This fact - coupled with the constant media campaign representing the stereotype of housing in single-family homes - has a primary impact on professionals (including laypeople, i.e. their clients) in the segment.

2.1.3. Examples of best practice, experience

PUBLIC SECTOR / HOTEL BAUHOFFSTRASSE / LUDWIGSBURG / GERMANY / ATELIER VON M / 2019

The Department of Urban Development of the City of Ludwigsburg required that - in addition to standard spatial and functional regulation - a building be constructed in the area that would be an exemplary example of the first CO₂-neutral building in the city. The hotel is located in an exposed position in a long-neglected part of the city, so ATELIER VON M accepted the requirement to set the parameters for the future development of the area by accentuating the architectural/structural/environmental quality of the buildings as natural and the only possible way to achieve the goal. The new building volume of the hotel is integrated into the environment of the revitalized district with a scale and tectonics appropriate for the site. The massive application of prefabrication based on timber construction (and a traditionally precise energy-efficient concept) resulted in a premium hotel design with a consciously reduced CO₂ footprint to the current maximum possible level (the installation of the infrastructure of the fully equipped timber modules of the building - 2,058 m² of gross usable area - took 5 days).¹

CORPORATE SECTOR / POWERHOUSE TELEMAR - OFFICE BUILDINGS / NORWAY / SNØHETTA / 2020

POWERHOUSE TELEMAR's ambition is to create a new standard for environmentally sustainable office buildings by massively integrating systems for autonomous/in situ production of heat or electricity required for building operation. The currently implemented projects Powerhouse Kjørbo, Powerhouse Montessori and Powerhouse Brattørkaia demonstrate that they are capable of operating with 70% less energy consumption with comparable conventionally implemented office buildings. At the same time, they are able to produce energy in situ beyond their consumption and transfer the surplus to the local grid. Of course, SNØHETTA's work is characterised by a thoughtful architectural design that results in a working environment capable of responding flexibly not only to the technical requirements of environmentally friendly buildings, but also to the socio-cultural concomitant phenomena of the currently experienced Covid-19 pandemic, which is dramatically changing the requirements for workspace. "With the implementation of these buildings, we have demonstrated that there are no longer any excuses not to build carbon-neutral buildings. All the technologies we used in the implementation are commonly available on the market." Kjetil Thorse, founding partner of SNØHETTA.

2.1.4 Conclusions

The internal tension of "pragmatism versus principle" in architects' work is actually quite redundant in the current empirical experience of the application of the environmental approach in architecture and construction. Even sensitivity to the environment already produces pragmatic results. Concepts such as passive standard, off grid, zero carbon footprint buildings due to the massive deployment of wooden structures, consistent waste and water management, environmental empathy, urban biodiversity, etc. bring economically relevant and sustainable results in realised buildings. It creates a free space for designers who do not see normative requirements as a constraint, but as an opportunity and challenge to go qualitatively beyond them.

The public sector, through the instrument of spatial planning, must become a key player in the implementation of carbon-neutral architecture. A prerequisite for fulfilling this goal is the rigorous control of A0 certification and rewarding (e.g. tax policy) those actors that actively bring solutions qualitatively beyond the limits of the standard requirement into the public space.

A necessary part of the qualitative change is a legislative shift in the field of fire safety of buildings in favour of timber structures (alignment with the EU, whose legislation favours multi-storey timber-based buildings).

The corporate sector will then follow the public sector - it will have no choice. By its inherent nature and setup, the corporate sector will actively market such solutions (to differentiate itself from the competition), ultimately benefiting the entire affected community.

The individual sector, in the context of the public/corporate relationship thus set up, will create the preconditions for a rigorous control of A0 and a transparent bonusing of solutions that exceed the limits of the standard in their ambition to achieve CO2 neutral solutions.

2.2 Nora Vranová: Sustainable architecture - from constraints to opportunities

2.2.1 Introduction

The Slovak Chamber of Architects (SKA) is a professional organisation that brings together approximately 1900 authorized architects and landscape architects in Slovakia. In addition to the delegated exercise of state administration in the field of regulation of access to the profession, one of the important tasks of the chamber is to take care of the growth of the professionalism of authorised architects through professional education.

Architects are becoming more and more aware of the urgency of our everyday situation. We are aware that the phrase 'climate change' is being replaced by 'climate crisis'. We know that we work in an industry that is responsible for almost 40% of global greenhouse gas emissions (UN 2017). And we equally know that we hold unprecedented potential to do something about it. But to achieve a more fundamental shift, we need a complete paradigm shift in the way we design buildings, neighborhoods, and cities. In other words, it won't happen without the active participation of architects.

2.2.2 Identifying the problem

Current methods of building construction and renovation, mainly focused on improving energy efficiency through the use of technology and materials for architects, have not yet shown satisfactory results, not to mention the necessary trade-offs in terms of sustainability of cultural, aesthetic and historical values. A large part of architects struggle with the feeling of imposed solutions that we do not know or do not want to accept as our own in the creative process. But neither can we offer alternative solutions that meet the high demands of sustainability and aesthetics at the same time. We lack arguments and alternatives, we still have more questions than answers.

We need to find tools to sensitise architects to the issue of sustainability - to make designing environmentally sensitive architecture their natural first choice.

2.2.3 Identifying barriers

In addition to the undeniable barriers in our heads, as discussed by Pavol Pokorný (see chapter 2.1), there are also some objective barriers that could be summarised under three main headings:

- As architects, we want to maintain control over the project - from initial designs to implementation. Understanding the whole process of integrated design will help to eliminate the fear of "forced" solutions. Fears stem mainly from:
 - Of losing control of the project; the feeling of forced solutions that do not fit the author's concept;
 - devaluation of aesthetic, cultural and historical values;
 - lack of awareness of the variety of possible solutions, their alternatives and impacts.
- a lack of competent partners on the part of designers and contractors - partners who can think creatively and exploit the synergies of building, environment and technology.
- But above all, we lack sufficient demand for sustainable solutions. The architectural profession is largely dependent on the client. Without an educated and motivated client, the implementation of sustainable architecture is almost impossible - be it individual clients, the development and corporate sectors, but especially the public sector (see chapter 2.1.).

2.2.4 Objective of the chapter

The aim of the chapter is to propose and describe measures to sensitise the community of practicing architects to the issue of sustainability. Within the intentions of the New European Bauhaus initiative (https://europa.eu/new-european-bauhaus/about/about-initiative_en), we want to see sustainability together with aesthetics and inclusion. Such a broader context of sensitivity has the potential to change the environment in which architects work and create a natural demand for sustainable solutions.

2.2.5 Examples of the best practice

It is currently very difficult to find examples of good practice in our context that are emulated in all respects. However, there are already quite a lot of examples - whether in the field of architectural realisations or architectural initiatives - that point the way.

A selection of works from the CE-ZA-AR awards archive that, in addition to their undisputed architectural qualities, meet the requirements of sustainability in different ways:

- House within a House, Bernolákovo (Martin Jančok, 2016)
- House by the forest, Rusovce (Ľubomír Peráček Sr., Ľubomír Peráček Jr., 2017)
- ABW Administration Building, Kráľová pri Senci (René Baranyai, Borislav Benedek, 2018)
- Extension to the cottage, Čachtice (Pavol Paňák, 2020)
- Private primary school Guliver, Banská Štiavnica (Richard Murgaš, Martin Lepej, Lukáš Cesnak, 2021)

Examples of SKA initiatives (and suggestions for their improvement):

- occasional magazine about architecture for children Priestor (published by the SKA Institute) - include an issue on sustainability
- SKA Competition Manual - prepare a methodology for assessing sustainability aspects following this template

- Regular training of competition processors, competition organisers and competition juries organised by the SKA
- prepare and add to the established system a tailor-made module on sustainable solutions for design competitions
- improving the professional qualifications of jurors through targeted training on sustainable architecture principles
- #greenaprearchitecture - the current slogan of the CE ZAAR Prize's communication line for 2021, adding to the global call to mitigate the environmental impact of architecture. The CE ZAAR Award (SKA awarding body) draws attention to the social value of architectural works and the professional achievements of Slovak architects, while creating a space for discussion about the impact of architecture on the quality of our lives. In the current edition, all submitted works were also assessed with regard to the degree of environmental responsibility.

2.2.6 Main recommendations

As already indicated, the public sector should be the first to respond to political and societal demand.

Proposals for public investment measures:

- Use spatial planning tools to ensure the building of compact settlements and integrated urban development with jobs and services closer to housing. Ensure the regulation of the conditions of development and land use with the implementation of climate protection measures (green and blue infrastructure, RES, energy-neutral districts, etc.) through the quality and professional preparation of spatial planning documentation at the appropriate stages.
- Create transparent economic and legislative conditions for promoting environmentally sustainable investments; ensure a transparent permitting process; e.g. conditions in land-use plans binding on all actors, graduation of property taxes based on their sustainability, etc.
- Apply the latest knowledge and technologies in practice;
- In the spirit of the Davos Declaration (<https://davosdeclaration2018.ch/davos-declaration-2018/>), implement the ideas of a high quality building culture (Baukultur) as a basic condition for creating a sustainable society characterised by a high quality of life, cultural diversity, protection of historical heritage, individual and collective prosperity, social justice and cohesion, and economic efficiency.

The corporate sector, alongside public administration, can become another driver in the field of sustainable architecture, which is increasingly becoming a matter of prestige. The economic aspect - e.g. progressive taxation or marketing (so watch out for greenwashing) - will also be important in the future.

Proposals for measures to sensitise the commercial sector:

In a competitive environment, which is most sensitive to examples of good practice, it is therefore in the interest of the actors themselves:

- Encourage company reputation building through certification schemes;
- Place more emphasis on operational rather than procurement costs of buildings.

The property development sector is now more involved in building cities than any other sector. Therefore, it cannot be left out of the decarbonisation process. It is characteristic of property development that, as a rule, the builder and the user of the building are not the same entity. The

decisive factor is the demand from the client, and at the moment it is still the demand for the lowest possible price.

Proposals for measures to sensitise developers:

- Client education - public education about the impacts of the climate crisis, the user benefits of sustainable solutions (e.g. indoor environmental quality, operating costs), etc;
- Setting uniform transparent rules included in spatial plans and building legislation that cannot be circumvented; avoiding competitive advantage for those who do not respect sustainable solutions e.g. by higher tax burden;
- Reduce the market price of sustainable technologies and materials through mass use;
- Increase the flexibility of zoning plans - to allow for the valorisation of less attractive areas (e.g. due to commercially unviable zoning functions, the need to dispose of old environmental burdens, etc.) by way of building carbon-neutral neighbourhoods (see Chapter 3).

For individual clients, there is the greatest scope for education - both formal and informal. In order to make sustainable solutions a priority for each individual builder, education needs to focus primarily on:

- Improving the relationship with architecture, the environment and sustainable solutions from a young age;
- Communicating the concrete impacts of the climate crisis on humanity, the landscape, the city, the community and its individual members;
- Present the tangible benefits of sustainable solutions through examples of good practice
- Approaching the topic of sustainability through social, cultural and economic aspects to which the public is now more sensitive.

All these market demands will generate pressure on the professional readiness of architects. It is therefore essential to prepare architects for the challenges of sustainable construction through specific training - formal, professional and informal.

- Regularly update the syllabus of formal education of architects with the latest knowledge
- to integrate sustainable architecture topics more intensively into architects' professional education through concrete examples of good practice that establish a new aesthetics of sustainability.

2.2.7 Concrete steps and actions needed to implement the recommendations

Objective 1: Include sustainability considerations in the terms and conditions of competitions and public procurement, compulsory for public investment; prioritise 'value' over 'price' in green public procurement.

Proposed solutions:

- Raise awareness of the positive benefits of design competitions among local government entities through training for contracting authorities; the cost of organising a competition is around 1% of the investment cost, yet it can bring not only much greater savings in investment costs, but also comparison and optimisation of proposed solutions;
- prepare a methodology for assessing the sustainability aspects of the tenders submitted, in addition to the existing SKA Competition Manual (SKA 2021);
- training and education of jurors and competition processors on sustainable solutions for architecture and construction in the form of certified training courses.

