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Green Buildings for Greening Supply Chains – Selected Organisational and Legal Solutions on the Polish Commercial Warehouse Space Market

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Abstract:

Purpose: *The main objective of this article is to determine the conditions and current state of development of selected organisational and legal solutions relating to the greening of resources in the commercial warehouse space market in Poland, taking into account international trends, applicable legislation and expectations of entities operating within Green Supply Chains.*

Design/Methodology/Approach: *To achieve the main objective of the article, mostly secondary sources of information were used. Literature on Green Supply Chains, Green Supply Chain Management and on Green Buildings was analysed. In addition, the study used data from consultancies and real estate agencies on the development of the commercial warehouse space market in Poland. In order to achieve the objective, annual reports of the Polish Green Building Council on sustainable, certified buildings were utilised. An in-depth analysis of a number of reports by national and international institutions on the real estate market and its legal solutions was also carried out. The author also analysed selected legal acts concerning the subject issue.*

Findings: *The results of the survey indicate that the market for commercial warehouse space in Poland is developing dynamically. As the years go by, there is a growing interest on the part of tenants operating within the structures of various supply chains in leasing warehouses with green solutions - buildings certified under multi-criteria certification systems. This is also due to EU regulations coming into force. This is also being followed by the introduction of green leases and green clauses in the commercial space market (especially office and retail space). There are various types of such clauses. Due to the specific nature of the commercial industrial and warehouse space market, green lease agreements undoubtedly also have great potential for development here.*

Practical Implications: *An analysis of secondary sources made it possible to identify practical implications for the development of the commercial warehouse space market in Poland in the context of the need to green its stock. Attention was drawn to the development of the stock of certified facilities and popular certification schemes, in addition to suggestions from experts regarding the likelihood of modifying certification criteria to meet new legal requirements. At the same time, other possible practices that market participants can reach for, such as the use of green lease agreements, were pointed out. This approach is important for the various stakeholders in the commercial warehouse space market to look for*

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new solutions for the future, in view of the intensification of environmental requirements in cooperation in supply chains.
Originality/Value: *This article attempts to identify ways of greening the market for commercial storage facilities in Poland, taking into account selected organisational and legal solutions. This approach, which has the character of a specific case study of Polish market conditions, is intended to contribute to enriching the literature on the subject with theoretical and utilitarian aspects.*

Keywords: *Green Supply Chain Management, Green Building, Warehouses, Green Certification, Green Lease Agreements.*

JEL Classification: *D49, K29, L89.*

Paper type: *Research paper.*

1. Introduction

The greening of supply chains, i.e., the incorporation of environmentally friendly solutions into their operations, has become increasingly important. This is mainly due to the implementation, in various spheres of economic activity, of a number of legal regulations in the area of environmental protection and sustainable development. Under EU conditions, entrepreneurs are (or will soon be) subject to regulations that create a system of regulations within the framework of, among others, the introduced European Green Deal and impose a number of new obligations on them.

The subject of this article is the issue of warehouses used in logistics, which play an important role in the path of product flow in the final stage of supply chains. Their construction and operation is undoubtedly one of the spheres of activity burdened with a high rate of negative externalities.

In this context, it is worth pointing out that, according to the Polish Green Building Council, the operation and use of various types of buildings in Europe results in approximately 40% of energy consumption and, at the same time, 36% of carbon dioxide emissions, while, in addition, the production of building materials, their transport, as well as construction processes are responsible for 11% of all carbon dioxide emissions worldwide (PLGBC as cited in CBRE, 2023b).

Similar values are also cited in the literature for USA conditions - here, buildings (residential and commercial) account for about 40% of total energy consumption

and about one-third of total energy-related CO_2 emissions (EIA as cited in Adekanye, Davis and Azevedo, 2020).

The operation of warehouses is usually accompanied by increased truck traffic in the immediate vicinity, as well as the use of other emission-creating devices; their work also involves a large amount of waste and the need for lighting.

As a result, the issue of Green Buildings - Green Warehouses, i.e., the implementation of pro-environmental solutions within these facilities, has for some time now become an area for the introduction of viable technical and technological solutions as well as organisational and legal changes.

This issue is also becoming an interesting area of research, as many entrepreneurs are now turning to the option of leasing warehouses rather than owning them. This is due, among other things, to the abundant offer of such facilities in the dynamically developing market for commercial, modern warehouse space.

