

## Article

# Sustainability of AI: The Case of Provision of Information to Consumers

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**Abstract:** The potential of artificial intelligence (AI) and its manifold applications have fueled the discussion around how AI can be used to facilitate sustainable objectives. However, the technical, ethical, and legal literature on how AI, including its design, training, implementation, and use can be sustainable, is rather limited. At the same time, consumers incrementally pay more attention to sustainability information, whereas businesses are increasingly engaging in greenwashing practices, especially in relation to digital products and services, raising concerns about the efficiency of the existing consumer protection framework in this regard. The objective of this paper is to contribute to the discussion toward sustainable AI from a legal and consumer protection standpoint while focusing on the environmental and societal pillar of sustainability. After analyzing the multidisciplinary literature available on the topic of the environmentally sustainable AI lifecycle, as well as the latest EU policies and initiatives regarding consumer protection and sustainability, we will examine whether the current consumer protection framework is sufficient to promote sharing and substantiation of sustainability information in B2C contracts involving AI products and services. Moreover, we will assess whether AI-related AI initiatives can promote a sustainable AI development. Finally, we will propose a set of recommendations capable of encouraging a sustainable and environmentally-conscious AI lifecycle while enhancing information transparency among stakeholders, aligning the various EU policies and initiatives, and ultimately empowering consumers.

**Keywords:** sustainability; artificial intelligence; sustainable AI; greenwashing; unfair commercial practices; AI Act



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## 1. Introduction

The disruptive capabilities of artificial intelligence (AI) are unquestionable. Over the last years, regulators, academics, and various stakeholders have been investigating the impacts of AI on the economy, society, and the personal lives of individuals. Although the main discussion revolves around the inherent problems of machine learning and deep learning techniques, such as explainability (for an analysis of this matter from a data protection perspective see amongst others Cabral, T.S. [1]). AI biases, and privacy infringement, there is an increasing discussion not only about how AI can be used for sustainable purposes [2], but also about how the development of AI products and services can be sustainable [3].

In November 2020, the European Commission launched its New Consumer Agenda [4]. The New Consumer Agenda outlines the EU consumer policy vision until 2025 and is based on five strategic areas, among which are the *Green Transition* and the *Digital Transformation*. Both initiatives set the EU consumers in the epicenter of a green and technology-based EU-wide plan, while they predominantly focus on the importance of information to ensure higher levels of consumer protection and engagement, as well as transparency in digital

practices and environmental sustainability claims. In this regard, the Green Transition legislative proposal is expected during 2021.

Starting from these EU initiatives, we will identify the need for sustainable AI, and we will examine whether the current consumer protection regime and the latest EU policies and proposals regarding consumer protection are capable of fostering an information obligation regarding environmental sustainability in B2C contracts when AI is involved. Furthermore, we will analyze how the requirement of societal and environmental wellbeing, identified by the AI High-Level Expert Group (AI HLEG) in the Guidelines for Trustworthy AI, can promote sustainability. Considering a recent proposal for an AI Act [5], we will assess whether this new initiative can assist in materializing the sustainability objectives of the New Consumer Agenda. Lastly, we will propose a set of recommendations aiming to link the *Green Transition* objectives with the design, development, and use of sustainable AI.

In the present analysis, we will focus on consumer protection laws horizontally applicable and, therefore, we will not analyze the obligation to provide information to consumers based on sector-specific regulations applicable to particular AI products and services, for instance, medical devices in the healthcare sector.

For clarity, it should be noted that when we refer to artificial intelligence, we refer only to machine learning (including its subset deep learning AI) either embedded in hardware devices or software-based, and the terms AI or algorithm are used interchangeably. Furthermore, note that since the difference between an algorithm and a model is purely technical and not necessarily consistent across works in this field, and as it does not affect the scope of our paper to avoid constant sentences like ‘the AI model created by the AI algorithm’, we will frequently use the term ‘algorithm’ to encompass the entire procedure from learning to result

## 2. Materials and Methods

This paper is based on a legal doctrinal and interdisciplinary analysis, comprising theoretical and descriptive material from a legal and technological point of view. Writing of this work includes a small comparative analysis for the enforceability of the Unfair Commercial Practices Directive. All materials used are available in the references section.

## 3. Sustainable and Non-Sustainable AI

In 2019, a well-cited study carried out by Strubell et al. concluded that the training process of a single, deep learning, natural language processing model can lead to approximately 600,000 lb of carbon dioxide emissions [6], which roughly amounts to as much carbon dioxide emissions as the ones produced by five cars in their lifetime [7]. These problematic emissions only increase when deep neural networks are deployed on hardware platforms [6]. Considering the manifold applications of AI and the different models being developed, the environmental costs are significant.

