sustainability

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Review

Origins of the Sustainability Concept and Its Application to the Construction Sector in the EU

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Abstract: Sustainability aims to integrate environmental and social considerations into decision-making, alongside purely economic factors, in a balanced manner. Here, a concise critical review of policy instruments concerning the definition and implementation of this concept is presented. The sources were selected as the most relevant to capturing the origins and evolution of the idea of sustainability from the 1960s to the present day. The analysis narrows down to the construction sector within the European Union (EU), of which the perspective guides the work. As it emerges, the historical path led to the materialization of the sustainability concept into the UN's 17 Sustainable Development Goals (SDGs). Despite interpretative discussions around the concept, these SDGs became the relevant sustainability model for sectors like construction. Its application to practice, however, faces three major challenges that must be acknowledged and addressed to allow defining robust and genuinely sustainable decision-making strategies: greenwashing, commodification, and "cherry picking".

Keywords: sustainability; CPR; level(s); standards; greenwashing; commodification; cherry picking

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1. Introduction

Sustainability is the attribute of an ideal economic system in which economic development derives from a balance between purely economic factors and considerations for environmental preservation and social fairness.

The concept has its roots in the 1960s. In this period, there was widespread social unrest and protests in many countries, with people voicing their concerns about environmental and social issues such as pollution, chemical contamination of the environment due to the use of agricultural pesticides like dichloro-diphenyl-trichloroethane (DDT), deforestation, as well as social, racial and gender inequality. The protests reflected a growing dissatisfaction with the persistent and obsessive focus of economic policies on monetary and financial aspects while disregarding ecological pressures and social problems.

Sustainability policies are aimed at integrating the overlooked environmental and social aspects into decision-making, thereby changing the economy of countries and regions. The economy is the system by which goods and services are produced, distributed, and consumed. It is studied and managed on the basis of sets of models that constitute what is called economic theory. Economic theory traditionally considers economic growth as the driver of the economy and does not take into account environmental and social issues, which are seen as externalities. Economic growth is the increase in the quantity or quality of those goods and services and is commonly measured by the monetary increase in Gross Domestic Product. Due to this focus on money and finances, economic development became almost synonymous with economic growth in most Western countries' policymaking. This is precisely what the present concept of sustainability aims to change: it wants to bring the environmental and the social aspects into the system so that they are considered in the economic theory alongside the financial/monetary aspects.

This idea is usually conveyed by the well-known three-pillar or three-circle sustainability diagram (Figure 1). Purvis et al. [1] studied the origins of the diagram. This seems

to have been first used by Barbier [2] in the form depicted on the left, although with a somewhat different meaning (among other differences, the idea was limited to developing nations). However, the point at which it emerged into the mainstream, in its various shapes, is not clear. It does not have a solid theoretical background, and it seems to be due to the intervention of multiple policy actors. Indeed, the tripartite diagram is used primarily for the pragmatic purpose of communicating a policy message in an accessible and visually engaging way.

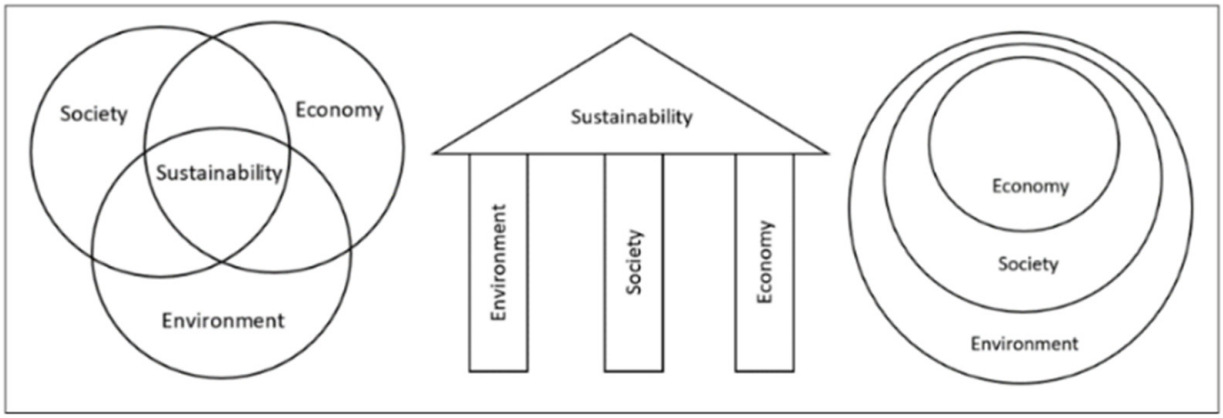

Figure 1. Common versions of the sustainability diagram.

This definition of the sustainability concept contains an inconsistency, which stems from the ambiguity in the term "economic", which has virtually become synonymous with money and finances. Indeed, the fundamental objective of sustainability is to change how the economy operates by internalizing social and environmental factors, which will eventually become as important as the money-related aspects. However, sustainability theory continues calling "economic" to the money-related aspects that constitute one of its three pillars (Figure 1). This perpetuates the notion that the economy is solely focused on money/profit, which contradicts the fundamental objective of sustainability. For this reason, whenever possible, we will call "purely economic" the economic factors that concern profit and money in general. This will not remove all ambiguity but, hopefully, it will make discussions clearer.

