

Genesis and Role of Education for Sustainable Development in the Context of Climate Change

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Abstract:

Throughout much of recent history, humanity has adopted an economic model centered on productive growth, relegating the environmental impacts resulting from anthropogenic activities to a secondary position. This situation intensified with the Industrial Revolution, a period that, despite technological and socioeconomic advances, caused a substantial increase in greenhouse gas (GHG) emissions. This increase accentuated the process of global warming and triggered the climate crisis that is now becoming increasingly evident. In this context, the scientific community has pointed to Education for Sustainable Development (ESD) as a fundamental strategy to mitigate and address the challenges of climate change. Thus, this study aims to analyze the genesis and relevance of ESD as an instrument to combat the global environmental crisis, with a special focus on climate change.

Methodologically, the research adopts a qualitative approach of a bibliographical nature, using the analysis of documents and studies that discuss the problem of Climate Change and the role of ESD (Education for Sustainable Development). The results show that ESD emerges in a context of contestation against the unsustainable development model consolidated throughout the 20th century, establishing itself as a mechanism oriented towards environmental awareness and the promotion of sustainable practices among citizens. Furthermore, it is concluded that this educational approach has established itself, over the last few decades, as a consensual strategy in promoting sustainable development and addressing Climate Change, a role widely recognized by international organizations such as the United Nations.

Keywords: Climate Change. Education. Sustainable Development.

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1. Introduction

For a long historical period, humanity satisfied its material needs exclusively through artisanal production. This production method, based essentially manual labor, it required limited quantities of natural resources to serve its purpose of raw materials. This form of production maintained a relative balance within human society and the environment, due to the reduced environmental impact resulting from its activities.

However, the advent of the Industrial Revolution brought about a significant increase in pressure. The impact exerted by humankind on the planet. This occurred because humans developed processes and Technological tools that radically transformed the production systems that were in place until then.

The aforementioned technological processes and tools, designed to optimize and expand the production, were also responsible for an excessive extraction of natural resources, by deforestation and destruction of biodiversity, due to widespread environmental pollution, by extinction of species, among other serious problems. The rate of consumption has exceeded, progressively, the regenerative capacity of natural resources is diminishing, generating profound crises environmental and promoting unsustainable development.

Currently, one of the most significant environmental problems is associated with consumption. The increasing use of fossil fuels has caused environmental pollution on a global scale, mainly due to the substantial increase in GHG emissions, consequently worsening, Global warming and climate change.

Faced with this multidimensional crisis and recognizing that environmental degradation generates direct harm to the very populations that depend on these resources, the international community identified in ESD the essential catalyst for developing environmental awareness of citizens. In this context, the imperative need to implement ESD arose. Its objective is to form citizens who are aware of and committed to preserving the environment and to... promoting sustainable development.

In this sense, this work aims to analyze the genesis and relevance of ESD as An instrument for combating the global environmental crisis, with a special focus on climate change.

For the development of the research, a qualitative approach was chosen, based on... Literature review. For this purpose, works primarily on the Changes were consulted. Climate, Sustainable Development and Education for Sustainable Development. Among the Among the main authors who address topics related to our object of study, we highlight: IPCC (2023), Paas (2004), Pacheco de Sá (2008), Santos (2014), Santos (2021), Tréz (2014), Velho (2022), UNESCO (2005; 2005b; 2014; 2017).

The criteria for selecting the authors are based on their ability to provide theoretical support.



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the proposed analysis regarding the importance of Education for Sustainable Development in Addressing the contemporary challenges facing humanity, particularly climate change.

A descriptive research approach was adopted, in which data processing was based on... in the technique of content analysis, given its dual descriptive and interpretative nature, which derives from the problematizations of the researcher in relation to the object of study (Guerra, 2006). Priority was given to the The following analytical categories: Climate Change, Sustainable Development, Emergency of Education for Sustainable Development and Affirmation of Education for Development Sustainable.

2. Climate Change

The terms "weather" and "climate" are frequently mentioned in common parlance, although, for Sometimes, its use does not strictly correspond to its scientific definition. Therefore Thus, understanding climate change must begin with a clear distinction. between these concepts.