At the same time, an increasing discussion has started in academia not only about how AI can be used for sustainable purposes, but also how the development of AI can be sustainable. For instance, it was recently reported that MIT researchers have developed a new method of deep learning training capable of reducing costs, as well as the AI training carbon footprint [8].

From the perspective of AI Ethics, Aimee van Wynsberghe defined the term sustainable AI as “... a field of research that applies to the technology of AI (...) while addressing issues of AI sustainability and/or sustainable development” [3]. In other words, the term of sustainable AI takes into consideration the entire AI lifecycle, from training to its implementation and use. The author goes on to distinguish between two sub-concepts included under the umbrella term of sustainable AI: AI for sustainability and sustainability of AI.

*AI for sustainability* has been explored more over the past years. From private non-profit organizations [9] such as *AI4Good* to elaborate academic work as the *AI4People* ethical framework developed by Floridi et al. [2], the potential of AI to solve complicated

environmental and societal issues and help meet the United Nations Sustainable Development Goals (SDGs) and the 2030 Agenda is being promoted. On a European level, the European Commission in its White Paper on AI clearly referred to the value of AI in achieving sustainable economic growth and societal wellbeing [10], attaining the Green Deal goals [11], as well as promoting circularity in the single market in its Circular Economy Action Plan [12,13].

At the same time, the Commission, also in the AI White Paper, made a small, but nonetheless important reference to the *sustainability of AI* by referring to the importance of assessing the environmental impact of AI throughout its lifecycle and its supply chain. Interestingly, the Commission included specifically the example of “*resources usage for the training of algorithm and the storage of data*”, showcasing that the European regulator is aware of the intrinsic environmental problems of AI training (the same example is mentioned in the AI HLEG Assessment List for Trustworthy Artificial Intelligence [14]). It is further suggested in the conclusion, without being defined, that AI can benefit citizens, companies, and society, when, among others, it is sustainable [10].

For the purposes of our analysis, when we use the term *sustainable AI*, we will refer only to the *sustainability of AI*, meaning the sustainable development and use of the technology, taking into consideration its environmental impact, and not when it is used to meet sustainable objectives.

It should be noted, however, that sustainability as such is not defined. In 1987, the Brundtland Commission, or the World Commission on Environment and Development (WCED), in its report, *Our Common Future*, defined sustainable development as “*development that meets the needs of the present generation without compromising the ability of future generations to meet their needs*” [15]. This definition has since been specified as to be anchored in three pillars: (i) environment, (ii) economy, and (iii) society [16].

Translating this definition, for AI to be considered sustainable throughout its lifecycle, it should not harm or otherwise impair these areas. In other words, the stakeholders involved in the designing, training, validation, verification processes, and implementation and use of AI should ensure that it serves the needs of environment, economy, and society. This is also in line with the United Nations Guidelines for Consumer Protection, and in particular regarding promoting sustainable consumption, paragraph 52 which suggests when designing, developing and using products their energy and resource efficiency should take into consideration their full lifecycle [17].

In relation to the environment (i), although not referring to AI in particular, one of the three streams of action identified in the Commission’s Communication of Shaping Europe’s Digital Future [18] is the promotion of an open, democratic, and sustainable society. One of the goals of this action is to reduce the carbon emissions in the digital sector. This objective will certainly impact the development of AI, considering that one of the key upcoming initiatives is achieving high energy-efficient and sustainable data centers by 2030.

Moreover, it should be noted that the scope of the Ecodesign Directive [19] covers AI-powered products. In particular, considering the broad definition of “*energy-related product*” (see article 2(1))—products which are AI-embedded—as long as they have an impact on energy consumption during their use, before entering the Single Market, they should comply with the Community ecodesign requirements set in the Directive, including bearing the CE marking. However, for the time being, this involves only devices that can function autonomously in a limited manner, as for instance, robot vacuums [20]. Although the definition of AI, as proposed by the AI HLEG and developing the 2018 Commission’s definition, [10,21] and ultimately included in the Proposal for an AI Act (article 3(1) [5]), is very broad to include “*not-smart*” robots, the training and designing of such devices has limited environmental impact compared to advanced AI systems that are using machine learning and deep learning techniques. Additionally, considering the scope of the present, such products exceed the objective of our analysis.

Notwithstanding, the Sustainable Products Initiative, already announced in the Circular Economy Action Plan [12] in March 2020, will aim to address durability, reusability,

repairability, recyclability, and energy efficiency issues of various products, revising the Ecodesign Directive and extending its scope beyond energy-related products [19]. In relation to digital products, a “digital passport” will be developed (an initiative also announced in the EU Data Strategy). It should be noted, however, that sustainability issues of AI development are not currently contemplated in the Circular Economy Action Plan.