In this article, we explore the origins and trace the development pathways of the sustainability concept, narrowing down the analysis to the European case and its construction sector. A fundamental aspect that has guided our approach is that sustainability is primarily a policy construct originating outside the scientific system rather than a scientific or philosophical concept. Therefore, we have focused our analysis on primary sources, which offer first-hand evidence in the form of policy instruments deemed to be the most pertinent to shaping the concept. We deliberately avoided a less factual approach based on secondary sources that interpret the concept through personal ideals or attempt to uncover hidden meanings. Nonetheless, we selectively considered certain secondary sources selected within scientific literature for offering relevant insights or serving illustrative purposes.

As the primary focus of the article is on the general concept of sustainability, a historical-philosophical approach is followed. We believe that this type of conceptual analysis is essential to thoroughly comprehend a concept that, despite the lack of a sound sustainability theory [1], is increasingly becoming an integral part of the technical paradigm in various sectors, namely in construction. This article maintains, therefore, a general focus: our aim is not to conduct analyses within the paradigm but rather to scrutinize the concept itself.

The article provides a concise critical review of policy instruments related to the definition and implementation of the sustainability concept, covering its evolution from the 1960s to the present day. To the best of our knowledge, such an up-to-date critical review

of policy instruments is absent in the literature, namely one focusing on the European Union and its construction sector. Section 2 of the article outlines the historical path that led to the development of essential policy instruments defining sustainability, both at an international level and within the European Union (EU). Section 3 addresses specifically the construction sector in the EU by analyzing three key instruments that are currently employed to implement sustainability in this sector: the construction products regulation (CPR), the set of sustainability standards published by the European Committee for Standardization (CEN), and the Level(s) system promoted by the European Commission (EC). Section 4 identifies and explains three types of systemic dysfunctions that may arise from internal conflicts within the sustainability concept. Lastly, Section 5 contains a summary of the work performed and the conclusions drawn.

2. Birth of the Sustainability Model

2.1. Onset and Materialization of the Model

The concept of sustainability arose, to a large extent, in the aftermath of the civil society protests of the 1960s. These protests were grounded in a wide array of critiques, ranging from scientific observations on environmental issues such as for instance the book 'The Silent Spring' in the USA, which examined the effects of DDT [3], to profound critiques of the economic model itself. In the context of the latter, movements at the core of the protests advocated for economic degrowth to counteract the environmental and social devastation caused by a prevailing economic model centered on the accumulation of wealth [4].

Eventually, some policy proposals started being put forward that acknowledged the environmental and social problems but progressively deviated from the original revolutionary approach. In the 1970s, for example, MIT's report 'The Limits to Growth' proposed to replace the objective of economic growth with that of economic equilibrium [5]. In addition, in the 1980s, the UN report, 'Our Common Future', returned to the idea of economic growth, suggesting that this could be managed so as not to result in excessive pressures on the environment and society [6]. This report, also known as the Brundtland Report, introduces the idea of sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs".

The motivations behind this emergence of the sustainability concept and its subsequent development are not universally agreed upon. Some authors ascribe a potentially deceptive character to the concept; they view sustainability as possibly being little more than a tactic to repackage capitalism in such a way that permits it to sidestep and neutralize public opposition and criticisms concerning the issues arising from limitless economic expansion. One recent example of this line of thinking is Oliveira, who follows in the footsteps of authors like Enrique Leff and Carlos Walter Porto-Gonçalves [7]. Oliveira notes that the Brundtland Report sustains that social issues (such as poverty) and environmental issues (like pollution) can only be resolved by a "new era of economic growth". This contrasts with the social and environmental critiques of the 1960s and 1970s, which attributed these problems precisely to the prevailing philosophy of economic growth. Oliveira contends that, despite the report's mention of the social and environmental needs of both present and future generations, what is truly at stake in its analyses is defending the capitalist type of economy, specifically by avoiding a potential scarcity of raw materials. In the end, sustainability policies operate as a catalyst for environmental and social catastrophe, as they perpetuate economic growth along with its harms. In the same vein, another author, Singer, simply defines the Brundtland Report as a "neoliberal business-as-usual approach to development" [8].

Differently, other authors identify the core of the sustainability concept as a genuine concern regarding capitalism's trajectory. They typically acknowledge that its origins are rooted in concerns about resource scarcity but maintain a positive view of the motivations behind the whole concept. The concerns about resource scarcity emerged with Harrison Brown's publication 'The Challenge of Man's Future', and its alerts that population growth and global development of every nation to Western standards would lead to complete

depletion of Earth's natural resources [8–10]. This perspective extends to iconic books such as Fuller's 'Operating Manual for Spaceship Earth' [11], or Schumacher's 'Small is Beautiful' [12]. It also includes authors like Sachs, who distanced himself from the revolutionary ideas of the counterculture of the 1960s and 1970s, embracing the idea of sustainable development as a 'middle ground' between unchecked growth and the cessation of economic expansion [13]. A more recent author, Molotokienė, unveils key limitations of the concept, such as the contradiction between "sustainability" and "development" [14]. Nonetheless, she defines sustainable development as "a holistic philosophy that harmonizes and integrates the activities of economic, socio-political and ecological systems towards the enhancement of global well-being by providing a world fit for human habitation".