Therefore, the notion of "weather" refers to the meteorological conditions observed in a location. specific and over a short period, describing parameters such as temperature, pressure, humidity, wind, cloudiness, precipitation, or sandstorms (Azevedo et al., 2018; Santos, 2021). On the other hand On the other hand, the term "climate" refers to long-term average weather conditions. conventionally established over more than thirty years of measurements (Velho, 2022). In this Perspective, when discussing climate change, regardless of the variable, is a condition. It is essential that this change manifests itself as a persistent trend for at least three years. decades (Azevedo et al., 2018).

It is important to note that changes in climate can be influenced by natural causes or by human activities. However, the United Nations Framework Convention on Climate Change (UNFCCC, acronym in English) specifically defines climate change as an alteration attributable directly or indirectly to human activity, which modifies the composition of the atmosphere. global and overlaps with the natural climate variability observed in equivalent periods. (UNFCCC, 1992).

In addition to natural and anthropogenic causes that influence globally, there are other factors... Key factors in determining climate typology include latitude, altitude, and... Location relative to the sea, ocean and atmospheric currents, mountains, and bodies of water. This set of elements creates a wide variety of climates, ranging from polar to tropical. and Mediterranean climates to desert climates (Santos, 2021).

All these climate types, belonging to distinct regions, are part of a single climate system.



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global. This system is generally defined as consisting of the atmosphere, hydrosphere (oceans and surface and groundwater), cryosphere (ocean ice, glaciers and polar ice caps), lithosphere (Earth's rigid outer layer) and biosphere. Changes in this system are driven by External forces, such as changes in carbon dioxide concentration, volcanic activity or Earth's orbital parameters, as well as internal interactions (Velho, 2022).

The climate system receives energy primarily from solar radiation (predominantly Ultraviolet radiation (ultraviolet), with approximately 30% of the incident energy being reflected back into space. This The reflected fraction is called albedo, with the Earth's albedo being approximately 0.3. The remaining 70% is absorbed and subsequently re-emitted in the form of infrared radiation. In order to maintain For the planet to maintain thermal equilibrium, the total energy received must equal the energy emitted, if Conversely, cooling or heating will occur. This energy balance, called equilibrium Radioactive material plays a key role in climate change (Santos, 2021).

As previously mentioned, the climate can be influenced by natural causes and Humans. Both origins can disrupt the radiative balance, thus triggering changes. Climate (Karl; Melillo; Peterson, 2009). The impact of human activities on the climate system It has intensified significantly in recent decades, due to factors such as growth. population growth, deforestation, disordered land occupation, urbanization, and the emission of GHGs and industrial processes (Velho, 2022).

The IPCC (2023) warns that human activities affect all major components of The climate system, in such a way that continuous greenhouse gas emissions cause global warming. Additionally, this is fueling increasingly significant changes in climate extremes.

It is crucial to emphasize that the beginning of the Industrial Revolution contributed decisively to the increased atmospheric concentration of carbon dioxide (CO₂), one of the main GHGs (Old, (2022). The IPCC (2023) reiterates that, in addition to CO₂, there has historically been an increase widespread in global emissions of all GHGs, resulting from unsustainable energy use, Land management and its alteration, as well as lifestyles and patterns of consumption and production.

This increase in the concentration of CO₂ and other GHGs, of anthropogenic origin, has induced an increase in global temperature, a phenomenon known as "global warming". "anthropogenic," since it is not primarily caused by natural factors, but rather by the action of humans. human. The scientific community maintains that the progressive increase of GHGs in the atmosphere will lead to catastrophic climate change, underlining that only a drastic reduction and Immediate control of emissions could prevent large-magnitude events (Velho, 2022).

Climate change resulting from increased anthropogenic GHG emissions. They cause various impacts, such as: rising sea levels, reduced availability of freshwater resources, greater frequency and intensity of extreme weather events,



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Ocean acidification, disruption of ecosystems, as well as adverse effects on human health and in agricultural production (Lucon, 2022).