#### 4. The Growing Trend towards the Green Consumer

In a survey on the *Attitudes of European citizens towards the Environment*, requested by the European Commission and the Directorate-General for Environment and published in March 2020, it was found that 53% of Europeans recognize protecting the environment as very important to them personally, and 41% as fairly important, while 68% agree that their consumption habits adversely affect the environment [22]. At the same time, the majority believes that neither the companies nor the citizens themselves are doing enough to protect the environment. Moreover, a 2018 study for the European Commission [23], aiming to provide insights on consumers’ engagement in circular economy, including to sustainable consumption, found that when consumers receive adequate information on the durability of products, they also focus more on their environmental characteristics, while sufficient information on durability can almost triple the sales of products [23].

These two surveys showcase that the EU consumer is interested in participating in the circular economy, however, in doing so, it needs more information and more opportunities to actively engage in this *green transition*. Additionally, reflecting this tendency, green or environmental claims are used more and more as a marketing and advertising tool for the promotion of products and services [24].

Furthermore, the COVID-19 pandemic changed the consumption and behavioral patterns of consumers around the world and brought to the surface the need to reinforce the current consumer protection regime, especially in the context of digital transformation. It would be of interest for future policies in the area of consumer protection and circular economy to investigate the long-term effects of the pandemic in the consumption behavioral patterns of consumers to assess not only the environmental impact, such as the increase on single-use packaging waste, or the incremental online purchases, but whether following the pandemic, the interest of consumers in sustainable claims of products and services has increased or decreased. In this regard, it is also interesting to note that the Commission has announced that it plans during 2022 to explore the impact of COVID-19 on the consumption patterns of EU citizen [23].

The above were taken into consideration by the European Commission, which published in November 2020 its New Consumer Agenda following a public consultation [4]. The New Consumer Agenda outlines the EU consumer policy vision until 2025, and is based on five strategic areas: (i) the *Green Transition*, (ii) the *Digital Transformation*, (iii) redress and enforcement of consumer rights, (iv) specific needs of certain consumer groups, and (v) international cooperation. As it is understood from the context of each strategy, the agenda is following a holistic approach, addressing various existing consumer protection policies or the consumer protection aspects of other initiatives of the European Commission, as for instance, the EU Digital Strategy [15], aiming to align their objectives. For the purpose of this paper, we will focus on the first two priority areas of the Agenda.

One of the core findings of the public consultation of the New Consumer Agenda was identifying the need of consumers for “better and more reliable information on sustainability . . . while avoiding information overload” [4]. As it was highlighted, such information either is not available to consumers, or there is little to no reliability of the various existing environmental claims. In the screening of websites carried out by the Commission, in “37% of cases, the claim included vague and general statements such as “conscious”, “ecofriendly”, “sustainable” which aimed to convey the unsubstantiated impression to consumers that a product had no negative impact on the environment”. Moreover, “in 59% of cases the trader had not provided easily accessible evidence to support its claim” [25]. Evidently, the obscurity of sustainability

information, or the lack of it, creates greater barriers in the decision-making process of consumers and, concomitantly, in their engagement in the circular economy.

With the Sustainable Products Initiative, the Commission wishes to increase the access of consumers to information regarding products' environmental characteristics, their durability, reparability, and reusability (as stated above). Nonetheless, to effectively change the current situation, the issues of reliability and the substantiation of sustainability claims should be tackled.

Currently, there are no specific rules on the substantiation of environmental claims. The only available tool is the Directive on Unfair Commercial Practices, which prohibits any environmental claims that are found to be misleading vis-à-vis the consumer as we will see below. However, it does not contain any specific rules on environmental claims. Nonetheless, in general, under the Unfair Commercial Practices Directive, a commercial claim is not misleading if it is presented in a clear, specific, unambiguous, and accurate manner, while the traders need to have scientific evidence available to substantiate their claims, if challenged. These criteria should be assessed on a case-by-case basis. Considering that the transposition and enforcement levels of the directive vary among member states, its application to greenwashing practices is limited and fragmented across the EU. Interestingly, already in 2013, the Commission identified in the first Impact Assessment of the Directive that "further regulation of environmental claims can only be achieved through a revision of the UCPD or the adoption of other (specific) EU legislation" [24].

