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The Techno-Optimists of Climate Change: Science Communication or Technowashing?

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Abstract: Although it is important to communicate scientific knowledge, it seems that this assumption is even more evident when it comes to environment-related themes, which have gained more relevance in the public sphere in the last decades. This article evaluates the spectacularization techniques of technology and science displayed as if they were the only solution to the environmental crisis. Firstly, from a literature perspective, this article shows the evolution of science communication and the relationship between society and science over the last centuries. After that, it presents a critical view on the excessive optimism around technology and scientific advancement, arguing that the possible solutions to the environmental crisis cannot come exclusively through technology substitution. The article thus shows that there is today a clear distinction between science communication and the communication of science as a mass product, which is promoted today by different stakeholders to manipulate public opinion for different reasons. Finally, the article identifies some common elements of this phenomenon that we call technowashing, insofar as it aims at a laundering of responsibilities and harmful impacts of business and political decisions.

Keywords: techno-optimists; technowashing; science communication; climate change

Citation: Ribeiro, S.; Soromenho-Marques, V. The Techno-Optimists of Climate Change: Science Communication or Technowashing? *Societies* **2022**, *12*, 64. https://doi.org/10.3390/soc12020064

Academic Editors: Sandro Serpa and Gregor Wolbring

Received: 20 December 2021
Accepted: 1 April 2022
Published: 4 April 2022

Publisher's Note: MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.

1. Introduction

There is agreement among scientists that human activity is the main cause of climate change due to increased greenhouse gas (GHG) emissions resulting from unsustainable patterns of human production and consumption [1].

The communication and dissemination of this data has been seriously undertaken by the world's leading academies due to the urgency and seriousness that the impacts will have on the life carrying capacity of the planet. Science dissemination plays an essential role since it provides science-based tools, sound information and knowledge, allowing individuals to exercise their role as citizens [2]. According to the 2021 European Commission Eurobarometer survey, 93% of European citizens consider climate change a serious problem and 78% a very serious problem, and 75% think their national governments are not doing enough to tackle climate change [3]. In recent decades, groups of people have emerged focused on environmental issues and demanding changes and greater transparency from companies and governments. They struggle to find new approaches and new ways of governance, greater efficiency, and a faster response to today's complex challenges related to the planet as a home.

Therefore, all over the world, countries and companies have sought to adapt and set mitigation and adaptation targets to address the complexity of climate change challenges. For example, under the Paris Agreement of 2015, in the context of COP21 (Conference of the Parties), three main goals were established: (a) to ensure that the increase of the global average temperature of the earth stays below 2 °C compared to pre-industrial standards and to pursue efforts to limit that increase to up to 1.5 °C, to increase the adaptation capacity to the adverse impacts of climate change and to develop consistently financial

flows aiming the promoting of lower GHG emissions. However, nowadays it seems that the main question for policymakers and businesses is not so much on what we should do but how to put the toolkit of options in place.

While a profound change is necessary, what we see in plans to fight the climate crisis is a techno-optimistic position, centred on an unlimited belief in human power and ingenuity, neglecting the rather short timeframe, we have to reverse the path we are on. A full lifestyle and socio-economic change seem to be a stronger priority compared to the sheer replacement or creation of new technologies. Furthermore, we identify, from the outset, two basic disputable statements: the assumption that technology will solve all our problems and the lack of a critical assessment of the hierarchy of technological options, and, regardless of their feasibility and impact, they all may be developed and used as weapons in the fight against the climate crisis. In this paper, we intend to study the differences between the rightful communication of science and its use as a political, commercial, or business product, which will result in a concept that helps to understand the hope in technology and science.

2. A Brief Review of Science Communication

One of the intrinsic elements of scientific methodology is the ability to communicate results and conclusions since knowledge sharing between researchers and scientists becomes essential for the progress and development of scientific work.

The concern of bringing scientific knowledge to the public is not an exclusive practice of our days, but it has gained special relevance in recent years: first, because scientific research requires public investment [4], and also because a discovery can be the source of controversy, due to the social, economic, environmental, or ethical impact that it may entail.