Objective 2: Make designing environmentally sustainable solutions a natural first choice for architects.

Proposed solutions:

- Collaboration between practitioners and academia to develop and update the content of formal architectural education; consider all school assignments comprehensively, including with respect to sustainability;
- Targeted inclusion of specific sustainable architecture topics in the professional education of architects organised by the SKA, with an emphasis on integrated design;
- education through examples of good practice - e.g. works entered in architectural prizes (e.g. CE-ZA-AR) to be assessed comprehensively also with regard to sustainability and environmental impacts of the proposed solutions. Communicate these to the public.

2.2.8 Conclusions

Our goal is that sustainability becomes a new aesthetic that fully reflects the imperatives of global challenges and that architects will not only accept, but consider as an inspiration and driver of their work. It is important that they know how and have someone to work for. So that their efforts are not atomized into individual endeavours, but become part of a society-wide demand for change.

Table 1: Examples of good practices (SR)

Example	Specification	Notes
House in a house Bernolákovo Year of realization: 2016 Author: Martin Jančok; PLURAL	The energy concept is rather intuitive, but quite effective due to its compact shape, natural light and orientation to the cardinal points. The house is also an example of limiting energy consumption, where energy-intensive interior spaces are minimized and, conversely, the living area of the house is extended into the intermediate space, which has no energy requirements.	The house is divided into two concentric parts: the inner one consists of living area (living room and bedrooms) with a vertically accented dining room in the centre. The outer part of the house contains additional functions that do not require year-round use (garage, swimming pool, patio and storage areas).
House by the forest 4 Rusovce Year of realization: 2017 Authors: Ľubomír Peráček, st., Ľubomír Peráček, ml.; ateliér MOLNÁR-PERÁČEK	The composition and construction of the house fully respects the environment in which it is located, including the existing greenery. The construction is made of renewable material - wooden CLT panels - in a low-energy standard. The vegetated roof contributes to water retention and to improving the climate both outdoors and indoors.	The house is part of a complex of six houses on the border of the floodplain forest in Rusovce, with which it creates a harmonious unity. Roof terrace with extensive vegetation roof and jacuzzi. (CEZAAR 2018 - nomination)
Mlynica Bratislava Year of realization: 2017 Authors: Štefan Polakovič, Lukáš Kordík, Jana Benková, Tomáš Vrtek; Gutgut	Mlynica The mill is part of a large post-industrial complex in Bratislava. It is an example of "spatial recycling", in which instead of uncontrolled expansion of the built-up area to the detriment of natural areas or agricultural land, the inner reserve of the city is used, which consists of unused industrial areas, the so-called brownfields.	The design builds on the contrast of old and new, emphasising the quality of the original building. After the reconstruction, the former industrial building of a purely manufacturing character became a modern mixed-function building designed for cultural and social events, administration and, to a small extent, housing. (CEZAAR 2018 - laureate)
Office building ABW	The office building is located on the	The balance of aesthetic, functional

Example	Specification	Notes
Kráľová pri Senci Year of realization: 2018 Authors: René Baranyai, Borislav Benedek; RB ARCHITECTS + LANG BENEDEK ASSOCIATED ARCHITECTS	premises of a concrete elements factory. The concept of the building is based on three main principles: 1. a green atrium open to every room in the building; 2. transparency and clarity of the layout in the customer-employee relationship; 3. strict compliance with the principles of passive standard in the design and construction of the building (the final result of the energy balance of 13 kWh/(m ² .year)	and energy criteria contributes to the quality of the working environment and the sustainability of the overall project. (CEZAAR 2019 - nomination)
Extension of cottage Čachtice Year of realization: 2020 Authors: Pavol Paňák	The renovation and extension project represents a comprehensive approach to sustainability - from the cultural appropriateness of building in a rural environment, to low-tech solutions to ensure a balanced energy balance, to the use of recycled materials	The extension to the original country house is situated in the area of the former village brickyard and serves as weekend housing. The branded bricks used in the construction of the roof trusses are ancient products of this former brickyard. (CEZAAR 2020 - laureate)
Private elementary school Guliver Banská Štiavnica Year of realization: 2021 Authors: Richard Murgaš, Martin Lepej, Lukáš Cesnak	Children have the opportunity to stay in a variety of spaces that are not necessarily predetermined for a specific function. Flexibility creates a creative and stimulating environment, developing the potential of both the users and the learning process. Passive standards and a high quality indoor environment are a priority. Although it is a private investment, it is also an example for public institutions to follow (CEZAAR 2021 - laureate).	A former industrial area on the outskirts of the city transformed into a sports ground with a simple block school building. The educational process is organized into spatial clusters for 40-60 pupils. The school is complemented by a gymnasium and a swimming pool hall.

2.3. M. Stohl: Carbon Neutral Districts

2.3.1 Introduction

The theme of Carbon Neutral Districts (CND)* is based on the archetype of community settlements based on shared provision of needs that have been around since the agricultural revolution. The relevance of dealing with smaller, self-managed units has again gained currency in the search for more efficient and sustainable models of cities and their zoning.

* Carbon neutral neighborhoods are those neighborhoods that have zero greenhouse gas (GHG) emissions in the total year-round balance, a coordinated effort serving the entire neighborhood. Not infrequently, excess green energy production is diverted to the grid for use outside the district. Looking back in history, it is also worth briefly mentioning the utopian concepts associated with human settlements from the late 19th and first half of the 20th century. They reflected the given reality of society, responded to its problems, tried to give it order and orderliness and to contribute to its prosperity or protection from threats. Three well-known examples that have already responded to the deteriorating environmental conditions of industrial metropolises:

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- Ebenezer Howard: Garden City / Garden City (1898) Ebenezer Howard's Garden City Idea and the Ideology of Industrialism
- Frank Lloyd Wright: Broadacre City (1932) Decentralization Integration: Frank Lloyd Wright's Broadacre City
- Le Corbusier: Ville Radieuse / Shining City (1938) AD Classics: Ville Radieuse / Le Corbusier

All these theories, however, were strongly anthropocentric, focusing primarily on man, his benefit. They assumed the use of nature and all available means and modern technologies. With a deteriorating environment that has a direct impact on health, safety and quality of life, we have gradually come to understand that humans are part of nature and need to ensure a balance with it for its sustainability and our own survival. Today we are already facing a climate crisis where immediate, radical solutions are existentially necessary, including global carbon neutrality by 2050 at the latest.

One concrete solution for our cities to respond to the climate crisis of our time is carbon neutral neighborhoods, which provide an environmentally, socially, and economically sustainable community solution with high efficiency (central solutions for green energy production and distribution, circular waste and water management are significantly more efficient and less expensive than providing them individually) and many benefits for the city as a whole. They are an intermediate step between the solution of energy efficient and carbon neutral buildings on the one hand and the solution of the city as a whole on the other hand. There are a number of examples in northern and western Europe that have been operating successfully for years, whether they are called sustainable communities, urban villages, circular or low-energy neighbourhoods.

Characteristic principles of the CNDs:

- Reducing energy consumption: 1. buildings, 2. infrastructure
- Shared local renewable energy
- Shared efficient water management (rainwater harvesting, grey water treatment and recycling)
- Joint waste management (recycling, replacement, repair)
- Transport - walkability, facilities for cyclists, car sharing
- Shared and democratic public space
- Greenery - orchard landscaping, green roofs, community gardens, emphasis on biodiversity (meadow planting instead of lawns and limited mowing, trellises and irrigation-intensive plants, strategy to reduce heat islands with shade trees, etc.)
- Identity, diverse community, common neighbourhood management
- State/regional/city-supported funding programmes

2.3.2 Problem identification

Key phenomena with negative environmental and climate impacts include, but are not limited to:

- Urban sprawl, low density, long distances
- Encroachment on green spaces and agricultural land
- Dependence on road transport, congestion and huge time loss

- Air quality and emissions of CO₂, NO_x, PM_x, GHG, smog
- Heat islands
- Climate change and associated extreme weather events - e.g. floods, droughts and heat waves, wind, storms, hail
- Energy dependence and vulnerability
- Huge amounts of unsorted waste and exploitation of mineral resources
- Loss of identity and interest in the city, anonymity of big cities, growing social divisions and tensions and related crime

2.3.3 Identification of barriers

- Regional level - in practice, there is still a lack of systematic support for regional energy network
- Urban and spatial planning in general have great potential for promoting sustainable development, but today they generally lack criteria for energy efficiency, circularity and carbon neutrality. It should be mandatory for every municipality and city to have its own climate neutrality plan by 2050 and GHG emission reduction by 2030. At the same time, implement support for local community solutions and initiatives such as energy independent and carbon neutral neighbourhoods, waste management driven by a circular economy model, rainwater and grey water capture and reuse, completion of cycling infrastructure and green transport in general, etc.
- To date, there is no uniform policy on residual carbon offsetting for individual or community developments.
- Financial and banking sector: products targeted to support the creation and development of decarbonised neighbourhoods and communities are still not available.
- The development of carbon-neutral neighbourhoods needs to be primarily a city initiative, with the support and potential of developers and communities.
- There is a lack of conceptual policy preparation at all administrative levels, including financial support, tax incentives and other incentives.
- The current legislative environment in Slovakia does not allow for the development of CNDs.

The most important shortcomings include the following:

- Impossibility to disconnect from district heating, monopoly of suppliers (amendment to Act No. 100/2014 Coll. on Thermal Energy) - district heating mandatory also for communities of flat owners with their own heat sources

- The National Integrated Energy and Climate Plan (NIEKP) (2019) calls for an increase of RES in CHP by only 1% per year. Note (2022): the plan is fundamentally updated after Russia's aggression on Ukraine, the strengthening of RES to reduce fossil fuel supply from Russia becomes a priority.

- Low Emission Zones according to Law 137/2010 Coll. are only related to restrictions for motor vehicles, there is no legislation for low emission/carbon neutral districts.

- The so called "stop state", where the possibility to supply excess renewable energy to the grid for individual property owners with RES was strictly limited, has been formally abolished (SEPS,

6.4.2021): But the transposition of the EU RES Directive is still pending, in particular the liberalisation of the restrictions on small individual sources and local energy sources

2.3.4 The aim of the chapter

The aim of the chapter is to promote the idea of carbon neutral neighbourhoods as a very effective alternative for cities as well as rural settlements, not only in terms of energy efficiency, self-sufficiency and reduction of greenhouse gases, including CO₂, but also in water and waste management, social inclusion, building community life and awareness of shared environmental responsibility, security and place identity.

