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INTRODUCTION

Climate change is a pressing global issue that requires our immediate attention and concerted efforts. The scientific evidence overwhelmingly supports the reality of climate change, its human causes, and the urgent need for action. Climate change poses significant risks and challenges to the environment, ecosystems, human health, economies, and social well-being.

Climate change impact is far-reaching and multifaceted. Rising global temperatures are causing more frequent and severe heatwaves, storms, droughts, and floods, resulting in devastating impacts on communities, infrastructure, and economies. The loss of biodiversity and degradation of ecosystems further exacerbate the vulnerability of both natural and human systems. The unequal distribution of impacts disproportionately affects marginalized communities and exacerbates social inequalities.

It threatens food security, water availability, and public health, amplifying existing socio-economic challenges. It disrupts agricultural patterns, contributes to the spread of diseases, and intensifies natural disasters, leading to displacement and migration. The economic costs of climate change, in terms of damage and loss, are substantial and put additional strains on societies and governments.

The European Union (EU) has been at the forefront of global efforts to mitigate climate change. It has implemented a range of policies and initiatives aimed at reducing greenhouse gas emissions, promoting renewable energy, and fostering a transition to a low-carbon economy. The main EU establishment in this direction is the European Green Deal. The European Green Deal is a comprehensive policy framework and roadmap, which outlines the European Union's ambitious plan to help make Europe the climate-neutral by 2050 and to transform its economy into a sustainable and resource-efficient one. The European Green Deal covers a wide range of sectors and aims to address not only climate change but also other environmental and social challenges.

Tackling climate change involves learning and being able to transfer knowledge within society. It highlights the need for immediate action to reduce greenhouse gas emissions, transition to clean and renewable energy sources, enhance energy efficiency, and promote sustainable practices across all sectors. It involves our involvement as individuals, limiting our personal impact on climate change and being able to help and assist our friends and families in improving their habits and limiting potential harm to the environment.

We prepared a glossary of sustainability that aims to serve as a valuable resource which provides definitions and explanations of key terms and concepts related to sustainability in the European Union. Our aim is to help everyone clarify terminology regarding sustainability since it encompasses a wide range of interconnected concepts, disciplines, and practices. A glossary helps to define and clarify the terminology used in the field, ensuring a common understanding of terms among various stakeholders, researchers, practitioners, and the general public. It also prevents confusion and promotes effective communication.

We believe knowing these terms can contribute to possible (and necessary) involvement in society towards sustainability. Starting from a community, by internalizing these concepts people can use a common language and, thus, facilitate effective communication among stakeholders from diverse backgrounds. It enables collaboration, knowledge sharing, and interdisciplinary dialogue. Making the transition towards the decision-makers, a glossary helps in establishing consistent terminology and definitions within the field of sustainability. It aids in standardizing the language used in policies, guidelines, and regulations related to sustainability. This promotes coherence, comparability, and effective implementation of sustainability practices across different contexts.

ADAPTIVE CAPACITY

Adaptive capacity refers to the ability of a system to adapt its structure and functions to climate change over the long term (ex-ante action).

In the context of climate change planning, we understand adaptive capacity as the ability of systems, institutions and people to adjust their characteristics in response to potential damage or consequences.

Adaptive capacity can help reduce vulnerability by mitigating the effects of sensitivity and responding positively to the effects of exposure. Good adaptive capacity (e.g., proper management of water resources, civil defence warning plan, etc.) requires the interaction of multiple socio-economic processes (financial, social, institutional, technological, and cognitive) at different scales that help anticipate, prevent, and reduce expected potential risks.

Adaptation options include actions aimed at building adaptive capacity (e.g. information sharing, creating institutional support, etc.) and concrete actions to define adaptation measures (e.g. technical solutions, financing mechanisms, etc.) (Pezzoli&Quagliolo, 2020, pp. 76-77).

