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ECONOMIC GROWTH AND SUSTAINABLE DEVELOPMENT: THE CASE OF CHINA

Prof. Paolo GIORDANI

Supervisor

Vittoria MOSCHETTI Matr. 273351

Candidate

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Introduction

The work addresses a much-debated topic in the socio-economic and political sphere: that of sustainability in economic growth, evaluating its implications linked to the industrial development of countries such as China which is experiencing a particularly accelerated development.

The topic was described by analyzing, in the first chapter, the aspects relating to sustainability and its progress inherent in the introduction by companies of principles for evaluating the externalities they produce. ESG, Environmental, Social and Governance, is, today, the reference for all companies that, in their operations, pay attention to the aspects described, thus contributing to improving the quality of their performance.

In practice, many companies, initially induced by international public solicitations and subsequently on their own initiative, have revised their organizational model by enhancing the aspects described, thus obtaining results, reported annually, which are configured as limiting pollution and improving working conditions and the community in which they operate.

The second chapter describes the growth models developed by economists, highlighting the evolutions that have taken into account the implications of sustainability. These are advances that have revolutionized the way of understanding growth by evaluating, alongside the quantitative aspects of development, also the qualitative ones (specifically, the chapter describes the Kuznets growth model and the Solow green model). The attention to new issues is also evident in the development of new growth indicators, such as the "human development" index that considers aspects such as education or life expectancy of the population, thus going beyond the mere consideration of economic growth.

The paper concludes with an analysis of the industrial development of the most polluting country in the world: China. In this part of the work, the existence of a part of the planet that still considers growth in terms of volumes is highlighted, considering attention to the environment and the community a superfluous part and a cost, rather than an investment. Today, China is the country that emits the

greatest amount of CO2 and greenhouse gases and although it has officially joined international agreements aimed at ensuring sustainable approaches, excessive margins of impact remain.

This study also describes the important role that international politics is having in terms of containing such impacts. Through forums such as the G20 or programs such as The Silk Road, they are negotiating, in fact, solutions to integrate sustainability also among Chinese industries that, to date, are conforming only to be able to market their products globally immersed in a national system that is still not very sustainable.

The work therefore highlights the potential for an affirmation of the Kuznets curve also in China, or a reduction in pollution over time thanks to the adoption of increasingly green plants.

CHAPTER I
ECONOMIC SUSTAINABILITY

1.1 The origins and evolution of the notion of sustainable development

The term “sustainability” derives from the Latin word *sustinere*, which means to support, in the sense of defending and conserving, or taking care of something. This notion became the subject of debate in the academic world initially in the 1980s to indicate environmental protection needs.

It is precisely in those years that the problems relating to environmental pollution deriving from economic activity were taking shape in the thoughts of scholars, politicians, and public opinion.

To date, there is still no formal definition of what the concept of sustainability is. In fact, its implications are multiple and subject to different interpretations.

The universally recognized definition originates from the 1987 Brundtland Report entitled: “Our common future”[1]. The report, which takes its name from the then President of the United Nations World Commission on Environment and Development, Norwegian Minister Gro Harlem Brundtland, defines the concept of sustainable development as "development that meets the needs of present generations without compromising ability of future generations to satisfy their own needs".

This definition emphasizes for the first time the balance that must exist between economic development, environmental conservation, and social well-being. In this first form, sustainable development is therefore directly linked in an interdependent way to environmental protection, according to a principle that will later be taken up again in the United Nations conference on environment and development held in 1992 in Rio de Janeiro[2].

[1] The report is known as the Brundtland Report, published in 1987 by the *World Commission on Environment and Development* (WCED).

[2] United Nation Conference on environment and development, United Nation, Rio de Janeiro, 1992.

At this conference, also known as “The Earth Summit”, in which delegations from 172 countries participated, environmental issues arising from economic growth were discussed for the first time[3]. Among the highlights of the summit is the so-called “2021 Agenda”, a global action plan to promote sustainable development in the twenty-first century.

The agenda focuses on areas such as the fight against poverty, the change in consumption models projected towards a circular economy, the protection and promotion of natural resources. The so-called United Nations Framework on the Convention on Climate Change (UNFCCC) is also published at the summit. This treaty establishes a global framework to ensure efforts between different countries that are aimed at addressing the challenge posed by climate change.

The conference laid the foundations for future protocols such as, for example, the Kyoto Protocol. Following what was described above, the concept of sustainable development has therefore consolidated itself as a principle of international law, thus contributing to the evolution of environmental issues at an international level, through the conclusion of regional agreements and global treaties.

Among these, the Paris agreement called COP 21 represented the first universal and legally binding agreement on a global action plan in 2015, gathering the support of 195 states.

Also in 2015, the United Nations developed the “2030 Agenda”, which identifies 17 objectives called "Sustainable Development Goals" (SDGs), in turn divided into 169 targets to be achieved by 2030.

The 2030 Agenda denounces the unsustainability of the current development model, overcoming the concept that sustainability is a factor solely related to the environment.

An integrated vision of development is therefore provided, simultaneously involving the environmental, economic, and social plan. The SDGs are therefore strongly interconnected with each other, as are the very spheres of development to which they belong.

[3] United Nation Conference on environment and development, United Nation, Rio de Janeiro, 1992.

The following table shows the 17 sustainable development goals included in the 2030 agenda.

Fig. 1: UN: Sustainable goals

Source: United Nations

From the objectives listed, the achievement of each purpose is inextricably linked to the achievement of the others.

Many authors in the economic literature have highlighted how the concept of sustainability, expressed since the first agreements, was too vague and abstract to allow the development of a regulatory apparatus capable of guiding government authorities towards the implementation of concrete actions.

Among these, Campbell (1996)[4] underlines the vulnerability of the concept of sustainability which risks remaining a vague ideal. The author tries to define this concept as "the ability of a system to reproduce".

From this, obviously, some characteristics derive:

1) Reproduction, the ability of a system to reproduce itself

[4] Scott Campbell, "Green cities, growing cities, just cities? Urban planning and contradictions of sustainable development", in *Journal of American Planning Association,* 1996, 112.

2) Balance between environment, economy, and social values

3) "Link global to global concerns", i.e., sustainable development requires that local communities carry out this process not only for their size but also in accordance with the global dimension

4) Sustainable development is the result of a dynamic evolution that requires the ability to respond to emerging trends, as well as knowing how to involve individual citizens in the achievement of objectives.

Berke and Conroy (2000) still define the same concept as: "Sustainable development is a dynamic process in which communities anticipate and accommodate the needs of current and future generations in ways that reproduce and balance local social, economic, and ecological systems, and link local actions to global concerns."[5]

Not even the economic literature has managed to give a clear and formal definition of sustainable development, even if starting from the results obtained from the Brundtland report there has been a unanimous increase in consensus on the fact that the notion of sustainable development is coherent and compatible with the classical economic theory.

In fact, several authors believe it is possible to incorporate the concept of sustainability into the paradigm of traditional economic theory, provided that the reserve function of both money and capital is recognized, which makes finance the ideal instrument through which to satisfy not only the needs of current generations, but also the needs of future generations. This vision must also recognize the interdependence between the economic dimension and the environment, i.e., with the so-called ESG factors. Porter (Porter M. E., Reinhardt L. (2007) "A strategic approach to climate", in Harvard Business Review) also states that if companies persist in treating climate change issues as exclusively a social responsibility problem, instead of considering them in an economic environment as a business opportunity, they will only expose themselves to great risks. Other authors including Hart and Milstein instead propose a scheme to classify investments from the point of view of companies that have set themselves

[5] Philip R. Berke, Maria Manta Conroy, "Are we planning for sustainable development? An evaluation of 30 comprehensive plans", *Journal of American Planning Association,* 2000, 123.

the objective of increasing their profitability but in a synergistic way with sustainability[6].

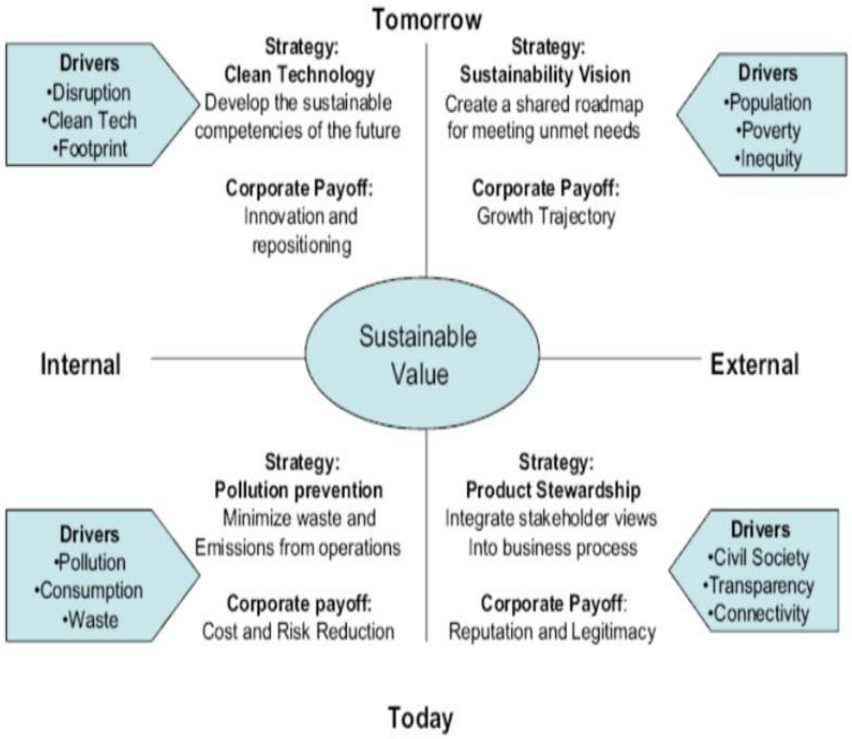
These investments aim to effectively target solutions to address the following issues:

1) Increase in the world population
2) Limit of the availability of environmental resources
3) Limits to growth due to scarcity of energy and raw materials
4) Globalization
5) Social problems

Still following the thinking of Hart and Milstein, these concepts can be represented through a 2x2 matrix, in which the returns of sustainability investments that produce value both today and, in the future, and which use a vision both internal and external to the company, are analyzed. In practice, the authors aim to highlight the relationship between the business world and society in general.

[6] Stuart L. Hart. and Marc B. Milstein, 2003."Creating sustainable Value", *Academy of Management Executive.*

Fig. 2: Relationship between the business world and society



Source: Hart and Milstein, 2003 – "Hart and Milstein matrix for evaluating the value of sustainability in the strategic plan of an organization"

Over time, the concept of sustainability has evolved significantly from its earliest iterations. Initially focused mainly on ecological issues, it then moved towards a broader framework which includes, as will be seen, environmental, economic, and social dimensions. These dimensions are seen in a synergistic and systemic way, considering them as effects that develop in unison, contributing to a holistic vision of progress and well-being that surpasses conventional measures such as GDP.

In its essence, attention to sustainability implies something that goes beyond simple attention to the environment, being the search for a coherent and ideally improving state of well-being in all environmental, social, and economic areas, ensuring, at the same time, that future generations inherit a quality of life no less than that of past generations.

In other words, the new concept of development considers "how" resources are used, their impacts, their origin, and their reproducibility. It is important to understand that sustainability is a "dynamic" concept, continuously influenced by the evolution of technology and changes in the interaction between ecological and

anthropic systems[7]. All this precisely because of the acceleration of the evolution of production processes and forms of consumption.

1.2 Sustainable development and Corporate Social Responsibility (CSR)

The definition of the concept of corporate social responsibility has changed significantly, evolving over time both in corporate management literature and in the institutional debates of international communities.