IPCC data (2023) indicate that in 2019, atmospheric CO₂ concentrations (410 parts per million) were higher than at any period in at least 2 million years, and the concentrations of methane (1866 parts per billion) and nitrous oxide (332 parts per billion) were higher than at any time in at least 800,000 years (IPCC, 2023).

Given this scenario, Velho (2022) argues for the need to reverse the trend through implementation of measures to reduce atmospheric concentrations of greenhouse gases, which are currently high. Regarding the reduction of GHG emissions, Karl, Melillo and Peterson (2009) reiterate that cuts anticipated measures would have a significantly greater impact on mitigating climate change. what equivalent reductions were made later.

3. Sustainable development

Currently, there is a consensus among scientists that a large part of global problems This results from the consolidation of a societal model that promotes unsustainable development. marked by inequalities in the distribution of resources (Santos, 2014). This model has its roots in the Industrial Revolution, which began in the mid-18th century, and which, over the course of Over time, a series of problems arose in the social, economic, and environmental domains.

The emergence of these problems raised questions about the viability of the model of current development, as well as the need to consider more sustainable alternatives. (Oliveira, 2012).

In this sense, the "development movement" began to emerge and consolidate. sustainable", driven by the various problems that intensified in the 1970s and 1980. These problems were strongly associated with production and consumption patterns. characteristic of industrialized societies, which not only exerted increasing pressure on natural resources, as well as contributing to environmental degradation and worsening of social inequalities (UNESCO, 2005b).

The rise of the movement in favor of sustainable development was marked by... The year 1987 is symbolic, marking the official presentation of the concept in the United Nations report. entitled "Our Common Future", also known as the Brundtland Report. This The document resulted from the work of the World Commission on Environment and Development. Development, coordinated by Gro Harlem Brundtland, whose objective was to investigate and reflect about environmental concerns that were gaining prominence on the international stage (Tréz, 2014).

The report underlines that human development is the main cause of degradation.



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environmental. However, he argues that sustainable development could represent an alternative. viable for the progress of humanity, provided it is aligned with environmental protection. (Pacheco de Sá, 2008; Oliveira, 2012).

According to the Brundtland Report, sustainable development is defined as “sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (Brundtland et al., 1987).

In other words, this definition acknowledges that, although development is Fundamental to satisfying human needs and improving quality of life, it must occur in a way that does not compromise the natural environment's ability to meet the needs of present and future generations (UNESCO, 2005b).

In addition to the Brundtland Report, other documents produced in subsequent years They contributed to strengthening the principles of sustainable development, namely the Agenda. 21, the Millennium Development Goals and the Johannesburg Implementation Plan (PAAS, 2004).

It is important to note that, in order to achieve the much-desired sustainable development, As stipulated in the aforementioned documents, it becomes essential, among other measures, Investing in education. In this regard, UNESCO (2014) emphasizes that sustainable development It requires profound transformations in the way individuals think and act, thus recognizing, The fundamental role of education in promoting these changes.

In this context, we will now discuss the role of education in promoting sustainable development, taking into account the complexity of the contemporary world, characterized by a global environmental crisis, exacerbated by the impacts of climate change Climate change is creating a growing need to equip citizens with new skills.

3.1. The emergence of education for sustainable development

Currently, education faces the challenge of preparing students for a world in Constant transformation, where changes occur at an increasingly accelerated pace. It is predicted, Thus, the complexity and uncertainty of the future will surpass those of the current world. These changes constants, characterized by complex problems of a social, economic and environmental nature, They require citizens to possess a set of skills that differ significantly from those demanded in past decades (Tréz, 2014).

Given this scenario of multiple challenges in the social, economic, and environmental spheres, it reinforces- if there is a need for a restructuring of education, with a view to training individuals equipped with knowledge, attitudes and values associated with sustainability. In this same sense, Paas (2004,) He argues that, in order to achieve sustainability, it is essential to educate citizens so that they become...



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aware and responsible for the implications of their actions, both individual and collective,

They can operate on a global scale.

Additionally, Santos (2014) points out that, in addition to education for sustainability, it is
It is equally essential to promote education for life, for citizenship and for solidarity,
in order to build sustainable societies and sustainable development processes.