2.3.5 Examples of good practice

Table 2: Examples of good practice

Example	Specification	Notes
Summy boat (Das Sonnenschiff), Freiburg (Germany): Energy positive district (2004)	Author: architect Rolf Disch (author of Heliotrope (1994), the first sustainable, carbon-neutral building that produces more energy than it consumes) - A small community in the Vauban district of Freiburg, is powered entirely by solar energy. - It produces four times more energy than it consumes (approx. 1000 m ² of PV panels).	it is a solution for houses made of light steel construction. - The buildings are designed with natural ventilation so that passive shading cools in summer and stores heat energy in winter. - Mixed function retail, commercial and residential space, with 60 apartments in PlusEnergy standard. - The district is designed for approximately 25,000 residents. - Carbon neutral (life cycle) - Financed by a series of green investment funds, for each phase of the project.
Espoo , (Finland): The most sustainable city in Europe (initiative from 1990s)	2nd largest city in Finland after Helsinki with 280 000 inhabitants - Awarded the title of the most sustainable city in Europe - 89% of people use the central heating system, which has a network of 900 km - The city has developed its own sustainability programme based on 5 pillars: 1 Building a sustainable Espoo through smart solutions 2 Developing simplified and sustainable transport 3 Achieving emission-free and smart energy production 4 Encourage city residents to live sustainably 5 Better integration of the city with the surrounding natural environment	- Kera, one of Espoo's neighbourhoods as an example - The Kera industrial district in Espoo has been transformed into a smart and circular urban residential district - A residential district for 14,000 people and a commercial district with office space for 10,000 employees - The development of the district was supported by a digital platform through which the flow of energy, waste, materials and information is monitored and managed, to ensure a functional circular economy of the district, in integration with the whole city - Regional and supra-regional impact: Strategy 6 cities - Espoo, Helsinki, Tampere, Vantaa, Oulu, Turku - EU-supported regional initiative brought together 6 cities and other stakeholders to create an integrated strategy for the country and higher level governance and services
Chytré Lichy , Židlochovice (CR): First sustainable district in Czech republic (2021)	5 studios in the competition for the greenest district in the Czech Republic in 2021 A carbon-neutral district of 3.4 ha in the planning stage, much of which will consist of green space and water features. Planned completion: The end of 2023	- Diverse social mix, including senior and starter social housing for new families (social innovation) - Car-free zone, cars only on the perimeter of the zone, car-sharing system, promotion of cycling - Renewables (photovoltaics) - energy self-sufficiency zone, with a plan to generate more energy than is consumed - Use of grey water, rainwater harvesting - Smart technologies throughout the neighbourhood
Western Harbour , Malmö (Sweden) – First carbon neutral district in	Revitalisation of the brownfield (derelict port) including decontamination from hydrocarbons and salt into a carbon neutral district	Source: https://smartcitysweden.com/best-practice/161/the-ecological-city-of-tomorrow-in-the-western-harbour-malmo/

Europe	<ul style="list-style-type: none"> - The district also includes e.g. a biomethane station, a CHP system, etc. The development continues - From the beginning, the city has been in control of the planning and preparation of the project. Funding comes from city and national sources. 	
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2.3.6 Main recommendations

Carbon Neutral Neighbourhoods have the potential to go far beyond the environmental. Other benefits can be both social and economic, for example integrating seniors and disabled people with young families, addressing social housing, developing the local economy and increasing employment.

a) Legislation and strategic documents of the SR and the EU

- Legislation and standards related to energy performance of buildings, emission reduction, protection of nature, water and biodiversity need to be complemented, clarified and aligned with the above goals set by the EU, to which Slovakia is also a signatory, with the ambition of carbon neutrality by 2050.
- Review the inter-ministerial set-up and competences of the ministries for the individual priority themes, so that there are clear responsibilities for each theme.
- Renewal Plan, Fit for 55, National Energy and Climate Plan, Long-term Strategy for the Renewal of the Building Stock and other EU-funded programmes - focus on their most effective, targeted use and regular annual audit by independent professional auditors, including an assessment of the effectiveness of the achievement of the set targets and the use of funds (in terms of value for money)

b) Spatial planning

A key enabler for the start-up and development of the CND is the municipal governments and their main instrument for regulating development, which are spatial plans and regulations. As can be seen from the examples of already successfully functioning CND from Northern Europe, it has often been the municipalities that, through appropriate regulation, support for infrastructure preparation and other incentives, have been able to kick-start the development of sustainable neighbourhoods in zones that were first a problem area, such as an environmentally burdened brownfield or a socially distressed neighbourhood. Among the points that are needed, the following appear to be a priority:

- Identification of areas for CND development. Note that these may not be exclusively vacant areas, but also existing neglected clusters of buildings (example: Nová Cvernovka in the suburbs of Bratislava)
- Preparation of an urban study and a zoning plan for each selected district
- Adjustment of regulation and strict addition of requirements for common solution of connection to renewable emission-free energy sources, common waste management, common water management, including rainwater and wastewater, common solution of greenery, barrier-free and emission-free transport in and to the area

c) Financing

We are experiencing a groundbreaking time, with unprecedented funding allocated to strengthen sustainability and reduce greenhouse gases as part of the Recovery and Resilience Plan (MoF 2021). There is a significant amount of subsidy allocation for the refurbishment of public buildings under the ESIF (2021-2027). The President's Office also officially launched the Presidential Green Seal, a prestigious award for superior sustainably renovated public buildings, in early 2022. Alongside this, the awakening interest of investors and banking institutions in investing in green housing and sustainable initiatives is also evident. The missing links so far are both the state and municipalities.

d) Education and promotion

There are non-profit organisations in Slovakia, such as IEPD, SK GBC, BPB and others, which already have sufficient expertise and contacts to support education for the development of CNDs in Slovakia. However, it is the task of the state, administrations of higher territorial units and associations of local governments (Union of Slovak Cities, Association of Towns and Municipalities of Slovakia), as well as local governments themselves to take the initiative in creating conditions for the development of CNDs, their promotion and education.

2.3.7 Conclusions

Carbon Neutral Districts are an effective tool to address the climate crisis in our cities, while also having the potential to address the other social and economic problems of cities mentioned above. However, a prerequisite for the emergence of CNDs in Slovakia is the creation of legislative and practical conditions for the development of renewable energy sources and sustainable energy in Slovakia in general.



CHAPTER

SUSTAINABLE **ENERGETICS** OF BUILDINGS

JÁN KARABA
JURAJ ZAMKOVSKÝ

CLIM**ARCHI**NET

3 Sustainable energetics of buildings (J. Karaba, J. Zamkovský)

3.1 J. Karaba: Development of the use of energy from RES as part of sustainable buildings

3.1.1 The aim of the chapter

This part of the material deals with modern ways of using energy from renewable energy sources (RES), which should be understood as an integral part of energy solutions in buildings designed and implemented according to the concepts of sustainable architecture and construction. The aim of this chapter is to identify the advantages and benefits of these energy solutions, but also the main problems and obstacles that cause these solutions not to be developed and applied to the extent that they have technical and economic potential. The examples of best practice demonstrate the proven possibilities and opportunities for their use not only in buildings but also in urban areas, which creates a model for their wider use in Slovakia. Based on these findings, a number of recommendations for public policy and legislation are formulated, as well as specific steps and measures needed to implement these recommendations.

3.1.2 Introduction

All new buildings must meet the parameters of energy class A0 according to Decree no. 364/2012 Coll. implementing Act No. 555/2005 Coll. on the energy performance of buildings and on the amendment of certain laws as amended, which in practice requires the use of at least one type of renewable energy sources (RES). In many cases, even this class of energy efficiency can only be achieved by a combination of several types of RES. At the same time, based on the ongoing revision of the Energy Performance of Buildings Directive, it is clear that the energy performance requirements of buildings in the EU will be further tightened (EPBD 2021). energy-efficient buildings that produce more energy than their own consumption. The legislative environment in the field of building energy is therefore also evolving and moving towards sustainable design.

If we consider part of the sustainable design of buildings a state where 100% of their own energy consumption is covered only from renewable sources, then to achieve such a state it is appropriate to consider not only own energy sources located on or in the building (so-called "on-site" production).), but also the ability of buildings to obtain energy from externally located renewable sources (so-called "off-site" production). From the technological point of view, photovoltaics, thermal collectors and heat pumps, which convert the energy of the environment into heat or cold, are most often used for on-site production from RES. Under certain circumstances, heat in buildings could also be produced from bioenergy, either biomethane or wood biomass. However, these technologies also have relatively significant technical and economic limitations, such as the availability of fuel and the possibilities of transporting it to the place of consumption.

As not all buildings have the technical or spatial possibilities to use on-site production from RES, coverage of own consumption can be achieved in these cases by external supply of energy from RES. The new European energy market design is also based on this principle, which supports the development of renewable energy purchases through long-term purchase contracts in physical form through direct management, in virtual form as a supply with guarantees of origin or sharing within the civil energy community, or community producing energy from RES. In addition to

meeting the energy performance of buildings and the positive effects of reducing greenhouse gas emissions associated with reducing the carbon footprint, the use of renewables in buildings generally has significant economic benefits in terms of savings in energy costs and the use of grant funds under the new EU policy Green Deal, which focuses on the decarbonization of all sectors. One of the aims of EU legislation is to promote and accelerate social innovation through energy communities by increasing the use of renewable energy in buildings, which also strengthens the social and environmental responsibility of building users (Rescoop 2018).

3.1.3 Problem identification

Despite the above-mentioned clear and convincing reasons, which speak in favor of the use of RES in buildings, in Slovakia the development of sustainable energy in this sector does not reach the pace at which it has potential. According to official Eurostat statistics, the share of renewables in heating and cooling in buildings in 2011-2018 was practically at the same level of around 10%. In 2019, the statistics included additionally reported and insufficiently validated data on energy produced from biomass, which sharply increased the share of RES to 19.7%. However, this situation did not show a growing trend and in 2020 the share of renewable energy in the sector even fell to 19.43% (<https://ec.europa.eu/eurostat/web/energy/data/shares>). Insufficient development of the use of RES has several causes, which can generally be divided into the following areas:

- Legislation in the field of energy of the buildings
- Statistics on the use of energy from RES
- User access / RES awareness
- The approach of designers and investors/owners to sustainable energy

3.1.4 Identification of barriers

- Legislation in the field of building energy

Regarding legislation, it is necessary to point out that many building authorities in Slovakia also allow and approve new buildings that do not meet the requirements for energy class A1, resp. A0 from 2021 in accordance with the valid Decree no. 364/2012 Coll. on the energy performance of buildings due to insufficient quality control of energy certificates (BPB 2020). In practice, therefore, builders, investors and developers often resort to less expensive but high-emission heat sources. Another obstacle is Act no. 657/2004 Coll. on thermal energy, which in the defined area of the district heating system (DH) practically makes it impossible to build individual heat sources, even those that are in all respects better than the source used by the DH operator - i. they have a higher share of RES, lower emissions and higher efficiency (eg heat pumps). An example is the project Zelené Grunty, apartment building project in Košice, where the developer wanted to build its own heat source using heat pump technology, but TEKO, a.s. as a DH operator in the defined area, he did not give him the consent opinion, which was necessary to obtain a zoning and building permit, and ultimately forced the builder to connect to their distribution.

This legislation is particularly restrictive for residents of existing apartment buildings connected to DH systems, who cannot include the implementation of a full-fledged sustainable energy solution

using renewable energy in the plan for significant renovation of their building, as they are not approved by the DH operator, which is cases and their heat suppliers. One of the examples is the project of deep renovation of an apartment building in Bratislava, Pavla Horova street 17 - 19, in which air /water heat pumps were to be used as a heat source for heating and hot water and photovoltaics as an additional source of electricity. The project received two dissenting statements for disconnection, from the DH system, which was managed to change only on the basis of intervention by the Ministry of Economy of the Slovak Republic due to the fact that the project was supported by European subsidies.

- Statistics on the use of energy from RES

In Slovakia, there is currently no authority at the level of state bodies or agencies that would systematically collect, classify and evaluate data on the use of energy from RES in the building sector, respectively in general in the heating and cooling sector. There is a lack of data on the number and types of technology equipment, their performance and the energy production and consumption, also regionally structured, which would allow to create low-carbon strategies at the regional and local government level. This function is currently performed to a certain extent by the Statistical Office of the Slovak Republic, which, however, collects only data on total energy consumption from entities, or sectors.

The lack of data on the use of energy from RES leads to the fact that self-governing regions and cities lack an important analytical basis for the creation of decarbonization strategies as well as more complex energy concepts related to the integration of RES in district heating (DH) systems. Quality data are also essential for the creation of the state energy policy, which has been embodied in the Integrated National and Climate Plan of the Slovak Republic (INEKP) since 2019 as a road map for achieving the goals of the EU climate agenda by 2030 and carbon neutrality by 2050.

- Users approach / awareness of RES

For a more significant development of sustainable energy based on the use of RES, it will be necessary to change the approach of building users to the energy origine consumed daily for heating, cooling and hot water. As revealed by the current opinion poll from the Focus agency from June 2021, more than a third of Slovaks do not have sufficient information about the possibilities of using RES when build or renovate their family house (Focus 2021). At the same time, it can be assumed that in the sector of apartment buildings, the results of this survey would be even more significant in relation to RES.

- The approach of architects and investors to sustainable energetics

Architects and investors should certainly be a significant driving force for the faster development of sustainable energy systems. Quite often, however, there are only economic reasons, which are mainly the requirements for minimizing investment costs, while the long-term operating costs of the building or the impact of its operation on the CO₂ emissions production are of very little interest to them. In the case of architects, we also encounter a lack of technical skills in designing modern energy solutions based on RES, and very often lacks an integrated approach to design that would ensure that RES are an integral part of the building from the beginning and not just its "green" complement. We thus commonly encounter development projects, which are first designed into a

certain basic form in order to go through the permitting process and then additionally and relatively demandingly adapt to the requirements of users for the implementation of progressive technologies.