As regards the latter theory, it established itself in the seventies of the last century, relying on the neoclassical vision of the so-called "Shareholder Theory". This considers the company as a "black box" whose objective corresponds to that of maximizing short-term profits for the benefit of shareholders. From this perspective, managing and introducing various protective measures to achieve other objectives (including environmental and social objectives) is a task left in the hands of public institutions. Parallel to this theory, another strand of managerial theory called "Stakeholder Theory" develops. According to this doctrine, profit maximization represents one of the objectives that the company must achieve as part of a decision-making and strategic process that considers the interests of the different categories of interested actors and not just the shareholders involved.

However, in this context, Corporate Social Responsibility is still considered as a necessary cost, deriving from the company's duties, and from constraints placed on the company by the society in which it operates.

In the 1980s, through the work of Robert Edward Freeman (1984), the theory contributed to defining in a more detailed way the concept of corporate social responsibility, which until then had still not been well defined, and helped to identify subjects with respect to which the company must maintain and adopt socially responsible behavior.

Also in the 1980s, through the "*Contractualist Model*", the theory was further developed. This model provides that normative ethics is used to underline the

[7] https://www.esg360.it/.

duties that the company has towards its stakeholders. It was therefore highlighted the need to stipulate a social contract and adopt a corporate governance model that is broad and balances different interests, extending the fiduciary duties of those who govern the company to all the stakeholders involved.

The evolution of the concept of CSR within the management literature has therefore implied a progressive expansion of the company's objective functions, linking them to the consideration of the interests of categories and subjects other than just the shareholders. However, its link with sustainability manifests itself and develops above all in the institutional context since the 1990s, thanks to the multiple initiatives of international institutions such as the UN, the OECD (Organization for Economic Cooperation and Development) and the European Union. In fact, the major supranational organizations began to issue some guidelines at that time to connect the concepts of CSR and sustainability of public policies. Further developments in the European context fully consider the theme of social responsibility by embracing the principle according to which all company performances must not be evaluated by considering only economic parameters, but also by producing social and environmental evaluation parameters.

In the 2000s, it was witnessed a subsequent evolution of the concept, and various logics linked to CSR emerged. In this framework, the company is no longer seen solely as an entity owned by shareholders and achieved by managers, but rather represents a social good that continuously interacts with society. CSR therefore no longer represents a cost for the company but rather an investment and an opportunity, becoming a factor connected to the strategic management and competitiveness of the company itself. As regards the legal aspect, the evolution of the concept of "Corporate Social Responsibility" and the consideration of ESG factors among the objectives of the company's activity is reflected in the European legal systems in the definitions of social interest and the hobbies to which they must subordinate the administrators.

Nowadays, attention is placed both on the evaluation of performance and the impact that these strategies have in terms of revenues and costs, also from an

environmental perspective. In recent times, the concept of "creation of shared value" has begun to become predominant.
The company, therefore, fits into a broader framework, in which all the players in the value chain are involved, such as suppliers, customers, the community and the territory.

1.2.1 The European Corporate Social Responsibility Directive (CSRD)

Corporate social responsibility has a solid tradition of experience in Europe: companies of all sizes often manage to find a strategic balance between economic interests, social expectations, and environmental needs.
The countries of the European Union have undertaken, at different times, initiatives in this field through solutions and approaches that are sometimes different from the impulses coming from the European Commission.
In any case, there are two key elements that make it fundamental for the EU economy to have a fabric of companies that are socially responsible: the first aspect is linked to the affirmation of the competitiveness of the European industrial system, while the second is connected to the convention policy that CSR must be intrinsically linked to a concept of long-lasting and sustainable development over time.
Thanks to the impulse of the then President of the European Commission Jaques Delors, and of the so-called "Lisbon Strategy" of 2000, the old continent began to focus on the topic of CSR. The strategy aimed to make Europe a knowledge economy with broad dynamic competitiveness, capable of achieving sustainable economic growth accompanied by a qualitative and quantitative improvement in employment and greater social cohesion. In 2001 and 2002, further factors

highlight the topics concerning CSR: the publication of the so-called "Green Book"[8] and subsequently of the “White Paper”[9].

These two texts include regulations that invite all stakeholders to participate in all actions involving CSR.

In 2006, the well-known European alliance for corporate social responsibility was also launched, which makes a strong contribution to spreading a strategy that is based on its voluntariness.

Finally, in 2011 there was a radical change of pace through a publication by the European Commission aimed at guiding and coordinating policies in this area in the Member States, with the aim of reducing the risk of divergent approaches which could bring additional costs for companies operating in different Member States.

In this document, the European Commission proposes to evaluate the effects of corporate social responsibility based on the effects it has on society. The document outlines two fundamental objectives: the first is to maximize the creation of shared value for all stakeholders in a broad sense, through a long-term strategic approach; the second is to identify, prevent and mitigate the possible negative impacts of companies' actions.

However, the turning point in the European context regarding CSR is given by the birth of the CSRD directive (Corporate sustainability reporting directive), published by the European Commission on 16 December 2022.

The directive, together with the Green Deal, has the objective of encouraging companies to implement behaviors that allow them to eliminate net greenhouse gas emissions by 2050. The objective also involves the drafting by companies of the so-called "balance sheet of sustainability”, also known as “sustainability report”. This document is a report that companies use to communicate their environmental, social and governance performance to their stakeholders, allowing

[8] This document is published by the European Commission with the aim of promoting a European framework for corporate social responsibility. That year, the debate was launched on the ways in which the EU could promote such concepts, defining them as “a voluntary integration of companies' social and ecological concerns into their business operations and their relationships with interested parties”.

[9] European Commission White Paper, 2002, “Corporate social responsibility: a business contribution to sustainable development”.

companies to show their commitment to promoting sustainable practices, and to measure progress towards set sustainability objectives.

The report also covers a wide range of topics, including the reduction of environmental impact, respect for human rights, transparent and responsible management of the company and finally the promotion of safe and fair working conditions. Therefore, drawing up these financial statements represents a fundamental point for the company that wants to demonstrate its commitment to the environment, to respond to the growing expectations of stakeholders in terms of responsibility and transparency.

In Europe, there are currently around 11,600 listed companies for which there is an obligation to draw up sustainability reports. Micro-enterprises are excluded from the obligation while listed small and medium-sized enterprises are included.

The European Union, through the new corporate reporting directive based on the concepts expressed previously, mainly intends to pursue three objectives: firstly, it wants to address the shortcomings of the current legislation regarding the declaration of non-financial information.

Another objective of the CSRD is to stem the phenomenon of greenwashing, i.e., facade ecologism: with the adoption of the directive, companies will no longer be able to disguise an interest in the environment in order to improve their image and reputation. In fact, the directive will allow customers, suppliers, and investors to be comprehensively informed about the sustainable practices carried out by the company.

The third objective of the CSRD, closely related to the previous ones, is finally to improve the information created in this area, to fully exploit the potential offered by the European single market, and thus contributing to the transition towards an inclusive financial system and respectful of the environment and the related impact of business activities.

1.3 From sustainable development to ESG factors

Although sustainability involves many actors (individuals, institutions, politics, businesses, and any other subject involved), production activities are the most

involved due to the extent of their impacts. In 1994, John Elkington introduced a revolutionary concept to the landscape of business practices: the “Triple Bottom Line”[10] (TBL). Basically, at a time when attention to social and environmental issues was progressively increasing in the global economy, Elkington highlighted the need for companies to broaden their vision so as not to limit themselves to evaluating only the conditions for maximizing profits by considering also implications related to production.

The “Triple Bottom Line” proposes a new paradigm for evaluating company performance that goes beyond traditional financial indicators and adds the social and environmental dimension in the sense that it associates these impacts with the production processes of companies.

The new approach invites companies to consider the impact on society and the environment in their assessments, pursuing, however, a logic of profitability.

According to Elkington, adopting a broader and more holistic perspective is fundamental to making a company sustainable in the long term, in other words, the scholar believed that integrating the social and environmental dimensions in the evaluation of the company's economic performance requires considering, in addition to profit, also the needs of people and the planet (Elkington J., 1997).

In this way, TBL positions itself as a catalyst for positive changes in the way companies operate and interact with the world around them. This method was well received by the European Commission which defined the "Triple Approach" as the "vision according to which the overall performance of a company should be measured on the basis of its combined contribution to prosperity, environmental quality and social capital" [20].

With it, sustainability, therefore, no longer refers only to environmental impact but is also evaluated through three fundamental perspectives: environmental, social, and economic. The economic perspective refers to the company's ability to generate wealth and guarantee its survival and growth over time. On the other hand, the social perspective concerns the responsibility of the company towards all stakeholders, both internal and external to the organization. Finally, the

[10] The notion was disclosed in 1994 and subsequently exposed in the text: John Elkington, “Cannibals with Forks: The Triple Bottom Line of 21st Century Business”, *John Wiley and Sons Ltd*, 1997.

environmental one focuses on maintaining the ecological balance and the impact that the company has on the environment.

These three aspects are commonly summarized through the aforementioned acronym ESG (Environmental, Social, Governance), now commonly known as the commitment made by responsible companies towards the community. While in the definitions of "Triple Bottom Line" and three-pronged approach the environmental and social dynamics seem to overlap, in the ESG definition they go further (https://www.esg360.it).

In fact, the economic dimension is expanded through the introduction of the concept of Governance. This element is fundamental to indicate the need to adopt a type of business organization and assign specific responsibilities to prevent social and environmental impacts.

This component focuses on a company's environmental practices and policies and includes considerations such as the impact on climate change, the sustainable use of natural resources, the management of waste and polluting emissions.

The social perspective concerns a company's relationships with the people and communities involved in its activities and includes issues such as management of working relationships with employees, workplace safety, diversity, and inclusion, as well as social impact of company operations on local communities.

Finally, governance refers to the management practices and decision-making structures of a company, which concern the transparency of financial information, the independence of the board of directors when making its choices, corporate ethics, and management of conflicts of interest.

Today, the guidelines of listed companies provide that managers are also remunerated based on the ESG objectives achieved, highlighting how the model has established itself in large companies.

1.4 Does “Sustainable Development” actually interact with economic growth?

Reconciling the principles of sustainability with the economic development pursued by various countries is a complex but possible challenge and is

fundamental to ensuring that population growth occurs in a prosperous and equitable manner.

Economic growth consists of the increase in the production of goods and services of a country or company and is a factor that aims to increase the wealth and well-being of a nation. Development is, ultimately, a concept pursued in all economies. However, the actions included in this strategy can often lead to both environmental and social problems, just think of traditional production impacts such as [22]:

- the increase in greenhouse gases;
- the exhaustion of natural resources;
- deforestation
- the increase in economic and social inequalities.

The doctrine has tried to identify some useful tools to make it possible to combine these aspects. First, the concept of "Circular Economy" which involves the reuse and recycling of resources, the repair of products, the reduction of waste, together with the increase and use of natural resources.

“Sustainable Design” goes in the same direction and is based on the creation, already in the design phase, of products that last longer and are easy to repair and recycle.

Central to the process described is the use of renewable energy which is based on the increase and use of energy sources such as sun, wind, and hydroelectric energy to reduce greenhouse gas emissions and not consume exhaustible sources.

In this context, energy efficiency is another prerequisite that implies improving the energy efficiency of buildings, industries, and transport to ensure a reduction in energy consumption. More and more space is occupied by technological innovation, which is based on the development and adoption of devices that reduce environmental impact, such as electric cars, precision agriculture and low-emission industrial processes. From this perspective, research and development aimed at promoting innovative solutions that combine economic growth and sustainability is extremely important, so support for such studies cannot be ignored. From a political point of view, tax incentives are very important, aimed at offering help to companies that adopt sustainable practices and penalizing those

that pollute, and in this sense the work of legislators is increasingly crucial. Environmental education is also of no small importance, which aims to raise awareness among people and businesses of the importance of sustainability through educational programs and communication campaigns. Schools and the media, in this sense, are very important in spreading healthy consumption practices.