These two distinct views on the motivations behind the sustainability concept constitute an ongoing debate. The first perspective, "negative motivations", contends that sustainability is a defensive reaction of capitalism to popular contestation, ultimately aimed at deception and diversion. In contrast, the second perspective, "positive motivations", is grounded in the belief that the idea of sustainability represents a genuine awakening of the capitalist system to environmental and social issues. On either side of this debate, we also find authors and activists who seek to utilize the sustainability concept, which has become mainstream but retains considerable flexibility, to champion their social and ecological aims [10].

However, regardless of the divergences and the more or less profound changes each perspective advocates concerning the economic model and the concept of sustainability, as well as the ambiguities inherent in such debates, there is an identifiable thread that global policies have followed since the Brundtland Report. A thread that has materialized in critical policy documents with a profound impact on the praxis of sectors such as construction. It is this trajectory that we will follow in this article, as our primary interest lies in understanding 'what is' as it refers to the definition of sustainability.

One such document is Agenda 21, which in the 1990s established two key features of the current concept of sustainability: (i) the tripartite character, by defining the "economic, social and environmental dimensions" of sustainable development, and (ii) the need for achieving a balance between the three dimensions, by stating that all should be considered in decision-making [15].

Eventually, 20 years later, the United Nations (UN) set forth its 17 sustainable development goals (SDGs) [16]. These provide a more precise definition of what sustainability is, configuring a normative model, that is, a model that is aimed at shaping reality rather than just describing it. The model is quantifiable through specific targets and measurable indicators [17]. It implies that to achieve sustainability we need to consider the consequences on a wide range of environmental, social, and purely economic aspects: poverty, hunger, health and well-being, education, gender equality, clean water and sanitation, affordable and clean energy, decent work and economic growth, industry, innovation and infrastructure, reduced inequalities, cities and communities, responsible consumption and production, climate action, life below water, life on land, peace, justice as well as strong institutions and partnerships for achieving the SDGs.

Among the SDGs most relevant to the construction industry, such as SDG 6 (clean water and sanitation), SDG9 (industry, innovation, and infrastructure), SDG 11 (sustainable cities and communities) or SGD 12 (sustainable consumption and production), SDG 8 (economic growth and decent work) must also be considered. Decent work is defined by the International Labour Organization (ILO) as "work that is productive, delivers a fair income, security in the workplace, social protection, prospects for personal development and social integration, freedom of expression, organization and participation in decision making, and equality of opportunity and treatment" [18]. Goal 8 is materialized in targets and indicators covering core social aspects such as the proportion of formal employment, the earnings of employees, the unemployment rate, the proportion of youth not in education, employment, or training, the percentage of occupational injuries or the level of compliance with international labor rights.

2.2. Major Policies at the EU Level

The sustainability model conveyed by the 17 SDGs, its targets and indicators, was followed by several initiatives at the European level. The action plan for the circular economy, for example, advocates reuse and recycling as a way to decouple economic growth from environmental pressures on resources [19]. On the social side, the plan refers to a close collaboration with the International Labour Organization (ILO) to ensure that the new green jobs would be decent jobs.

The European Green Deal is another key initiative of the EC, which proposes climate neutrality as an economic growth strategy [20]. Climate neutrality is achieved when net greenhouse gas emissions (CO_2, methane, etc.) are zero, that is when the amount of gas released by human activities is less than or equal to the amount absorbed by the Earth's natural processes (soil, forests, and oceans are natural carbon sinks). Two strategies are outlined: (i) reducing emissions and (ii) offsetting emissions from one sector by reducing them somewhere else. To enable these, the Green Deal proposes, among other things, that companies should be required to hold a permit for each ton of CO_2 emitted. It is the so-called "polluter-pays" principle, a financial incentive to pollute less. At the same time, the adoption of measures to limit those emissions can be encouraged outside the European single market. Two regulations are worth mentioning: the implementation of the carbon border adjustment mechanism (CBAM) entered into force on 16 May 2023—cement, iron&steel, aluminum, fertilizer, electricity, and hydrogen are the sectors covered in the first phase of the CBAM [21]; and the EU Deforestation-Free Regulation (EUDR), which ensures that products circulating on the European market are not promoting deforestation in the world [22]. As to the social dimension, the Green Deal points to the so-called European Pillar of Social Rights, a joint creation of the European Parliament, European Council, and European Commission [23]. This policy initiative brings forward 20 principles, broken down into three categories, to support inclusive and sustainable economic growth in the EU: (i) equality of opportunities, (ii) social protection and inclusion, and (iii) fair working conditions, which concern aspects such as job security, wages, work-life balance or health and safety at work.