3.1.5 Best practice examples, experiences

The construction of sustainable buildings is getting more interesting, and there are already several inspiring best practice examples. A very good example of the RES use in the city district is the Western Harbor project in Malmö, Sweden, whose energy systems are based on a district heating system powered by ground-to-water heat pumps, and electricity is supplied to the district by a combination of wind turbine and solar photovoltaics (Journal of Green Building, July 2013). This district was created over a period of 15 years, which only underlines the importance of spatial planning and the forward-thinking energy concept of the whole area. Another interesting project was created in 2016 in Vienna's Simmering district, which supported the renovation of several major public buildings using photovoltaics and smart technologies (Implementation Report of Smarter Together Vienna 2016-2019). However, several buildings with a high share of RES use also exist in Slovakia. One of the notable projects is the residential building development Einpark in Bratislava. The new owner decided to change his originally proposed conventional energy concept based on natural gas heating into the system water / water heat pumps, which are used for heating and cooling. The project was awarded by the highest LEED Platinum certificate for energy and environmental design.

3.1.6 Main recommendations

In the field of energy legislation, it is necessary to focus on the systematic removal of obstacles that complicate investors to use RES in their projects. In the case of thermal energy, as part of the transposition of the "Clean Energy for All Europeans" package, Act no. 657/2004 Coll. on thermal energy so as to create effective pressure on existing central heat supply system operators to increase the use of RES, resp. to integrate decentralized RES into their systems and open them to external sources that use RES.

The area of building users' approach to sustainable energy and awareness of the use of RES probably has the greatest potential for improvement and further development, as in Slovakia the use of advanced RES technologies began significantly later than in most of other EU countries. One of the reasons for this situation is the fact that in Slovakia there is traditionally a highly developed gas infrastructure, which was until recently owned by the state, and due to which natural gas was perceived as a priority energy carrier in supplying buildings with heat. The approach of building users and the relatively low awareness of the use of RES certainly influenced the high share of flats that are connected to DH systems (assuming 65% of all housing units for 2020 (Slovak Innovation Energy Agency, 2014)), whose operators have not had sufficient economic motivation or significant obligation to increase the share of RES in its resources, while the government, through Act no. 309/2009 Coll., even granted the right to install combine heat and power unit with the natural gas. Therefore, the government plays a key role in this area, which by law sets rules, goals and development plans and, together with subsidy financial mechanisms, can regulate energy producers and suppliers and at the same time motivate building users to prioritize the use of renewable energy over fossil fuel solutions. However, the role of non-governmental

organizations and interest groups in educating residents about the technical and economic possibilities of using RES-based technologies in the renovation of their buildings is also very important.

The approach of designers largely depends on the requirements of investors, resp. developers who, due to insufficient legislation concerning the Building Act (No. 50/1976 Coll. on Spatial Planning and Building Regulations) and Act No. 555/2005 Coll. on the energy performance of buildings have so far relied on the possibility of reducing investment costs by using fossil fuels for heating, in particular natural gas boilers. Act no. Remains an important factor in design activities. 657/2004 Coll. on thermal energy, which forces investors to connect to existing DH systems if the buildings are located in their area. In practice, however, we perceive that the approach of architects and engineers is changing, especially under the influence of requirements from investors and building users, especially in the segment of office buildings, where more and more new projects meet more demanding requirements for sustainable architecture and construction (such as STEINERKA Business Center in Bratislava, which was awarded by LEED Gold certificate). At the same time, the attitude of the investors and developers themselves is changing, who are already beginning to respond to higher user requirements for ecological building design, at least in the administration and retail sector (for example, the above-mentioned Einpark project). However, it does not work at public sector. The local governments should set an example for the public by systematically approaching the renovation or construction of the public buildings in a sustainable way and afterward serve as a promotion of the best practice examples. If the government really wants to achieve significant decarbonisation of buildings within the framework of the new EU policy based on the effort for the fastest possible transition to clean energy (so-called "energy transition"), it must necessarily start its own example in the use of RES. The state should take a much more active approach to the renovation of public buildings and its efficient financing.

3.1.7 Specific steps and measures needed to implement the recommendations

Legislation recommendations will be based on the expert comments and suggestions for the Ministry of Economy of the Slovak Republic, which is responsible for creating energy legislation, which will ensure that the transposition of the package of regulations and directives "Clean Energy for All Europeans" removes or significantly reduces barriers to the use of energy from RES for on-site producer, but also for the possibility of purchasing energy from off-site sources. In the area of buildings, this activity will mainly concern the topic of active customers (prosumers), energy storage facilities, energy communities, access to energy markets and the possibility of connecting RES sources to existing DH systems. At the same time, in Decree no. 364/2012 Coll. on energy efficiency of buildings and Decree no. 308/2016 Coll., which establishes the procedure for calculating the primary energy factor of the district heating system, it is necessary to design and implement a new method of determining primary energy factors and carbon footprint on the principle of LCA (life cycle assessment) for all sources and especially for DH systems so as to eliminate the distortion of the calculation of the carbon footprint of buildings connected to these systems. Measures in this area can be implemented in the short term, as they are linked to the ongoing transposition of energy legislation.

In the field of statistics on the use of energy from RES, the Ministry of Economy in coordination with the Ministry of Construction should designate one authority, which could be, for example, the Slovak Innovation and Energy Agency (SIEA), which would carry out systematic collection and evaluation of missing data in cooperation with the Slovak Statistical Office, up to the regional level.

Given that the SIEA should also act as the only information point under the new legislation, such a function would only be an extension of its existing activities. Data collection and evaluation is an activity that can be initiated in the short term, but the resulting effects will be visible after several years.

Professionals and professional organizations of architects, engineers and contractors, as well as educational institutions, will play a key role in improving user access and awareness of RES, as these are typically closer to building users than the state and government agencies. It is necessary to prepare for the fact that projects of sustainable construction, greening of operation and increasing energy efficiency of buildings will be tied up with significant subsidies within the EU Green Deal programs and these will naturally generate interest of people and companies in quality and meaningful technical and technological solutions. It will therefore be necessary to prepare technical materials in the form of recommendations, manuals and presentations, based on examples of good practice, which will be used to develop and define standards and best practices for the successful implementation of these solutions. Measures in this area are of a long-term nature.

In the area of the approach of designers and builders, the most important factor is the development of the legislative environment and the market, which is already up-to-date and essentially unstoppable, making them increasingly forced to adopt and embrace sustainable construction concepts. In this context, there is probably a need to significantly strengthen the role of energy consultants, who should become natural partners of designers and builders in the field of creating sustainable energy solutions based on a high level of energy use from RES.

3.1.8 Conclusions

This part of the material describes the basic concepts and ways of using energy from RES, which should be a necessary part of sustainable buildings, in which it is assumed that their own energy consumption can be covered by the production of energy from RES, either by technological solutions located directly on on-site or by an external supply of energy from renewable sources. Although there is an obvious energy, climate, but also economic justification for the use of RES in buildings, in Slovakia this sector is still far from reaching a pace of development that would correspond to its potential. This is due to obstacles in the legislation, which for some types of buildings make it literally impossible to use RES-based solutions, but also to lack of statistics on RES use, which prevent the creation and adoption of more comprehensive and integrated regional and national strategies, which could more clearly identify goals and plans at both national and regional levels for cities and counties. Another problem is the inexperience of users and low awareness of the possibilities and benefits of using RES, as well as the approach of architects and investors, who have been little motivated to design and implement construction so far, including modern and sustainable energy solutions.

On the other hand, several examples of good practice examples were presented - two from abroad and one from Slovakia - which should serve as inspiration for the government, investors and building users, as they represent already established and functional solutions in which not only individual buildings, but also entire city districts was able to use the available technical potential of energy solutions for RES. These buildings and neighborhoods successfully use solar energy to

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produce electricity and heat, heat pumps to supply heat and cold, but also, for example, wind turbines, which increase the energy balance in favor of energy from renewable sources.

In the last two parts of the chapter, specific recommendations, steps and measures have been proposed, which should be implemented in the individual problem areas identified in order to remove these obstacles to development. Some of these steps and measures can be implemented immediately and some are long-term and need to be addressed systematically.

3.2 J. Zamkovský: Coordination of regional energetics - guarantee of a systematic approach to the construction and renovation of buildings

3.2.1 The aim of the chapter

This part of analysis is focused on the outline of the system procedure for the creation of infrastructure for planning and coordination of regional energetics in the context of the commitment of the Slovak Republic to achieve carbon neutrality by 2050.

3.2.2 Introduction

In 2019, Slovakia committed itself to the EU's commitment to achieving carbon neutrality by 2050 [1]. At the same time, Slovakia has committed itself to achieving a goal that is unparalleled in its history. Achieving this goal will require not only huge amounts of public money, but in particular precise coordination and planning at all levels, in all sectors that directly or indirectly contribute to greenhouse gas emissions, including the buildings sector.

3.2.3 Problem identification

The collapse of heavy industry in the 1990s had a significant share in the reduction of CO₂ emissions in the Slovak Republic since 1990. Only part of the emissions can be attributed to targeted decarbonisation measures. Given the resources that Slovakia has so far invested in order to reduce emissions (mainly thanks to the European Structural Funds), the achieved reduction in carbon emissions is in fact relatively low. Targeted subsidies for single projects are also enough to reduce the first 20 or 30 percent of emissions in the country. However, any further emission reductions will require not only much higher specific costs, but also smart management, a quality energy planning system and stable professional capacities, not only within sectors but also regionally. Therefore, we need to expect that demands on resources, system quality and capacity levels will skyrocket over time.

The complexity of the commitment to carbon neutrality also requires a much broader interpretation of the term "energy" than is commonly used. In addition to the production and distribution of fuels and energy, it must cover all sectors that have a significant impact on the energy and emissions balance (apart from the buildings, industry or public lighting sectors, transport, services, agriculture and other sectors). In this context, energy development must also be understood as a coordinated shift towards decarbonisation and optimization of energy needs based on renewable energy sources (RES) with strict respect for the limits of the natural environment.

The regional aspect is important: Slovakia can only be carbon neutral if all its regions are decarbonised. Without a thorough transposition of the national climate target to the regional level, Slovakia cannot meet its international commitment.

The new context therefore necessarily requires the emergence of a new discipline of public policy - regional energy policy. However, such a policy has not yet existed in Slovakia and the regions have no capacity in this area. (A limited number of city or county energy managers cannot be considered as such. Regional energy planning is a much broader concept than the energy management of buildings). A serious consequence of the absence of a systemic approach to regional energy is the natural development in this area.

The lack of capacity for regional energy planning means that, instead of planning systemic energy measures beyond the term, regions and local governments usually only compile current project plans, the long-term meaning of which is questionable. Their development priorities are often set by external consultants without objective analysis and standardized methodological procedures, the quality of which the contracting authorities have no way of verifying. The purpose of such development plans is to ensure that local governments have access to current subsidies rather than responding to critical energy and climate trends. Progress towards decarbonisation of the regions is, by current circumstances, a coincidence rather than the rule.

3.2.4 Identification of barriers

There are several reasons why the regions do not plan and coordinate the development of decarbonised, sustainable and self-sufficient energy system. They are interconnected and form a vicious circle, one of the results of which is that the development plans of the regions almost never consider energy systems as a sector determining their future economic, social and environmental stability.

An important factor is the lack of awareness of the relationship between politics, territorial governance and the day-to-day behavior of companies and people on the one hand, and global warming and the changing climate on the other. Analyzes of Friends of the Earth-CEPA have shown huge shortcomings in the way of educating and informing about climate change and its context and solutions at the regional level (PZ - CEPA 2019). The failure of regional education and the media is reflected in the low level of general climate and energy literacy (more than 80% of the population in the regions are people with the highest secondary education, ie graduates of regional education). The result is little or no public demand for a higher quality decarbonisation policy.