Regardless of the different labels it may assume—science dissemination, public understanding of science, scientific literacy, science communication, public engagement in science, with science or about science, scientific culture, citizen science or science education [2]—the dissemination of scientific knowledge dates back to the 18th century, during the period known as the Enlightenment. Newspapers, magazines and books saw a high increase in print and urban circulation, contributing to the emergence of the 'public sphere', a group of people that emerged through discourse, dialogues and consensual definitions of ideas, as Habermas [5] states.

The following century was strongly marked by the idea that scientific knowledge was useful and even indispensable to our daily life, with science being presented as practical, useful, fun and popular [6]. Science should be for everyone; hundreds of science dissemination activities emerged throughout the century, such as conferences, exhibitions (World Exhibitions that promoted images and models of futuristic technological systems), museums, observatories, botanical gardens and zoos, as well as many scientific dissemination publications (such as The Scientific American, in 1845, the British weekly newspaper Nature, in 1869 or the National Geographic Society, in 1888).

However, it is in the 20th century that there was a profound turn int the relationship between society and the scientific community. If, on the one hand, the establishment of the scientific method [7,8] was decisive for the progress of science, at the same time, a cleavage started to appear between professional scientists and those non-professional amateurs whose interest in scientific matters was looked at with suspicion. In spite of the fact that science was a collective activity, this community remained separate, and the connection between the scientific city and the rest of the society was only allowed in one direction, from the scientists to the public [6].

Thus, if the science communication of the 19th century assumed that the gap between scientists and the public was accidental and did not disqualify it, the science communication of the 20th century is based on the idea that there is a problem of ignorance, a factor that is a basis for society's lack of support for science issues [9]. As a way to remedy this fractured relationship, there is a need to focus on the literacy of society, which should involve a greater understanding of basic scientific words and facts, the general scientific

process and the political issues related to science. However, although this model, known as the knowledge deficit model of science communication, persists in science and its public communication [9,10], it has been criticised and fundamentally reconsidered, in part, for being overly simplistic and ineffective [10] and for positioning the public as sociologically incompetent [6,11]. Another movement very popular in the 1970s and 1980s was the Public Understanding of Science. However, it revealed some problems at the end of the century [12,13], serving as an impetus to move toward more participatory models (e.g., Public Engagement). Miller's work [14] has led to a greater awareness of the need to engage the public in science, recognising that while until the 1960s, people welcomed scientific information and lived in awe of the advancement of science and technology, from that time on, and in some part due to the release of books (e.g., 'Silent Spring' by Rachel Carson), discoveries (e.g., the impact of CFC's on the Ozone Layer, by James Lovelock) and events (e.g., oil spills in the Gulf of Mexico or Alaska or the Chernobyl accident) that began to show the harmful consequences that some scientific discoveries had on life [15], society became more aware and concerned about these issues.

However, the engagement model also had some problems [16], mainly due to issues of representativeness and inclusion or the effectiveness of public opinion in policymaking. Despite the various declinations of the following years, in which Public Engagement in, with or about science was discussed, in 2009, the idea of responsible research and innovation emerged in European policy. The report [17] explains that nowadays, we are living through a transformation as important as the one experienced with the ideals of the 15th- and 16th-century Italian Renaissance, advancing our century as a 'New Renaissance'; it sets the shared responsibility between science, policy and society to ensure that science promotes socially beneficial actions as well as freedom of thought [16–18].

For this reason, the concept of Citizen Science has also attracted attention, as it encompasses collaboration and partnership between professional scientists and volunteers in scientific activities—citizens again assume an important role in scientific work, from data collection, problem identification and methodology design to dissemination of results [15].

Thus, this new model makes clear the importance of making science increasingly transparent and easily accessible to everyone, highlighting the limitations of managing ethically problematic areas of science and innovation and the emergence of new technologies [19,20].

3. Over-Optimism in Technology and the Promotion of the Powerful Man

In discussions around climate change, solutions are often thought of with long timeframes, whether because of the long time scale associated with possible changes in the climate or earth system or because of the long life of infrastructure that provides some inertia or delays in the implementation of effective measures.

