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CLASSIFICATION OF METHODS TO REDUCE THE CARBON FOOTPRINT

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ABSTRACT

The ever-increasing amount of greenhouse gases in the atmosphere has an adverse impact on the environment, causing global warming and related adverse effects. One of the most important greenhouse gases is carbon dioxide, the production of which is perceived as a carbon footprint. The carbon footprint is intended to be a tool for appropriate emission reductions and verification, so there is a great need for its standardization at the global level. In carrying out basic research and after working out the advantages and disadvantages, many methods of decarbonization have been identified. The author believes that by simplifying the classification of carbon footprint reduction approaches into appropriate classes, a clear tool guiding companies in decarbonizing their operations will be created so that the negative impacts of global warming on the Earth are averted as quickly as possible. The aim is, therefore, to identify similarities and differences in methods, which will lead to the identification of new main groups of approaches. Within the framework of the evaluation and after making a comparison according to selected aspects of intensity, seven basic approaches have emerged, thus achieving greater clarity, usability, and better orientation for companies on the issue of reducing their carbon footprint. The results are illustrated at the end of the paper. The least challenging method for low-carbon technology adoption is the promotion of education and dissemination of climate impact awareness. Conversely, the most challenging method appears to be the construction of new green buildings.

Keywords: Advantages; Carbon footprint; Classification of ways; Comparison; Disadvantages.

1 INTRODUCTION

The warming of the Earth in the 20th and 21st centuries is increasingly causing climate change. Greenhouse gases, either directly or indirectly, are being released from virtually every activity. These activities are varied, for example, food or transport, etc. The cause of the Earth‘s greenhouse effect is due to the large production of harmful gases. These are mainly carbon dioxide (CO_2), the production of which is called the carbon footprint; other gases are nitrous oxide (N_2O) and methane (CH_4). They are mainly produced in the following four processes – the combustion of fossil fuels and biomass, industrial production, waste storage, and the anaerobic decomposition of organic matter.

The carbon footprint is a measure of the impact of human activity on the environment and, in particular, on climate change. The carbon footprint is (like the ecological footprint) an indirect indicator of the consumption of energy, products, and services. It measures the number of greenhouse gases that correspond to a particular activity or product. [1] The carbon footprint can be determined at different levels – national, city, individual, enterprise, and product. In simple terms, the carbon footprint is the amount of carbon dioxide and other greenhouse gases released during the life cycle of a product or service, the operation of a household, during transport, etc. [2].

Reducing the carbon footprint is currently a hot topic, not only in the economic and environmental environment but also in the media sector. The concept of a low-carbon economy has emerged as a result of an active response

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to global climate change and the effective control of greenhouse gas emissions, the reduction of carbon dioxide emissions in particular. In this context, many new concepts and policies have emerged, including ‘carbon footprint’, ‘low-carbon production’, ‘low-carbon development’, ‘low-carbon living’, etc.

Despite the emergence of new concepts and a number of benefits, decarbonization has several drawbacks. These include barriers to the implementation of carbon footprint reduction in businesses. Barriers to uptake can be: political, economic, social, technological, and environmental.

Reducing energy and greenhouse gas emissions is now a major challenge for communities around the world. In their book, Franchetti and Apula [3] describe up-to-date technical information and practical guidelines for measuring and reducing energy and GHG emissions and provide an overview of the necessary background as well as systematic tools and practices for organizations to measure and reduce their carbon footprint and begin to adapt to a carbon-constrained world.

Terms such as environmental protection or sustainable development are increasingly being used. In an effort to reduce the impact of human activity and gradually repair the damage to the environment, legislation is being developed around the world. Tinsley [4] writes about the issue of implementing environmental management systems. In the transition to a low-carbon economy, it is an important support for companies. Urban and Nordensvard [5] discuss the key conceptual, empirical, and policy-related issues of low-carbon development and take an international and interdisciplinary approach to the topic, drawing on insights from the natural and social sciences. Dzikuć and Dzikuć [6] present the economic determinants of low-carbon development, assessing the environmental effectiveness of currently used solutions in energy, industry, and other sectors of the economy that have a negative impact on the environment. They also discuss the potential of renewable energy sources, which are an important element in the development of low-carbon technologies.