Indeed, the construction of sustainable societies and development processes
Sustainable development depends decisively on reorienting education. This should focus on promoting...
a critical and reflective awareness of sustainable development (Santos, 2014; Pacheco
de Sá, 2008; UNESCO, 2005b). According to Santos (2014), the inclusion of themes such as
Environment, sustainability, and development can contribute to making teaching more effective and
Motivating, provided that such issues are integrated into all disciplines through methods.
Formal and effective communication strategies.

In this way, individuals can be empowered to make informed decisions and
adopt responsible behaviors that ensure environmental integrity and viability.
economic and social justice, both for current and future generations (UNESCO, 2017).

As can be seen, the complexities of the contemporary world impose the urgency of
to implement an education geared towards promoting the sustainable development of
societies. Along these lines, Tréz (2014) adds that educational systems must assume a role
central to the socialization process, contributing to the development of children and young people with
skills that enable them to participate actively and responsibly in society.

However, in order for education systems to fulfill this role effectively, it is
It is essential to revise the current curricula, both in terms of their objectives.
as well as the content. This review should aim at developing transdisciplinary understandings.
regarding social, economic, environmental, and cultural sustainability. Furthermore, there is a need for...
reassess the recommended and mandatory pedagogical approaches for teaching, learning and
assessment, with the aim of promoting essential skills for lifelong learning,
such as critical and creative thinking, oral and written communication, collaboration and cooperation,
Conflict management, decision-making, problem-solving, planning, and utilization.
appropriate use of ICT and the exercise of citizenship (UNESCO, 2005b).

It is important to emphasize that the integration of themes related to sustainable development in
School curricula have been widely promoted by international organizations, as is the case
of the United Nations Educational, Scientific and Cultural Organization (UNESCO, in the acronym for
In this sense, Tréz (2014) states that the implementation of ESD constitutes an element
structural in current educational policies.



3.2. Affirming education for sustainable development

ESD, also known as Education for Sustainability or Education for Societies Sustainable (Santos, 2014) has been assuming an increasingly central role as a factor. This educational approach is crucial for achieving sustainable development. gaining increasing prominence internationally (UNESCO, 2017).

The emergence of ESD is closely linked to international debates on the sustainable development, which have intensified in scale and relevance since the report of the United Nations entitled "Our Common Future", known as the Brundtland Report, Published in 1987, this document presented the first widely disseminated definition of... concept of sustainable development (UNESCO, 2014).

Subsequently, the role of education as a crucial element in achieving development. Sustainability was reaffirmed at three high-impact international conferences, namely: United Nations Conference on Environment and Development (UNCED, in its acronym) (English), held in 1992 in Rio de Janeiro; the World Summit on Sustainable Development (WSSD, in its English acronym), in 2002, in Johannesburg, South Africa; and the United Nations Conference United Nations Conference on Sustainable Development (UNCSD), in 2012, also in Rio. January (UNESCO, 2017).

At the 1992 conference, Agenda 21 was approved, a document of practical guidance for sustainable development. One of its most innovative chapters, chapter 36, emphasizes explicitly the role of education as an essential element in achieving development. sustainable (Paas, 2004). The document states:

Education is critical for promoting sustainable development and improving the capacity of the people to address environmental and development issues. Both formal and non-formal education are indispensable to changing people's attitudes so that they have the capacity to assess and address their sustainable development concerns. It is also critical for achieving environmental and ethical awareness, values and attitudes, skills and behavior consistent with sustainable development and for effective public participation in decision-making. (UN, 1993)

In addition to valuing formal and non-formal education, UNESCO (2017) highlights that the ESD should be understood as an integral part of quality education, within the context of a Lifelong learning, which also implies the inclusion of informal education. Additionally, ESD should cover all levels of education, from preschool to high school. higher education.