The Polish market, which is the subject of this article, is also an area of intensive development. Here, the stock of commercial warehouse space currently exceeds 32 million m^2 (Colliers, 2024). The scale of measures that can be implemented is therefore significant and their effects can undoubtedly bring about an improvement in the state of the natural environment.

The first initiatives to green commercial warehousing facilities were recorded in the early years of market development in Poland, but these were rather incidental. As interest in such solutions has grown, developers have expanded their suite of green initiatives, including the use of LED lighting, mounting photovoltaic panels on roofs or next to buildings, installing heat pumps, introducing roof and wall insulation, using air destratification and rainwater and grey water recovery systems and using CO_2 for cooling (Cushman&Wakefield, 2020).

With the emergence of further legal regulations related to the issue of pro-environmental solutions, the greening process has taken on greater momentum, also encompassing formal solutions in the commercial space market.

Formal and legal actions in the commercial space market may include solutions that support the development and confirm greening initiatives. The literature cites, among others, their certification or the use of "green lease agreements" and the "green clauses" that occur here.

Hence, the main objective of this article is to determine the conditions and current state of development of selected organisational and legal solutions relating to the greening of resources in the commercial warehouse space market in Poland, taking into account international trends, applicable legislation and expectations of entities operating within Green Supply Chains.

2. Literature Review – Green Supply Chain and Green Buildings

2.1 Green Supply Chain Issue

The term Green Supply Chain (GSC) is quite widely used and unanimously understood in the literature. It is emphasised that approaching the supply chain from a green perspective means first and foremost paying more attention to society and the environment (Ivascu *et al.,* 2015), as the environment and resource problem is, indeed, a social problem (Ying and Li-jun, 2012).

Ivascu *et al.* (2015) point out that nowadays, green thinking is becoming a kind of normal activity and forces companies to introduce new solutions, while at the same time representing a step in their development (Ivascu *et al.,* 2015). Undoubtedly, this is a significant challenge for many entities, and the degree of implementation of green solutions varies significantly between actors.

Following Wisniewski and Tundys, it should also be emphasised that, however, the declarations of players do not always coincide with the actual application of „green principles", which often remain uncovered in reality (Wiśniewski and Tundys, 2018).

However, this must not discourage efforts to implement green practices where necessary and reasonable and where the benefits have a wider dimension. In many cases, it is difficult for a company to undertake greening efforts independently and alone. Collaboration is necessary here, and Green Supply Chain Management (GSCM) is the way to reach the goal (Ying and Li-jun, 2012).

The specifics of the implementation of the GSC and GSCM concepts are analysed in the literature with reference to the circumstances of different countries, both European and non-European. Among others, there is a discussion of experiences in Romania (Ivascu *et al.*, 2015), with reference to German-speaking countries (Kim *et al.*, 2022), India (Koul, Ghatak, and Sinha, 2023) or China (Ying and Li-jun, 2012). There are also studies relating to Polish conditions (Wiśniewski and Tundys, 2018).

For the issue of the functioning of green supply chains, the question of the drivers of their development, but also those constituting barriers, is important. This subject is also addressed by many authors (Koul, Ghatak and Sinha, 2023), usually taking into account Internal Drivers and External Drivers (Wiśniewski and Tundys, 2018; Khan and Pasha, 2022). Khan and Pasha (2022) include in the first group, „internal environmental orientation, organisational culture, expected benefits, strategic orientation, green strategy and firm's view of green, environmental policy", while the second includes, „customers, competitor's initiatives, government rules and regulations, socio-cultural responsibility, eco-reputation, supplier commitment towards green" (Khan and Pasha, 2022).

The multiple approaches to the issue of green supply chain management undoubtedly indicate the holistic and cross-cutting nature of the concept. Studies cite specific areas within which green solutions are applied, such as Green strategy, Green design, Green procurement, Green manufacturing, Green materials, Green production and processing, Green logistics, Green recycling (Ying and Li-jun, 2012; Kim *et al.*, 2022).