In the Czech Republic, CI2, o. p. s., has been significantly involved in the issue of reducing the carbon footprint. Khajlová, Pavelčík, and Petrucha [7] present to Czech businesses how foreign companies are responsibly addressing climate protection within their corporate strategy, how they are successfully implementing climate protection policies, and what specific measures they are implementing to reduce their carbon footprint. Last but not least, it shows how these companies disclose their positions on this issue and communicate with their customers, suppliers, or other stakeholders. Březovská and Novák [2] write about the means of offset projects whose main purpose is to reduce carbon emissions. How to proceed with the inventory of greenhouse gases related to production or business activities is addressed and presented to business representatives by Třebický in his clear guide [8].

The transition to new, cleaner technologies, as Davidová [9] points out, presents an opportunity for new investments, for example, in industrial equipment or infrastructure. Efforts to reduce dependence on new materials (i.e., the pursuit of a circular economy) will encourage innovation and open up new market opportunities. Reducing imports of fossil fuels from abroad will contribute to a better trade balance and energy self-sufficiency. As regards the competitiveness of our products on the international market, decarbonization of their production can also bring opportunities rather than threats.

A large number of research teams in academia are incorporating the issue of decarbonization into the development of teaching aids, and many research papers are emerging from them, but the classification of approaches into groups is explored very rarely. To prevent poor decisions by companies, which can often have fatal consequences, to simplify the navigation of all the different procedures, regulations, measures, or laws, and to avoid the impacts of global warming on the Earth as quickly as possible, the author believes that by classifying and simplifying decarbonization approaches into appropriate classes, a clear tool suitable for use in companies will be created. It will be particularly useful in companies that are finding the issue of reducing their carbon footprint difficult to navigate, or in companies that are not currently taking any action, although it is clear that if they want to continue to remain relevant, they will need to take action and decarbonize their operations in the near future.

2 METHODOLOGY

There is a significant number of methods to reduce the carbon footprint of businesses, but not all are suitable for every type of business. In particular, small and medium-sized enterprises can get by with a limited number of classification classes, as a large number of methods could make them difficult to navigate and thus not have the

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desired effect. The main objective of the paper is to describe, classify and simplify the classification of carbon footprint reduction methods into the relevant classes. The aim is, therefore, to find similarities and differences between methods that will lead to the identification of new main groups of methods. The advantages and disadvantages of reducing the carbon footprint are an important support, and these are presented subsequently in the evaluation section of the paper. The aim of the paper is developed through the research question, which is posed as follows: 'Are companies familiar with the classification of carbon footprint reduction methods? Which ones are most suitable for use in small and medium-sized industrial enterprises?" In addition to the advantages and disadvantages of reducing carbon footprint, one of the multi-criteria decision-making methods, namely the ranking method, will be used to meet the described objectives.

The methodological part of the paper will first briefly describe the issue of multi-criteria decision-making, which is the basis for determining the complexity of selected methods for implementing carbon footprint reduction in enterprises. Specifically, the ranking method will be used. In the following sections of this paper, the new main classification of carbon footprint reduction methods will be described. Based on the knowledge gained from academic sources and articles, a total of seven groups emerged and were compared according to five aspects. The main classes are briefly characterized individually in subsection *2.2* below. It is these aspects that are closely linked to the issue of reducing the carbon footprint and therefore have one of the biggest impacts in the considered transformation to a low-carbon economy. The chapter aims to introduce the reader to the basic multi-criteria method used in the results chapter and to present the different methods selected for the classification of carbon footprint reduction.

2.1 Multi-criteria decision making

Multi-criteria decision-making is a discipline of operations research that deals with the analysis of decision situations in which decision options are evaluated according to not just one but several, usually conflicting criteria. There are several methods for multi-criteria option evaluation. These methods are general, independent of the content of the decision options, and therefore it is possible to use the same methods to determine the preference ordering of substantively different options.