3. Implementing Sustainability in the Construction Sector

Construction is a critical sector to achieve higher levels of sustainability in the EU, not only due to its purely economic relevance but also due to its social relevance and the environmental impacts it generates. According to EC figures, the sector represents 10% of the EU's total added value and employs some 25 million people across 5 million companies, mainly SMEs. It is also one of the most resource-intensive sectors of the economy, with construction products representing 30% of the EU's annual waste generation. Furthermore, it has significant climate impacts: buildings account for 40% of the EU's energy consumption, construction and construction works generate 9.4% of the total domestic carbon footprint, and the production of cement, steel, aluminum, and plastics (CSAP) alone contributes to 15% of EU's carbon emissions [24].

Nevertheless, the three sustainability dimensions do not seem to be getting similar attention in this sector. Lima et al. present a review of the literature on sustainability in the construction industry, covering the period from 2000 to 2017 [25]. Their study sourced data from the Web of Science, revealing a significant increase in the scientific community's interest in this topic. The analysis highlights the need to better explore social issues: only 0.2% of the studies are focused on the social pillar, 5.5% address both the social and environmental pillars, and 35.3% address the three pillars (economic, social, and environmental). Notably, a significant portion of the papers (37.9%) exclusively concentrate on the environmental dimension, which, currently, seems to be the dimension attracting the most interest.

Specific policy instruments are being used to translate the sustainability model into the construction sector, among which we highlight the Construction Products Regulation (CPR) and CEN standards.

The CPR defines the rules under which construction products can be marketed in the EU [26]. For that, it sets out the so-called basic requirements for construction works—A set of general characteristics that serve as a basis for the preparation of harmonized standards (Table 1). Looking at these basic requirements, we see that the prevailing aspects are the technical (engineering or architectural) ones, such as mechanical resistance and stability, fire safety, protection against noise, safety, and accessibility in use or dampness. Then, we have the environmental requirements such as the release of dangerous radiations or substances, greenhouse gases, the quality of drinking water, proper disposal of wastes, emission of fuel gases, energy economy, energy efficiency, and the sustainable use of natural resources. As to social aspects, they are represented only by the consideration of the potential effects of environmental aspects on the hygiene and health of workers, occupants, or neighbors.

The Construction Products Regulation is currently being revised; one of the main objectives of that revision is precisely to achieve a better coverage of sustainability aspects [24]. As per the last proposal, while the technical (engineering or architectural) aspects continue to hold prominence, environmental requirements are substantially strengthened [27,28]. Among other changes: (i) the requirement regarding the sustainable use of natural resources is reinforced, and it now mentions specifically the use of materials with a low environmental footprint and the need to minimize the use of raw materials, energy, and water, (ii) the possibility of removal of greenhouse gases is added, by introducing a requirement on net greenhouse gas emissions and (iii) an extensive set of essential characteristics to be covered in harmonized specifications is defined, all concerning the environmental dimension, which will make the declaration of environmental impacts a common essential characteristic to all construction products. As to the social dimension, there is a slight improvement: the requirement on physical injuries, which pertained to the use phase category "Safety and accessibility in use" and therefore referred only to users, was moved to the life cycle covering category "Hygiene and health impacts to workers, occupants or neighbors", which means it will also include construction workers.

Another important instrument is CEN standards, in particular, the set of standards produced by TC 350—Sustainability of Construction Works. These standards define a sectorial sustainability model based on the categories and aspects depicted in Table 2. As can be seen, the model includes a generous set of environmental impacts. The purely economic dimension is also represented by the core characteristics of monetary costs and monetary value. However, in relation to the social dimension, we see mostly technical (engineering and architectural) aspects already addressed in Eurocodes and national diplomas. Even health and comfort are seen just from the point of view of the user. It is true that the last four categories go a little further in the social dimension, considering features such as the sourcing of materials and services, community engagement, creation of jobs (still distant from the SDG8 concept of decent work), or the protection of cultural heritage. However, no agreement has been reached on how these four categories could be considered, and, therefore, they are not addressed at the building level standard for the social dimension [29].

Table 1. Summary of basic requirements of construction works and essential characteristics of construction products, according to the CPR.