As greenwashing practices increase across industries, especially in relation to digital products and services [4], the contribution of the second strategic area of the New Consumer Agenda—*Digital Transformation*—is essential. By tackling consumer protection challenges related to the use of platforms, such as fraudulent commercial practices, misinformation, and fake consumer reviews, the (truthful) information exchange and accessibility to environmental and sustainability characteristics of digital (or not) products and services can be promoted. Ultimately, the transparency of information will empower consumers, allowing them to carry out informed decisions, and increase the value and impact of sustainability claims in consumer consumption patterns.

## 5. Sustainability of AI and Sustainability Claims

### 5.1. AI HLEG Ethics Guidelines for Trustworthy AI

In April 2019, the High-Level Expert Group on Artificial Intelligence (AI-HLEG) set up by the European Commission published its final version of the *Ethics Guidelines for Trustworthy AI* following a public consultation [21]. According to the guidelines, an AI-system will be considered trustworthy when, throughout its lifecycle, it meets the following components cumulatively: (i) it is *lawful*, meaning that it complies with the applicable laws and regulations; (ii) it is *ethical*, meaning that it observes ethical principles and values, and (iii) it is technically and socially *robust*. For these components to materialize, a set of core ethical principles, as well as seven requirements based on technical and non-technical methods, should be met.

The ethical principles and requirements are identified in the Table 1 below:

**Table 1.** Trustworthy AI ethical principles and requirements.

Ethical Principles	Requirements
Respect for human autonomy	Human agency and oversight
Prevention of harm	Technical robustness and safety
Fairness	Privacy and data governance
Explicability	Transparency
	Diversity, non-discrimination, and fairness
	Environmental and societal well-being
	Accountability

It should be noted that AI HLEG advises that when implementing these ethical principles or “*ethical imperatives*” identified throughout the lifecycle of the technology, especially in adherence to the principle of prevention of harm, vulnerable groups and relationships where there are information asymmetries, as for instance, between businesses and consumers, should be taken into account. At the same time, one of the proposed non-technical means to facilitate meeting these requirements is information transparency. In particular, the AI HLEG suggests that providing information to stakeholders in a clear and proactive manner about the capabilities and limitations of AI, as well as of the means used to implement the seven requirements, is essential. The objective of this measure is to ensure that the stakeholders have realistic expectations about the technology.

More specifically, in order to meet the requirement of diversity, non-discrimination, and fairness, which is closely related to the ethical principle of fairness itself, aside from avoiding unfair bias and promoting stakeholder participation in AI development, accessibility and universal design is pivotal. Under this sub-requirement, it is advised that AI products and services are accessible to consumers, irrespective of their own abilities. To this, we add that the accessibility requirement does not necessarily involve only the functionality of the product or service, but also the information provided about the product or service. Information, including sustainability information and claims, should be put in a clear, legible, and accessible manner for the consumer. Therefore, overly technical and specialized vocabulary should be avoided.

In addition, the requirement of environmental and societal well-being suggests that the sustainability of AI systems should be ensured and promoted throughout the AI value chain and lifecycle. To determine whether an AI product or service is sustainable, AI HLEG suggests a critical assessment of “*resources, energy consumption during training*” [21]. In its Assessment List for Trustworthy AI (ALTAI) [14], in order to assess the conformity with the societal and environmental well-being requirement, AI HLEG proposes the following self-assessment checklist:

- “Are there potential negative impacts of the AI system on the environment?
  - Which potential impact(s) do you identify?
- Where possible, did you establish mechanisms to evaluate the environmental impact of the AI system’s development, deployment and/or use (for example, the amount of energy used and carbon emissions)?
  - Did you define measures to reduce the environmental impact of the AI system throughout its lifecycle?” [14]

Notwithstanding, examples of the possible methodology or mechanisms that can be used to assess the environmental impact, or to mitigate it, are not provided.

Furthermore, although AI HLEG does not analyze or provide recommendations in relation to the lawfulness component for a trustworthy AI, these *soft law* recommendations to some extent reflect already existing legal provisions, and may influence future legislative initiatives. Especially in relation to the information transparency method, it is clear that it reflects principles embedded in various laws addressing information asymmetries such as GDPR (Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC) for the protection of data subjects, the Prospectus Regulation (Regulation (EU) 2017/1129 of the European Parliament and of the Council of 14 June 2017 on the prospectus to be published when securities are offered to the public or admitted to trading on a regulated market, and repealing Directive 2003/71/EC) for the protection of investors (, and, of course, the panoply EU consumer protection laws. In this regard, the ethical approach proposed in the guidelines is based on the fundamental rights of the EU Treaties and the Charter of Fundamental Rights of the EU (“EU Charter”). In relation to consumer protection, Article 38 of the EU Charter and Article 169 of the Treaty on the Functioning of the European Union (TFEU) are of relevance.