As indicated, one of these is green logistics, responsible for the movement of products, accompanied by improvements in the degree of environmental performance of processes, involving, for example, green packaging and reverse logistics etc., (Ying and Li-jun, 2012). The rationale for greening logistics stems from the fact that it is the sphere of logistics activities in supply chains that is known to be responsible for creating a significant proportion of negative externalities. In many spheres of logistics, the issue of greening is very topical; this is also the case with the use of green warehouses here.

2.2. Green Building - Areas of Analysis and Legal Issues

A review of the economic and the management literature reveals a number of issues with which the Green Building concept is associated. These issues are analysed in the literature for different types of real estate, including commercial properties of various types. It is noteworthy to point out articles treating several types of facilities (building projects) altogether - offices, shopping centres and other commercial buildings, hotels or warehouses (Hwang, Shan and Supa'at, 2017).

It is also possible to identify studies that refer explicitly to one type of green commercial building - for example office buildings (Rodi *et al.*, 2015), mall projects (Koul, Ghatak and Sinha, 2023; Miklinska, 2022) or warehouse (Wilczynski, 2024).

Onuoha, Aliagha and Rahman (2018), in their study for commercial property investment, identify and model the motivating factors that affect developers‘ and investors’ decisions to invest in green properties of this type. The authors indicate that among the various drivers, it is mainly monetary green tax incentives and green skills that have a significant impact on supply in this regard; others include green certification (Onuoha, Aliagha, and Rahman, 2018).

Hwang, Shan and Supa'at (2017) point out that numerous risks factors can be identified in green commercial building projects. The main five are: “inflation,” “currency and interest rate volatility worsened by the import of green materials,” “durability of green materials,” “damages caused by human error,” and “shortage of green materials” (Hwang, Shan, and Supa'at, 2017). At the same time, however, the authors cite measures to mitigate the risks, such as for example ensuring robust design or rigorous contractor selection (Hwang, Shan, and Supa'at, 2017).

Experiences with the development of green buildings and green investments, mainly in the field of commercial spaces, are discussed for various countries from different corners of the world taking into account local conditions, for example the USA (Qiu, Tiwari, and Wang, 2015; Qiu, Yin, and Wang, 2016), India (Koul, Ghatak, and Sinha, 2023) and also Singapore (Hwang, Shan, and Supa'at, 2017) or Malaysia (Onuoha, Aliagha, and Rahman, 2018).

It should therefore be emphasised that this problem is also recognised outside the EU structures and in countries from different climate zones, with diverse access to energy sources etc., which undoubtedly influences the interest in greening facilities.

Within the structures of the European Union, the issue of green buildings has gained prominence in the face of existing regulations. At the end of 2019, the European Commission proposed a package of regulations referred to as the European Green Deal, within which environmental, social and corporate governance (ESG) factors have an important place, from a business perspective (CBRE, 2023b).

The key legislative acts setting out the regulatory framework under the Sustainable Finance Strategy for the European Green Deal and ESG are (Baran *et al.*, 2023; Hincz, 2023):

-Regulation (EU) 2020/852 of the European Parliament and of the Council of 18 June 2020 on the establishment of a framework to facilitate sustainable investment, and amending Regulation (EU) 2019/2088 (Text with EEA relevance) (EU Taxonomy),
-Regulation (EU) 2019/2088 of the European Parliament and of the Council of 27 November 2019 on sustainability-related disclosures in the financial services sector (SFDR - Sustainable Finance Disclosure Regulation),
-Directive (EU) 2022/2464 of the European Parliament and of the Council of 14 December 2022 amending Regulation (EU) No 537/2014, Directive 2004/109/EC, Directive 2006/43/EC and Directive 2013/34/EU, as regards corporate sustainability reporting (CSRD - Corporate Sustainability Reporting Directive),
in furthermore, the Non-Financial Reporting Directive (NFRD).

The literature emphasises that the EU Taxonomy is a foundation stone of the EU Sustainable Finance Framework and an important tool to help invest in those economic activities that serve the ecological transition (Assanowicz, Mokrzański and Plaisant, 2023). It identifies the following environmental objectives: „1. climate change mitigation; 2. climate change adaptation; 3. sustainable use and protection of water and marine resources; 4. transition to a circular economy; 5. pollution prevention and control; 6. protection and restoration of biodiversity and ecosystems“ (Hincz, 2023).