Promoting the social responsibility of companies by encouraging them to integrate environmental and social considerations into their activities is a further crucial initiative, since the productive fabric is the protagonist of development and, as widely illustrated, is the main polluter. In recent decades, initiatives aimed at stimulating collaboration between governments of different countries, businesses and non-governmental organizations have also spread. The intent is to develop and implement sustainable and functional solutions for economic growth, involving local communities in the planning and implementation of development initiatives that guarantee equitably distributed benefits.

Other projects in this direction are visible in the public incentive of companies that respect environmental, social and governance (ESG) criteria, allowing the issuance, as mentioned, of green bonds to finance sustainable projects.

In the agricultural sector, a central role in ensuring that development is sustainable is played by practices that aim to conserve natural resources, improve soil fertility, and protect biodiversity.

Finally, sustainable development that does not negatively impact growth can be observed in local markets that adopt the short supply chain to reduce the environmental impact of transport and support their production.

The attention to the topic covered is evident in the diffusion of green development models that have been produced in the field of economic sciences and which subsequently constitute a reason for in-depth discussion.

CHAPTER II
MODELS OF ECONOMIC GROWTH

2.1 Economic growth: concept and measurement

Studies on economic growth have interested economists since the beginning of the twentieth century, when the importance of the topic began to be perceived. This interest also arose in response to the increase in the birth rate which, on the one hand, would have led to a greater availability of manpower, and on the other raised questions about the propensity of the system to be able to guarantee an adequate income for all individuals in society[11].

In general, economic growth is defined as the sustained, long-term increase in the productive capacity of an economy, which is measured through indicators such as gross domestic product (GDP). This reflects the expansion of a country's economic activities, improving the population's standard of living and allowing greater investments in infrastructure, technology, and public services. Therefore, economic development is universally considered as the key indicator of economic and social progress, as it contributes to the creation of jobs, increased incomes, and improved general well-being.

The rise in economic activity, therefore, became the objective of all industrialized countries which they tried to pursue through their policies.

The versatility of the implications of economic growth became the subject of numerous economic theories also based on empirical evidence, developed to explain the effects it induces on numerous macroeconomic aspects of an economic system. Furthermore, political interest on the topic explains the monetary and fiscal policy interventions, as well as the institutional measures aimed at guaranteeing political stability to support growth. Today, as a century ago, there is no doubt that economic growth represents a key objective and a fundamental measure for evaluating the success and health of an economy in the long term. In

[11] Marco Cattini, "Europe towards the global market. From the 14th to the 21st century, processes, and dynamics", *Egea,* Milan, 2006, 14.

the economic field, among the first to delve into the topic was Joseph Schumpeter (1883-1950) who considered innovation the true determinant of industrial change and economic development[12].

The economist offered an in-depth analysis of the distinction between 'invention' and 'innovation', defining the former as the acquisition of scientific and technological knowledge to be applied directly to production while the innovative aspects consisted simply of "doing something new" with respect to the past[13].

According to Schumpeter, innovation is achieved by introducing new tools and production methods but also by creating increasingly advanced organizational forms or conquering new sources of supply (in this sense, an invention is not always necessary to innovate).

The political economy expert recognized the 'innovative entrepreneur' as the subject (or organizational unit) that implements innovation and does so simply by putting together different factors as inspired by creativity and intelligence.[14].

Innovation, thus defined, requires favorable combinations, in which different types of knowledge, skills, competences and resources are mixed. In addition to the possession of resources, it was necessary, in the economist's opinion, to "know" the production mechanisms as well as the functioning of the market but also to possess adequate skills, which implies the acceptance of knowledge as a crucial factor of growth. In underlining the role of technological innovation and entrepreneurship in promoting long-term economic growth, Joseph Schumpeter introduced the concept of "creative destruction", to indicate the dynamic nature of development and the need to continually overcome various constraints that gradually manifest themselves. The author thus arrives at formulating a detailed "growth theory" which describes the need for the increase in population to be accompanied by an "adequate" increase in technological equipment. Schumpeter's theory occupies a leading role among studies on the topic of growth, acting as a driving force for further investigations. The twentieth century also offered other theories considered fundamental for understanding economic growth, such as that

[12] Adelino Zanini, "Principles and forms of social sciences. Five studies on Schumpeter", Bologna, 2013, 64.
[13] Ibid, 67.
[14] Ibid, 68.

of the economist Robert Merton Solow (1924-1923), known for his "exogenous growth model", for which the author won the Nobel Prize for Economics in 1987. This work provided a theoretical framework for understanding the factors that determine long-term growth, constituting a starting point for subsequent investigations.

Among these, there is the model of Trevor Swan (1918-1989), who developed work on exogenous growth, with additions, significantly influencing economic theory.

The model focuses on long-term economic growth and tries to understand the reasons why countries become richer. Capital accumulation[15] is described as the main driver of growth as it is responsible for increasing production and income in the long term. The model postulates that the savings rate (the portion of income that is saved) and the investment rate (the portion of savings that is invested in productive capital) are the two determining variables of economic growth. One of the constraints posed by Swan's theory is the assumption that the economy is in a state of "stable equilibrium" in the long run, in which the growth rate of income per person depends on the rate of capital accumulation. Although not always explicit in the Swan model, technological progress is believed to be incorporated, providing explanations for changes in productivity and economic growth in the long term[16]. In the Swan model, the growth of income per capita is represented by the following equation:

$$\frac{dY}{Y} = \frac{sY}{Y} - \delta$$

Where:

- Y is the per capita income,
- s is the savings rate,
- δ is the rate of depreciation of capital.

According to the equation, income per capita growth depends on the nation's net saving rate (savings minus depreciation). Therefore, only if the savings rate is

[15] By capital accumulation we mean its net growth with respect to depreciation.

[16] Marco Cattini, “Europe towards the global market. From the 14th to the 21st century, processes and dynamics”, 148.

sufficiently high, the country can accumulate capital more quickly, speeding up economic growth in the long term.

Although it has provided an important contribution in the macroeconomic field, Trevor Swan's model has been criticized for its simplicity and for not having considered some factors such as the impact of policies implemented by governments and economic institutions, and the international dynamics which, are able to influence economic growth. However, the theory is considered a useful reference for understanding the mechanisms that can fuel economic growth through long-term capital accumulation. Other authors, in addition to Solow and Swan, have developed models of economic growth: among these is Paul Romer.

The author's work is focused on the role of "knowledge", considered capable of stimulating "endogenous growth", supported by innovation, research, and development. Together with other authors Romer formulated the theory called Endogenous Growth Theory. This theory introduced the notion of economic growth generated "internally" by factors such as human capital, technological innovation, and the accumulation of knowledge[17].

However, in the theories described, economic growth has long been examined solely in the sense of socioeconomic advantage, without evaluating it from a qualitative perspective. In other words, its environmental and social impacts have been ignored, although empirical observations demonstrate that the spread of industrial machinery often has an impact above all on greenhouse gas emissions that pollute the air, or with discharges into water and soil. The intensive use of fossil fuels, which in most cases power machinery, is one of the main causes of these problems and this explains the current energy transition[18] which aims to spread renewable sources.

Economic growth often implies the expansion of land use for agricultural purposes, as well as urbanization, leading to deforestation and, therefore, reducing biodiversity, contributing to climate change, and altering local ecosystems. It is

[17] Marco Cattini, "Europe towards the global market. From the 14th to the 21st century, processes and dynamics", 150.

[18] At COP26 in Glasgow, Conference of the Parties on Climate Change, held in 2021, it was established that the main tool to combat the problem was the energy transition, the transition from an energy mix based on fossil fuels to one with low or zero emissions of carbon, focused on renewable sources.

also very worrying the data relating to the intensive exploitation of natural resources such as minerals, water and fossil fuels which can lead to their exhaustion, compromising future economies and the wealth of the next generations[19]. Among other things, the increase in production and consumption generates more waste which must be managed adequately to avoid non-reversible forms of pollution and particularly serious environmental damage. Initially, these concerns only affected communities and consequently politics but, over time, the topic also took on economic importance, leading to the analysis of new reference frameworks which led to the conclusion that integration of sustainable practices is important across all production sectors. The use of renewable energy, the adoption of clean technologies and the promotion of energy efficiency are notions that have acquired economic dignity leading to the development of new theoretical models. For example, the "circular" economy model has been developed to promote a form of production in which materials and products are reused and recycled, eliminating, or minimizing waste, with the result of reducing the demand for natural resources and, therefore, the environmental impact. By raising awareness on the topic, governments and institutions have also begun to implement regulations and promote incentives to reduce pollution and guarantee sustainability (think, for example, of the introduction of carbon taxes or regulations on emissions and subsidies for renewable energy).[20] In Europe, countries such as Denmark and Germany have invested heavily in renewable energy, reducing their dependence on fossil fuels and lowering greenhouse gas emissions; cities such as Amsterdam and Copenhagen promote the use of bicycles and public transport, with the aim of reducing pollution and improving the quality of urban life; practices such as organic farming and agroecology are reducing the use of pesticides and chemical fertilizers, preserving biodiversity and soil health. These initiatives demonstrate that economic growth and environmental protection do not necessarily have to be in conflict. Intelligent policies, technological

[19] Ta Das N Almeida. et al., "Economic growth and environmental impacts: an analysis based on a composite index of environmental damage", *Ecological indicators, Elsevier BV*, 2017, 108.
[20] It has also been understood that informing and raising awareness among people and businesses about the environmental impacts of their actions can lead to changes in behavior, making them more sustainable.

innovations, and greater awareness can promote economic development and, at the same time, respectful of the environment and a standard of living on a human scale, more supportive and attentive to the needs of others. An aspect that reflects the criticality of the topic refers to the effects that each country suffers because of the choices made by others. This also explains the constraints that countries are taking on within the community based on cooperation between nations, sectors, and communities. These are aimed at addressing the environmental challenges linked to economic growth in the awareness that it is not possible to organize an impact-free economy if neighboring countries keep their production systems unchanged[21]. Among the economists who have offered a suitable model to describe the impact of growth on the environment, Simon Kuznets has a central role.

2.2 Kuznets curve of the environmental model. Analysis and implications

Simon Kuznets (1901-1981) is considered one of the most prestigious economists in the field of studies on the environmental impacts determined by the production models adopted.

Kuznets' theory argues that economic growth goes through several phases, during which initial trends can change over time. In particular, in the initial phase of growth, the environmental impact tends to increase. However, once a certain level of development is reached, we begin to invest in cleaner technologies and introduce regulations to protect the ecosystem. This process, in the long term, leads to a reduction in pressure on the environment[22].

Kuznets coined the notion of *Decoupling*, precisely to indicate the physiological ability of an economy to grow without causing adverse effects on the environment, where investments are made in technological innovations and improvements in production efficiency. Obviously, if growth is associated with an increase in GDP,

[21] Ta Das N. Almeida. et al., "Economic growth and environmental impacts: an analysis based on a composite index of environmental damage", *Ecological Indicators*, 109.