Another barrier to the emergence of serious energy planning at the regional level is the absence of suitably qualified and experienced professionals. The education system in the Slovak Republic does not prepare specialists for this important cross-sectional field. However, even if the regions had such experts at their disposal, there are currently no methodologies to ensure a uniform and mutually compatible approach. There is also no system that would financially, organizationally, technically and informatively support and guide the progress of the regions in this type of planning and link it with energy planning and monitoring of the fulfillment of emission and energy targets of Slovakia.

Systematic work with energy information is a necessary precondition for the development of decarbonised and sustainable regional energy systems. Energy planning requires objective, up-to-date, appropriately structured and reliable information, as well as the ability of regions to monitor,

classify, process, evaluate, archive and update such information. Although the legislation requires various entities at local and regional level to collect, process and provide various energy information for statistical purposes or for the needs of central government, almost no one usually works with them at the local level.

Reforms in this area (creation of the RCUE - see next chapter) failed to allocate funds from the Recovery and Resilience Plan ("money for reforms") (MF SR 2021), despite repeated proposals from NGO's.

3.2.5 Best practice examples, experiences

The starting point for this vicious circle is systematic and comprehensive planning and coordination of sustainable energy systems. This has already been proven by the many examples of regions abroad that are already approaching energy self-sufficiency (for example, in Austria, Germany, Denmark or Scandinavia). Decarbonisation, increased energy efficiency and the massive use of RES have brought them a significant and permanent reduction in living (operating) costs, new job opportunities, considerable resources for local development and significantly improved the environment.

However, the regions did not come to these results spontaneously, but thanks to the fact that they built up their own planning capacities for the development well in advance. The same needs to happen in Slovakia, and we have the advantage that we can apply several examples of good practice, also we have considerable financial resources from EU decarbonisation funds.

3.2.6 Main recommendations

The guarantee of a systemic approach to decarbonisation, as well as to the renovation of buildings, is the emergence of systematic energy planning, which must be based on quality and stable planning and coordination infrastructure for sustainable regional energy development, including adequate capacity at state, regional and local levels and municipalities. While at the state administration level it is sufficient to strengthen existing capacities and allocate them to the regions, completely new capacities need to be built in all regions.

The design of such infrastructure, prepared by the Friends of the Earth-CEPA association, takes into account the need for complementarity of its individual elements and also the need for comprehensive coverage of the entire territory of Slovakia, not only selected regions. The proposal has found understanding in the economic sector, it has also been reflected in the government's strategic material (MH SR 2019) and steps are currently being prepared for its gradual implementation.

A key element of the proposal is the so-called the Regional Sustainable Energy Centers (RCUEs) on which this chapter focuses. Their main mission is to support the optimization of energy needs and consumption, the growth of their energy self-sufficiency based on renewable sources, increasing local control over the development of regional energy and thus active support for Slovakia's international climate and energy commitments. For the state administration, the RCUE should be a guarantee of reliable data and stimuli from the level needed for analytical activities, monitoring the fulfillment of national goals and setting up support schemes aimed at increasing energy efficiency and the use of renewable resources in the regions.

A precondition for the effective functioning of the RCUE is a well-prepared system. Slovakia has not taken the opportunity to budget funds from the Recovery and Resilience Plan ("money for reforms") for this purpose.

Therefore, it will be necessary to find resources for this purpose either from the unspent structural funds in the past programming period 2014-2020 or from other public funds.

3.2.7 Specific steps and measures needed to implement the recommendations

The expected start of the creation of the RCUE is the year 2024. However, the RCUE will fulfill their tasks and mission only if they have well-prepared conditions for operation. This means that by 2024 it is necessary in particular:

- correctly set up their organizational model (in close cooperation between the state and key actors in regional development - the Association of Slovak Towns and Municipalities, the Union of Slovak Towns and the Association of Self-Governing Regions),
- to ensure stable financing of RCUE from public budget until the end of the current decade so that their territorial scope covers the entire territory of the Slovak Republic (their establishment costs and activities should be covered mainly by European Structural Funds under the forthcoming Slovakia Program for 2021-2027, should cover the state budget),
- develop and adopt a unified methodology for standardized regional energy planning (especially methodology for quantification of energy need or consumption and savings potential in the sectors of buildings, transport, industry, agriculture and other sectors significantly affecting the energy and emission balance of the Slovak Republic, methodology for quantification of sustainable usable regional potential individual renewable energy sources - in particular solar, low-potential heat, biomass, wind and geothermal energy, methodology for uniform calculation of carbon emissions, etc.),
- prepare a sufficient number of experts for the RCUE (in cooperation with Universities and possibly also secondary vocational schools with a technical focus).

3.2.7 Conclusions

Achieving carbon neutrality by 2050, to which Slovakia has committed itself internationally, requires the establishment of capacities for the coordination and planning of consistent decarbonisation of all sectors and regions. Such capacities do not currently exist, and they need to be thoroughly prepared, built and established, so that their scope covers the entire territory of the Slovak Republic. This is a long-term and challenging task that will require the coordination of several departments (economy, construction, environment, investment and regional development as well as education).

However, the consequences of climate change, together with the international policy response to this trend, show that this is an intention that is clearly in line with the public and regional interests. If it is successfully and timely translated into practice, conditions will arise not only for a shift from natural to sustainable development of regions, but also to the systematic development of individual sectors, including a comprehensive so-called deep renovation of buildings with respect to the wider context of sustainability.

Table 6: Best practice examples from other countries

Example	Specification	Notes
Energy planning in Austrian town of Güssing	<p>The flagship of the green local energy policy in Austria. The town of Güssing (3,700 inhabitants) together with the district of the same name (26,000 inhabitants) belonged to the economic periphery of Austria in the 1980s. As many as 70% of the region's economically active population commuted to Vienna, and almost all of the energy consumed was imported. The city became increasingly aware of the unsustainability of a permanent financial leak due to its heavy dependence on imports of increasingly expensive fossil fuels. The town hall therefore decided in 1992 on the need to halve the city's energy consumption (this goal was already achieved by the city in 2000). Three years later, the city adopted a strategy to achieve energy self-sufficiency based on RES and a plan to maintain jobs and financial resources in the local economy by taking control of its own energy. Since then, it has implemented innovations in the use of wind energy, biomass, biogas and photovoltaics. In 1995, the Energiepark association was established in the city, which provides a professional background for the implementation of regional energy policy. The association helps to prepare and implement projects to improve energy efficiency, the RES use and the development of sustainable transport, also provides education and training.</p> <p>60 small and medium-sized companies have grown in the city, providing 1,500 new jobs. The annual income from the sale of electricity / heat from RES exceeds 14 M EUR. It has attracted research and development to support innovation. The results of the city's energy program led to the creation of energy tourism - an additional but not negligible source of local income. Thanks to a targeted energy policy, the entire Güssing region also achieved energy self-sufficiency (in 2013).</p>	<p>The example is inspiring but non-transferable due to the very different starting conditions in Austria and Slovakia (legislation, economic power of local governments, government support, level of environmental awareness and energy literacy, levels of corruption, quality and culture of public administration, tradition of cooperation at local / regional level).). However, there are also common features of the initial situation: the city and the region were the economic periphery within the state, energy allowed an outflow of funds out of the region, a high level of energy dependence, etc.</p> <p>Sources: Zamkovský J.: Príklady lokálneho/regionálneho energetického plánovania na Slovensku a v zahraničí. Priatelia Zeme-CEPA 2021. Zamkovský J., Ftáčnik M.: Zelená lokálna energia – cesta pre Slovensko. Friedrich Ebert Stiftung 2019.</p>



CHAPTER

LEGISLATIVE AND LEGAL ASPECTS OF BUILDING SUSTAINABILITY

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CLIM  **ARCHI** **NET**

4 Legislative and legal aspects of building sustainability

(Š. Hudák, J. Bendžalová)

This section addresses, on the one hand, legal issues in the field of sustainable construction, both the problems, the challenges and the legal precedents, which represent a significant step forward in this area. The second subchapter specifies some legislative changes in more detail and also describes the forthcoming changes in European legislation that will need to be transposed into the Slovak legislative system.

4.1 Š. Hudák: Law for sustainable construction in Slovakia - challenges, solutions and important precedents

4.1.1 Introduction

Even young students in law schools are learning that the law should regulate relations in society as general as possible to cover all possible situations. However, it often happens that the law does not "catch up" or have gaps behind these situations. Either it does not correct the situation at all or it does not respond to it precisely enough. One of the reasons for these shortcomings may be the faster development of social relations or, as has been emphasized in recent years, the "rapidly changing world".

Climate change as a global problem teaches us, to think in new categories. It introduces words like "sustainability", "renewable" or "carbon neutrality" into the dictionary. As society gradually gets used to these words, it can be said that the legal order is trying to catch up with this trend.

Construction as one of the sectors is most affecting the climate change. So for the reason there is a legitimate pressure on this sector, which will lead to the need for its transformation in the coming years. Questions about how to build, renovate, from which materials and where, the basic climate definitions will be asked in response. Over time, the construction industry will turn (not only verbally but in terms of content) into "sustainable construction" - environmentally sensitive throughout its process. The law will have to follow this transformation.

The aim of the legislative and legal group involved in the preparation of this analysis is to offer several proposals, after the implementation of which the construction industry could be called a little more sustainable.

Any proposal to change legislation needs to start with an identification of the current situation (including the identification of problems and barriers) and trends (Green deal and Renovation wave). At the same time, it will be necessary to monitor the development of domestic and foreign case law and it will also be necessary to point out examples of good practice. We will address these topics in the following sections of this subchapter.

4.1.2 The aim of the chapter

The aim of the legislative and legal group involved in the preparation of this analysis is to offer several proposals, after the implementation of which the construction industry could be called a little more sustainable.

Any proposal to change legislation needs to start with an identification of the current situation (including the identification of problems and barriers) and trends (Green Deal and Renovation Wave). At the same time, it will be necessary to monitor the development of domestic and foreign case law and it will also be necessary to point out examples of good practice. We will address these topics in the following sections of this subchapter.

4.1.3 Identification of the current legal status

We would like to begin by pointing out three legal institutes which, in our view, have been successfully integrated into the Slovak legal system and which help to sustainable construction development and building renovation.

• Local resource, small resource

Above all, it is necessary to mention the "local resource" and "small resource", which were included in the implementation of the so-called the "Winter Energy Package" of the European Union in Act no. 309/2009 Coll. on the promotion of renewable energy sources and high-efficient combined heat and power production. These are tools that significantly help the energy self-sufficiency of buildings.

They base their small and local resources on the notion of "self-consumer", based on the premise that electricity produced from RES is consumed at the point of production. In this way, a high level of energy self-sufficiency and economy can be achieved. "Self-consumers" are legislatively relieved of several administrative obligations and producers - entrepreneurs - are even allowed to sell surplus unconsumed electricity to the network.

The concept of local and small energy sources offers a high degree of usability in both private and business use. The installation of these sources has the potential to significantly contribute to the energy self-sufficiency of buildings.

• Green public procurement

Another of the institutes enforced in Slovak legislation is green public procurement, which makes it possible to assess the issue of materials used in construction and reconstruction. Act no. 343/2015 Coll. on public procurement makes it possible to apply environmental aspects in the public procurement process at several levels.

Contracting authorities or contracting authorities may set "greener" requirements for supplied services or materials already in the conditions of participation in public procurement. The description of the subject of the contract (in particular its technical requirements) may contain specific environmental characteristics which the contracting authority may insist on without reservation. The environmental aspects of the contract may subsequently be taken into account in the evaluation of tenders.

• Energy certification of buildings

Finally, the introduction of legal obligations related to the energy certification of buildings should not be overlooked in the context of the renovation of buildings. The obligation for investors or building owners to keep the energy certificate, or to attach it to building procedures or to show it when

transferring real estate, increases the transparency of the building stock and the awareness of third parties of the energy performance of a building.

4.1.3 Identification of some barriers

Despite the integration of the above-mentioned legal institutes, our legal system is facing some fundamental problems that hinder the progress of the construction and building renovation segment.

The first problem is the current state of the Construction Act (Act No 50/1976 Coll.), but also the poor quality of the currently proposed new legislation on the Construction Act and the Act on Regional Development and Planning.