The aforementioned CSRD refers to the key role of value chains in determining the total environmental footprint of companies and thus helps various stakeholders (e.g. investors or consumers) to assess the sustainability performance of companies (Assanowicz, Mokrzanski, and Plaisant, 2023).

Experts highlight that in the commercial real estate sector, it is currently difficult to address the challenges of ESG reporting without obtaining the relevant environmental certifications for the facility (Czerniewski as cited in Franke and Kuczera 2024). The literature points out: „The international certificate is a transparent system that allows a multi-level view of a building and its assessment, taking into account environmental aspects, energy optimisation and social factors" (Baran *et al.*, 2023).

The multi-criteria certification systems in operation allow for the assessment of both new and existing buildings (Baran *et al.,* 2023). Among the internationally popular multi-criteria assessment systems used in Poland are: BREEAM (Building Research Establishment Environmental Assessment Method), LEED (Leadership in Energy and Enviromental Design), DGNB (Deutsche Gesellschaft für Nachhaltiges Bauen) and HQE and WELL (Kuczera, 2018; BREEAM 2024; Green Building Alliance, 2024; DGNB, 2024).

Leaving aside the differences between the various certification schemes, it should be pointed out that, in general, the facility certification in question addresses several main areas: energy efficiency, indoor environmental quality of the building, water efficiency, waste reduction and maximising recycling, materials used to construct the building, transport and location (Kuczera, 2018). The circumstances and scope of application of multi-criteria certification in the warehouse space market in Poland will be discussed in the next section of the article.

In addition to certification, another element in the implementation of ESG strategy in the commercial real estate market is the use of so-called "green leases" (Baran *et al.,* 2023) It should be noted that: „A "green" lease agreement is a standard lease agreement supplemented with additional provisions or annexes aimed at defining the mutual efforts of the parties to ensure that the leased building and the rented space within it are used and managed in a manner conducive to sustainable development and improving the environmental efficiency of the building and leased spaces" (Lakowski *et al.,* 2023).

The lease and use of commercial buildings under green leases therefore involves stipulations in the form of so-called „green clauses" also referred to as „green provisions" or „green annexes" (Zakrzewska *et al.,* 2024) or „Sustainable Property Management Guidelines" (Baran *et al.,* 2023).

Experts point out that in Western European countries the use of green leases is already becoming a kind of standard (Zakrzewska *et al.,* 2024). In Poland, this

solution is encountered only rarely. Quite a few publications have also appeared in the literature on the subject so far, hence to fill this gap, the following section discusses in more detail the conditions and specifics of green leases on the Polish market.

3. Research Results

3.1 The Commercial Warehouse Space Market in Poland, Its Greening and Certification of Facilities

Poland is a Central European country and, due to its favourable location, the market for commercial warehouse space has been developing dynamically here since the early 2000s. In addition, this development has been fuelled by various reasons. In particular, the country's accession to the European Union in 2004 was a dynamic factor in this phenomenon, as the logistics services market also began to develop, as did other sectors, creating a demand for modern warehouses (Miklinska, 2020).

As the years passed, other phenomena and trends emerged, making their mark and requiring new solutions in the market - these were: the development of e-commerce, the demand for warehouse space emerging from entrepreneurs involved in light manufacturing, the introduction of automation solutions into warehouses or, finally, the trend towards the greening of warehouses (Miklinska 2020 with cited literature), which is the subject of this article.

When analysing the development of the commercial warehouse space market, it should be noted that while back in 2004 its stock in the country was only 1 million m^2, in the first quarter of 2016 it exceeded 10.4 million m^2 (Colliers International, 2016). After only seven years, this result tripled, as the stock size was 31 million m^2 at the end of 2023. Nearly 3 million m^2 are under construction which will bring another significant increase at the end of 2024 (CBRE Research, 2024).

It should also be added that recently, despite the problems in various segments of the construction market caused by the global and European economic and geopolitical situation, or the increase in the price of fossil fuels and the difficult availability of materials, the market stock of commercial warehouse space has continued to grow significantly. In addition, the process of their greening is being effectively implemented, as indicated by the number of environmental certifications being carried out (Franke and Kuczera, 2024).