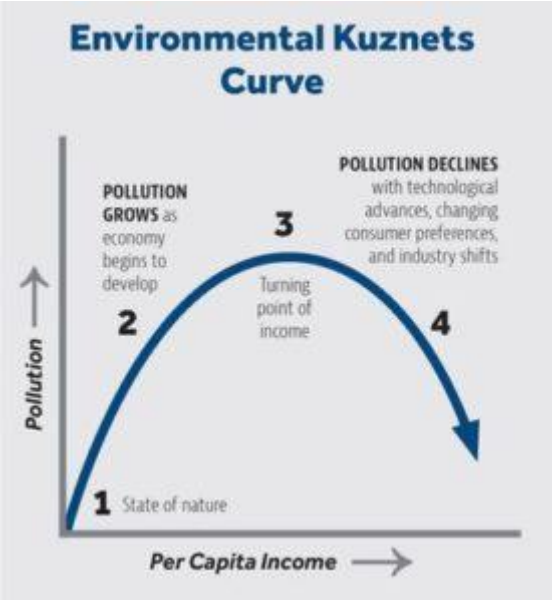
[22]Davide Dal Maso, Giuseppe Fiorentini, "Creating long-term value: knowing, promoting, and managing sustainable and responsible investment", *Egea*, Milano, 2013, 107.

the conclusion of the model leads us to believe that an increase in wealth is accompanied by a decrease in environmental impacts.

In his description, Kuznets hypothesizes a start that sees economic growth based on heavy industries, urbanization, and the intensive use of natural resources, resulting in a significant increase in pollution and environmental degradation. After reaching a certain level of income per capita, society naturally begins to suffer such implications, paying more attention to environmental problems, especially its impacts on public health. Social pressure transfers to politics, and greater environmental awareness ends up leading to a demand for stricter regulations and cleaner technologies. Therefore, also thanks to the higher level of disposable income, companies find it convenient to invest in less polluting technologies, improve energy efficiency and implement more effective environmental policies.[23]. Furthermore, less polluting economic sectors (such as, for example, the tertiary sector) in a growing economy begin to become more prominent, significantly contributing to the overall reduction of environmental impact. The environmental Kuznets Curve can be represented graphically by relating two variables: income per capita and pollution level. The graph, which will have an inverted "U" shape, shows how pollution, which initially increases together with income, reaches a peak, and then decreases with the further increase in income.

[23] Theodore Panayotou, "Demystifying the Environmental Kuznets Curve: Turning Black Box into a Policy Tool". *Environmental and Development Economics*, vol. 2, 1997, 68.

Fig. 3: The environmental Kuznets curve



Source: PANAYOTOU T. (1997)

In summary, the model explains that, if economic development is initially responsible for the degradation of the environment, once a certain level of economic prosperity is reached, it transforms into a promoter of greater sustainability.

Kuznets' theory, although convincing, has not received unanimous approval. This is because, although there are examples that support it, it does not seem universally applicable. In fact, the development of some countries may not follow the pattern described due to different economic policies, the industrial structures held, and the levels of technological progress achieved[24]. Furthermore, developed countries could neutralize the effects described by moving the most polluting industries to developing countries, which does not result in a true global reduction in pollution. Finally, it is noted that the relationship described by Kuznets could vary depending on the type of pollution considered (for example, CO2, SO2, water pollution, etc.) which is not always easily controlled[25].

[24] Davis I. Stern, "The environmental Kuznets curve after 25 years", *Journal of Bioeconomics*. Springer United States, 19 (1), 2017, 88.

[25] Susmita Dasgupta, Benoite Laplante, Hia Wang, David Wheeler, "Confronting the Environmental Kuznets Curve", *The Journal of Economic Perspectives*, Vol. 16, No. 1. 2002, 166-168.

2.3. The Green Solow Model: the environmental impacts of growth

The Green Solow Model is one of the best-known theories on the environmental impacts created by economic development.
For its illustration it is necessary to briefly introduce the classic model proposed by the economist in 1956 in which all the factors involved in long-term growth were analyzed: capital accumulation, technological progress, and population growth. Solow used a neoclassical production function of the type:

$Y=F(K, L)$

where Y is the product (output), K is the physical capital used by companies in the production process and L is the labor factor used by companies in the production process. A production function with constant returns to scale is assumed; the marginal productivity of capital and labor is decreasing (it decreases as each input increases, keeping the other constant); technological progress is considered "exogenous" and, over time, has a positive impact on labor productivity; finally, a fixed part of the income is saved and invested in new capital.[26]
The basic equations are:

Production function: $Y = F(K, L)$ (often specified as a Cobb-Douglas: $Y=K^{\alpha}L^{1-\alpha}$)

Growth of the capital factor: $K^* = sY - \delta K$

Where K^* is the variation of the K factor; s instead is the savings rate and δ is the capital depreciation rate (depreciation due to obsolescence and senescence).
Population growth: $L^*=nL$
Where n is the population growth rate (L)
Technological progress: $A^*=gA$

[26] Haji K. Yusuph, "Solow growth model", ed. *La Sapienza*, 2022, 111.

Where A is the technological level and is the growth rate of technological progress.

Solow demonstrated that, in the long run, the economy reaches a "steady state" in which capital per worker (and therefore output per worker) stops the previous growth trend. “Steady state” conditions are reached when capital per worker is constant, i.e., if:

$$s\frac{Y}{L} = (\delta+n+g)\frac{K}{L}$$

In summary, when the economy reaches "steady state", the growth rate of total GDP is determined by the sum of the population growth rate and technological progress.

As is evident, the theory did not consider the impacts on the environment associated with growth, that is done in the subsequent Green Model which, therefore, is configured as an extension of the previous Solow growth model by incorporating environmental considerations, in particular the pollution and environmental sustainability. While the classic Solow growth model adopts physical capital, labour, and technological progress as determinants of economic growth, the Green Model adds a new dimension: the interaction between economic growth and the environment.

The new model comprises “natural capital”, which includes natural resources and environmental quality, that is considered perishable by economic activity. It is believed that production activity generates pollution, and that the latter degrades natural capital. But, to reduce the impacts and, with them, the consequent effects, it is considered possible to intervene through investments in clean technologies and "sustainable" production practices. According to the model, technological progress must be weighed not only relating to its impacts on the increase in labor productivity and physical capital but also in relation to the improvement of environmental efficiency. The adoption of technology must also consider the environmental impact; and this means that it must be developed with the aim of

intervening on all the repercussions that are generated, and not just those relating to production[27].

As regards the production function, compared to the original model, it has been modified by including, among the variables, natural capital, and pollution (generally a revised Cobb-Douglas production function is adopted). Finally, the model considers an "ecological balance", in which the growth rate of pollution is well-adjusted with the rate of absorption of natural resources and the necessary mitigation efforts.

Analytically, the basic version of the Solow Green Model is represented by a system of equations enriched compared to the previous one:

The trend of physical capital is given by the following equation:

$$K^* = sY - \delta K$$

where K is the physical capital, s is the savings rate, Y is the gross domestic product and δ the depreciation rate.

The trend of natural capital:

$$N^* = -\phi Y + \theta N$$

where N is the natural capital, ϕ is the pollution coefficient per unit of output, and θ is the recovery rate of natural capital.

The production function is:

$$Y = AK^{\alpha}L^{\beta}N^{\gamma}$$

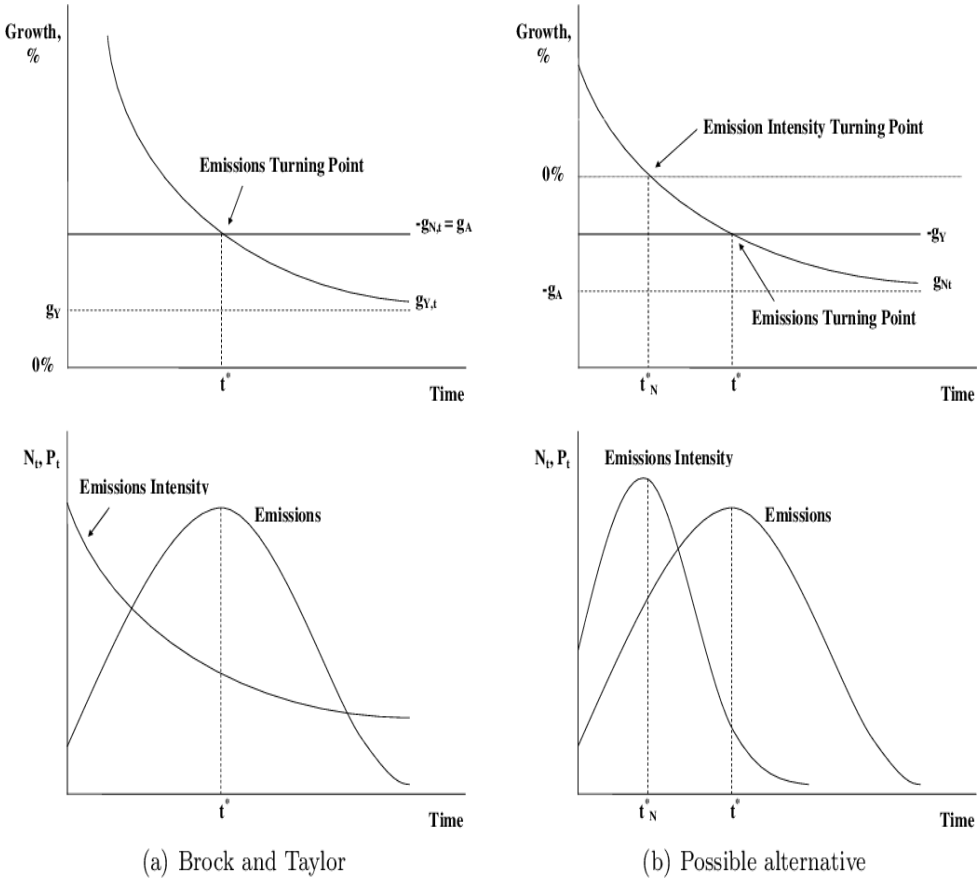
where, A indicates technological progress, α, β and γ are the production elasticity coefficients related, respectively, to physical capital, labor, and natural capital. The model, therefore, highlights that the economy reaches a "steady state" in the long term which shows the growth of GDP per capita also being determined by technological progress and the sustainability of natural capital (where

[27] Haji K. Yusuph, “Solow growth model”, 114.

technological progress also considers its quality)[28]. Policies that incentivize clean technological innovation and pollution reduction can also increase the long-term growth rate, and "sustainable economic growth" can only be achieved if the use of natural resources is balanced by corresponding rates of recovery and interventions aimed at mitigating pollution.

The following figure highlights the interactions assumed by the model.

Fig. 4: Interactions in the Solow Green Model



(a) Brock and Taylor (b) Possible alternative

Source: BROCK, W. A., AND TAYLOR M. S., *The green Solow model*, Journal of Economic Growth, I, 2010

In the graph at the top left, growth rates are compared (g_n indicates the growth rate of natural capital and g_y indicates that of production) with time, highlighting that sustainability depends both on the percentage of development and on the emissions linked to it. The convex curve then indicates the intensity of emissions.

[28] See William A. Brock, M. Scott Taylor, "The green Solow model", *Journal of Economic Growth*, I, 2010.

It is therefore necessary to wait for the time instant t* so that the emissions do not exceed the benefits, and that the value of the impact is equal to that created by the growth in employment. In the graph at the top right, various technologies are related, showing the possibility of combining greater levels of growth and a shorter time to reach equilibrium.

Furthermore, it is observed that the lower the emissions (for example 0%) the greater the growth. The graph at the bottom left highlights a comparison between the curve that associates N (natural capital) and P (pollution) with that of the intensity of emissions.[29].

Precisely in correspondence with the equilibrium, found in the upper box, the maximum distance between net emissions and emission intensity is achieved, while from that moment on, an inversion is observed[30]. Finally, in the graph at the bottom right we observe the changes linked to different levels of emission intensity (associated with different technologies), in which it is possible to record a growth equal to 0% if associated with high levels of use of natural resources and pollution.

Since the emission intensity depends on the type of technology used, to guarantee high growth and low pollution, the model suggests the adoption of advanced, low-impact technologies.

The Green Solow Model represents an important evolution of the economic theory of growth, offering a more complete framework for the analysis of sustainable development but, however, there has been no shortage of criticism.