Nevertheless, there is consensus among scientists that we must drastically reduce the emission of CO_2 and other GHGs in order to achieve carbon neutrality by the middle of our century and we must stop the destruction of the great forests and oceans, which represent important sinks in the carbon cycle. In fact, the question today is not so much what we should do but how we should do it. In fact, we live in an epoch in which it is necessary to answer the challenge of how to govern the Earth as a whole [21], which allows managing and protecting the common parts, like a big condominium [22]. Otherwise, as Hardin wrote in his well-known article 'Tragedy of Commons', the free use of the commons brings ruin to all, to the extent that "each man is locked into a system that compels him to increase his herd without limit—in a world that is limited" [23] (p. 1244).

If before technological modernity, the problem of humanity lay in the disproportion of its fragile power before the overwhelming force of Nature, today, in the epoch of the Environmental Crisis (which, more correctly, is the biggest humanity's identity crisis [22], and of our capacity to continue to inhabit the Earth [21]), our problem is the immense power of human culture and the lack of an internal or external principle of containment regarding the use the immense accumulated power. In fact, the quest to dominate and control the biosphere is nothing more than an exponential accumulation of power, of a will

to power [24–26], which goes beyond the technical mastery of nature to achieve human good. Sometimes, as Martins [24] states, the technological dimension of science ceases to be seen as a by-product of epistemological virtues or methodological merits previously defined by science but rather a "conceptual and ontological dependence of science in relation to technique", where science "always serves a 'technological a priori'" (p. 52), no longer assuming a 'necessitarian' end, to assume a 'destinitarian' end of a kind of technique's determinism.

In effect, if we can assume our culture as a technosphere, then its two basic constitutive elements—the state and the market—are obvious, which function to the exact extent of "the imperative needs of military hegemony, or the imperatives of mercantile expansion" [21] (p. 177) and not to the extent of human needs. For example, Hardin [23] recalls the article by Wiesner and York or Jaspers [26], which advances that the technique behind nuclear war and the atomic bomb allows a will to power to be satisfied; despite the recognition that its use means the death of all humanity, technological improvement in the field of atomic weapons continues to grow.

Although social issues and norms fit in a chapter of the IPCC, they are considered "alternatives or complements" to technological mitigation solutions [27] (p. 254), making evident the focus of most countries' and companies' strategic plans on the myopic solutions that technoscience can provide.

In fact, when we talk about CO_2 emissions from transport, one of the solutions is the introduction and development of 'green technologies', namely electric vehicles; when we talk about CO_2 emissions caused by intensive agriculture or by land use change, the solution is the development of more and more efficient technologies that allow maximum efficiency of agriculture; or when we talk about CO_2 emissions caused by industry, many point out as a solution the development of technologies capable of capturing and storing, temporarily, the emitted pollutant. In fact, the idea seems to us to be wrong—that we can continue to drive our cars, fly on holiday, buy objects and products or eat large portions of meat, provided that cars are electric, planes use biofuels, packaging is recycled, products are bio and meat is synthetic, like Turner [28] said, without giving up any privileges. It is indisputable, as Hardin advanced in his article, that "in our day, technical solutions are always welcome" (p. 1243); however, it cannot be seen as unique.

In recent years, several theorists and scientists have put forward alternative solutions [28–30]; for example, designing solutions related to better choices of farming systems, through policies and incentives for more effective land use has shown to be a solution for reducing the environmental footprint of farming practice, even with practically unchanged technologies [31,32]. Furthermore, changing social practices regarding dominant patterns of food cultures represents an excellent opportunity in mitigating GHG emissions, as evidenced by a WWF (2017) report related to food. The authors put forward that a change in UK diets, by reducing red meat consumption by over 50%, could reduce the country's carbon footprint by 30%, even without a change in technology. Additionally, many social science researchers have sought to show the importance of multidisciplinarity in designing solutions. Several sociologists [33–35] have delved into the field of social practices, advancing the thesis that for effective change to occur, it is necessary to understand how social and individual practices evolve and interrelate. Although this, and with the adaptation of communities and ecosystems gaining more prominence in public debate, techno-scientific values still prevail strongly.