The first cases of the greening of commercial warehousing facilities were recorded in the early years of the market's development, but these were rather incidental. As the years passed and tenants became more interested, developers expanded the range of environmentally friendly solutions in warehouses, offering, for example, the installation of photovoltaic panels, the use of LED lighting, the installation of heat pumps, the introduction of roof and wall insulation, the use of air destratification and

rainwater and grey water recovery systems, as well as the use of CO_2 for cooling (Cushman&Wakefield, 2020).

Currently, green warehouses, in the broadest sense, are facilities that are designed, built, operated and managed with care for the environment (Wilczynski, 2024). The basic attributes that such facilities are currently characterised by are, energy efficiency (which is taken into account already at the design stage of the facility or as a result of the thermo-modernisation carried out); recycling and waste management (its minimisation and recycling; sustainable transport (both of cargo and employees); sustainable water management (e.g., minimisation of water consumption and use of rainwater); nature conservation (e.g., local flora and fauna) and employee education (implemented training, actions) (Wilczynski, 2024). A number of specific solutions are applied in each area, and confirmation of the green solutions is provided by obtaining an environmental certificate (Wilczynski, 2024).

The very first certified warehouse was launched in Poland in 2012 (Kuczera, 2020). At the beginning of the development of certification, the growth in the number of certified warehouses was quite slow. However, as can be seen in Table 1, the process has gained momentum since 2019.

The area of certified warehouses reached an increasingly higher share of the total certified area of facilities of different types (including office and retail). In 2023, certified warehouse space reached a share of 44.5% of the total certified space of different types of facilities, while the total share of certified warehouse space in the total area of modern warehouses was more than half - 55% (Franke and Kuczera, 2023).

***Table 1**. Characteristics of the development of the stock of certified warehouses in Poland*

	03.2018	**03.2019**	**03.2020**	**03.2021**	**03.2022**	**03.2023**	**03.2024**
Share of certified warehouse space in total certified space	13,9%	15,1%	1,3%	27,4%	36,4%	44,5%	46,8%
Number of certified warehouses/share in number of certified buildings of all types	58 (11,6%)	86 (13,3%)	141 (16,7%)	227 (21%)	398 (29,3%)	541 (33%)	750 (36%)
Share of certified warehouse space in total warehouse space	no data available	no data available	no data available	28%	41%	55%	53%
Annual increase	15%	48%	70%	76%	66%	56%	11%

in certified warehouse space/yearly increase in number of certified warehouses	51	28	55	86	171	143	209

Source: *Elaborated based on Kuczera 2018-2022; Franke and Kuczera 2023-2024.*

It should be noted that in Poland, both newly constructed buildings and buildings that have been in existence for some time are certified. Among the certification systems, the BREEAM certificate clearly dominates, LEED and DGNB are less popular, while recently there has been an emerging interest in WELL Building Standard and Fitwell certifications emphasising mainly employee welfare and health (Chwalbińska-Kusek as cited in Przybylski, 2022). Due to the aforementioned occurring differences between the different certification schemes, a summary of their categories and levels is provided in Table 2 to illustrate the areas they cover.

Table 2*. Categories and levels of selected certification schemes*

Name of certification scheme	**Categories**	**Certification Levels**
BREEAM	Management, Water, Energy, Transport, Health & wellbeing, Resources, Resilience, Land use & ecology, Pollution, Materials, Waste, Innovation	Unclassivied <30%; Pass ≥30%; Good ≥45%; Very good ≥55%; Excellent ≥70%; Outstanding ≥85%
LEED	Integrative Process, Location and Transportation, Sustainable Sites, Water Efficiency, Energy &Atmosphere, Materials & Resources, Indor Environmental Quality, (Innovation in Design, Regional Priority – Bonus Credit Categories)	Certified (40-49 points), Silver (50-59 points), Gold (60-79 points), Platinum (80+ points)
DGNB	Environmental quality, Economic quality, Sociocultural and functional quality, Technical quality, Process quality, Site quality	Platinum 80% and higher; Gold 65% and higher; Silver 50% and higher; Bronze 35% and higher

Source: *elaborated based on BREEAM, 2024; Green Building Alliance, 2024; DGNB, 2024.*

With regard to BREEAM and LEED, it should be noted that they are based on an analysis of similar parameters, such as the location of the building, the construction process and materials used, the energy efficiency of the building, landscaping and the user-friendliness of the building. When comparing these systems, it is important to note the differences in the number of schemes used to assess new or existing facilities (CBRE, 2023a). Also in the case of the DGNB scheme, there are many

variants and, according to the status of the project, it is used as a planning, optimisation or management instrument (DGNB, 2024).