CPR (Regulation No. 305/2011)	New CPR Proposal (March 2022)
Basic requirements for construction works	
• Mechanical resistance and stability (collapse, major deformations, damage due to deformation, disproportionate damage due to an event); • Safety in case of fire (load-bearing capacity, generation and spread of fire and smoke, exit and rescue of occupants, safety of rescue teams); • Hygiene and health of workers, occupants or neighbors, and the environment (release dangerous radiations or substances to air, soil or water, greenhouse gases, quality of drinking water, proper disposal of wastes, emission of flue gases, dampness); • Safety and accessibility in use (physical injuries, access disabled); • Protection against noise; • Energy economy and efficiency; • Sustainable use of natural resources (reuse or recyclability, durability, environmental compatibility of materials).	• Structural integrity (durability, structural resistance, serviceability, and robustness); • Fire safety (load-bearing capacity, access/safety of rescuers, exit, generation, and spread of fire/smoke); • Hygiene and health impacts to workers, occupants, or neighbors (release dangerous radiations or substances to air, soil or water, greenhouse gases, quality drinking water, proper disposal of wastes, emission flue gases, dampness, physical injuries); • Safety and accessibility (unacceptable risks of accidents or damage in service or in operation) [1] • Sound and acoustics; • Energy efficiency and thermal performance; • Emissions into the outdoor environment (hazardous substances/radiation, discharge/disposal wastes, flue gases, substances damaging to the building, net greenhouse emissions); • Sustainable use of natural resources (reuse or recyclability, materials with a low environmental footprint, minimizing the amount of raw materials, embodied energy, and drinking and brown water).
Essential characteristics of construction products	
To be defined in harmonized standards.	To be covered by harmonized standards as possible: • Climate change effects (mandatory); • Ozone depletion; • Acidification potential; • Eutrophication: freshwater; marine; terrestrial; • Photochemical ozone; • Abiotic depletion; minerals, metals; fossil fuels; • Water use; • Particulate matter; • Ionizing radiation, human health; • Eco-toxicity, freshwater; • Human toxicity: cancer; non-cancer; • Land use-related impacts.

[1] added in later discussions, as of June 2023.

Table 2. Categories and aspects for assessing sustainability performance, according to CEN/TC 350 sustainability standards.

Environmental Categories [1] and Aspects [2]	**Social Categories [1] and Aspects [5]**	**Economic Categories [1] and Aspects [10]**
1 - Use of water • Use of fresh water	11 - Accessibility • Users with special needs • Access to building services	22 - Life cycle costs (LCC) • Discount Factor • Net Present Value • Annual Cost
2 - Use of energy • Primary renewable energy • Primary non-renewable energy • Secondary materials and fuels	12 - Adaptability to users' needs • Ease of adaptation to other uses	23 - External costs and benefits • LCC and end-of-life costs
3 - Use of materials • Depletion of minerals, metals • Depletion fossil fuels	13 - Health and comfort and indoor environment • Thermal • Indoor air quality • Acoustic • Visual comfort • Spatial	24 - Value stability and performance: – Value stability from a short-term perspective – Value stability and performance from a medium to long-term perspective • Flexibility and adaptability • Energy performance • Environmental performance • Adaptability to climate change • Durability
4 - Waste • Hazardous waste • Non-hazardous waste	14 - Loads on the neighborhood • Noise • Emissions • Glare/overshadowing • Shocks/vibrations	
5 - Emissions to air • Global warming potential • Ozone depletion • Photochemical ozone	15 - Maintenance and maintainability [6] • Maintenance operations	
6 - Discharges to soil and water • Acidification • Eutrophication	16 - Safety and security [7] • Climate change (rain, wind, snow, flood, solar radiation) • Accidental actions (earthquake, explosion, fire, traffic) • Intruders and vandalism • Interruptions of supply utility	
7 - Output flows [3] • Reuse • Recycling • Energy recovery • Energy exports	17 - Resilience [8] [9]	
8 - Radiation • Radioactive waste	18 - Sourcing of materials and services [9]	
9 - Consequences for local ecology and biodiversity [4]	19 - Stakeholder involvement/community engagement (including in relation to local society and users of buildings) [9]	
10 - Use of land and change in landscape or biodiversity [4]	20 - Employment/job creation (including in relation to local society) [4]	
	21 - Protection of cultural heritage [9]	

[1] categories indicated in the framework level standard [30]; [2] aspects indicated in the building level standard for the environmental dimension ([31]; [3] category not mentioned in the framework level standard [30] but indicated in the building level standard for the environmental dimension [31]; [4] category not addressed in the building level standard for the environmental dimension [31]; [5] aspects addressed by the building level standard for the social dimension [29]; [6] category not mentioned in the framework level standard [30] but indicated in the building level standard for the social dimension [29]; [7] The standard recognizes that "minimum requirements for wind, snow, earthquake and explosions are specified in the Eurocodes and their National Annexes"; [8] defined as the ability to anticipate and adapt to, withstand, or quickly recover from a potentially disruptive event, whether natural or manmade; [9] categories indicated in the framework level standard [30] but not covered in the building level social performance standard [29], which states that only the remaining categories "are deemed to have an agreed basis for European standardization at this time"; [10] aspects addressed by the building level standard for the economic dimension [32].

Level(s) is a third relevant policy instrument. It is a system put forward by the European Commission to make it easier to compare the sustainability of buildings [33]. Level(s) relies on six macro-objectives and 16 indicators and provides a simplified Life Cycle Assessment (LCA) with 10 environmental impacts (Table 3). As seen, this system is highly focused on environmental aspects, too, and also addresses the purely economic aspects of cost and of monetary value. As to the social dimension, it is virtually absent, with the health-and-comfort macro-objective focusing on technical (engineering and architectural) aspects such as indoor air quality, thermal and lighting comfort, and acoustics.