2.4 The critical issues of the Solow Green model

Despite its undeniable innovations, the Green Solow Model has received several criticisms that weaken its scope, casting doubt on its application. First, it assumes that natural resources can be treated like any other capital, ignoring, in doing so, the complexity that characterizes them and which is derived from observing the versatility of the interactions between the economy and the environment. For

[29] In practice, the consumption of natural capital and the impacts on pollution are balanced.
[30] William A. Brock, M. Scott Taylor, *The green Solow model*, 12

example, the model assumes the hypothesis of perfect substitutability between produced capital and natural resources, a hypothesis that was not considered realistic by many[31].

Specifically, when analyzing the use of non-renewable resources or unique ecosystems, such substitutability should reflect the true extent of the dynamics. Furthermore, as we have seen, the model is based on the idea that technological progress can always compensate for the depletion of natural resources. Which may not always be confirmed, especially in a context of climate change and biodiversity loss. From an intergenerational point of view, among other things, the model does not adequately consider the distribution of resources between current and future generations. Furthermore, the model ignores the potential intertemporal equity problems that excessive exploitation of natural factors in the short term can lead to the detriment of future well-being. Likewise, the importance of the guidelines dictated by institutions and environmental policies in the management of natural resources and the promotion of sustainability is not considered.

There also seems to be a lack of careful exploration of the potential impacts of fiscal and regulatory policies which, can incentivize sustainable behavior. Even from a methodological perspective, the theory uses a framework characterized by static nature: a requirement that may fail to adequately capture the temporal dynamics of ecological and economic processes, just as the availability and quality of environmental data may prove limited, influencing its adequacy. Overall, the framework appeared overly simplified, failing to adequately capture the complex ecological dynamics and various negative externalities that can emerge from severe environmental degradation. Among other things, some negative impacts resulting from environmental degradation are often ignored or underestimated, such as climate change, the compromise of biodiversity and pollution, which can negatively influence economic growth.

In summary, if on the one hand the Solow green model represents a step forward in the study of growth, on the other, it does not propose universal solutions,

[31] William A. Brock, M. Scott Taylor, *The green Solow model*, 13

applicable in every context, thus reducing the value of the conclusions to simple theoretical abstractions[32].

There is no doubt, however, that the attention to the impacts of growth highlighted in the analyzed Green Model denotes a new orientation of economic studies, confirmed by the diffusion of innovative ratings, such as the one that measures well-being linked to growth.

2.5 A new rating: "wellbeing and economic development"

For many years the objective of achieving constant growth in Gross Domestic Product (GDP) has represented the main condition to be achieved to guarantee a high level of social well-being and the development of economic systems. Many economists associated the achievement of this objective with full employment and the use of all available resources. This approach was based on the idea that the only concerns to take care of were about income, considering the functions of aggregate demand and supply the only elements that needed to be taken into consideration.

For many years the objective of achieving constant growth in GDP has represented the main condition to be achieved to guarantee a high level of social well-being and the development of economic systems. Many economists associated the achievement of this objective with full employment and the use of all available resources. This approach was based on the idea that the only concerns to take care of were income ones, considering the functions of aggregate demand and supply the only ones that needed to be taken into consideration[33].

Over time, the economic literature has begun to understand the negative effects of growth which are reflected on the quality of life. A process then began and led to giving greater importance to this aspect, elevating it to the same level as the income aspect. Therefore, a new awareness has emerged regarding the importance of measuring human well-being in broader terms, and not limited only to the use of traditional economic indicators, such as GDP. This has directed to a significant

[32] VV. AA., "Proposal for a directive on corporate sustainability reporting", *in europa.eu*, 2021

[33] Massimo Ingrosso, "The promotion of social well-being", Bologna, 2006, 99.

change in how a society's progress is evaluated. At the end of the 20th century this awareness launched a new line of investigation concerning the reconcilability between "well-being" and economic development, where the former must be understood as an overall state of health, happiness, and prosperity of the community. Well-being, in other words, is a human condition that reflects the way in which we live, and which involves various aspects, starting from the care of both physical and mental health, to be guaranteed with access to quality health services, to an adequate nutrition, physical activity and psychological support. An economic system focuses only on GDP growth and neglects spillover effects[34] and any other negative externality cannot be considered adequate to safeguard the values described. Little by little, the notion of "well-being" began to be given an increasingly broader meaning, also integrating the need for economic security, which presupposes that the economic and institutional system guarantees financial stability, safe and adequately paid work, and constant fight against poverty.

Naturally, the spread of education and, with it, access to quality education that allows the acquisition of skills and knowledge also influence the level of well-being. Therefore, considering what has been described, the "demand for well-being" can only include a qualitative evaluation of the system where one lives which is obtained by balancing the advantages of economic development with the sacrifices that it requires (which must be evaluated in terms of limitation access to the goods described). On the one hand, economic development is measured through indicators such as GDP, income per capita, the employment rate and factor productivity, in particular labour, and on the other, well-being, which quantifies the value data described. In the search for a conciliation between economic development and well-being, new objectives must be identified, such as increasing the production of goods and services useful to the community and not just to businesses; job creation, reduction of unemployment and wage inequities; investments in research and development to promote innovation and contain pollution; the development of infrastructure such as roads, bridges, telecommunications and transport and investments in education and workforce

[34] Spillover effects represent the effects that occur on environments close to the polluters without there being any responsibility on the part of those who suffer them.

training. Modern economics moves away from the traditional orthodox school; therefore, it moves away from the past one, trying to understand the appropriate solutions to achieve the maximum level of development and social well-being.

These are objectives that can be achieved by introducing the necessary measures, for example, by promoting "inclusive growth", according to which, for economic development to translate into well-being it is important that it does not negatively impact on inclusiveness and that the benefits are distributed equally among the population. Particular attention must also be paid to the care of "quality of life", financing services for health, education, and the protection of green spaces, which are not always directly correlated to economic growth. The new perspective adopts "alternative indicators" to GDP intended to measure well-being, which considers life expectancy, education, and income. In general, attention to well-being requires the pursuit of "sustainable" economic development that aims to satisfy current needs without compromising future generations through the responsible management of natural resources and the protection of the environment. As has been said, in the new culture of growth, policies of social protection, universal access to health and educational services and the reduction of inequalities take on centrality, abandoning their marginal qualification that characterized them in the past[35].

Considering these observations, particular attention is required to the inequalities that occur when the benefits are not distributed equally but also to the critical issues of globalization which imposes goods often obtained using production processes with a significant impact[36].

It is therefore desirable to develop a new technology that improves production efficiency from a pollution point of view, thus promoting a transition towards an economy with low emissions of pollutants. Well-being and economic development are, therefore, interdependent and require an integrated and sustainable approach to ensure that the benefits of growth concretely contribute to improving the quality of life of all citizens[37]. What has been described, however,

[35] Massimo Ingrosso, "The promotion of social well-being", 45.
[36] MINISTRY OF ECONOMY AND FINANCE, "The new Report on Fair and Sustainable Wellbeing", attached to the DEF 2022, 11.
[37] MINISTRY OF ECONOMY AND FINANCE. "The new Report on Fair and Sustainable Wellbeing", 55.

is not just a theoretical aspect, a warning reserved for theoretical fields, as "well-being" is one of the objectives of the Agenda 2030 (goal number 3).

2.5.1 The Human Development Index

The alignment of the economy with social issues has contributed to the introduction of new metrics to evaluate growth, including the Human Development Index (HDI) a synthetic measure used to identify the development of a country, considering, in addition to the economic aspects, including those linked to "well-being"[38].

The HDI was developed in 1990 by the Pakistani economist Mahbub ul Haq and, in 1997, the United Nations Development Program (UNDP) adopted it, also providing for its annual report on its trend.

The HDI evaluates three dimensions of well-being:

1. Longevity and Health: measured through life expectancy at birth and obtained with the following formula:

$$\text{LEI} = \frac{LE-20\ (ex\ of\ minimum\ value)}{85(life\ expectancy)-20}$$

Where LEI is the Life Expectancy Index and LE indicates life expectancy at birth.

2. Education: assessed by adopting two indicators, the average years of education enjoyed by adults aged 25 and over; and the expected years of education for school-age children.

$$\text{EI} = \frac{MYS+EYS}{2}$$

Where, EI is the education index;

[38] Esteban Ortiz-Ospina, Max Roser, "Happiness and life satisfaction", 2017, https://ourworldindata.org/happiness-and-life-satisfaction.

MYS is the Average Years of Education Index $\frac{MYS}{15\ (number\ of\ years\ of\ schooling)}$;

EYS is the Expected Years of Education Index $\frac{EYS}{18\ (years\ of\ education)}$

In which, MYS indicates the years that those over twenty-five have dedicated to education compared to the minimum required.
EYS denotes the expected years of education for under-18-year-olds in their lifetime.

3. Standard of Living: which is measured by observing the gross national income (GNI) per capita, adjusted for purchasing power parity (PPP).

$II = \frac{ln(GNIpc) - \ln(100)}{\ln(75{,}000) - (\ln(100)}$

Where II is the Income Index, GNPpc is the gross national income per capita of the country corrected for the PPP and ln is the natural logarithm and 75,000 the reference income of the hypothesized period.
Each quantity is normalized on a scale from 0 to 1 and the total HDI is obtained as the geometric mean of the three indices indicated.
In algebraic terms the general formula for the HDI is:

$ISU = \sqrt[3]{LEI\ x\ EI\ x\ II}$

The HDI results lend themselves to comparing levels of human development between different countries by evaluating their progress over time. The value is the subject of reflection for politicians who refer to it in their choices of direction for development interventions and to identify the areas that require more urgent measures[39]. The HDI allows us to focus attention on a more holistic vision of human well-being, highlighting the importance of investing in assets that interfere

[39] Esteban Ortiz-Ospina, Max Roser, "Happiness and life satisfaction", 2017, https://ourworldindata.org/happiness-and-life-satisfaction.

with well-being such as health, education, and possible standards of living. In summary, the HDI offers a more complete picture of the development achieved by countries than GDP per capita alone, since it also considers the well-being and access to opportunities offered to people. It also allows us to compare the level of human development between different countries and monitor progress over time. Despite its benefits, the HDI presents many critical issues, such as, for example, the failure to consider values like inequalities present in countries, environmental conditions, political freedom, and human rights[40]. These limitations have been addressed by the UNDP which has provided some modified versions of the HDI, namely, the Index of Human Development corrected for Inequalities (IHDI) and the Multidimensional Poverty Index (MPI) which, today, are present in annual reports.

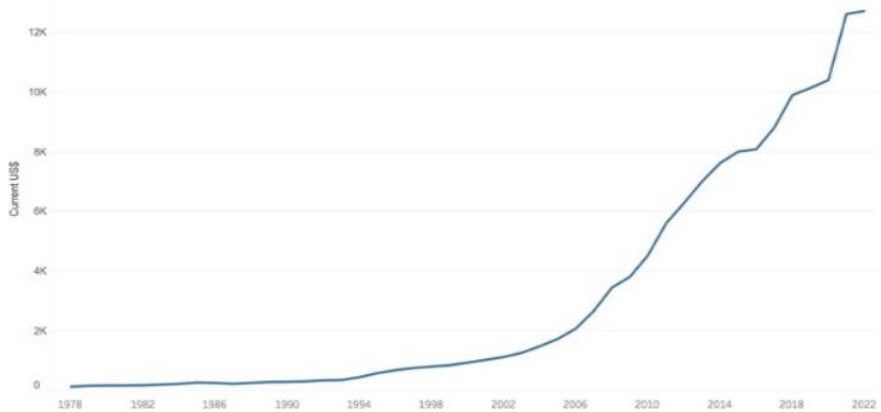
[40] Ibid.