The guidelines and the assessment list are non-binding, and therefore non-enforceable by administrative authorities or courts. However, they can provide guidance to the various stakeholders involved in the AI lifecycle. From a consumer protection and sustainability claims standpoint, although the obligation to provide the information to the consumer lies with the trader, a transparent and facilitated flow of information between the stakeholders of the AI value chain is essential to ensure the substantiation of such claims. Especially when the provider of information is not the same as the designer, developer, or manufacturer of the AI, it is advised that information regarding the sustainable features of the product or service are addressed and supported after the product or service is put on the market and given to the trader in order to meet their own obligations vis-à-vis consumers. Such practice can be enforced contractually. Although the contractual enforcement of such an obligation to the third-party designer, developer, or manufacturer can help the trader to demonstrate, if requested by a supervisory authority or court, that substantiated information was provided to the consumers, a formal contractual relationships with the third-party that will permit contract negotiation and, secondly, a certain level of market power of the AI-trader over the third-party developer are presupposed [26]. Therefore, the scope of application of this measure may be limited in the AI-field.

### 5.2. Could Sustainability Information Be Included in the “Main Characteristics” of AI Products and Services?

As it was briefly mentioned in Section 4, under Article 6 of the Unfair Commercial Practices Directive, the trader cannot provide misleading information to the consumer [27]. The requirement to not mislead the consumer through untrue environmental or sustainability related claims is, of course, included in this obligation. In other words, the trader cannot engage in greenwashing practices. For instance, this is the case when a trader states that “*due to its composition, how it has been manufactured or produced, how it can be disposed of and the reduction in energy or pollution expected from its use*” a product or service will have a positive impact in the environment or a less negative impact than its competitors, without such claim being true or, at least, verifiable [28]. According to a screening conducted by the European Commission and national consumer authorities a percentage as high as 42% of market players may actually be engaging in some type of greenwashing [10].

For example, for AI, this would mean that it would not be possible to advertise a certain algorithm as trained using 100% renewable energy if, in fact, the energy had come from non-renewable sources, or if there is no adequate manner to ensure that the sources were indeed renewable. In the same manner, a trader using an AI algorithm to offer predictive maintenance to the consumer should be able to adequately substantiate any sustainability benefits (for example, related to energy consumption and waste) that they claimed to achieve, if requested.

Nonetheless, it is important to go one step further and understand that if there is margin in the current legislation to argue that in certain cases, there can be a proactive requirement to offer sustainability-related information for AI-based products and services. In this regard, both the Consumer Rights Directive [Directive 2011/83/EU of the European Parliament and of the Council of 25 October 2011 on consumer rights (as amended)], in its Articles 5 and 6, and the Unfair Commercial Practices Directive through Article 7(4) are clearly establishing that the consumer should be informed about “*the main characteristics of the goods or services, to the extent appropriate to the medium and to the goods or services*”. This obligation should be interpreted in a coherent manner between both legal instruments. This should mean that a trader complying with these obligations under the Consumer Rights Directive is also complying with the obligations under the Unfair Commercial Practices Directive, as sustained by the European Commission in the Directorate-General for Justice and Consumers’ Guidance Document for the application of the Consumer’s Rights Directive [29] (both this Guidance document and the one related to the Unfair Commercial Practices Directive are to be updated by 2022, as announced in the New Consumer Agenda, to take into account the changes brought by the Omnibus Directive).

The question here is in fact whether in a world where consumers overwhelmingly find the environment to be important, and 57% of consumers are willing to change their purchasing habits based on sustainability considerations, 72% are willing to pay a premium for brands that promote sustainable or environmentally responsible behaviors, and 71% for brands that are fully transparent, information related to sustainability can be considered in determined cases as being part of the main characteristics of the product or service [30]. The question can be particularly relevant for AI-based products and services because as we have seen, AI can be both an engine for sustainability, but also a drain on natural resources, and consumers may want to know in which category the good or service they are buying falls in before completing the transaction. Trustworthy AI, according to the commission and AI HLEG, means both transparent and sustainable AI.

The answer to the abovementioned question is that under the instruments analyzed in this section, there is no clear legally binding requirement to provide sustainability-related information specifically for AI-based products and services. While it is certainly true that consumers are aware of sustainability in general, it would be relevant to know if they value it more when it relates to AI comparing to other characteristics to understand if it should be considered as one of AI's "main characteristics". Of course, conclusions can differ based on particular applications of the technology. For instance, if an autonomous vehicle can reduce emissions and fuel/electricity consumption by 40% due to the algorithm used for autonomous driving, one can certainly argue that this is very important information (maybe even a main characteristic of the product). On the opposite side, the fact that Gaming Console A consumes 5% less electricity than Gaming Console B due to some form of AI-based technology deployed will probably not be the key factor driving the consumer's decision to purchase.