Table 3. Macro-objectives, indicators, and LCA impacts of the Level(s) system.

The Six Macro-Objectives and 16 Indicators	**LCA Impacts (Related to Macro-Objectives 1, 2 and 3)**
1. Greenhouse gas and air pollutant emissions throughout a building's life cycle 1.1 Use-stage energy performance 1.2 Adaptation and resilience to climate change (summer overheating, inadequate winter heating, extreme weather events, floods) 2. Resource-efficient and circular material life cycles 2.1 Bill of quantities, materials, and lifespans 2.2 Construction & demolition waste and materials 2.3 Adaptability and renovation 2.4 Deconstruction, reuse, and recycling 3. Efficient use of water resources 3.1 Use stage water consumption 4. Healthy and comfortable spaces 4.1 Indoor air quality (ventilation, humidity, and air pollutants) 4.2 Time outside the thermal comfort range 4.3 Lighting and visual comfort 4.4 Acoustics and protection against noise 5. Adaptation and resilience to climate change 5.1 Protection of occupiers' health and thermal comfort 5.2 Increased risk of extreme weather events (under development) 5.3 Increased risk of flood events (under development) 6. Optimized life cycle cost (LCC) and value 6.1 Life cycle costs 6.2 Value creation and risk exposure	• Climate change • Ozone depletion • Acidification • Eutrophication aquatic freshwater • Eutrophication aquatic marine • Eutrophication terrestrial • Photochemical ozone formation • Depletion abiotic—minerals, metals • Depletion abiotic—fossil fuels • Water use

Tables 1–3 show that the implementation of sustainability in construction in the EU puts significant emphasis on the environmental dimension and that this aspect is pursued especially through the concept of circularity. However, the praxis of the sector does not seem to have caught up yet. Until now, the changes towards sustainability have been largely supported by manufacturers through their environment product declarations (EPD), based on a life cycle assessment (LCA), and disclosing the environmental impacts [34]. However, overall, these practices are still in their infancy. The rate of recycling of construction materials is low, leading some authors to call for the development of standards on the incorporation of recycled materials [35] and for a better definition of the recycling concept [36]. Knoth et al. [37] conducted a survey including key stakeholders (manufacturers, architects, building owners, consultants, and public institutions) to obtain enlightening information from different viewpoints about the challenges and the success factors related to the reuse of construction products in Norway. Here, as in the EU in general, traditional methods of end-of-life building disposal are still dominating, and the study calls for more effective communication between stakeholders across the value chain. The same lack of perception of the advantages of a circular economy was found by Moscati et al. [38] in a survey of the construction and manufacturing stakeholders in Sweden. These authors believe that policymakers should ensure more effective guidelines, laws, and regulations to drive the change; construction and manufacturing industries need to implement new digital strategies and enforced standards; end-users should put pressure by demanding and

purchasing products that fulfill the circular economy principles; academic institutions must prepare generations entering the market. The integration with BIM and a close connection between the planning team, manufacturers, and authorities are also, according to Hild [39], needed to establish a circular economy in construction.

4. Navigating Internal Conflicts and Dysfunction: An Ongoing Challenge

4.1. Conceptual Challenges

In addition to the technical difficulties illustrated in the previous section, the implementation of the sustainability concept in sectors like construction faces other, much less discussed yet deeper obstacles. These derive from internal conflicts in the concept of sustainability that can lead to systemic dysfunction. Such conflicts arise between the three constituent dimensions, particularly between the currently dominant purely economic dimension and the environmental and social dimensions that sustainability aims to incorporate into decision-making processes. In the next subsections, we will discuss, based on an analysis of relevant literature, three of the most important obstacles of this type.

4.2. Greenwashing

Greenwashing is an important (and well-known) dysfunctional symptom. The concept became popular in the 1990s after the publication of 'The Greenpeace Book of Greenwash' [40], generating substantial initial resistance. Its emphatic illustration of the practice focuses on the case of large transnational corporations and reads as follows:

> *A leader in ozone destruction takes credit for being a leader in ozone protection. A giant oil company professes to take a "precautionary approach" to global warming. A major agrochemical manufacturer trades in a pesticide so hazardous it has been banned in many countries, while implying the company is helping to feed the hungry. A petrochemical firm uses the waste from one polluting process as raw material for another, and boasts that this is an important recycling initiative. A company cuts timber from natural rainforest, and replaces it with plantations of a single exotic species, and calls the project "sustainable forest development". And these companies, with the help of their business associations and public relations firms, help set the agenda for an unprecedent global negotiation on the crises of environment and development. This is GREENWASH, where transnational corporations (TNC) are preserving and expanding their markets by posing as friends of the environment and leaders in the struggle to eradicate poverty.*
>
> Excerpt from 'The Greenpeace Book of Greenwash' [40]

In the end, greenwashing means using persuasive marketing and public relations rhetoric to mislead people into believing that products, services, or processes are positive for the environment when that is not (at all or fully) true. This is accomplished by the use of misleading advertisements or labels; the misuse of ecolabels is an example of this practice. A similar type of problem can be seen in the social dimension, where it is sometimes called "social corporate washing". It occurs, for example, when corporate codes of conduct claim social concerns that do not correspond to the company's practice. "Bluewashing" is another term which is typically used to encompass both the environmental and the social dimensions by reference to the blue UN flag, in which companies figuratively drape themselves to better their image in relation to environmental and human rights records [41].