Following the 1992 UNCED, the World Summit on Development was held. Sustainable Development Goals (WSSD), in 2002, whose main objective was to evaluate the progress achieved in the ten In the years following UNCED, reaffirm the global commitment to sustainable development. (Pacheco de Sá, 2008). One of the conclusions of the WSSD was that little had been done in terms of

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 concrete action, which led to the development of the Johannesburg Plan of Implementation (JPOI).
 (in English). This document reiterated the central role of education in development.
 sustainable, as evidenced in the following excerpts:

“Education is critical for promoting sustainable development (...). Integrate sustainable development into education systems at all levels of education in order to promote education as a key agent for change” (UN, 2002)

It is also important to highlight that the JPOI proposed to the UN General Assembly the establishment of "Decade of Education for Sustainable Development" (DESD), which began in 2005:

“Support the use of education to promote sustainable development, including through urgent actions at all levels to: (d) Recommend to the United Nations General Assembly that it consider adopting a decade of education for sustainable development, starting in 2005” (UN, 2002).

This proposal was accepted, and Resolution 57/254 was adopted, which established officially the DEEDS (2005 – 2014), whose implementation was the responsibility of UNESCO (UNESCO, 2005b). The main objective of this initiative was to integrate the values of development. Sustainable in all aspects of learning, in order to promote behavioral change. oriented towards building fairer and more sustainable societies (UNESCO, 2005).

To achieve this overall goal, five specific objectives were defined, which They guide the activities of the parties involved in the implementation of the DEEDS:

1. Give an enhanced profile to the central role of education and learning in the common pursuit of sustainable development;
2. Facilitate links and networking, exchange and interaction among stakeholders in ESD;
3. Provide a space and opportunity for refining and promoting the vision of, and transition to sustainable development – through all forms of learning and public awareness;
4. Foster increased quality of teaching and learning in education for sustainable development;
5. Develop strategies at every level to strengthen capacity in ESD. (UNESCO, 2005b)

Given the challenges facing the sustainable development of the planet and humanity, the UNESCO has placed its bet on education as a *sine qua non* condition for achieving development. sustainable (Tréz, 2014; Santos, 2014). Thus, the Decade initiative (2005 – 2014) aimed to address in an integrated way three fundamental dimensions: society, the environment and the economy (table 1).

Table 1: Priority areas of the DEEDS (2005-2014)

Area	Description
Society	Knowledge of social institutions and their role that play a role in change and in social development, as well as systems democratic and participatory, which give opportunity to express opinions, to elect

	governments, establish consensus and resolve controversies.
Environment	Awareness of resources and fragility of the physical environment and the effects of activities and human decisions relating to the environment, with the commitment to include the issues environmental factors as a primary element in development of social and economic policies.
Economy	Awareness of limitations and potential of economic growth and its impacts on society and the environment, with a commitment to reduce individual and collective consumption, taking into account the environment and social justice.

Source: UNESCO (2005b)

In this context, the DEEDS plan sought to develop in individuals a set of skills that would allow them to respond effectively to contemporary challenges. A UNESCO (2005b) identified several priority areas for ESD, such as: human rights, peace and human security, gender equality, cultural diversity, intercultural understanding, health, HIV/AIDS, governance, natural resources, climate change, rural development, sustainable urbanization, disaster prevention and mitigation, poverty eradication, Corporate responsibility and accountability, as well as market economics.

With the aim of consolidating the progress achieved and continuing the EDS after its completion. In 2013, UNESCO conceived the Global Action Programme, launched during the Decade of Action – GAP) on Education for Sustainable Development. This was approved by the Conference General UNESCO and officially launched on November 12, 2014, at the World Conference of UNESCO conference on ESD, held in Aichi-Nagoya, Japan (UNESCO, 2017). The GAP aimed to expand the educational actions initiated by DEEDS, with the general objective of “generating and expanding actions in all areas levels and areas of education and learning to accelerate progress towards sustainable development” (UNESCO, 2014).

It is important to note that the adoption of GAP coincided with the period in which the community The international community was outlining a new set of guiding objectives for the global development. These efforts culminated on September 25, 2015, with the adoption of “Agenda 2030 for Sustainable Development”, by the United Nations General Assembly (UN,



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2015).

At the heart of the 2030 Agenda are the 17 Sustainable Development Goals. (SDGs), which aim to address the main obstacles to sustainable development, such as Inequality, unsustainable consumption patterns, institutional fragility, and degradation. environmental (UNESCO, 2017).