The evaluation of the options according to each criterion can be in different units and on different scales. It is then important to transform the input information into comparable units to allow aggregation across all criteria. This is made possible by scales and scales, which are among the simplest methods of multi-criteria evaluation.

Methods using scales and scales can be used in the context of expert judgement in the evaluation of public projects. Their advantages include their relative simplicity in evaluating alternatives. Disadvantages include the fact that these procedures do not distinguish between the importance of different criteria. Perhaps only when using an interval scale can we infer the magnitude of preference from the difference in values between two alternatives. The shortcoming that the scales do not distinguish between the importance of the criteria, can then be addressed by expressing preferences between the criteria.

Clearly, the use of scales and scales alone encounters a shortcoming of evaluation in that they do not respect the importance of the criteria. Information about the importance of criteria can be expressed, for example, in cardinal form using criteria weights [10].

2.1.1 Ranking method

This method only requires the evaluator to rank the criteria in order of importance. The most important criterion is assigned a value *k* (*k* is the number of criteria), the second criterion *k-1*, and the least important *1*. If we denote the value assigned to the *i-th* criterion by p_i, then an estimate of the weight of this criterion can be obtained using the following relation:

$$v_i = \frac{p_i}{\sum_{i=1}^{k} p_i}, \qquad \textbf{(1)}$$

where

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$$\sum_{i=1}^{k} p_i = \frac{k\,(k+1)}{2}\,.\,[10] \qquad \textbf{(2)}$$

In our particular case, the individual numerical weights range from one to seven, with the most important difficulty weight being the highest number, namely *7*, and the lowest weight is *1*. The classification of the individual weights is based on the knowledge gained by the author from peer-reviewed scientific articles that deal with research on the issue of carbon footprint reduction. These publications are included in the research of the article. The results and classification of the individual weights are subsequently presented in Section *3.2*.

2.2 Classification of ways to reduce the carbon footprint

In this part of the article, the basic classes of carbon footprint reduction classification will be described. The classification system consists of seven methods – they will briefly be characterized in the subsections below.

2.2.1 Reduction of energy consumption

Gross consumption of primary energy resources equals the sum of natural resources, imports, quantities drawn from stocks and other sources, minus exports, quantities supplied to stocks, and other losses. [11]

By definition, final energy consumption is the consumption of fuels and energy captured before entering the appliances in which it is used for the final utility effect and not for the production of other energy (excluding secondary energy sources). De facto, final energy consumption indicates the last metered (billed) energy. [12] The consumption of energy produced from fossil fuels (coal, natural gas, oil, and others) makes up a significant part of the carbon footprint, so it is imperative to limit or reduce this production. [8]

2.2.2 Electromobility

It includes all means of transport that use electricity to operate and, thus, have less impact on the environment. There are electric cars, scooters, motorbikes, but also bicycles, scooters, or even hoverboards.

Slowly but surely, electromobility is expanding not only abroad, but also in the Czech Republic. At the end of 2021, there were over 8,500 electric cars in the Czech Republic that could charge at more than 1,800 charging points. It is the charging stations that are growing and making it easier for drivers to travel. By the end of 2022, there should be over 2,000 of them in the Czech Republic. [13]

2.2.3 Replacing fossil fuels with renewables

According to the study, the share of intermittent renewables, i.e., photovoltaic and wind power plants, in net electricity generation will reach almost one quarter of electricity by 2030 and up to 36 % in 2050. [14]

The change we need is to stop burning fossil fuels – coal, oil, and gas – as quickly as possible. We must replace them with less energy and renewable sources, especially electricity from the sun and wind. “The ‘decarbonization’ of electricity generation is, among other things, a prerequisite for reducing emissions in other areas, particularly transport, and heating in buildings, where large-scale electrification is needed.” [15]

2.2.4 Minimising waste production

In simple terms, municipal waste can be divided into mixed municipal waste and sorted waste. Mixed municipal waste cannot be sorted further and ends up in a landfill or an energy recovery facility. Sorted municipal waste first passes through a sorting line or goes directly for processing (paper, glass) and is then processed as much as possible in material recovery facilities.