We can, therefore, say that greenwashing consists in disguising the purely economic as environmental or social (Figure 2).

In the construction sector, greenwashing often relies on the use of nature-related imagery and symbols, vague statements, or undefined terms like "eco-friendly", "sustainable", "natural", "green", or "eco-safe". It is also common to emphasize a product's environmental benefits without considering its entire life cycle, for example, promoting a building material as sustainable because it is recyclable but ignoring the energy-intensive manufacturing process [42]. This type of greenwashing, which consists of an incomplete LCA perspective, may also be found in research articles, in which unsubstantiated claims are used to justify the study (earth materials presented as the revival of traditional sus-

tainable practices, failing to take into account that these materials are now applied using diesel-powered machinery; indicating the sustainability advantages of biobased additions without evaluating their effects on the long-term durability of the material, etc.). In construction projects, boasting about the recycling of a high percentage of waste materials without considering what percentage could have been avoided by more efficient design or construction practices is also a reality. Another type of greenwashing is using intentional distraction strategies, such as installing solar panels or other green features and boasting about their sustainability relevance while cutting a nearby forest for construction.

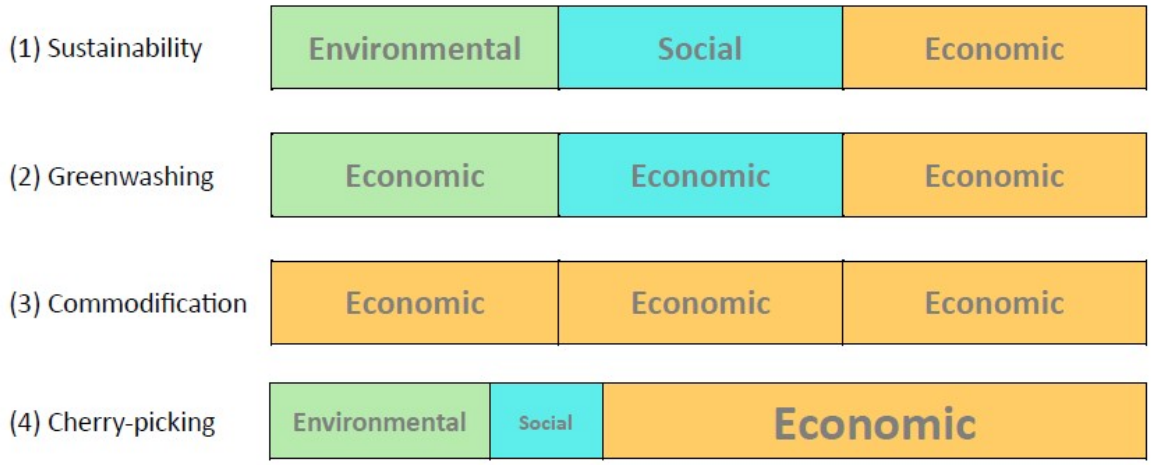

Figure 2. Graphical representation of the three types of systemic dysfunction in the sustainability model: (1) ideal situation; (2) greenwashing dysfunction; (3) commodification dysfunction; (4) "cherry picking" dysfunction.

Recently, 30 years after 'The Greenpeace Book of Greenwash' was first published, the EC is taking action by proposing a "ban on greenwashing" against generic or vague claims that cannot be supported by evidence, such as misleading claims regarding carbon footprint, climate change, working conditions, charity contributions or animal welfare, as well as against non-credible sustainability labels [43].

4.3. Commodification

Commodification is another dysfunction that may derive from the mentioned type of internal conflict. In this case, the environmental or the social are absorbed by the purely economic and, ultimately, become part of it (Figure 2). This means that the environmental and social aspects will be valued and protected not by themselves but only as long as and to the extent they provide profit. Therefore, there will be no change in the economic model, and increased degradation of the environment and society may actually take place. One example is the over-exploitation of cultural aspects (both material and immaterial) in the context of tourism, under the pretext of protecting them, but in fact, reducing these aspects to mere decorative or theatrical elements, which often leads to greater loss of historical vestiges and cultural meanings than the abandonment itself.