CHAPTER III
SUSTAINABILITY: THE CASE OF CHINA

3.1 Characteristics of Chinese industrial development

Since the 1980s, China has established itself on the international scene, recording extraordinary economic growth, becoming the second largest economy in the world, after the United States[41]. Unlike many Western economies, the industrial development that has characterized China has been made possible by preventive political planning, aided by a large availability of resources and a particularly low wage level, which have allowed an immediate growth in exports. This has been a particularly fast development, demonstrating that, behind private initiatives, there was a solid political strategy aimed at supporting them. Following these economic policy strategies, China's Gross Domestic Product (GDP) has shown a clear growth from 1978 to 2022, the dynamics of which are shown in the graph below.

Fig.5: China's GDP per capita trend



Source: World Bank (2023)

[41] Dwight H. Perkins, "The Evolution of China's Industrial Policies and Its Impact on Economic Development", *Research papers*, 2015, 11.

Public interventions have been varied, acting on the most incisive variables of economic growth, supporting technological innovations implemented by companies, incentives to invest, international trade relations and more.

Wanting to find the origin of the transformation described, it is necessary to remember the 1978 reforms implemented under the leadership of President Deng Xiaoping, which marked the transition from a centrally planned economy to a socialist market economy. The first step was to proceed with economic decentralization that saw state-owned enterprises (SOE) receive greater autonomy than in the past and private ones begin to emerge progressively. All this also thanks to favorable sector regulations and the construction of infrastructure. Furthermore, Special Economic Zones were created, among which the most famous is that of Shenzhen, aimed at attracting foreign investments thanks to tax advantages and the provision of advanced infrastructure. A stage that represented the decisive turning point for development was China's entry into the World Trade Organization (WTO), which occurred in 2001 and significantly contributed to the increase in exports. China has thus become the "factory of the world", where various products are produced, ranging from consumer goods to high-tech[42]. The key factors of manufacturing growth are undoubtedly linked to the low cost of labor, which has attracted foreign investors, but other advantages have also captured the interest of foreign companies, such as the construction of a complex network of supply chains that serve vast areas supporting large-scale production. Aided by the context described, in recent years, China has made important steps forward thanks to huge technological investments and a culture of continuous innovation, with a particular focus on artificial intelligence, electric vehicles and telecommunications[43]. However, tensions with the United States, particularly those recorded under the Trump administration, have demonstrated the vulnerability of this architecture, subjected to trade wars and the introduction of duties on numerous products from China. To date, the country is among those that have invested the most in Research and Development, with a focus on sectors

[42] David Dollar, "China's Engagement with Africa. From Natural Resources to Human Resources, Washington D.C.", *The John L. Thornton China Centre at Brookings*, 2016, 56.

[43] Eugenio Basile, Cesare Cecchi, "The Uncertain Sustainability of BRICS Strategies for Sustainable Development". *Rivista di Studi Politici Internazionali*, vol. 3 (342), 2019, 56.

operating in biotechnology and new energy[44]. This led its Human Development Index (HDI) to reach a numerical level of 0.767 in 2023, ranking it among the countries with "high human development" according to the 2023/2024 report of the United Nations Development Programme (UNDP), demonstrating a significant improvement compared to 1990, when China's HDI was just 0.499[45]. The progress of the Chinese HDI is attributed to the modernization policy followed by the country, in fact, since 1990 it has made enormous progress in eliminating poverty, reaching objectives ten years ahead of the United Nations program for 2030. Other development indicators, such as life expectancy, have also seen significant improvements reaching 77.2 years of age while the annual disposable income per capita is, today, close to 40,000 yuan (about 5,559 dollars) still low but constantly growing. Below, a table that summarizes the evolution of some expressive indices of the quality of life in China from 2010 to 2023, highlighting the positive trend.

Tab. 1: China – various indexes

Year	HDI	Life Expectancy (Years)	Mean Years of Schooling	Expected Years of Schooling
2010	0.717	74.7	7.5	11.3
2011	0.724	74.9	7.5	11.4
2012	0.731	75.1	7.6	11.5
2013	0.737	75.3	7.7	11.6
2014	0.741	75.5	7.7	11.6
2015	0.747	75.7	7.8	11.6
2016	0.752	75.9	7.8	11.6
2017	0.756	76.1	7.8	11.7
2018	0.758	76.3	7.9	11.7
2019	0.761	76.5	7.9	11.8
2020	0.762	76.7	8.0	11.8
2021	0.764	76.9	8.0	11.8
2022	0.765	77.1	8.1	11.9
2023	0.767*	77.2*	8.1*	11.9*

Source: ONU (2024)

[44] https://www.chinadaily.com.cn/
[45] https://www.chinadaily.com.cn/

3.2 China's Industrial Development and Sustainability

The speed with which China has faced industrial development has prevented this from happening in a geographically homogeneous manner, leaving large internal territories still without services and infrastructures. Furthermore, the dynamics with which the development described has taken place has seen companies try to ride the opportunity, expanding without any consideration of the environmental and social impacts caused[46].

Although the Chinese government has tried every formula to involve the country in international agreements aimed at harmonizing policies, aspects related to sustainability have long been ignored, demonstrating attention only to the objectives of economic growth. The lack of an environmental culture has contributed to increasing the problem, overwhelmed by the valorization of personal productivity, even more felt, in a context of development never recorded in the history of the country[47].

The UN was one of the first organizations to take an interest in the implications of Chinese development on sustainability and did so by carrying out various investigations and studies and publishing reports on air and water pollution, greenhouse gas emissions, biodiversity loss and other ecological effects, as well as its sociological consequences[48].

The UN has denounced that Chinese cities often exceed safety levels identified for fine particulate matter (PM2.5) and other air pollutants. In fact, it has publicly reported, that coal combustion is one of the main sources of pollution in the country and that its volumes are such as to impact globally[49]. Furthermore, research commissioned by the UN shows that China is one of the world's largest emitters of greenhouse gases. Due to untreated industrial waste, industrialization has also caused serious problems of water pollution, with cases of contamination

[46] BRICS, *10th BRICS Summit Johannesburg Declaration.* 2018, http://www.brics.utoronto.ca/docs/180726-johannesburg.html.
[47] Ibid.
[48] Alessandro Bonini, "The faces of China in UN missions: between responsibilities and investments", orizzontipolitici.it, 2021, 19.
[49] UNESCO, "2021 – 2030 Il Decennio ONU delle Scienze del mare per lo sviluppo sostenibile", 2020, 77.

of rivers and lakes that have compromised the water supply of millions of people (UN studies have highlighted the need to intervene with specific regulations in order to improve the management and treatment of industrial wastewater). Industrial development, among other things, has been responsible for rapid urban growth that has caused a significant loss of natural habitats, putting many plant and animal species at risk. In this sense, the UN has stressed the urgency of protecting natural areas and implementing sustainable development policies to preserve biodiversity. The studies conducted by the UN on the violations of sustainable principles by Chinese industries have been various, below is a summary of them with the findings made.

Tab. 2: UN Studies on Sustainability in China

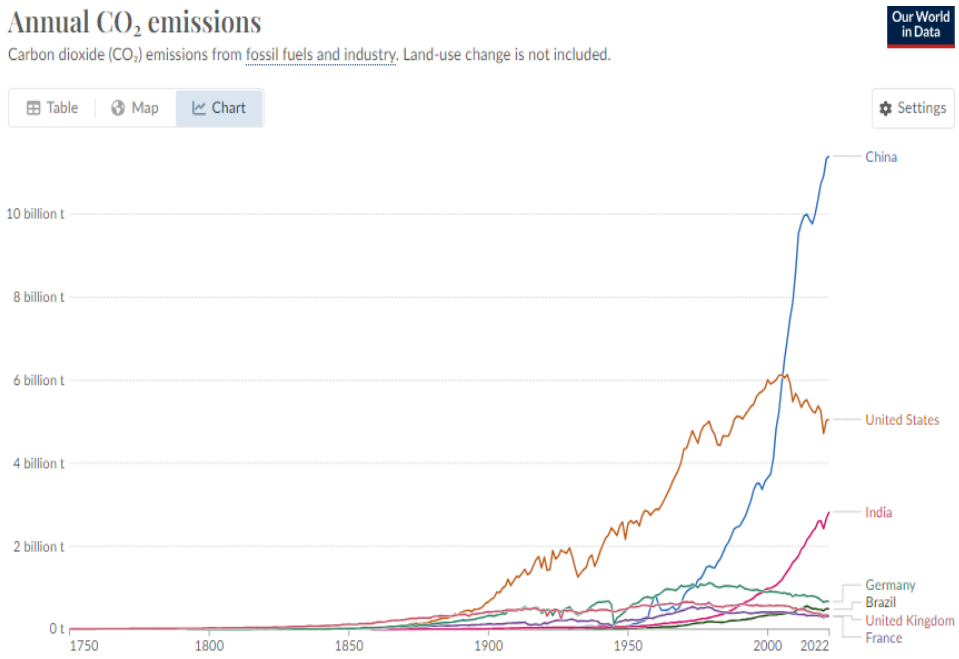
Impact reported	Description	Source
Air pollution	China suffers from high levels of air pollution, especially in urban areas. PM2.5 and PM10 (fine particles) often exceed WHO safety levels.	UNEP (United Nations Environment Programme) Report 2020.
Respiratory diseases and mortality	Air pollution is linked to about 1 million premature deaths per year in China. Respiratory diseases, cardiovascular diseases and lung cancer are common in polluted areas.	WHO (World Health Organization), 2019 data.
Land degradation and desertification and lack of social cohesion	Soil pollution, largely caused by chemicals and heavy metals, has reduced soil fertility, and contributed to desertification in some regions with isolation of residents and impacts on social cohesion.	FAO (Food and Agriculture Organization), UN Report 2021.
Water pollution	About 70% of China's rivers and lakes are polluted, mainly due to industries, household waste and agriculture. Access to safe drinking water is limited.	UNDP (United Nations Development Programme) Report, 2019.
Impact on the economy	The economic costs of pollution are estimated at around 6-9% of China's GDP, including healthcare costs and lost productivity.	UNEP, UN Economic Study 2020.
Greenhouse gas emissions	China is the world's largest emitter of CO2, responsible for about 28% of global emissions, with significant impacts on climate change. This creates international political tensions.	IPCC (Intergovernmental Panel on Climate Change), Report 2021.
Effects on biodiversity	Pollution has had devastating impacts on China's biodiversity, with habitats degraded and species facing extinction, especially in industrial areas.	UN Biodiversity Conference (COP15), Kunming, Cina, 2021.
Effects on the oceans	Coastal pollution, including plastic and chemical spills, has severely harmed marine life, and contributed to the creation of dead zones in the East China Sea. This impacts the local economy, resulting in socioeconomic hardship.	UN Environment Assembly, 2019 Report.

Source: Personal processing on UN data

It is precisely thanks to these studies that some agreements have been reached that see the UN collaborate with China to meet shared sustainability goals, achieved thanks to the collaboration of various agencies, including the United Nations Environment Programme (UNEP) and the United Nations Industrial Development Organization (UNIDO). These agreements aim to provide technical assistance,

share best practices, and support China in achieving its sustainable development goals by directing it towards investments in renewable energy (particularly solar and wind). Despite the collaboration described, now, there is still no short-term commitment from the Chinese government aimed at intervening with structural investments in order to moderate the impacts that, in fact, remain high compared to shared international standards. In the following graph, focusing only on CO2 emissions, it is clear that China has reached particularly serious levels of pollution, continuing to pollute, despite the commitments made. In response, the Chinese government has asked for more years to reach significant goals, justifying itself by having prepared an industrialization focused on the use of technologies that require time to be modified.