To begin with, it should be stressed that the current Building Act does not reflect the rapidly changing trends and, moreover, contains procedural institutes whose interpretation in practice is different and causes complications. This makes the construction process not only time-consuming, but also unpredictable, expensive and, in some situations, almost unworkable.

From the point of view of building renovation, there is a need, above all, to change the way we look at spatial planning. The biggest problem at present is the way in which the spatial plan is interpreted and the inability of cities/municipalities to set specific conditions in the plan to enable sustainable urban development in a given area. Building authorities often take a restrictive view of the zoning plan and refuse to allow construction simply because it should be built in ways that qualitatively exceed the "green" limits formulated in the zoning plan. In other words, if the zoning plan does not explicitly provide for something, it cannot be allowed. It will be important to allow cities and towns more freedom to set the sustainability of their site. Legislation should allow the zoning plan not to say "what can" be built, but to change the setting and state only what explicitly "cannot" be built. The zoning plan can specifically regulate where energy efficient buildings, neighborhoods and entire parks can be built. Defining the area in the zoning plan for the construction of energy-efficient buildings has the potential to positively influence builders and the general public and change their attitudes in favour of such construction.

The above assumes that the concept of excessive centralisation in spatial planning will be abandoned. The legal regulation should set clear criteria for controlling and possibly sanctioning spatial planning that is not in line with national or European objectives. At the same time, the legislation should allow the regions (knowing best the local conditions, advantages and disadvantages of a given location and the demand for housing and construction) to be able to regulate the building conditions independently. The basic motto of spatial planning should be to allow regions more planning freedom, while at the same time having strict control mechanisms from the state.

Another problem is the informal practices of the participants in the building procedure or even the staff of the building authorities. The aim should be to set the rules of the construction procedure precisely in advance and thus avoid situations that allow non-transparent procedures. In practical terms, I see the first step to be the full computerisation of the construction procedure and the standardisation of procedures. Electronic communication through controlled channels will make the rules for certain submissions/applications more transparent.

Applications and submissions to the building authority should be standardised so that they can be easily assessed and checked by the building authority. The aim is to have uniform forms with descriptions of attachments and how they are marked.

Plans to create one specialised construction authority should be viewed with great caution. Insofar as such a central state body would have competences at the level of harmonising the decision-making practice of building authorities (say, in appeal proceedings) or control powers, such a status of a building authority could be accepted. However, possible attempts to centralise construction and planning procedures and to remove these competences from municipalities can be viewed with concern. Spatial planning should be left as far as possible to the local level.

Another problem with the construction procedure is the circle of participants in the procedure and the way in which it is decided who actually belongs to the circle of participants. The circle of parties is often disproportionately large, which complicates the whole procedure. In particular, our legal order does not sufficiently address the situation where some entities wish to become parties to proceedings only on purpose, in order to block ongoing processes. At this point, it is possible to take inspiration from the Czech legislation, which makes it possible to decide on the presence of such 'parties' more quickly, without burdening the process more. The aim should be to set out the scope of the parties to the proceedings in as much detail as possible in a specific regulation.

A very serious problem in the construction procedure is the current set-up of binding opinions.

Especially problematic are the cases where state authorities submit contradictory binding opinions in administrative or construction proceedings. The process of reconciling these opinions is too rigid and takes a disproportionately long time, which can significantly disrupt the course of the procedure. If there is a lack of consistency in the binding opinions in the procedure, the procedure is practically stalled for several months.

More significant problems in the current legislation can also be seen in the field of thermal energy, which will undergo more significant changes in the near future as a result of the gradual implementation of European Union directives.

In particular, the decarbonisation of the district heating systems (DHS) will be one of the main topics. This will involve the transition to the 3rd generation of district heating and then to the 4th generation of district heating, which should include elements of 'smart' solutions and a considerably higher percentage of renewable sources used.

The current setting of Act No. 657/2004 Coll. on thermal energy allows disconnection from the DHS in order to use alternative heating sources based on renewable energy sources, but the process of such disconnection is very strict and legally complicated. In practice, it often generates disputes as a result of disagreements with binding opinions on disconnection, which are submitted to the procedure by both the state authorities and the existing heat producer in the territory. Several well-known district heating projects based on renewable energy sources (e.g. using solar and geothermal energy) can thus be blocked in these strict procedures. An equally important issue for district heating is the energy performance of buildings and the question of what the building is heated with. A large proportion of buildings are currently still heated using fossil fuels. The aim should be that new or refurbished buildings (possibly constructed with more environmentally friendly materials) can be as energy self-sufficient as possible and produce as few greenhouse gas

emissions as possible. Consideration may be given to a higher level of installation of solar collectors, use of heat pumps, etc.

Finally, the issue of penalties for incorrectly issued energy certificates is often raised as a problem. The legislation on this issue is not clear.

The energy certificate is handed over at the time of building approval, i.e. at the time when the building has already been constructed. If the building does not meet the declared energy class in the design, the following risks exist.

The beneficiary may be administratively penalised. The Slovak Trade Inspection Authority may fine the building owner for misconduct. It cannot be ruled out that a professional examination of the person may also be initiated under Act No 138/1992 Coll. on Authorised Architects. It is also possible to order the authorised person to remedy the deficiency in the energy certification. The potential civil liability of the authorised person for such incorrect certification cannot be ruled out if the defective certification results in damage which would have to be proven in such a case.

The energy certificate is part of the decision issued in the construction procedure and therefore one of the grounds for its issue. It is appropriate to ask whether a defective certificate does not also render the entire decision defective. This legal question must be assessed on a case-by-case basis, taking into account the specific defect in the certificate.

No less, the question of liability for a defective energy certificate raises many questions and uncertainties among builders. It seems desirable that legal practice should respond to these inconsistencies and explicitly set out the limits of the potential liability of authorised persons.

4.1.4 Main recommendations

The main recommendations from a legislative and legal point of view include:

- consistent adjustment of the construction legislation, which contains a number of ambiguities hindering the process of (not only) sustainable construction;
- consistent transposition of the European Union directives, which in the field of thermal energy would enable heat producers and suppliers to make a smoother and faster transition to 4th generation DHS;
- allow for a greater possibility to implement renewable energy sources in the building sector and thus ensure greater energy efficiency of buildings;
- Clarify the legislation on energy certification in the field of energy performance of buildings.

4.1.5 Specific steps and measures needed to implement the recommendations

Specific steps include:

- In the area of building legislation, we recommend defining the possibility for cities and municipalities to set looser criteria in their spatial plans that would allow urban development qualitatively exceeding the previously established standards of sustainable spatial development, e.g. that municipalities and cities could set conditions in their spatial plans for the construction of carbon-neutral districts, construction of a high degree of sustainability (e.g. BREEAM and LEED), and that the spatial plan would be interpreted in favour of such construction;

- Ensure that the construction procedure is conducted fully electronically and, where possible, through form submissions, thereby eliminating the potential for non-transparent procedures in the procedure;
- amend the rules on participation in construction proceedings so as to allow for a more specific definition of the range of parties to the proceedings and to protect the proceedings from those who claim to be parties to the proceedings but are not entitled to the status of party;
- to elaborate in more detail the legal regulation on the elimination of contradictions in binding opinions, which is, in particular, complicated (multi-stage) and lengthy;
- complete the transposition of the directives of the so-called Winter Package so that heat producers and suppliers can more smoothly transition to the 4th generation CHP, which foresees the decentralisation of CHP, innovative solutions in the field of heat management, energy efficiency of buildings and the wide implementation of renewable energy sources;
- allow for an increase in the capacity to install small sources and local sources, clarify the legal regulation of the control of energy certification of buildings, in particular the legal regulation of the control of compliance with energy certification in the construction procedure and after construction has been carried out, introduce clear legal rules for the control of energy certification (who will carry it out) and the liability for violation of these rules;
- raise awareness (especially in the regions) of the need to move away from heating with solid or fossil fuels.

4.1.6 Conclusions

In conclusion, we refer to one of the decisions of the Supreme Court of the Slovak Republic (Case No.: 4Sžk/6/2016), according to which the reduction of the energy performance of buildings is in the public interest (Supreme Court of the Slovak Republic 2017).

If energy efficiency is defined by the courts as an area of public interest, it is necessary that the legislation is set in the same spirit. It is desirable that the legislation allows for greener projects in the building sector. The speed of these proceedings is also important, as is the need to eliminate inconsistencies in the procedural regulation of certain laws on construction and thermal energy (e.g. in the elimination of contradictions in binding opinions or in obtaining them). However, the speed of the procedure must in no case be at the expense of transparency and public information on the planned construction plans.

Table 8: Best practice examples - Slovakia

Example	Specification sources	Notes /
Transition from coal-fired DHS to 3rd generation DHS - Upper Nitra region (Slovakia)	At the end of 2023, the state subsidy programme for the production of electricity from domestic coal will come to an end. The Nováky coal-fired power plant will thus cease its operations in the Upper Nitra region, which has opened a debate on the future of heat production in this region. The project of the local company Prievdzské tepelné hospodárstvo, a.s. envisages the replacement of heat production from fossil fuels and its replacement by the 3rd generation of DHS, i.e. a new heat source that will produce heat more locally (closer to the customer), using solar energy and geothermal	From a legal point of view, this is an exceptional project where the two existing heat suppliers in the region have agreed on an arrangement whereby one of them will take over the production and supply of heat. The current legislation did not address a number of issues raised by this project. The project has thus exposed weaknesses in the legal regulation of thermal energy, particularly in terms of the lack of clarity of legal terminology, which causes the greatest confusion in the application of the law.

Example	Specification sources	Notes /
	<p>energy, and partly also gas. This is a greener and more economically attractive option for the inhabitants of the region, which is currently undergoing significant transformational changes following the announcement of the phase-out of mining activities.</p> <p>It is a unique project of its kind in the Slovak Republic. The Upper Nitra region will undergo significant changes in the coming years. Replacement of the current DHS based on brown coal combustion with a new heat source is a significant step forward. The town of Prievidza also has the potential to be an example of how the construction of a new DHS source can be implemented with the gradual implementation of 4th generation DHS elements in the future, in combination with the ongoing renovation of buildings.</p>	

4.2 J. Bendžalová: Legislative aspects of energy efficient buildings - challenges and solutions: the Slovak Republic and the EU

4.2.1 Introduction

The legislation has a major impact on enforcement of EU goals. Slovakia is in the process of implementing the EPBD 2018/844 / EU requirements and the European Commission presented a relatively fundamental revision of this directive in December 2021 [7]. The revision envisages stricter building requirements and greater use of national energy certificates for legal action, for the introduction of minimum energy standards (MEPS), ie the energy efficiency threshold from which a building will have to be renewed, or for green taxes.

Another important European legislative document, Regulation 2020/852 / EU on taxonomies for sustainable investments [5], will be needed to be implemented in the coming years. This important document will affect the operation of financial institutions and investment in general. Commission Delegated Regulation (EU) 2021/2139 [6] of 4 June 2021 supplementing Regulation (EU) 2020/852 of the European Parliament and of the Council refers to a large degree to energy demand (NZEB) in national legislation.

For both of the above reasons, national legislation has minimum requirements for construction and the entire environment, which is set out in the legislation on energy efficiency of buildings in Act no. 555/2005 Coll. on the energy performance of buildings [3], has a significant impact on achieving the carbon neutrality target.

4.2.2 Problem identification

Legislation is an important tool for influencing the construction sector. In the Slovak Republic, we are witnessing massive circumvention of legislation, its significance is often not properly understood. The aim should be not only to benefit, for example through tax instruments, efficient and sustainable solutions, but also to protect building owners and users. The pressure of investors

to reduce investment costs at the expense of operating costs for owners in the use of buildings is evident. In addition to coercive legislation, there is a need to improve public confidence and show that building requirements also protect their interests. There is a need for an objective presentation of costs over the life cycle of a building, taking into account future scenarios for the development of EU climate legislation and the consequences for owners of inefficient buildings.