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To protect the environment and conserve primary resources, it is inevitable to try minimizing the production of all types of waste, regardless of whether they are recyclable. Although recycling of sorted components helps to manage waste efficiently, it is an energy-intensive process, and it is not possible to recycle all of it. Even processing it generates additional waste that ends up in a landfill or an energy recovery facility. [16]

2.2.5 Construction of new green buildings

Green, environmentally friendly, ecological, or sustainable construction refers to the process by which buildings are designed and subsequently constructed in accordance with the environment. The aim is to reduce the negative impact on our planet while providing an adequate level of comfort for the occupants of the home.

Buildings are responsible for 38 % of the world‘s CO_2 emissions, and we spend about 90 % of our lives in them. For a building to achieve the green building label, it must meet certain criteria across several areas. These include: reducing the consumption of utilities (especially energy and water), minimizing waste, preserving green spaces in the landscape, improving health, and ensuring the comfort of the occupants. [17]

2.2.6 Production process innovation

It is not only the product itself that is subject to innovation but also production processes, management, and all activities related to the operation of the company. In today's markets, the importance of innovation is growing rapidly, and this is mainly due to two reasons. The first is the saturation of most contemporary markets, which limits firms from further sales growth. The second reason is that innovation enables a firm to strengthen its market position. [18]

The European Union considers process innovation to be a change that accelerates and improves the ways we design, develop, produce, and introduce new products, production processes, and services into the production of enterprises. [19]

2.2.7 Promoting education and awareness of climate impacts

Within the scope of expertise, organize regular training of employees or the public with regard to environmental issues, risk assessment, planned actions, and implementation of environmental standards and measurements. [7]

Climate education leads to the understanding of ongoing climate change, its natural and societal causes, and potential consequences at local, national, and global levels. It helps people to engage in climate protection and the overall transformation of society towards a climate-just society with zero greenhouse gas emissions by 2050. [20]

3 RESULTS AND DISCUSSION

The result chapter first presents the main advantages and disadvantages of reducing the carbon footprint, as they are an important basis for evaluating the methods. In the following subsection 3.2, the author proceeds to the method evaluation, dividing them into seven classes in terms of selected intensity aspects. The main output is a comparison table that presents a total of five selected demands. These are time, ecological, financial, personnel, and technological. The results were obtained and influenced mainly by data from books and articles dealing with the issue under study, which are a part of the article research. Thanks to the obtained data, it was possible to create a comparative table of demands and move the newly acquired knowledge to further professional research.

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3.1 Advantages and disadvantages of reducing the carbon footprint

The following table lists the main advantages and disadvantages of reducing the carbon footprint. The starting point for determining them was an expert article by Bacher [21] in which the pros and cons were examined. All the examples of advantages and disadvantages of reducing the carbon footprint were further detailed in the article. The basic breakdown is given below.

Table 1. *Reducing the carbon footprint – advantages and disadvantages [21]*

ADVANTAGES	• We can slow down global warming; • Assurance of livelihood for many people worldwide; • We can save many species from extinction; • Increase of attention of the general public; • An incentive for companies to invest in R&D; • Carbon offsets will speed up technological progress; • Crucial for sustainable development; • Efficiency improvements; • Fair distribution of social costs related to greenhouse gas emissions; • Important for the energy transition process; • Puts pressure on industries to behave eco-friendlier; • Eco-friendliness and profit maximization goals are aligned better; • Companies can improve their public image; • A simple way for companies to offset their carbon emissions; • Carbon offsetting might give you a good feeling.
DISADVANTAGES	• May increase product prices; • Lower company profits; • Higher unemployment rates; • Some companies may go out of business; • Expert knowledge is required; • Incorrect setup may lead to flawed incentives; • Effectiveness of carbon offsetting varies across industries; • Plenty of controls necessary; • High administrative costs; • Significant certification costs; • Carbon offsetting will often be not enough; • People may get the feeling that it is ok to emit large amounts of carbon; • Carbon compensation programs may rather be non-transparent.