4. Science Communication or Technowashing?

If previously we spoke about the evolution of the communication of scientific knowledge, what we are seeing today is a form of communication that seeks to stimulate technoscience as a 'magic' solution or even a product for 'mass consumption' through customer satisfaction techniques and the spectacularization of the offer.

The issue is neither simple nor is it confined to communication and, although we examine it with this lens, it is quite clear that excessive optimism around technology, which

we will henceforth refer to as technowashing, does not stop there. On the contrary—rather, it is a trend that is spreading across various areas, be they political, business, economic or even ethical, and in both the private and public spheres. The term technowashing seems very suitable for this article, by analogy with the concept of greenwashing, which is defined, simply, as " behaviour or activities that make people believe that a company is doing more to protect the environment than it really is" [36]. Similarly, the term technowashing that we use here also consists of organisational and political laundry by, on the one hand, promoting excessive optimism about techno-scientific solutions as the sole to the problem and, on the other hand, promoting megalomaniac technology-related ideas in order to deflect attention from the real problems.

In other words, we consider that technowashing may be applied within two different or combined contexts: as a practice that intends to promote and disseminate the ideal of optimism and confidence that techno-science is the silver bullet for solving all our problems, and as a practice that aims to support utopian ideas as a way to fulfil business purposes.

Thus, there are several reasons to use this practice, given the fact that it may: (1) deflect attention from the necessary and urgent reflection on the model of the neo-classical economy that governs the world's largest economies (and which are these with the most severe ecological footprint), (2) strengthen the human dominator of nature status, under the pretext that humans will always be able to develop better technology to address the problems they have caused with technology that is now obsolete, (3) legitimise economic markets freed from constraints or moderation mechanisms, ensuring continued business growth, financial returns and corporate image and reputation, since (4) investment in these techniques will divert attention away from planet-damaging practices promoted by both countries and companies, and (5) divert attention away from the responsibilities of policymakers as their action plans become dependent on what science and technology provide.

Whatever the motive, what this technique allows is to use science, in its modern incarnation as techno-science, as an object of consumption, with organisational practices of customer satisfaction and a flashy and ostentatious offering.

It is therefore important to distinguish technowashing from science communication, since, although the object of communication is science-based, the genesis of the two communicational practices is quite different. Science communication, as we have seen previously, has evolved in a way that increasingly allows for dialogue, debate, controversy and participation of various actors and interests in society. On the other hand, what technowashing really aims to do—despite allegedly bringing science content to everyone—is to, in a unilateral way, propagate 'science' and 'technology' products, using communicational and marketing techniques that allow supporting utopian or fantastic ideas. The Martian colonization, the exploration of lunar resources (the assumption being that if there are no resources on earth, we will be able to import them, even if it is from another celestial body) or some ideas related to the promotion of geoengineering methods (where the hypothetical value of scientific ideas is not in question) are some examples.

Regardless, whatever the reason for the use of technowashing, there are some common characterising elements, which will be listed below.

4.1. The Power of the Mentor

In many cases, technowashing is incited by a major individual or collective opinion leaders who aim to (i) deviate public attention from less sustainable business or personal practices, (ii) ensure the company's livelihood in situations where its business may be at stake with the need to shift to sustainable technologies, (iii) ensure reputation and positioning with audiences or (iv) ensure further economic growth, fulfil financial ambitions and confirm a power position in the global or regional markets.

For example, let us look at Elon Musk and Bill Gates. The first one has been spreading the word about his SpaceX Mars programme, which aims to put the first humans on Mars in 2026 in order to colonise the neighbouring planet in the coming decades or even for space tourism purposes. Despite all the scepticism and questions around these topics, he

continues to sell the idea that it will be possible and indispensable for humans because it acts as insurance if something goes wrong on Earth. For his part, Bill Gates, who has, in recent years, invested in technologies, companies and startups around geoengineering techniques, publicises them as effective solutions to combat climate change (although this is still a controversial topic in the scientific community [27]).