When assessing tenants' interest in certified warehouse facilities, it should be noted that only a few tenants asked about green solutions in warehouses around ten years ago (Cushman&Wakefield, 2020). On the other hand, there were already customers, for example logistics operators, who were looking for such warehouses in order to stand out from the competitors. At the end of the decade in 2020, this will have reached approximately 80% (Cushman&Wakefield, 2020).

Currently, as the entries in Table 1 indicate, the share of certified facilities in the market has increased significantly, but additionally the highest standards - levels of certification - are being achieved. For example, in 2023, in the case of the warehouses of the developer Panattoni in Poland, the first certificates of the highest level appeared - BREEAM Outstanding for an industrial-warehouse facility, first in Szczecin, followed by others in Konin and Robakowo (Dębowska as cited in Franke and Kuczera, 2024).

It should be noted that the certification situation has evolved over the years, first due to the voluntary nature of the procedures and more recently due to the introduction of the aforementioned EU regulations. Even today, experts point out that certificates are no longer sufficient in view of the aforementioned EU regulations and environmental targets. Systems are evolving to meet the new ESG guidelines, which may result in higher certification criteria (Dębowska as cited in Franke and Kuczera, 2024).

According to market participants, it is important to point out that many actors are successfully combining business objectives with the challenge of ensuring climate neutrality. Nowadays, it is important that initiatives are taken along the entire value chain and hence green lease agreements can provide significant support. Their provisions foster the implementation of requirements by tenants, who will create reports in accordance with CSRD regulations (Mitura-Papis, 2024). The issue of green lease agreements in the commercial space market in Poland is discussed further.

3.2 Green Clauses in Lease Agreements in the Commercial Space Market in Poland

When considering green clauses in lease agreements, it is necessary, first of all, to refer to the specifics of this type of agreement in the Polish legal system. Under Polish law, a lease agreement is one of the named contracts regulated by the Civil Code. Article 659§1 reads: „By a lease agreement, the lessor undertakes to give the tenant a thing to use for a definite or indefinite period of time and the tenant undertakes to pay the lessor the agreed rent". Code regulations formulate, inter alia, the basic obligations and rights of the parties to the agreement, which may include

additional benefits (e.g. the lessor undertakes to clean, heat, etc.) (Bieniek *et al.*, 1997).

From the point of view of the subject matter of this article, it is important that the principle of freedom of contract expressed in the Civil Code allows the content of a lease agreement to be shaped according to the needs of its parties. This mechanism works well in the market for modern warehouse space, leading to the expansion of the content of this agreement by subjectively important elements, such as maintenance of the logistics facility, the manner of use or even the introduction of pro-environmental practices resulting in the greening of the lease agreement.

The potential scale of the greening of lease agreements in the commercial warehouse space market may result, among other factors, from the number of contracts concluded in this market. Hence, it should be emphasised that the aforementioned dynamic development of the size of the commercial warehouse space market in Poland results in the annual signing of lease agreements for several million m^2 of warehouse space.

However, contracts are concluded not only for new space put into use, but also for space for which the „old" contract has just expired. For example, contracts signed in 2022 are 59% (in terms of space) new contracts, 34% are renegotiations (signing a contract with changed terms) and 7% are expansions, i.e., contracts signed by the tenant with the chosen lessor, for more industrial/warehouse space than before (Colliers, 2023). Green clauses can potentially be introduced within all of the aforementioned contract types, but this depends on the will of the lessor and the tenant.

The national experiences with green clauses discussed by lawyers or commercial real estate market participants so far mainly concern office and retail properties. However, they are without doubt also extremely valuable for the industrial and warehouse real estate market, both for warehouses and the accompanying offices. Moreover, now that the segment of warehouses located closer to city centres and equipped with significant office space - SBUs (Small Business Units) - is developing intensively in Poland, green lease agreements will undoubtedly gain in importance in their case.

Given the different approaches to the issue of green clauses in commercial leases, exemplary criteria for their classification and a specific typology can be recalled (Table 3). First of all, it is worth noting that the extent of the effects of introducing green clauses into a lease contract depends on the stage of operation of the building/space to which they relate (Zakrzewska *et al.*, 2024).