It can be seen from the table that due to the advantages and disadvantages of reducing the carbon footprint, there are different advantages and disadvantages associated with each method, and, therefore, each classification group will have different pros and cons for different businesses.

3.2 Evaluation of carbon footprint reduction methods according to selected aspects of intensity

Based on the evaluation of the advantages and disadvantages of reducing the carbon footprint and the characteristics of the respective methods, a comparison table of the selected intensities was derived. The intensity is evaluated using multi-criteria decision making, specifically the ranking method. The following table shows the results of the evaluation.

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Table 2. *Classification of carbon footprint reduction methods by intensity*

Item	Intensity					TOTAL	RANK
	TIME	ENVIRONMENTAL	FINANCIAL	PERSONNEL	TECHNOLOGICAL		
Reduction of energy consumption	2	6	3	4	3	**18**	**5.**
Electromobility	6	2	5	7	4	**24**	**3.**
Replacing fossil fuels with renewables	5	7	6	2	6	**26**	**2.**
Minimising waste production	1	5	2	3	1	**12**	**6.**
Construction of new green buildings	7	4	7	6	5	**29**	**1.**
Production process innovation	4	3	4	5	7	**23**	**4.**
Promoting education and awareness of climate impacts	3	1	1	1	2	**8**	**7.**

The comparison table compares the selected methods for reducing the carbon footprint in terms of different intensities. Time, ecological, financial, personnel, and technological requirements were selected. After assigning values from one to seven to the selected intensities, the table shows that the method with the lowest intensity value is the one of promoting education and spreading awareness of climate impacts. On the other hand, the method of construction of new ecological (green) buildings emerged as the most demanding, according to the resulting sum.

Although the reduction of energy consumption and minimization of waste production are considered to be among the most important measures in the fight against climate change, these two important items ranked fifth and sixth, respectively, in the comparison table according to the selected intensity. This fact can be explained by the statement that it is for these two items that it is important how environmentally responsible a company, business, or individual behaves. It is desirable to protect the environment, but it is also within the capacity of each company or individual to minimize waste production or reduce energy consumption, which is why these two items finished so low in the comparison table.

Although our analysis resulted in the winning method, i.e., the most demanding, for the construction of new green buildings, it should be considered that the issue of evaluating approaches according to demandingness is currently not sufficiently researched. However, according to the established facts about the carbon footprint, this result is in line with the research already carried out. The author intends to address the lack of research on the evaluation of approaches to reducing the carbon footprint further in his dissertation. However, for this, a primary survey of businesses needs to be carried out to determine whether the majority of businesses perceive the evaluation of carbon footprint reduction approaches by the intensity in the same way, or whether variations, either minor or major, will arise.

These results may therefore seem somewhat surprising. It is important to mention that the resulting values and rankings may differ because the selected approaches were evaluated by the author alone according to their difficulty. However, in a more thorough research, which would definitely be more time-consuming, the author believes, with the acquired knowledge of the given issue from professional sources (listed in the article's research) and after determining the procedures in the comparison table, that in the case of a higher number of evaluation team members, the differences in the final ranking would be minimal or none.

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4 CONCLUSION

The fundamental issue of human impacts on the environment and their consequences is no longer only addressed in academia. Increasingly, the issue is also being encountered by the general public. Therefore, it can be said that limiting the negative impacts of human behaviour is "a classic case of conflict between personal desires and interests that conflict with the general need for society to protect the environment for the generations that come after us." [22]

A limited carbon budget, driven by the need to keep the increase in global warming below 1.5 °C, means that the longer we delay the implementation of decarbonization measures, the faster the pace of decarbonization scenarios we must choose in the future. Tackling climate change is, therefore, the challenge for the next decade, as global greenhouse gas emissions must be on a clear downward trend by the end of the 2020s to achieve net zero by 2050.

The paper classified the methods of carbon footprint reduction into relevant classes. The methodological part of the paper was devoted to the classification of seven main decarbonization classes that help accelerate the transition to low-carbon sources that will reduce environmental impacts. A search of academic articles and publications on carbon footprint, low carbon technologies, and low carbon economy was conducted. There is a large body of literature on the subject, mainly from international authors, as reducing energy and greenhouse gas emissions is now one of the major challenges facing communities around the world.