In these cases, the mentor or leader plays an essential role: he assumes himself as an avant-garde promoter of revolutionary and innovative ideas, encouraging people's imagination. They sell the idea that they are committed to the environmental issue and that they invest in and support science, without highlighting the controversies and the feasibility of their ideas. Moreover, these mentors are generally influential in various sectors, aiming to reach and impact many people, who then consider them to be representatives of scientific knowledge.

4.2. Simplified Science Means Manipulated Public Opinion

A common technowashing technique is the use and exploitation of science concepts, methods and research projects.

Note that in the IPCC report [27], geoengineering projects and methods were presented as work in research, in many cases without scale or tested only in a laboratory environment, with the caveat that—although methodologically well designed—they have no immediate applicability in combating climate change due to the scale of the planet. The results of these methods are also presented, showing the negative impact they would have on other parts of the Earth systems if implemented.

However, there is in some cases an appropriation and dissemination of these scientific methods as if they were consensual solutions, ignoring the limitations or problems surrounding them, conveying the idea to people that the solution may go through these experiments and that everything is possible to achieve. It reinforces the human as the planet's dominator since a better and more evolved technology will allow overcoming the basic characteristics of the human condition, such as its finitude, mortality, corporality, animality and existential limitation [24,37].

The technowashing resort to the simplification of processes and steps, which are highly complex and with barriers. We can take for example SpaceX Mars' explanation and how it makes colonisation look like a simple process: "It is a little cold, but we can warm it up. Its atmosphere is primarily CO_2 with some nitrogen and argon and a few other trace elements, which means that we can grow plants on Mars just by compressing the atmosphere" [38].

It is important to simplify scientific concepts so that they can be easily accessed and understood, but it has to be a careful exercise, because the relativisation and oversimplification of scientific concepts and processes only worsens and reinforces the gap and/or ignorance. Furthermore, the emptying of the meaning of structural principles about nature and the environment in communications campaigns leads to extrapolation of ideas, which easily slip into conspiracy theories arguments [39].

Furthermore, in the communication of large utopian projects, it is common to see the use of a 'subversive appropriation' of the visual elements of scientific studies, such as graphs, schemes or models inherent in the academic basis of these projects, in order to convey the idea that those solutions or ideas are validated by science. Benefiting from the positive perspective that these signs represent in people's subconscious, the objective of manipulating opinion is not neglected [40].

These aspects we have described are closely related to the dependence of some scientific laboratories or programmes on funding. The mediatization of science (even if that means technowashing at times) represents an opportunity for funding for specific areas of academic research; that is why there are more and more scientists taking on parallel positions of consultants or collaborators in related private companies. While they are using their own academic prestige to lend scientific credibility to the intentions of the sponsoring organisation, they also see this as an opportunity to shape public perceptions in order to attract funding for their research [4].

4.3. Science Fiction and Pioneering Spirit: The More Exuberant, the More Realistic It Seems

It is common for human beings to see what they want to see. The idea that through science and technology, we can surpass ourselves and achieve immortality has been much exploited by communication and marketing campaigns. Moreover, marketing does not always promote the benefit of individuals, as it often fulfils a corporate financial agenda. A classic example is the cigarette promotion campaign in the United States of America by the controversial Edward Bernays, regarded as one of the pioneers of marketing and public relations, by claiming a 'crystallisation' of public opinion, based on the assumption that companies work on the 'engineering of consent' [40].

This campaign made clear the power of social symbols as well as their manipulation to the benefit of their clients. Indeed, the theories of structuralism and semiotics [41] have served, for better or worse, as support for corporate communication and marketing. Technowashing, as a communication practice, is no exception.

What we find is that the amphibological nature of meanings and symbols allows practitioners of technowashing to use them in their communication. As these companies recognise and identify the symbols and images that have been proliferated for decades by science fiction films and literature, associated with space exploration, science fantasy and super-intelligent humanity, their communications are constructed, often empty of practical meaning, encouraging people's imagination and appealing to their emotions. As an example, please see below Figure 1, which, despite being a mock-up of the colonisation of Mars, evokes cinematic elements such as golden colours or lights from beyond, spaceships as a recurring method of transportation or to the fantasy of human life on Mars, where an adult can point children to the fantastic world it has been building, as if contemplating nature.