Fig. 6: CO2 Emissions (2022)



Source: Our world in data

Even in the last 6 editions of the G20 (the forum of government representatives that meets to coordinate political choices at an international level), with regards to the environmental issue, the countries that are showing the fastest development, including China, have been constantly asked to intervene in a structural and

substantial way to slow down the impacts[50]. On this point, however, the Chinese government has shown resistance in signing more stringent agreements and commitments to combat pollution and climate change, arguing that it is still in a phase of economic development in which many of its industries are highly dependent on polluting energy sources such as coal, so the commitment required could slow down growth, negatively impacting employment. For this reason, China has been accused of defending its sovereignty at the expense of international bodies that it considered mere interference in internal affairs, demonstrating a lack of a vision of solidarity with the rest of the planet[51].The Chinese government has proposed the adoption of the principle of "common but differentiated" responsibilities, arguing that developed countries, being historically responsible for the majority of greenhouse gas emissions, should take on a greater burden in addressing climate change. Among the possible solutions, the adoption of cleaner but adequately efficient technologies financed by the most developed countries has been proposed, or their implementation in the richest countries, leaving the growing countries a margin of potential pollution for a certain period of time to be agreed upon[52]. The last position taken by the G20 in 2023, at the forum held in India, China refused to join the ambitious goals for reducing carbon emissions and phasing out the use of coal in the short term, maintaining medium-long term commitments.

The country, in fact, has committed to achieving Carbon Neutrality by 2060 and has introduced the Emission Trading System (ETS), a program that provides a system of trading emissions against money aimed at encouraging companies to reduce CO2 emissions[53]. Today, Chinese industries are responsible for certain volumes of environmental pollution emissions, in particular, those involved in the extraction and combustion of coal, which produce carbon dioxide (CO_2), sulfur oxides (SO_2) and other air pollutants. Among the most famous examples of pollution liability is that of the state-owned company PetroChina, which was

[50] Rosemary Foot, "China, the UN, and human protection: Beliefs, power, image", *Oxford University Press*, 2020, 13.
[51] Ibid.
[52] Ibid.
[53] Jinghan Zeng, "Slogan politics: Understanding Chinese foreign policy concepts", *Springer Nature*, London, 2020, 8.

accused of several oil spills that caused serious environmental damage in the country. One of the most famous incidents occurred in 2010, when one of its platforms exploded and subsequently spilled into the Yellow Sea, causing an oil slick several kilometers in diameter. This accident not only compromised the aquatic ecosystem, but also put at risk the sources of drinking water for local communities. As China's largest energy company, PetroChina still contributes significantly to greenhouse gas emissions and, despite global efforts to reduce the impact of climate change, its activity continues to be a major source of CO2 emissions. The overview highlights the existence of a poorly regulated industrial structure and a lack of political will to protect the environment. However, the severity of the situation is limited by the internationalization of many companies. Chinese exports, in fact, are affected by the demands of compliance with Environmental, Social and Governance (ESG) rules put forward by more developed countries, without which there is a risk of not being able to introduce products into many territories[54].

3.3 "Sustainable" Chinese companies

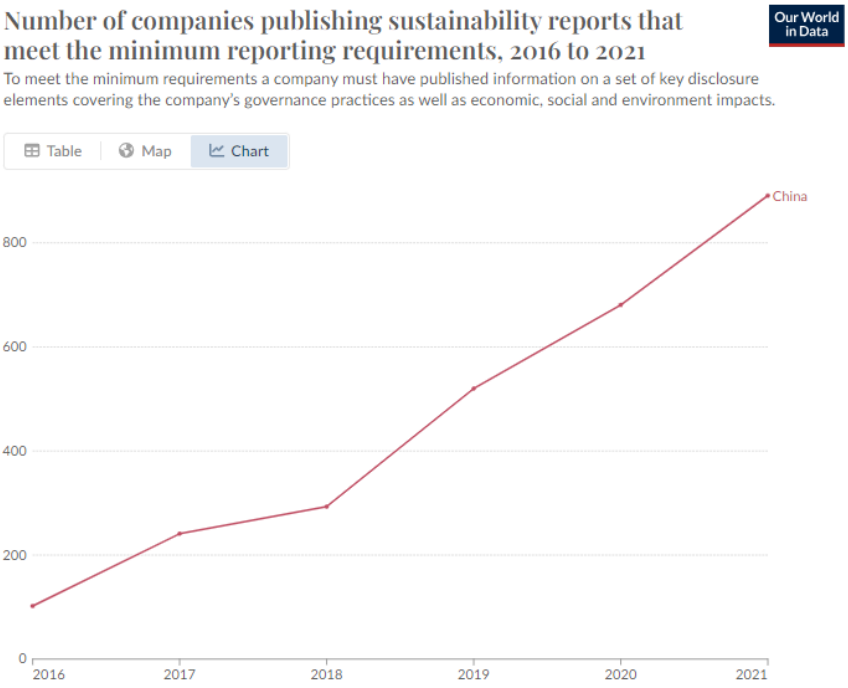
The speed with which China's industrial development has occurred has raised a series of debates related to the violation of the principles dictated by "sustainability" and the size of the country has constituted an aggravating factor of the problem, so much so that, today, China pollutes excessively compared to the shared parameters, contributing decisively to global warming[55].

In fact, China boasts many holding companies with hyper-sized plants that, although they claim to have a sustainable organization, have been the subject of extensive debates regarding their regularity[56].

In fact, there is no doubt that over the years, also due to international pressure, the companies operating in the country that have started to publish sustainability reports have grown.

[54] Jinghan Zeng, "Slogan politics: Understanding Chinese foreign policy concepts", 18.
[55] Zhun Xiaodong, "Understanding China's Growth: Past,Present, and Future", *Edr*, 2012, 5.
[56] Ibid.

Fig. 7: Adoption of sustainability reports in China (trend)



Source: Our world in data

Many corporations operating in China have implemented a sustainable organizational and production system both in order to comply with international standards, to safeguard their brand reputation and, finally, to be able to benefit from the possibility of marketing their products all over the world, passing the required controls[57].

[57] Zhun Xiaodong, "Understanding China's Growth: Past,Present, and Future", 7.

Tab. 3: Initiatives for the diffusion of ESG in China

Year	Key Event / Development	Description
2006	China joins UN PRI	China joins the United Nations Principles for Responsible Investment (PRI), signaling its intent to integrate ESG factors into the investment process.
2008	Green Credit Guidelines	The China Banking Regulatory Commission (CBRC) introduces Green Credit Guidelines to encourage banks to support environmentally-friendly projects.
2012	Shanghai Stock Exchange ESG Guidelines	The Shanghai Stock Exchange (SSE) issues ESG disclosure guidelines for listed companies, encouraging voluntary disclosure of environmental and social responsibilities.
2015	Green Bond Market Launch	China launches the Green Bond Market, aiming to fund sustainable development projects, becoming one of the largest green bond issuers globally.
2016	13th Five-Year Plan (2016-2020)	China's national plan emphasizes sustainable development, environmental protection, and introduces carbon emission reduction goals. ESG factors start to become key considerations in policy making.
2017	Guidelines for Listed Companies' ESG Disclosure	The China Securities Regulatory Commission (CSRC) issues Guidelines for Listed Companies, focusing on mandatory environmental disclosure for key industries such as energy and manufacturing.
2018	China's Blue Book on ESG	China releases its first Blue Book on ESG to analyze the trends, challenges, and future of ESG investment in the country. It highlights the importance of ESG integration in financial markets.
2020	China's Carbon Neutrality Commitment	China commits to achieving carbon neutrality by 2060 and aims to peak carbon emissions by 2030. ESG principles gain further traction as part of national development goals.
2021	CSRC ESG Disclosure Requirements	The China Securities Regulatory Commission (CSRC) formalizes ESG disclosure requirements for listed companies, making environmental disclosure mandatory and social/governance disclosure encouraged.
2022	Green Development Guidelines for Enterprises	The government issues comprehensive guidelines on integrating green development into corporate governance, focusing on sustainable practices across industries.
2023	ESG Fund Growth	China experiences significant growth in ESG-themed funds, with increased capital inflows, reflecting rising awareness among investors and companies regarding sustainability and social responsibility.

Source: ONU (2024)

Among the examples of efficient use of sustainability measures is Huawei Technologies Co., Ltd. Founded in 1987 (in Shenzhen), one of the leading companies in the telecommunications and consumer electronics sector and is known and appreciated throughout the world for its smartphones, network devices and ICT solutions. Huawei is one of the largest and most influential technology companies in the world and, for obvious commercial opportunities, it has immediately committed to integrating sustainable practices into its operations and business strategies. The firm adopted several initiatives to reduce its environmental impact, such as improving the energy efficiency of its products and

solutions, but also investing in research and development of technologies that consume less energy. Over the years, the group has recorded a constant reduction in greenhouse gas emissions by using renewable energy sources and recycling and electronic waste management programs that reduce the environmental impact of its end-of-life products. Huawei is also active in social responsibility, as demonstrated by various initiatives aimed at improving the communities in which it operates, with tree-lined streets and lights. It has also developed investments in educational and training programs, especially in developing regions, to improve the digital and technical skills of the population by proposing solutions that allow access to the Internet and digital services in remote and disadvantaged areas[58].

Huawei seeks to maintain sustainable economic growth through budgetary allocations for Research and Development (R&D) investment and expansion into various technology sectors (with the stated aim of reducing dependence on a single market segment). The company has a dedicated Sustainability Committee to oversee its sustainability and social responsibility initiatives and reports annually highlighting its progress and challenges. Below is a table highlighting some of Huawei's key sustainability initiatives in China.

[58] Huawei Tecnologies Co. Ltd, "Sustainability Progress Report - (2022–2023)", 88.

Tab. 4. Sustainability initiatives at Huawei

Initiave	Description	Sustainable goals
Huawei Green 5G	Huawei has developed energy-saving solutions for 5G networks, reducing the power consumption of telecommunications infrastructure.	Reduce energy consumption, decrease CO2 emissions, and promote energy efficiency.
Smart PV (Photovoltaic) Solutions	The company has developed technologies for photovoltaic solar energy, improving their efficiency.	Promote the use of renewable energy, reduce greenhouse gas emissions.
Tech4All Program	It has created a platform to promote digital inclusion, access to education and health services in rural and remote areas of China.	Reduce the digital gap, improve access to education and health.
Circular Economy Initiative	Huawei implements recycling and reuse practices for electronic devices and promotes the use of recycled materials in production.	Reduce e-waste, increase recycling, and minimize the extraction of new resources.
Developing Low-Consumption	Designing energy-efficient data centers using energy-efficient cooling technologies.	Reduce data center energy consumption and drive operational efficiency.
Reducing carbon emissions	Huawei has set goals to reduce carbon emissions through the transition to cleaner energy sources and green practices.	Aim for carbon neutrality and reduce emissions in business operations.
Partnership with NGOs and local governments	Huawei works with NGOs and local governments to develop environmental conservation projects, such as biodiversity protection.	Conservation of natural ecosystems and promotion of sustainable development at local level.
Smart Cities	Developing technologies for smart cities that help manage resources more efficiently, reduce pollution and improve the quality of life of residents.	Creating more sustainable, energy- and environmentally efficient cities.
Green Training and Innovation Program	Huawei offers training programs for employees and partners on sustainable innovation and environmental protection	Promote a corporate culture oriented towards sustainability and green innovation.

Source: Personal elaboration on data from Huawei Sustainability Progress Report (2022–2023)

Huawei, through its sustainable initiatives, aligns with the UN Sustainable Development Goals (SDGs), seeking to balance economic growth with environmental and social responsibility.

3.4 China's Growth Prospects

As illustrated, the role of the Chinese government in the development of the country has been central both in the start-up phase and in supporting investment initiatives organized by companies. There is currently a commitment to transform the country into a future technological leader, thanks to the Made in China 2025 program, a political strategy aimed at reducing dependence on foreign infrastructure. Today, the process of Chinese industrialization presents itself as a complex phenomenon, driven by economic reforms, targeted government policies, technological innovations, and global integration, raising concerns about environmental impact and international trade tensions.