Thus, it is possible to speak of clauses already introduced at the construction stage (concerning its construction or technical equipment), or those relating to the stage of operation and space management (they may concern, inter alia, the use of

sustainable energy sources) (Zakrzewska *et al.*, 2024).

Although, as indicated, generally applicable law does not presuppose the obligatory insertion of green clauses in lease agreements, the provisions applied by the parties to the agreement may speak of sanctions involving non-fulfilment. Hence, a distinction is made in the literature between dark green clauses and light green clauses (Zakrzewska *et al.*, 2024).

Dark green clauses introduce absolute obligations on the part of the parties, while light green clauses boil down to provisions stating that each party will make every effort to comply with these provisions (Lakowski *et al.*, 2023; Zakrzewska *et al.*, 2024). Furthermore, it must be additionally pointed out that these provisions can be introduced into the contract at the initiative of either the tenant or the lessor (Zakrzewska *et al.*, 2024).

Table 3. *Examples of criteria for classifying green clauses in lease agreements, together with their types*

Classification criterion	**Clause type**
-due to the time of implementation/life stage of the facility to which they relate	-relating to the construction of the facility or the development of the site
	-relating to the operation, maintenance and management of the property
- due to of rigour	-light green clauses
	-dark green clauses
- relating to the originator of the clause	-introduced into the contract at the initiative of the lessor
	-introduced into the contract at the initiative of the tenant

Source: *Own elaboration based on Zakrzewska et al., 2024; Lakowski et al., 2023.*

Green clauses include recommendations for tenants to conduct their activities in leased facilities taking into account environmentally friendly solutions, and may therefore relate to, for example: reducing energy consumption and CO_2 emissions, rational water management or even the use of environmentally friendly cleaning products and other accompanying activities, such as the use of alternative modes of transport and public transport (Baran *et al.*, 2023; Zakrzewska *et al.*, 2024).

Due to the limited volume of the study and its economic nature, it is difficult to enumerate them in more detail. As this type of solution also becomes more widespread in the commercial industrial-warehouse space market, undoubtedly their catalogue for this type of facility will grow, bringing specific provisions for their operation.

4. Conclusions

The greening process is nowadays a fairly dynamic phenomenon in supply chain

structures, accentuated by close cooperation between the actors involved. This situation leads to its multidirectional "spill-over" between the various links, thanks to effective Green Supply Chain Management.

On a wider scale, in an EU environment, this is also due to existing regulations, such as the ESG reporting obligation on many entrepreneurs. In turn, it is also important to refer to the companies with which cooperation takes place in the value chain.

The implementation of pro-environmental solutions in the market for commercial warehousing space in Poland by entrepreneurs is, on the one hand, the result of legal regulations in force, but, on the other hand, it is often an activity resulting from the desire to improve one's position in relation to market competitors or to gain attractiveness for potential partners. Regardless of the rationale, this is undoubtedly a phenomenon that is gaining strength and does not concern individual enterprises, but those forming cooperative arrangements, particularly in supply chain structures.

A formalised way of confirming greening are multi-criteria certification systems, which in Poland, following the example of foreign markets, are also being introduced for commercial warehouse space.

Only a few years ago, the share of certified warehousing space in total space was only a few per cent, while today certified warehousing space accounts for more than 50 per cent of total warehouse stock (Franke and Kuczera, 2024).

The implementation of certification systems brings significant, measurable benefits to commercial warehouse space market participants in the form of energy and water savings and even a reduction in the carbon footprint (Dębowska as cited in Franke and Kuczera 2024). In the face of new EU regulations, the trend towards certification will undoubtedly continue, although experts point to the likelihood of an increase in certification criteria (Dębowska as cited in Franke and Kuczera, 2024).

In addition, the use of green leases, which have recently been gaining in importance on the Polish commercial space market, may be helpful in this greening process. Here, legal regulations, despite the lack of special regulations devoted to them, provide the possibility to introduce green clauses.

Interest in such a solution can be seen on the part of tenants, among others from large capital groups, which are (or will be in the future) obliged to report ESG (Lakowski *et al.*, 2023).

Although this solution is currently used mainly in the case of office and retail space, the specifics of warehouse leases allow us to expect that such a solution will soon become widespread here.

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