Figure 1. Image of colonisation on Mars. Source: spacex.com (accessed on 3 December 2021).

Blackford [42], who has worked in the field of science fiction and fantasy, avers that the glorification of science and man through fiction is very old, going back according to his research to the 17th century. Nevertheless, with the Industrial Revolution, the explosion of modern technology has been feeding the imagination of future societies. As he stated, regardless of the era, the goal has generally always been the same: to become an increasingly technological and powerful body in order to combat human limitations and even fight against mortality.

With the emergence of mass television and cinema and the recent proliferation of other digital media, some fictional ideals have become present in the collective memory. The use of these signs allows for promoting an emphasising feeling of liking, curiosity and desire to experience. Marketing and communication campaigns aim to turn science fiction into reality, although they do not abandon the signs and symbols related to these imaginaries. It seems that the luxury, spectacular and fictional the idea is, the more realistic it seems to become for the public (such as the idea of transporting the human city to Mars

or releasing iron into the ocean to accelerate the metabolism of phytoplankton, proposed by some geoengineering ideas).

4.4. From Immortality to Fear

The apparent pioneer spirit of investment in techno-scientific projects feeds the idea that many of the problems we experience on Earth today will disappear.

In his critical article on the colonisation of Mars, Slobodan [37] proposes that fear and the desire for immortality are strong motivations for the colonisation of space. The rhetoric surrounding the urgency of exploring another planet, on the assumption that on Earth they no longer have a solution, intends to exploit immortality, a normal and widespread desire for humans, and "a feeling of being a part of something greater than the individual self" (p. 97).

Indeed, the expansion of some sciences, such as those linked to space and the biosphere, has proposed the idea that it is increasingly realistic that we can transform ourselves as we merge the finite nature of biological life with the technological nature [24], given our inherent urge to survive.

The promotion of fear should also be looked at here. The magnified rhetoric used by space marketing can trigger serious social and psychological problems that are not being considered yet. Slobodian [37] argues that before considering colonising Mars, it is necessary to investigate and consider all the dimensions surrounding such exploration. It cannot be acceptable to encourage fear in people by referring that if we do not colonise the neighbouring planet, our species will eventually die. In his study, Capstick [43] noticed that respondents have the idea that the climate dilemma is an intractable problem, using language that reflects a sense of resignation and fatalism regarding the ability of individuals and society to respond to climate change.

The point is that the technowashing used around Martian colonisation, for example, triggers two messages, both with exaggerated futuristic scenarios: a utopian vision, in which it will again bring glory, honour and virtue to humanity, or a bleak story with no way out, in which we either colonise now or otherwise humankind will be extinct.

When the factor is fear, reason vanishes. How come can someone dare to think that it is easier to make a planet without conditions and habitable than to improve and protect the unique wealth that exists on our home planet?

4.5. Technowashing and Public Bodies

Although we have been using examples of companies or public figures, technowashing practices do not end with them. Technological optimism has also been exploited by policymakers and/or public entities.

In this case, the purpose of technowashing does not necessarily respect a profit-driven business agenda but rather a strategy to postpone making essential and important decisions. After a brief analysis of the 18 strategic plans to combat climate change presented by the member states of the European Union [44], the focus on technological solutions becomes evident. The idea is that the growth of technology, modernity and efficiency will be the master solution to the environmental and climate problem, allowing us to continue to 'grow' financially and economically while ensuring the same lifestyle. It supports the belief of the use of technology as an instrument of hegemony and power, whereby the countries that dominate and design more technology consequently guarantee a position of domination, security, and sovereignty.