Today, China is investing large amounts of capital in high-tech sectors, such as artificial intelligence, renewable energy and 5G, which are shifting economic attention towards sectors with higher added value and lower environmental impact. With the increase in the average Chinese income, there is also a growth in domestic demand and the government, concerned about a possible increase in imports aimed at satisfying it, is promoting policies to stimulate consumption of domestic goods. But the most important project underway is the Belt and Road Initiative (BRI), an initiative implemented to create a global infrastructure network that connects China to other countries through investment and economic cooperation. Programs such as the New Silk Road (Belt and Road Initiative), launched in 2013, aim to create new economic opportunities, both domestically and internationally, through investments in infrastructure and projects to develop trade dynamics. Specifically, this project aims to improve connections and cooperation between Asia, Africa and Europe, with the aim of stimulating economic development and promoting international trade[59].

[59] Mario Corvino, "Internationalization and progress. The Silk Road: the future for Italian SMEs", *Borgomeo Editrice*, Naples, 2021, 106.

Despite the project's block (due mainly to interference from the United States), Italy and China are currently working on a rapprochement aimed at creating other conditions of mutual benefit.

To strengthen the commitment to sustainability, an important role has been assigned to the Asian Infrastructure Investment Bank (AIIB) and other multilateral development banks that have committed to supporting investments in infrastructures that adhere to the principles of sustainable development. The parties have also committed to promoting financing from international financial institutions to combat climate change and reduce biodiversity loss, within the framework of the principles agreed at international level and within the G20 Sustainable Finance Roadmap.

These agreements were also made possible following past "demonstrations" of interest in sustainability by the Chinese government, which has included them in its agenda. For example, the Chinese government has prepared the introduction of more stringent regulations to control pollution and promote sustainable development (such as the Action Plan for the Prevention and Control of Air Pollution introduced in 2014). Officially, the Chinese government has also announced ambitious targets to reach peak CO2 emissions by 2030 and, as anticipated, carbon neutrality by 2060. According to forecasts by various economic institutes[60], China will continue to grow, but at a more moderate pace than in recent decades, in particular, the International Monetary Fund (IMF) has estimated that Chinese GDP growth will be around 5-6% per year in the medium term, a growth rate that reflects a transition to a more sustainable and balanced development model[61]. However, as widely illustrated, China's development goals are often contradictory, as demonstrated by the introduction of the notion of "new quality productive forces" coined during an inspection of public authorities in Heilongjiang province in September 2023, which refers to the recovery of heavy industries in the area. In fact, Heilongjiang, together with two other provinces in Northeast China, Liaoning, and Jilin, forms the region of Manchuria where the

[60] ONU, IMF, World Bank.
[61] Mario Corvino, "Internationalization and Progress. The Silk Road: the Future for Italian SMEs", 119.

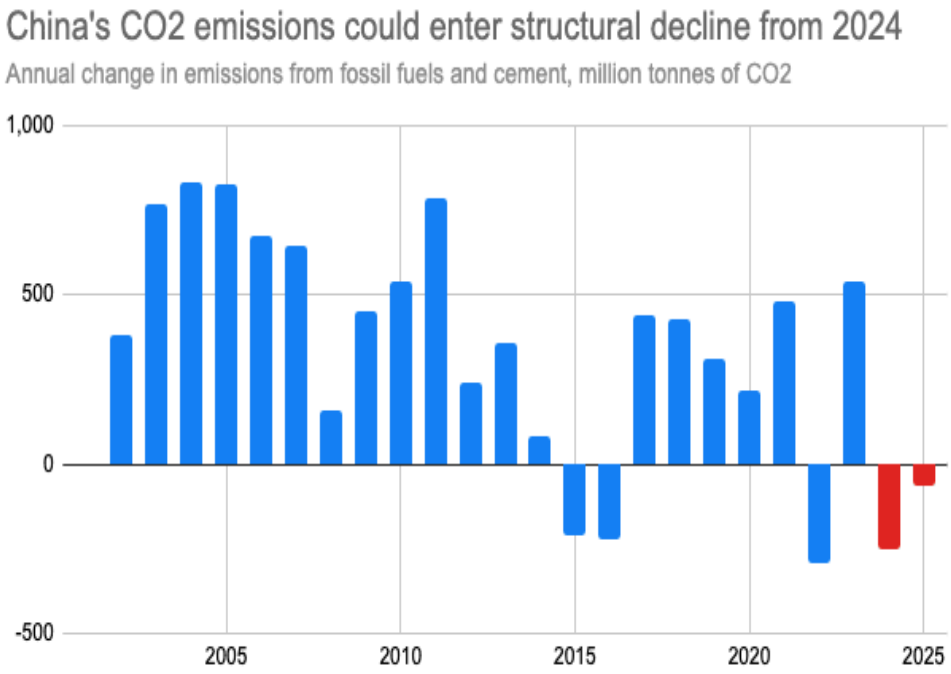
heavy industries of the communist period, namely mining and steel processing, were concentrated.

This is a concentration of industries that developed during the Japanese occupation of the country in the 1930s, which have not recorded the same growth as other sectors that began in the 1980s. Since 2003, the area has been incentivized with tax aid in order to relaunch it, even if the desired results are not achieved.

This area continues to produce by adopting impactful processes and plants. In short, the sustainability of Chinese industries seems to depend, in the future, on balancing the country's economic interests in maintaining growth levels, with negotiations with the West on the ways to pursue the objectives. The dialogue between China and the West, on the topic of sustainability, reached a peak in 2024, with the official confirmation of a contraction in CO2 emissions thanks to the record growth of clean energy, driven by photovoltaic and wind power, and the simultaneous reduction in the contribution of fossil fuels. For the first time, the expansion of renewables was greater than the average annual increase in total electricity demand. In particular, the data show a new photovoltaic installation of 210 GW, in addition to 65 GW of wind, 3 GW of nuclear and 7 GW of hydroelectric, for a total of 284 GW of low-CO2 emission plants corresponding to a total production equivalent to the entire electricity consumption of France[62]. The following graph shows the trend of Chinese CO2 emissions since 2005 and the forecast for the next two years, highlighting the contraction.

[62] https://www.qualenergia.it/articoli/cina-verso-declino-strutturale-emissioni-2024-spinta-rinnovabili/

Fig. 8: China's CO2 reduction expectation



Source: qualenergia.it

If once the pandemic emergency was over, emissions revealed an understandable increase (of around 4.7% on an annual basis), if we look at the trend after 2023, it appears to reverse the trend.

The explanation for this trend must be sought in the growth in demand for oil, which followed the stagnation of the pandemic period, and in the subsequent contraction of sectors with high emission intensity (especially steel and cement) linked to the crisis in the Chinese real estate sector. To this it must be added that the post-Covid Chinese economic recovery occurred thanks to a greater use of renewable energy sources.

However, if on the one hand, therefore, a countertrend of past polluting production practices seems undeniable, on the other, social inequalities remain in the country. Sustainability, as widely argued, also requires an affirmation of social equality that creates equal access to services for all, but the country is still based on a centralization of development that marginalizes many internal geographic areas. The Hukou system, present in China, still limits access to social services for migrant workers from rural areas. Hukou is, in fact, a family registration system used in China for thousands of years, but which took on its modern form in 1958

under the communist regime. It is essentially a national register that assigns everyone a specific residential status, categorizing people based on their residence (urban or rural) and their geographic location. The system has a profound impact on many aspects of people's lives, deciding their access to social services, job opportunities, education, healthcare, and housing. In this sense, an opinion about the nature of Chinese sustainability leads to considering it to be driven by economic opportunism and lacking a true consolidation of values as has instead happened in the West.

Conclusions

This paper provides an overview of the difficulties encountered by the introduction of sustainability principles at a global level, as this is a concept that requires an evaluation of economic results from a perspective that must take into account the impacts as well as the profits achieved.

Sustainability refers to the ability to meet the needs of the present without compromising the ability of future generations to meet their own needs and, over time, has been enriched by including environmental and social aspects, such as equity and community well-being.

The use of renewable energy, the reduction of carbon emissions, the promotion of diversity, inclusion and the implementation of ethical business practices are, today, essential aspects of sustainable processes.

In the corporate sphere, ESG (Environmental, Social, and Governance) represents a set of criteria used to evaluate the practices and performance of a company in three main areas: Environmental, a concept that refers to the management of natural resources and environmental impacts, considering factors such as greenhouse gas emissions, water use, waste, and biodiversity; Social, which indicates the care of the company's relationships with employees, suppliers, customers and the communities in which it operates, considering aspects such as workers' rights, working conditions, health and safety; Governance is the term used to indicate the structure and practices adopted by companies, taking care of aspects such as transparency, corporate ethics, shareholder rights, the presence of different genders on the Board of Directors and the forms of compensation for executives. In this sense, a company that adopts measures to reduce its carbon emissions, promotes gender diversity on its board of directors and ensures safe and fair working conditions for its employees, is applying ESG criteria. In short, sustainability is a broader concept, which embraces the holistic vision of how human activities interact with the planet and society to ensure a sustainable future, while ESG criteria are specific tools used to measure and evaluate corporate practices in terms of sustainability. Attention to these aspects has spread following the acquisition of awareness of the impacts related to their failure to take care of

them, however, it requires a culture open to their valorization, which in many countries is lacking. China, for example, has a highly impactful economic development and is currently the world's largest emitter of greenhouse gases, with a significant role in air pollution, consumption of natural resources and waste management. However, it is also a country that is investing heavily in renewable energy and is implementing policies to improve environmental sustainability.

China has significant water scarcity problems, exacerbated by industrial water pollution, and desertification and deforestation are showing impacts on agriculture and biodiversity.

The country is one of the largest producers of electronic waste, which is often not disposed of properly, but it is also a world leader in the creation of solar and wind energy, (among other things it has announced plans to peak CO2 emissions by 2030 and become carbon neutral by 2060).

Officially, China is an active participant in international climate agreements (such as the 2015 Paris Agreement), but its internal policies have yet to fully align with global commitments for which China is believed to have enormous responsibilities in the environmental impact, as well as those in the work and social fields that see excessive shifts and discrimination of entire territories, left without services.

Excessively rapid urbanization has also led to the construction of cities with unsustainable infrastructure, the loss of agricultural land and the destruction of natural habitats, creating social problems such as economic inequalities linked to the profound differences found in agricultural areas compared to urban ones and significant pressure on public services. In fact, Chinese economic development appears to be uneven, highlighting a gap between urban and rural areas, as well as between coastal regions and the hinterland. Moreover, although China boasts a rich biodiversity, many species are threatened precisely by urban expansion, intensive agriculture, and deforestation. The seriousness of the situation is evident in the data that sees health observers constantly alert to pollution and poor environmental conditions considering the serious impacts on public health, documented by the incidence of respiratory diseases and other chronic problems. Considering the conditions described a hope for a substantial and definitive

deviation from the impactful practices of Chinese industries comes from international negotiations aimed at establishing common projects. The paper highlighted the existence of corporations, such as Huawei, that adopt ESG principles in their activities, as well as the existence of political initiatives aimed at their introduction.

In this sense, although characterized by slowness, expectations regarding the full introduction of the principles on which sustainability is based in China can only be positive. Companies, especially large ones, seem to adopt an organization based on ESG, especially for opportunistic reasons, and the Chinese government is making efforts in this direction, however, adherence to the culture of sustainability that also includes aspects such as social cohesion and equal opportunities is still lacking.

The paper therefore framed sustainability in its natural guise, which is global, highlighting the need for planetary collaboration in view of the salvation of the planet and the balanced relationships between communities.

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