This dysfunction is deeply ingrained in the concept, as evidenced by its presence in the very policy instruments that define the sustainability model. In fact, a key example of commodification is the emissions market, a financial incentive to pollute less provided for in the European Green Deal [20]. This approach operates based on the "polluter pays" principle, requiring companies to hold permits for each ton of CO_2 emitted. However, such a system comes with social costs, as the larger companies and wealthier countries might have the means to emit more, giving them a significant competitive advantage over smaller companies and countries. This situation conflicts with SDG 10, which seeks to reduce inequalities within and among nations. In addition, environmental aspects would be reduced to purely economic value, undermining their significance and increasing the

risk of degradation as dictated by market criteria. Commodification, therefore, prevents true change in the economy; there is just an absorption of externalities into the same growth-centered economic model.

4.4. "Cherry Picking"

"Cherry picking" is the third type of dysfunction resulting from internal conflicts, which consists of looking only at selected aspects while ignoring others also potentially relevant to a sector, company, or service. This is problematic because, as argued above, (i) sustainability is the balanced consideration, in decision-making, of relevant environmental and social aspects together with purely economic ones, and (ii) the 17 SDGs, along with their targets and indicators, provide a normative model for what sustainability is meant to be. Therefore, if we cherry-pick some aspects as relevant to the sustainability policy while leaving out other aspects also at work in that sector, company, or service, then the resulting sustainability model is not founded on a balanced consideration of the relevant environmental, social, and economic factors, which configures a violation of clause (i), as illustrated in Figure 2.

In construction, "cherry picking" practices happen, for example, when companies assess their sustainability performance by focusing only on SDGs in relation to the aspects in which they are already performing well or can apply low-cost measures while ignoring others [42].

However, the dysfunction also manifests itself in the very policy instruments that are aimed at implementing sustainability in the sector. One example is the above-discussed fact that the sustainability standards of the construction sector focus mostly on environmental sustainability aspects and co-opting technical (engineering and architectural) aspects as social. Note that CEN's building level standard for the social dimension [29], for example, while indicating several types of accidental actions in its Safety and Security category, recognizes that minimum requirements for some of these actions (wind, snow, earthquake, and explosions) are already specified "in the Eurocodes and their National Annexes". This co-opting of technical (engineering and architectural) aspects as social happens while ignoring the impact of the activity on core societal dimensions, such as education (SDG 4), equality (SDGs 5 and 10), or decent work (SDG 8), that is, the problems behind the very birth of the sustainability concept. By keeping these aspects outside the system while internalizing others, such as the many environmental aspects finally tackled by the mentioned policy instruments, the ignored aspects become vulnerable to increased degradation under economic pressures. The internalization of environmental aspects in the construction sector can inadvertently lead to greater deterioration of social aspects, which is a significant concern considering the sector's relevance to society.

Note that "cherry picking" is sometimes categorized as a form of greenwashing, within a broader definition of the latter that encompasses all practices aimed at portraying companies and products in a more favorable light regarding their sustainability, as in Johnsson et al. [42]. When specifically referring to the "cherry picking" of SDGs in corporate reports, the term "SDG-washing" has been used [44]. However, we believe that "cherry picking" and greenwashing (or other types of "washing") are distinct issues, as illustrated in the section below.

4.5. Graphical Representation of the Three Types of Dysfunction

Figure 2 presents the three chief types of systemic dysfunction that can affect the implementation of the sustainability model. In the ideal situation (1), that is, sustainability, there is a balance between the three dimensions, each of them being represented by a colored rectangle with the corresponding designation. In greenwashing (2), the environmental and social dimensions merely appear as a facade, retaining their original colors, but in fact, all dimensions are economic. In commodification (3), the environmental and social dimensions are transformed into economic. In "cherry picking" (4), there is an imbalance among the three dimensions, typically resulting in diminished environmental and social dimensions.

5. Conclusions

To recap, the concept of sustainability arose as a response to society's concerns about environmental and social problems. It is a normative concept, that is, a concept aiming to shape rather than just describe reality. Its main objectives are to integrate the environmental and social aspects into decision-making and to address them alongside purely economic aspects in a balanced way. Driven by the UN, the idea eventually materialized into a system of SDGs, targets, and indicators, leading to the most comprehensive model of sustainability available to date.

The sectorial transposition of the concept to the construction sector in Europe is underway and involves instruments such as the Construction Products Regulation, which is being revised to better address sustainability issues; the set of sustainability standards of CEN TC 350; or the Level(s) system the EC has put forward to allow comparing the sustainability of buildings.

In this context, the following three potential dysfunctional patterns may arise due to resistance to change and to internal conflicts resulting from the interplay between conventional purely economic priorities and the relevant environmental and social objectives, which sustainability advocates should also be considered in decision-making:

- Greenwashing, which consists of disguising purely economic aspects as environmental or social;
- Commodification, in which environmental and social aspects are distorted and absorbed into the purely economic dimension where they lose their original meaning and value;
- "Cherry picking", which consists of ignoring relevant but challenging environmental or social aspects, thereby failing to achieve balance.

These dysfunctions sometimes originate from or impact the very policy instruments, such as standards and regulations, used to implement sustainability in the construction sector, particularly in the case of commodification and "cherry picking". The three dysfunctions need to be acknowledged to make it possible to establish robust and truly sustainable decision-making strategies at different organizational levels.

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