4.2.3 Identification of barriers

The main barriers identified in the current legislation for energy performance of buildings in the Slovak Republic are:

- **Inconsistency of legislation**, division of competences between different ministries, incompetent and poor-quality draft legislation without impact analysis, bypassing the expert public in the development of legislation;
- **Insufficient funding for the development of national legislation**, technical regulations and neglect of the development and implementation of innovations (analysis, development of new methods, new tools and indicators, revision of minimum requirements in line with more ambitious EU targets);
- **Mitigating the level of minimum requirements for the EHB by changing legislation and technical standards** under pressure from investors and energy suppliers, instead of the tightening we have seen in the SR in recent years (changes in 2016, 2019, proposal in 2021). In order to set the requirements correctly, an in-depth analysis is needed before any change in legislation, as it has always been done in the past and as it is done in neighbouring countries;
- **Insufficient information content in the certificate, missing indicators** that are important for the owner, lack of confidence in the data that are included in the certificate, values far from the real energy consumption for various reasons (incorrect calculation, calculation not taking into account climatic differences within the Slovak Republic), not taking into account innovative solutions in the calculation of the EHB, missing indicators for indoor environment, cooling, EU green taxonomy, data on CO₂ production during the life cycle;
- **Poor quality of implementation** of legislation in practice, insufficient control of compliance with legislation, insufficient sanctioning and non-enforcement of remedies (e.g. failure to achieve the required energy class is not a reason for not approving a building);
- **Lack of education** of architects, designers and competent persons and the wider professional public (building authorities, regions, public procurement), information and awareness of building owners, awareness of the importance and benefits and demand for energy efficient and sustainable solutions;
- **Greenwashing**, the process of creating a false impression or providing misleading information about how products are greener, at different levels (e.g. primary energy factors for CHP, selling "green electricity").

4.2.4 The aim of the chapter

The aim of this chapter is not only to draw attention to the problems and risks in the current Slovak legislation, but also to outline solutions and new approaches to the creation of legislation in the Slovak Republic. EU legislation is currently in the process of introducing more ambitious climate protection targets for carbon neutrality by 2050. The related revision of EU legislation is an

opportunity to propose changes to Slovak legislation, which will have to implement changes in EU directives.

The most significant changes at EU level are the forthcoming revision of Directive 2010/31/EU on the energy performance of buildings and the Energy Efficiency Directive, as amended, and the introduction of Regulation No. 2020/852/EU on EU taxonomy for sustainable investment. The changes that will be introduced in 2022 will have a significant impact on the behavior of building owners (eg. decommissioning of inefficient buildings by introducing minimum energy standards, a carbon tax with an impact on energy prices), the financial sector and the building sector as a whole.

The result should be to influence legislation by promoting ambitious transparent requirements, innovative solutions using renewable energy sources and motivating them to increase environmental sustainability. EHB legislation addresses the following main areas, which are the subject of this chapter:

- building design, calculation, verification and prediction of energy savings
- EHB minimum requirements, definition of targets (NZEB level, carbon neutral buildings)
- confirmation of the achieved parameters by energy certification of buildings
- financial instruments for promoting the energy performance of buildings

4.2.5 Best practice examples, experiences

To meet the EU's 2050 targets, around 97% of EU buildings need to be refurbished by 2050, but only around 0.4-1.2% of the EU's total building stock is refurbished annually. The EU's increased ambitions for carbon neutrality will require not only stricter requirements for new buildings in the coming years, but also the introduction of new approaches that will significantly increase the pace of refurbishment of older inefficient buildings.

Some examples are already known today.

In 2019, France introduced a public policy for energy transformation in the non-residential buildings sector, to be implemented by the energy agency ADEME (Éco énergie tertiaire), which introduces an obligation to achieve certain% energy savings (40% in 2030, 50% in 2040 and 60% in 2050) or the required value of energy consumption in the building. A pragmatic simplified approach will be introduced, which will require a gradual reduction in energy consumption compared to the reference year (2010). Energy savings will be evidenced by measured energy consumption (energy bills). (Source: <https://aldren.eu/aldren-final-conference/>).

The City of London has been implementing the "Be seen" policy since 2021, a London energy plan with a motto for investors: either frugal, be clean, or be green, be seen. The main principle is to monitor energy consumption and report to the city at least five years after the completion of a new building or renovation through an online portal and online forms. (Source: <https://aldren.eu/aldren-final-conference/>).

The United Kingdom introduced legislation in 2018 requiring owners of the most inefficient private rental buildings to improve these properties with energy efficiency measures. Landlords who have Energy Class (EPC) certificates with an F or G rating cannot offer their properties for rent and cannot enter into new leases until improvements have been made. Following a consultation in December 2020, the government announced changes to the minimum energy efficiency standards

for England and Wales. The government has proposed that all leased properties will need an EPC rating of “C” or higher by 2025. As in previous changes, the new regulations will be introduced first for new leases, which will be followed by all leases from 2028. A similar system is proposed by the Commission for the revision of the EHB Directive as a minimum energy standard (MEPS in its proposal of 15 December 2021) (Source: <https://www.lettingaproperty.com/landlord/blog/epc-certificates-2022/#epc-requirements-changing-in-2020>).

For comparability of building levels and transparency of minimum building requirements within EU Member States, it would be appropriate to introduce a common European building assessment (**European Quality Standard**) based on European standards. Such an assessment is required by market participants, in particular building owners in different countries, as well as by the Commission. The EHB Directive therefore contains Article 11 (9) on a common European certification scheme. To motivate the renovation of buildings, a tool is needed that provides owners, financial institutions and public authorities with a reliable picture of the condition of the building or building stock. The EHB Directive therefore emphasizes the use of CEN standards for the calculation of EHB, the development of which has been funded by the Commission. A common European building assessment procedure based on European standards is also needed for the comparability and transparency of the level of stringency of the minimum EHB requirements, which are very different in the EU Member States today. **A common European next-generation Energy Certificate** with new indicators aimed at motivating the owner to renovate and with a roadmap for renewal to achieve NZEB and a carbon-neutral building to prevent the lock-in effect could be such a tool. An example is the ALDREN joint European certificate presenting the wider benefits of recovery (not only energy savings, but also the impact on health and the indoor climate, market value and economic benefits beyond energy savings (www.aldren.eu)).

4.2.6 Main recommendations

To truly increase energy efficiency and reduce greenhouse gas emissions, reliable legislative and technical instruments are needed that not only intend but also deliver on their promises.

The main recommendations for **the legislative process** are:

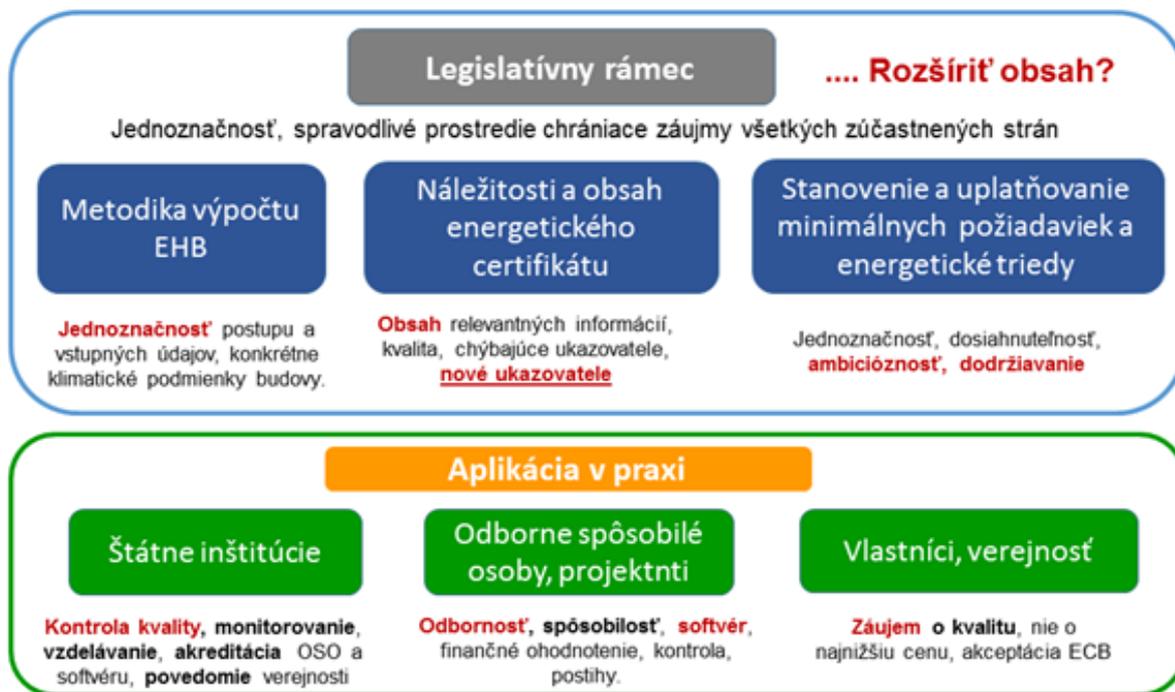
- harmonization of inconsistent legislative and technical regulations,
- deeper cooperation between the ministries responsible for EPB,
- quality technical studies and analyzes for changes in legislation, in particular for changes in the minimum requirements for EHB,
- involvement of the professional public in the creation and commenting of Slovak and European legislation.

The main recommendations for the technical implementation and innovation of the tools are:

- Creating a clear long-term strategy for the renovation of buildings, mobilizing investment in renovation
- Building Energy Certificates (ECB)
- Improving the quality of implementation of legislation in practice
- Awareness raising, education
- Creation of national legislation and technical regulations

The connection between legislation and implementation in practice is shown in Fig.1.

Figure 1: Legislative framework and its practical application



4.2.7 Specific steps and measures needed to implement the recommendations

Concrete steps in the near future should lead to the recommendations proposed in the previous chapters. They will also depend in detail on forthcoming changes in European legislation, in particular the revision of the EHB Directive, which, according to the first proposal (December 2021), will bring significant changes and significantly more ambitious requirements that Member States will have to incorporate into legislation. Thus, some of the proposed measures may become a direct requirement of the EHB Directive.

Specific recommendations for improvement are:

- Creating a clear long-term building renovation strategy, mobilizing investment for renovation, updating in line with the EU's more ambitious goals, including:
- increasing the stringency of the minimum requirements for new buildings. An increase in demands means a gradual reduction in the prices of materials and products. A more ambitious target level for building renovation will use the potential for savings through renovation (60-70% of non-renewable primary energy for office buildings, ALDREN, www.aldren.eu)
- tax instruments, green taxes, favoring efficient buildings and sustainable solutions
- obligation to renovate the worst buildings (MEPS - Minimum Energy Standards),
- reduction of rents for inefficient buildings - impact on the real estate market - planned and expected legislative changes in some countries are already reducing the market value of inefficient buildings
- introduction of a mandatory recovery roadmap for recovery in gradual steps from public finances to avoid the lock-in effect
- Consumer protection, correct setting of requirements with regard to costs during the use of the building (global costs), not favoring low investment costs (interest of developers, investors).

Building Energy Certificates (ECB):

- improving the quality and content of the ECB, strengthening the ECB's role by using financial instruments to demonstrate savings, presenting the wider benefits of recovery (not only energy savings, but also the impact on health, indoor climate, security and wider social and economic benefits beyond energy savings etc.), the introduction of new indicators, e.g. intelligent readiness indicator (SRI), internal thermal comfort. The new generation certificate should emphasize the practical indicators for the owner,
- harmonization with the EU, such as the Joint European Voluntary Certificate (ALDREN Horizon 2020 Research and Innovation Project),¹
- aligning the indicators in the energy certificate with the Level (s) environmental scheme and the EU taxonomy (Regulation 2020/852/EU), which provides a framework for sustainable investment and technical screening criteria requirements for a common definition of what is a sustainable investment and what is not. The technical screening criteria refer to national NZEB definitions and energy certificates to confirm the positive impact on climate change (draft delegated regulation), but some indicators are not reported in the Slovak ECB,
- increasing the quality, transparency and consistency of EHB calculations, by introducing accreditation of software that complies with CEN standards,
- extension of the assessment to groups of buildings with a common energy source (areas, neighborhoods),
- reduction of the difference between the calculated and actual energy consumption by calculation for specific climatic conditions, verification of the calculation model by the measured consumption (e.g. EPC RECAST project),²
- the introduction of a recovery roadmap for recommending step-by-step recovery measures,
- include energy for cooling in the energy performance assessment of residential buildings,
- include an assessment of carbon emissions throughout the building's life cycle.