The main objective of the paper was to describe, classify, and simplify the classification of carbon footprint reduction methods into relevant classes. The starting point for comparing the intensity of the selected methods was to define the advantages and disadvantages of reducing the carbon footprint. These may vary from company to company, and therefore differences will arise. To describe, classify, and compare, etc. these differences, it seems appropriate to carry out a primary survey among enterprises. A questionnaire will be sent to the industrial enterprises to identify the differences and propose appropriate carbon reduction approaches. Thanks to the data obtained, it will then be possible to take the newly acquired knowledge forward for further professional research.

REFERENCES

[1] Co je uhlíková stopa [What is a carbon footprint]. *CI2* [online]. [acc. 2023-02-09]. Available at: https://ci2.co.cz/cs/co-je-uhlikova-stopa

[2] BŘEZOVSKÁ, R. and J. NOVÁK. *Kompenzace uhlíkové stopy chytře. Offsetování emisí skleníkových plynů v České republice [Offsetting your carbon footprint smartly. Offsetting greenhouse gas emissions in the Czech Republic]*. Rudná: CI2, 2018. ISBN 978-80-907362-0-7. Available at: https://ci2.co.cz/sites/default/files/souboryredakce/ci2_kompenzace_uhlikove_stopy_preview_0.pdf

[3] FRANCHETTI, M.J. and D. APUL. *Carbon Footprint Analysis. Concepts, Methods, Implementation, and Case Studies*. CRC Press, 2012. ISBN 978-14-398-5783-0.

[4] TINSLEY, S. *Environmental Management in a Low Carbon Economy*. Routledge, 2014. ISBN 978-04-158-5550-1.

[5] URBAN, F. and J. NORDENSVARD (eds.). *Low Carbon Development. Key Issues*. Routledge, 2013. ISBN 978-04-155-3901-2.

[6] DZIKUĆ, M. and M. DZIKUĆ. The Analysis of Low-carbon Development of Czech Republic Economy. In: *Proceedings of the International Scientific Conference Hradec Economic Days 2020: April 2–3, 2020, Hradec Králové, Czech Republic*. 2020, vol. 10(1), pp. 114–123 [acc. 2023-02-09]. ISSN 2464-6067. DOI: 10.36689/uhk/hed/2020-01-013

[7] KHAJLOVÁ, V., P. PAVELČÍK and D. PETRUCHA. *Mezinárodní dobrá praxe jako inspirace. Klimaticky odpovědné podnikání v mezinárodní praxi [International Good Practice as Inspiration: Climate-Responsible Business in International Practice]*. Rudná: CI2, 2016. ISBN 978-80-906341-2-1. Available at: https://ci2.co.cz/sites/default/files/souboryredakce/mdpraxe_final_vystup.pdf

[8] TŘEBICKÝ, V. *Metodika stanovení uhlíkové stopy podniku a postup pro její snížení [The Methodology for Determining a Company's Carbon Footprint and a Procedure for Reducing It]*. Rudná: CI2, 2016. ISBN 978-80-906341-3-8. Available at: https://ci2.co.cz/sites/default/files/souboryredakce/metodika_final_vystup.pdf

[9] DAVIDOVÁ, K. Přechod na nízkouhlíkovou ekonomiku se vyplatí i České republice [The transition to a low-carbon economy will also pay off for the Czech Republic]. *Europeum* [online]. 4.11.2019 [acc. 2023-