### 5.3. The Commission's Proposal on AI Regulation

From late February to mid-June 2020, the European Commission ran a public consultation regarding the expected proposal for a regulation on artificial intelligence and policy options proposed in the White Paper: On Artificial Intelligence—A European approach to excellence and trust [10]. Arising from this public consultation on 21 April, the European Commission presented its proposal for an AI Act putting forward a single set of rules to regulate artificial intelligence in the European Union.

The Proposal for an AI Act came four years after the European Parliament called upon the commission to frame a legislative proposal for a set of civil law rules on robotics and artificial intelligence, arguably, the starting point of the EU's path to produce a specific AI legal instrument. It opts for a risk-based approach to AI regulation with most of its obligations being reserved for high-risk AI, and it possesses the makings of a potentially effective legal instrument with extraterritorial scope, detailed rules on market surveillance, and extremely high fines. With these characteristics, the proposal for an AI Act could have been designed in a manner that could contribute to further promoting transparency and sustainability and reinforcing consumer protection, information transparency, and fundamental rights enforceability regarding these matters. In this regard, it should be noted that the proposal for an AI Act imposes certain transparency obligations to the producer, as well as specific transparency obligations for certain AI uses. However, this information obligation focuses on the use and consequences of an AI system, and not on sustainability. Therefore, the issue of sustainability is mostly ignored in the proposal, with the exception of the possible integration of requirements related to environmental sustainability in voluntary codes of conduct (Article 69(2)) (for a more detailed assessment of the Proposal for an AI Act see Cabral and Kindylidi [31] and Cabral [32]).

In a proposal establishing requirements from risk management to data governance, and where transparency takes a central role, one cannot avoid thinking that it would be easy to go further. In fact, at least for high-risk AI systems, establishing an obligation to detail sustainability impacts in the technical documentation, and to disclose said impacts to the consumer, would not be difficult, nor would it appear out of context in the current



proposal. In addition, an important aspect that should not be disregarded is that the inclusion of rules or principles regarding environment and sustainability in the final text of the regulation, even if through a light touch principle-based approach, would mean that the EU's fundamental rights standard, based on Article 37 of the EU Charter, along with Article 3(3) TEU and 191 TFEU, will then be unquestionably applicable [33,34]. Concomitantly, this will make the likelihood of action by the Court of Justice of the European Union (ECJ) to protect and develop the "European standard" more likely.

## 6. Recommendations

Following our analysis, it is evident that to a large extent, AI sustainability is ignored, both in AI specific and in consumer protection legislations. Thus, it is evident that as the legislators contemplate upon the AI regulation, they should also take into consideration its impact on sustainability. Equally, new environment and sustainability legislation should take into account the specific challenges of AI. To adequately do so, a profound understanding of the various stages of the technology's lifecycle is necessary, while at the same time, incentives should be created to promote the sustainable development of the technology. For instance, measures such as requirements of environmental footprint reporting, tax benefits, and funding to entities developing and using Sustainable AI can be established in a national and European level.

Furthermore, van Wynsberghe proposes the elaboration of a "proportionality framework" at a European level in order to assess whether the environmental impact related to the training of particular AI applications is proportionate [3]. We believe that such proposal has merit, provided that larger scale studies are carried out to clearly map the environmental impact of AI and, concomitantly, the acceptable levels of energy consumption and carbon dioxide emissions per algorithmic training and use. Moreover, this also implies that the best practices and sustainability guidelines should be shared with the stakeholders, which should not burden excessively startups, SMEs, and smaller AI developers or hamper small scale training whose impact to sustainability will probably be lower.

In addition, the proportionality framework should be objective. In her opinion paper, van Wynsberghe contemplates whether the increased costs and environmental impact of AI training and *tuning* (i.e., AI repurposing or refining) may justify policy decisions that will limit certain AI-development practices for "*ethically charged tasks like recruitment of new employees or prediction of employees who may be on the verge of quitting*" [3]. The merit of the question from an ethical and societal standpoint is undeniable. However, considering the stage of the technology, we believe that such a policy decision will hinder its development and uptake. At the same time, it will prove particularly complicated for the regulator to define the criteria and design the balancing exercise of assessing which AI applications are "worthy" of their environmental impact. Furthermore, a certain AI technology that is originally developed for an ethically charged task can be later used to achieve a sustainable objective and vice-versa. Thus, such classification could end up being artificial at most. This is also true for any efforts to limit certain high-risk AI development, as defined in the proposal for an AI Act, to avoid the environmental impact. Therefore, we propose that any proportionality framework introduced should be detached from the particular application of AI and objective, especially in the training phase of its lifecycle. Notwithstanding, at the use stage, it is reasonable that different levels of energy consumption can be justified. For instance, a healthcare AI used in a hospital is expected to function for more hours, and therefore to consume more energy and have a more significant carbon footprint.