Improving the quality of implementation of legislation in practice, control, sanction, correction:

- introduction of verification of declared EHB and declared savings measured by energy consumption, confirmation of savings after renewal with support from public sources measured by energy consumption (will positively affect the quality of calculation and also the quality of implementation)
- improving the method of control of energy certificates, introduction of control of specific professionally qualified persons, introduction of the obligation to perform certification in person by persons who have passed the examination and proved professional competence (similar to the activities of experts and interpreters according to Act No. 382/2004 Coll.)

Awareness raising, education

- **Education of professionals** and building owners with a focus on the correct design, calculation, optimization, implementation and proper use of buildings.

¹ More information: <https://aldren.eu/>

² More information: <https://epc-recast.eu/>

- Better awareness of sustainability, the fight against **greenwashing** (the process of creating a false impression or providing misleading information about how society's products are greener). Examples of misleading information are buildings connected to the DH in some parts of Bratislava (Dúbravka, Karlová Ves, Ružinov), which are almost all "Buildings with almost zero energy demand" (class A0) for politically determined low primary energy factors (fPE = 0, 21 - 0.28), according to Decree of Ministry of Economy No. 308/2016 Col. – <https://www.batas.sk/zakaznicka-zona/faktor-primarnej-energie>).

At least the following steps and measures should be ensured in the legislative process:

- **The development of national legislation and technical regulations has long been underfunded** compared to 2005-2016 (analyzes, development of new methods, tools and new indicators in line with the EHB Directive). There is a need to increase resources for technical and regulatory innovation.
- **Professional analyses and studies before any change in requirements.** The right setting of requirements is the basis for achieving the EU's goals, especially with regard to the longevity of structures and buildings and the risk of a lock-in effect in the event of an insufficiently ambitious renovation.
- **Involvement of the professional public** in the drafting of legislation, for example in the form of technical commissions, already at the stage of preparation of draft legislation. The involvement of the professional public at the stage of public comment is not sufficient.

4.2.8 Conclusions

Getting the legislation and requirements for buildings right is essential for achieving the objectives of the Slovak Republic and the EU, especially with regard to the longevity of structures and buildings and the risk of a lock-in effect in the case of insufficiently ambitious construction of new buildings and renovation of existing buildings.

The ambition is also to contribute to the extension of the legislation to new aspects, such as the assessment of neighbourhoods or groups of buildings and the introduction of indicators beyond energy savings, in particular with regard to the indoor environment, smart building readiness and the use of renewable energy sources.

We are now at a time when attitudes to energy efficiency and sustainability and the preferences of building owners and the public will change significantly as a result of the forthcoming European legislation under the Fit for 55 package, which EU Member States will have to implement in national legislation. The new legislation will both directly and indirectly penalise inefficiency and financially promote efficient solutions. Within the next revisions of the Slovak legislation on the energy performance of buildings, there will be an opportunity to implement many of the measures proposed above, in particular in the area of tightening the minimum requirements for EHB, the use of energy certificates as a tool to confirm the performance of a building and to demonstrate the savings achieved after renovation.

Owners' efforts to improve the energy performance of buildings will also be more proactive in the face of rising energy prices. It will be all the more important to create the right legislative conditions, sufficiently ambitious requirements and the right tools.

5. Main Recommendations

- **Awareness, education:**
 - Educate general public about the impacts of climate change.
 - Raise awareness on sustainable solutions advantages for the users (including renewable energy sources, CND etc.).
 - Improve the attitudes towards architecture, environment and sustainability from the young age.
 - Fight **greenwashing** (the process of creating a false impression or spreading misleading information about the ecological impact of the company's products).
 - **Educate** specialists and building owners with a focus on quality design, calculations, optimization, execution of the renovation and proper use of the buildings.
 - **Improve professional awareness and readiness of the architects** through specific education – formal, professional as well as informal; ensure that the syllabi for the formal education of architects are continually updated with the newest knowledge and introduce sustainable architecture topics in the professional education of architects through specific examples of best practices.

- **Urban planning:**
 - **Increase the flexibility of zoning plans** – introduce the option for towns and villages to set more flexible criteria in their local planning which would allow for higher quality urban development compared to the current standards of sustainable urban development.
 - Utilize the urban planning tools to provide for the development of compact settlements as well as integrated urban development; ensure that the conditions for new construction and land use are regulated, implement the climate protection measures.
 - Amend the regulation of districts, **including a requirement for common solutions** regarding the use of zero emission renewable energy sources, common waste management and water management systems, including the use of rainwater and waste water, common green areas, accessibility and zero emission transport within and into the district.
 - The state and municipal governments should **identify areas for the Carbon neutral district development** (e.g. brown-fields).

- **Public sector:**
 - apply the most recent information and technologies; place emphasis on the operational costs rather than the building construction costs.
 - As intended by the Davos Declaration (2018), implement the ideas of the high-quality construction culture (Baukultur).

- The state institutions and municipalities should lead by example and systematically apply principles of sustainable architecture to the renovation or construction of their buildings.
 - **Create a clear long-term strategy for building renovation including these measures:**
 - mobilizing investments into renovations
 - increasing the ambition of minimum requirements for new construction
 - making use of tax incentives, green taxes
 - offering preferential treatment to energy efficient buildings and sustainable solutions
 - introducing the obligation to renovate the least energy efficient buildings
 - restricting the rental of inefficient buildings
 - introducing compulsory renovation roadmap for renovation in successive steps for all publicly financed projects in order to prevent lock-in effect
 - and introducing consumer protection measures in relation to long-term benefits of sustainable construction.
 - Ensure systematic approach towards decarbonization as well as building renovations; establish **systematic energy planning**, which will be based on quality and stable planning and coordination infrastructure for developing sustainable regional energy policy including adequate state, regional and local capacities.
 - Establish so-called **Regional Centres for Sustainable Energy Policy** (Slovak acronym RCUE), which will focus mainly on optimizing energy use in the regions and supporting their self-sufficiency based on RES; ensure a stable financing of these centres and set up an effective organizational model in cooperation with other relevant bodies (Table 4).
 - On national level, strengthen existing capacities in the area of regional energy policy and allocate necessary capacities in the regions, at regional level, all regions require fully new capacities.
- **Financing:**
 - **Create transparent economic conditions** to support environmentally sustainable investments; ensure a transparent authorisation process, prevent all those who do not honour sustainable solutions from gaining any competitive advantages (e.g. by taxing).
 - The state and municipalities should set up a fair and straightforward program of financial and other incentives for initiatives leading towards CND solutions and motivate all interested parties and investors in their development.
 - Schemes offering financial subsidies should regulate energy producers and suppliers as well as motivate the users of buildings to chose energy from RES over fossil fuels; it is necessary to focus on removing barriers that prevent builders and investors from considerably increasing the use of RES in their projects.
 - **Improve the access of the building users to sustainable energy solutions** and raise awareness about the use of RES; increase economic incentives for the operators of district heating networks to increase the portion of RES within their supply.
 - **Legislative measures**
 - closer cooperation of the relevant ministries responsible for EPB.

- Align the inconsistencies in legislation and technical regulations, this process should be based on quality technical studies and analyses conducted for the purpose of legislative changes, especially in order to adjust the minimum requirements on the energy performance of buildings (EPB).
- In decrees implementing the Act no. 555/2005 Coll. of laws on energy performance of buildings (as amended) the **factors of primary energy** should be adjusted and update. These factors, especially in the case of DH systems, were politically set to levels not corresponding to their real emission factors due to their fossil source.
- **Rigorous and consistent transposition of the EU directives**; finalize the implementation of so-called Winter package directives so that the heat producers and suppliers could smoothly transfer to the DH systems of the 4th generation, which includes decentralization of DH systems, innovative solutions for the heating sector, improving energy performance of buildings as well as significant use of RES;
- The transposition of Clean Energy for All Europeans package should include an amendment to Act no. 657/2004 Coll. of laws on heat power industry in order to effectively pressure the current heat network operators to increase the ratio of RES and/or to integrate decentralized RES into their networks etc.
- Ensure that the administration of the **planning and construction approval procedures is fully electronic**, ideally through online form applications, in order to limit non-transparent activities.
- Amend the **legislation regulating participation in the construction approval procedures** in order to better specify the eligible participants and to protect the proceedings against subjects who demand to be a part of such proceedings even though they are not entitled to participate.
- Elaborate in detail the legislation on **eliminating contradictions** in the legally binding statements, which is currently too complicated (multi-staged) and lengthy.
- Amend and precisely specify **the legislation regulating control of energy certificates of buildings**, especially the legislation on inspecting the adherence to energy certification during the construction approval proceedings and after the building is completed
- Involve the expert community in drafting and commenting on the Slovak and European legislation, e.g. in form of technical commissions, from the moment the draft is being prepared.
- Introduce **checks for declared EPB as well as declared energy savings** by comparing the declared values **with the real energy readings**.
- **Confirm the energy savings after renovation** which was financed from the public funds **with the real energy readings** (this would positively influence the quality of calculations as well as the quality of renovation).
- **Improve the process of energy certificates inspections**, introduce the reviews of specific technically competent persons and introduce the requirement that the certification must be performed personally by the respective technically competent person.
- **Increase resources used for innovating technical and legal regulations.**

- **Energy performance Certificates (EPC)**
 - Improve the quality and contents of EPCs and strengthen their role in the financial instruments as a proof of energy savings; present more advantages of renovations (not only energy savings but also impact of human health, indoor climate, security as well as wider social and economic benefits on the top of energy savings).
 - Introduce new indicators, e.g. smart readiness indicator (SRI), indicator of indoor thermal comfort.
 - The new generation of EPCs should highlight indicators practical for the owner.
 - Increase the quality, transparency and consistency of the EPB calculations.
 - Introduce **software accreditation** to prove a compliance with the CEN standards.
 - Broaden the evaluation to **groups of buildings with a common energy source** (neighbourhoods, districts).
 - Decrease the **difference between the calculated and real energy consumption**.
 - Implement **renovation roadmap**; include energy demand for **cooling** in the EPB assessment of residential buildings.
 - Include the evaluation of the greenhouse gas emissions during the lifecycle of the building.
 - Align the indicators in energy certificates in the Slovak legislation with the environmental scheme **Level(s)** as well as the **EU taxonomy** (Regulation 2020/852/EU).

6. Conclusions

Slovakia has committed itself to achieve carbon neutrality by the year 2050 on several levels: international (The Paris Agreement), European (The European Green Deal) as well as national (targets within the Low Carbon Strategy of the Slovak Republic Until 2030 With a View to 2050). In what way can the building sector contribute towards achieving these goals? Buildings, which are responsible for a considerable portion of energy consumption and greenhouse gas production, provide also significant energy saving and mitigation potential. Therefore, transformation of the construction sector is crucial for fulfilling the carbon neutrality targets.

This analysis points out the main problems, challenges and barriers for sustainable construction preventing a swift transformation of this sector in Slovakia. It provides recommendations and solutions, which have the potential to help achieve the carbon neutrality goals. Information and findings included in this analysis could contribute to drafting conceptual, strategic and program documents as well as legislation.

Based on the analysis, we can conclude that in the area of architecture, it is crucial to focus on education, urban planning and mechanisms, which will incentivize sustainable solutions. In the energy sector, we need to concentrate on implementing the principle Energy efficiency first. Transformation of this sector will not be possible without transferring competencies to the regions along appropriate financial resources and building regional capacities. In the area of law, certain decisions have been adopted, which present an important precedent for future legal cases. Among those is a decision acknowledging decreasing energy intensity of buildings as "a crucial public interest". In the legislative area, it is important to ensure proper transposition of EU directives and to ensure their enforcement.

Sustainable construction is a cross-cutting topic, which touches several issues (energy performance of buildings, efficiency of the technical systems, district heating networks, renewable energy sources, etc.), for which different ministries and governmental institutions are responsible. For the transformation to be possible, it is utmost important that these institutions cooperate with one another and effectively coordinate their activities in order to achieve the common goal.

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