02-09]. Available at: https://www.europeum.org/articles/detail/3069/prechod-na-nizkouhlikovou-ekonomiku-se-vyplati-i-ceske-republice
[10] SOUKOPOVÁ, J. Vícekriteriální metody hodnocení. [Multi-criteria assessment methods.] In: *Veřejné zakázky a veřejné projekty a jejich hodnocení* [online]. Brno: IS MUNI, 2013 [acc. 2023-02-09]. Available at: https://is.muni.cz/el/1456/jaro2013/MKV_VZVP/um/33149329/Studijni_text_metody_vicekriterialniho_rozhodovani.pdf 10
[11] 16. Průmysl a energetika. [16. Industry and energy.] In: *Statistická ročenka České republiky – 2005* [online]. Praha: Český statistický úřad, 2005 [acc. 2023-02-09]. Available at: https://www.czso.cz/csu/czso/10n1-05-_2005-energetika___metodika_b
[12] HRUBÝ, O. *Územní energetická koncepce hl. m. Prahy (2003–2022). Příloha 1: Energetická bilance – Současný stav [Territorial energy concept of the city of Prague (2003–2022). Annex 1: Energy Balance – Current Status]*. In: Praha, SEVEn, 2003. Available at: https://portalzp.praha.eu/public/a0/88/52/1700408_422100__1_EnBilanceS.pdf
[13] POHŮDKA, P. Elektromobily v Evropě 2022: Cena je stále vysoká. Srovnání zemí a jak je na tom Česko. [Electric cars in Europe 2022: The price is still high. Comparison of countries and how the Czech Republic is doing]. *E15* [online]. Praha, Czech News Center, 2022, 8. 10. 2022 [acc. 2023-02-09]. Available at: https://www.e15.cz/byznys/doprava-a-logistika/elektromobily-v-evrope-2022-cena-je-stale-vysoka-srovnani-zemi-a-jak-je-na-tom-cesko-1393535
[14] MAJLING, E. Infografika: Jak si představuje energetiku v roce 2050 Evropská unie? [Infographic: How does the European Union envision energy in 2050?] *O Energetice* [online]. Třebíč: OM Solutions, 2016, 24. 11. 2016 [acc. 2023-02-09]. Available at: https://oenergetice.cz/slug/energetika-2050-podle-evropske-unie
[15] PATOČKA, J. Jak pohřbít fosilní průmysl a nahradit jej energetikou budoucnosti [How to bury the fossil fuel industry and replace it with the energy of the future]. *Deník Referendum* [online]. Brno: Referendum, 2020, 22. 4. 2020 [acc. 2023-02-09]. Available at: https://denikreferendum.cz/clanek/31093-jak-pohrbit-fosilni-prumysl-a-nahradit-jej-energetikou-budoucnosti
[16] Nakládání s odpady [Waste management]. *Sociálně odpovědné veřejné zadávání* [online]. Praha: MPSV, 2022 [acc. 2023-02-09]. Available at: https://www.sovz.cz/predmety/nakladani-s-odpady/
[17] HABRNÁLOVÁ, E. „Zelené budovy" a jejich výstavba. ["Green buildings" and their construction] *Rockwool – Bydleni ve vate* [online]. 2022 [acc. 2023-02-09]. Available at: https://bydlenivevate.cz/inspirace/zelene-budovy-a-jejich-vystavba/
[18] BOUČKOVÁ, J. *Marketing*. Praha: C.H. Beck, 2003. Beckovy ekonomické učebnice. ISBN 80-7179-577-1.
[19] Turning Europe into a true Innovation Union. *European Commission* [online]. 2010 [acc. 2023-02-09]. Available at: https://ec.europa.eu/commission/presscorner/detail/fr/MEMO_10_473
[20] DANIŠ, P. (ed.). *Klima se mění – a co my? Proč a jak se učit o změně klimatu [The Climate Is Changing – What About Us? Why and How to Learn About Climate Change]*. Praha: Ministerstvo životního prostředí, 2021. ISBN 978-80-7212-652-1. Available at: https://www.greenpeace.org/static/planet4-czech-republic-stateless/2021/08/66dbe12d-klima-se-meni-a-co-my.pdf
[21] BACHER, A. Advantages & Disadvantages of Carbon Offsetting. *Environmental Conscience* [online]. 2020 [acc. 2023-02-09]. Available at: https://environmental-conscience.com/carbon-offsetting-pros-cons/
[22] BANISTER, D. Cities, mobility and climate change. *Journal of Transport Geography*. 2011, vol. 19(6), pp. 1538–1546. ISSN 1873-1236. DOI: 10.1016/j.jtrangeo.2011.03.009