Courts can also have a role in developing their understanding related to sustainability and applying it to AI. For example, taking into consideration the growing trend of the green consumer, the ECJ could decide that, for certain AI applications, providing sustainability-related information could be required by identifying sustainability as one of the main characteristics of the goods or services. Of course, the same could be achieved through a legislative change, but that takes more time and is less efficient, as the consumer protection enforcement is fragmented in the EU and may not be even necessary in this case.

For any regulatory solutions to produce the desired effect, their uptake by entities developing and using AI should be at a scale. This requires incentivizing the industry and promoting the monitoring and ultimately the reduction of AI-energy consumption and carbon emissions as a best practice. In this regard, to the extent that sustainable development of AI cannot be achieved fully, entities developing AI should carry a cost-benefit analysis of the various available algorithms and training methods available prior to selecting one. To facilitate this process, the sharing of information between the different stakeholders about the training time [6], computational power necessary in the deployment and implementation stages, as well as the energy consumption and carbon footprint of the AI is essential. In this regard, as van Wynsberghe mentions, there are two available technical tools that can support monitoring and real-time tracking respectively of energy consumption and carbon dioxide emissions of machine and deep learning algorithms [3]: (i) the “*Machine Learning Emissions Calculator*” by Lacoste et al. [35] and the “*Carbontracker*” as suggested by Anthony et al. [36] (note that carbontracker allows the user to stop the training process “*if the predicted environmental cost is exceeded*”), and (ii) the “*Experiment-impact-tracker framework*” introduced by Henderson et al. [37].

Furthermore, we should note that interoperability is essential to achieve the sustainable use of AI, as it can promote the reusability of algorithms. Interoperability and reusability have already been identified as crucial challenges of AI-based systems by academia [38]. For interoperability and concomitantly reusability to materialize, interoperable standards should be developed. Considering that interoperability has been one of the priorities of the European Commission for the development of the Single Digital Market in Europe, and that the circular electronics initiative, addressed in the Circular Economy Action Plan, is aiming to extend the lifecycle of electronic devices also through reusability, it is safe to assume that interoperability and reusability of algorithms will be addressed in the near future.

Nonetheless, in the European Commission’s White Paper on AI, the issues of reusability and interoperability are addressed in relation to the data used in AI development [10], and a reference to this issue also appears within the Proposal for an AI Act (Recital 81), pursuant to the FAIR data management principles [39]. In addition, although not expressly referring to AI applications, the principles of the EU Interoperability Framework, including the principle of reusability, should apply to AI-powered digital public services in the EU [40]. Moreover, from a practical standpoint, it should be noted that the *once-for-all* model developed by MIT researchers builds not only on the idea of reduction in energy consumption, but also in reusability [8], since it allows the training and development of an algorithm that can be later adapted to the “*diverse hardware platforms without retraining*” [41].

## 7. Conclusions

As more consumers are interested in and require more information on the sustainability features of products and services, and as the literature around Sustainability of AI increases, there is a need to promote a sustainable AI lifecycle.

Considering that at the time of writing, the sustainability of AI is overlooked in (i) AI-specific legislation and initiatives, such as the recent proposal for an AI Act, (ii) Consumer Protection legislations and initiatives, including the latest New Consumer Agenda, (iii) as well as in sustainability focused laws and initiatives such as the Circular Economy Action Plan, we believe that some targeted and carefully outlined rules, setting general requirements, regulatory guidance, and codes of conduct when it comes to Sustainable AI may be needed. Although a horizontal set of rules will be the first step, considering the unique characteristics of certain industries, products, and services, sector-specific guidance will be necessary. Similarly, although we suggest that AI-powered products and services are contemplated in the commission’s holistic initiatives, guidance focused on AI is necessary. As the proposal for an AI Act is under discussion, there is still time to address AI sustainability therein.