Although technology and therefore science play an indispensable and unquestionable role in the possible equations for solving the problems we have caused to the environment, namely in the capacity and development of more efficient and modern technologies, the issue should also be in the recognition that the planet has well-defined limits and physical barriers [45]. It cannot only be about the unsustainability of the uncontrolled exploitation of natural resources but, above all, about assuming that the planet has limits beyond the exclusive possibility of repair through techno-scientific solutions. However, the technowashing practised by policy-makers in placing their hope in technology and natural sciences (be-

cause social sciences are still little considered) conveys to society the appearance that they are committed to working on solutions and taking measures or commitments, even if they are not sufficient or sustainable enough. A technological 'washing' allows the urgency of more robust, inclusive, ethical, fair and multidisciplinary public measures and policies to be postponed. Alons [46], for example, analysed European agricultural policy and realised that although environmental objectives are a variable in the agricultural policy formulation equation, their coefficient remains small. Johnsson et al. [47] concluded in their study that many of the Sustainable Development Goal (SDG) commitments analysed represented a way of highlighting what companies and countries were already doing, hiding areas where the necessary improvements are more difficult to achieve.

It cannot therefore be possible to make global commitments to combat deforestation if investments are then maintained around biomass energy production technology, which will also depend on tree felling [48]. Equally, it cannot be feasible for developed countries to design and install cutting-edge renewable technology in their countries while continuing oil exploration in other territories, or even in their own, with the reasoning that profit serves to finance the green transition.

5. Conclusions and Brief Considerations

There is consensus among the scientific community [1] that human activity is the main cause of biodiversity loss and climate change due to the unsustainable consumption patterns that have marked the evolution and development of many countries and economies.

The transition to a more balanced and fairer society has been a concern, assuming itself as the main challenge for the first half of this century. Civic participation is today more visible and has demanded actions from governments, causing pressure on companies and organisations.

In fact, the current global environmental problems we are experiencing have reconnected the public with science. Certainly, the dissemination and knowledge of scientific data and studies on the impacts of climate change have been essential for active and conscious participation.

Despite the various stages and evolution of the relationship between people and science, with regard to contemporary science communication, it is consensual in the literature [2,18,20] to distinguish between two models: the first one is characterized by the unilateral dissemination of scientific information by scientists and the second as one that involves a two-way communication promoting dialogue between various stakeholders.

However, what we also see in this century is the promotion of techno-science as a product through customer satisfaction techniques and the spectacularization of the offer, which we called technowashing. This term is characterised by an excessive optimism around technology, aiming to promote the idea that the planetary problems made by man will be solved with more modern, evolved and efficient technology. It also allows various needs and intentions to be satisfied, be they financial, business, reputational or disempowering.

Some of the characterising elements of technowashing were identified; namely, the role of some opinion leaders in the use of this practice, the use and abuse of experiments and scientific knowledge, the abuse of the amphibological nature of science fiction concepts and symbols, the promotion of immortality or fear and finally the use of this technique by policymakers as a way to delay important and urgent decisions.

The balance between the responsible communication of science and techno-science, on one hand, and the communication of science and techno-science as a product, on the other hand, represents a crucial challenge for democratic societies.

It is unquestionable the role that technology plays in the solution for fighting what can be understood as the greatest crisis in human history, but promoting excessive optimism around technology and science, rather than expecting real change or effective solutions, will hide some key problems and/or ulterior motives.

Achieving rapid decarbonisation is undoubtedly a common goal for all humanity. However, this is not separable from the protection of terrestrial and marine biodiversity, preservation of arable land, enhancement of the quality and quantity of fresh water and even less from the necessary fight against inequality and social injustice. For this wide agenda we need technology, but even more so an ethic of responsibility and moderation, capable of including respect for future generations in the decisions we make today.

Author Contributions: Conceptualization, S.R. and V.S.-M.; methodology, S.R. and V.S.-M.; software, S.R. and V.S.-M.; validation, S.R. and V.S.-M.; formal analysis, S.R. and V.S.-M.; investigation, S.R. and V.S.-M.; resources, S.R. and V.S.-M.; data curation, S.R. and V.S.-M.; writing—original draft preparation, S.R.; writing—review and editing, S.R. and V.S.-M.; visualization S.R. and V.S.-M.; supervision, V.S.-M.; project administration, S.R. and V.S.-M. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Conflicts of Interest: The authors declare no conflict of interest.

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