The 2030 Agenda also highlights the importance of education as an instrument. essential for achieving sustainable development. This concern is found embodied in SDG 4, relating to "quality education", particularly in target 4.7, which establishes:

By 2030, ensure that all learners acquire the knowledge and skills needed to promote sustainable development, in particular through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship, appreciation of cultural diversity and the contribution of culture to sustainable development. (UN, 2015)

Meeting target 4.7, as well as the other targets of the 17 SDGs, depends on active involvement of all social actors, including governments, the private sector, and society. civil society and citizens in general. UNESCO (2017) emphasizes the universality and indivisibility of Agenda 2030 implies that all signatory countries must align their strategies. Development aimed at fostering progress while protecting the planet.

However, climate change represents one of the biggest obstacles to achieving this. sustainable development, directly compromising the progress foreseen by the 2030 Agenda. from the UN. SDG 13, which deals with action against global climate change, highlights the urgency of To face this challenge, given its cross-cutting impact on the other objectives. The increase in Global temperature, the intensification of extreme weather events, and environmental degradation affect food security, health, water resources and ecosystems, making it difficult to achieve a balance between economic development, social justice and environmental preservation.

This position is corroborated by the IPCC (2023), which states that the Changes Climate changes of anthropogenic origin have caused widespread adverse impacts, with losses and Significant damage to nature and populations. Consequently, without effective control measures. Due to climate change, achieving full sustainable development becomes unfeasible.

In fact, ESD is one of the fundamental pillars for achieving the 17 SDGs. including SDG 13, which deals with climate action. Target 13.3 of the 2030 Agenda establishes the the need to "improve education, raise awareness and human capacity and Institutional guidelines on mitigation, adaptation, impact reduction, and early warning of climate change. "Climate" (UN, 2015).

Given this scenario, several authors highlight the centrality of ESD as an instrument for Addressing Climate Change. Martins-Loução (2021) and Velho (2022) argue that,



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Among other strategies, investment in education through awareness is essential.

environmental measures to avoid repeating the mistakes that led to the current environmental degradation, thus promoting behavioral changes and concrete social actions. Corroborating this

From this perspective, Santos (2021) argues that training on Climate Change, aimed at both

Young people, as well as the general population, are considered one of the most effective ways to address this.

Climate Change: Now and in the future.

In short, ESD promotes the "emancipation" of individuals through the development of knowledge and skills that allow them, on the one hand, to understand the principles that

They guide the sustainable development goals and, on the other hand, act as informed citizens and

Committed to the transformations necessary for building a more sustainable future.

4. Final Considerations

This work allowed us to analyze the genesis and relevance of ESD as an instrument. fundamental to combating the global environmental crisis, with a special focus on Change Climate.

The evidence gathered reinforces the idea that climate change constitutes an obstacle. transversal to the scope of sustainable development, insofar as they directly affect sectors such as agriculture, water resources, health, biodiversity and socio-economic stability. In this context, promoting a development model that reconciles economic progress, Social justice and environmental preservation have become unavoidable requirements.

The investigation revealed that the response to this multidimensional crisis requires a A profound transformation in the thought and action patterns of societies. In this context, ESD It is established as the indispensable catalyst for this transformation, as has been established. by the international community.

ESD emerges as a transformative approach, capable of promoting skills, Values and attitudes geared towards responsible decision-making in the face of environmental challenges. contemporary social and economic factors.

Thus, it can be concluded that addressing climate change and promoting development Sustainable development requires profound changes in other sectors, particularly in systems. Educational. The systematic integration of ESD into school curricula constitutes not only a international recommendation, but a strategic necessity to prepare citizens for the The complexity of the contemporary world.

The global challenges posed by climate change demand equally comprehensive responses. global, articulated, and sustainable. ESD, by promoting knowledge, values, and practices oriented towards

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For sustainability, it represents one of the most powerful instruments for mitigating impacts.

Climate change, transforming behaviors and ensuring a fairer, more resilient and environmentally friendly future.

Balanced for present and future generations.

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