Notwithstanding, it should be noted that the uniqueness and particularities of AI do not exclude the application of existing tools that can help promote AI sustainability as well as providing sufficient information to consumers. In this regard, an update of the existing labelling system pursuant to the Ecodesign Directive and the Regulation for Energy Labelling Framework (Regulation (EU) 2017/1369 of the European Parliament and of the Council of 4 July 2017 setting a framework for energy labelling and repealing Directive 2010/30/EU) to cover more complex AI-powered products and services is advised. Parallely, following sufficient information exchange with the industry, specific criteria can be outlined for AI products and services to be awarded the EU Ecolabel (Regulation (EC) No 66/2010 of the European Parliament and of the Council of 25 November 2009 on the EU Ecolabel). The EU Ecolabel can be awarded to any goods and services distributed, consumed or used in the EU market that have a lower environmental impact than other products in the same group. Note, however, that medical devices are excluded from the EU Ecolabel system and as such AI medical devices cannot bear the label. To increase the efficiency of the labelling systems as well as its adoption by the industry, any initiatives, horizontal or sector-specific, should be aligned.

Lastly, as it was highlighted throughout the present, any efficient policy initiative on sustainable AI requires the support and collaboration of the AI ecosystem. As a starting point, and to ensure that there is sufficient information exchange amongst the various stakeholders and that the information asymmetries between the industry and the EU regulators are bridged, further multidisciplinary research in the area of AI Sustainability should be carried. In this regard, firstly, larger scale studies to clearly map the environmental impact of AI and the acceptable levels of energy consumption and carbon dioxide emissions per algorithmic training and use are necessary. Additionally, from a consumer protection perspective, an EU-wide study to assess whether consumers consider environmental sustainability information of AI products as material is essential to encourage and accelerate possible regulatory actions towards Sustainability of AI.

In the Table 2 below, we provide a systematic overview of the main issues identified, the recommendations proposed in this paper, and the legal instruments that can facilitate such recommendations, where relevant.

**Table 2.** Overview of issues, recommendations and relevant regulations and policies.

Issues	Recommendations	Relevant Regulations and Policies
Address the current regulatory gap on Sustainability of AI in AI regulation and policy initiatives	<ul style="list-style-type: none"> <li>Including environmental and societal sustainability obligations in the final wording of the AI Act</li> <li>Development of an objective proportionality framework for the training phase and specific standards for the use phase of AI</li> </ul>	Proposal for AI Act
	<ul style="list-style-type: none"> <li>Promote sustainability using the AI HLEG requirement of societal and environmental wellbeing</li> <li>AI accessibility should also pertain to accessibility to information, including sustainability information</li> <li>Providing guidance to stakeholders and influencing future legislative initiatives</li> </ul>	<ul style="list-style-type: none"> <li>AI HLEG Ethics Guidelines for Trustworthy AI</li> <li>AI HLEG Assessment List for Trustworthy AI</li> </ul>
Address the current regulatory gap on Sustainability of AI in Consumer Protection Laws	<ul style="list-style-type: none"> <li>Reducing carbon emissions in the EU digital sector</li> <li>High energy-efficient and sustainable data centres by 2030</li> </ul>	Shaping Europe's Digital Future
		<ul style="list-style-type: none"> <li>New Consumer Agenda</li> <li>Green Transition Proposal</li> </ul>

Table 2. Cont.

Issues	Recommendations	Relevant Regulations and Policies
Information obligation regarding environmental sustainability in B2C AI products	Providing further guidance and development of case law on substantiation of environmental sustainability claims in AI products to ensure harmonization and effective enforceability	Unfair Commercial Practices Directive
	Providing further guidance and development of case law on whether environmental sustainability claims consist main characteristics of AI products and services	Consumer Rights Directive
	EU-wide study to assess whether consumers consider environmental sustainability information of AI products as material	
Address the current regulatory gap on Sustainability of AI in Environmental Sustainability Laws	<ul style="list-style-type: none"> <li>• Extending scope beyond energy-related products</li> <li>• Broadening scope of digital products to include machine and deep learning AI</li> </ul>	<ul style="list-style-type: none"> <li>• Circular Economy Action Plan</li> <li>• Ecodesign Directive</li> <li>• Sustainable Products Initiative</li> <li>• Regulation for Energy Labelling Framework</li> </ul>
Promotion of Sustainability of AI in the AI ecosystem	<ul style="list-style-type: none"> <li>• Incentives (e.g., environmental footprint reporting, tax benefits and funding)</li> <li>• New case law on AI Sustainability</li> <li>• AI Sustainability guidelines and best practices</li> <li>• Larger scale studies to clearly map the environmental impact of AI and the acceptable levels of energy consumption and carbon dioxide emissions per algorithmic training and use</li> </ul>	
	Interoperable standards	<ul style="list-style-type: none"> <li>• Single Digital Market</li> <li>• Circular Economy Action Plan</li> <li>• White Paper on AI</li> <li>• Proposal for AI Act</li> <li>• EU Interoperability Framework</li> </ul>

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