AFFORESTATION

Afforestation is the process of establishing and growing forests in areas where there were no forests previously or where they have been depleted. It involves planting trees or allowing them to naturally regenerate to create new forest cover, which can provide various environmental, social, and economic benefits, such as carbon sequestration, biodiversity conservation, soil protection, and timber resources.

AGENDA 2030

The 2030 Agenda is a global plan of action based on 17 Sustainable Development Goals (SDGs) and 169 targets to be achieved by 2030. It was defined through a process involving not only United Nations (UN) member states, but also numerous international civil society actors, and was unanimously adopted by the UN General Assembly on September 25, 2015. It is the result of a desire to provide an effective response to the unsustainability of the current development model in the light of the largely unfulfilled achievements of the previous Millennium Development Goals (MDGs), which had guided the actions of the UN and many other actors in international development cooperation between 2000 and 2015. The agenda is addressed to all countries, regardless of their level of development (unlike the MDGs, which were intended only for developing countries), and proposes a vision of development in which the economic, environmental and social dimensions are interlinked and balanced (while the MDGs only provided for the social pillar), and in which each goal must be considered in its interrelationship with the other SDGs (Tecco&Maggiolini, 2020, pp. 41-42).

ARIDITY

Aridity is a climatic characteristic that is limited to areas with low precipitation. For example, regions that are characterized by annual precipitation of less than 250 mm.

Under these conditions, low rainfall does not allow the emergence and development of full vegetation, so the terrain of arid climatic regions is generally rocky or sandy.

Aridity may be of a structural type when such conditions are permanent or semi-permanent, or of an occasional type when it is associated with exceptional events of long duration. Aridity (and its associated water scarcity) is therefore a long-term climatic hydrological condition that requires local populations to implement adaptation strategies.
It differs from drought in that the former is a prolonged condition, while the latter is temporary (water deficit) (Fratianni&Baronetti, 2020, p. 49).

BIODEGRADABILITY

Biodegradability is the ability of a substance or material to be degraded into simpler substances by the enzymatic activity of microorganisms.

This process makes use of bacteria, sunlight and other natural physical agents and, when complete, there is a conversion of the starting substances into simple inorganic molecules such as water, carbon dioxide or methane.

It constitutes a process of great importance for maintaining ecological balance and is already part of the natural cycle of life on Earth. Organic waste from human activities can also be removed by biodegradation.

However, the effectiveness of the action depends on the chemical nature of the material, the environment and the duration of the process. The biological processes involved take place by means of microorganisms under aerobic or anaerobic conditions (Beltramo& Mollo, 2020, p. 68).

BIODIVERSITY

Biodiversity is a structural property of all systems, faunal and floristic populations, communities and ecosystems, and for each of these there are different levels of biodiversity corresponding to genetic, taxonomic, ecosystem and functional diversity.

Biodiversity regulates the predictability of the ecosystem, stabilizes it and guides it towards a precise goal that is only disturbed by internal and/or external variations.

Biological diversity or biodiversity in ecology is thus the variety of living organisms in their different forms in their respective terrestrial and aquatic ecosystems. It encompasses all biological variability: of genes, plant and animal species, ecological niches and ecosystems.

Biodiversity is not a fixed and stable value; in a given environment, the biodiversity of species present may increase or decrease over time due to various factors that may be natural and/or anthropogenic in nature.

Genetic resources are considered to be the defining component of biodiversity within a species.

The extinction of species as well as the loss of typical ecosystems (e.g. mountain wetlands or peatlands) and the reduction of intraspecific genetic diversity due to excessive selection (think of the market demands for agronomic species or, even more so, of animal husbandry and breeding of certain species with increasingly flattened gene pools at the expense of others that are less productive but have greater plasticity) represent a contraction of biodiversity.

This phenomenon is sometimes referred to as "biodiversity erosion" because of its negative impact on the biosphere and on the adaptive capacity, resilience and mitigation of climate change. The origins of erosion often lie in pressure on natural resources, land-use change, ocean acidification, deforestation, consumption (and consumerism), and pollution, with an ever-increasing ecological footprint.

Indeed, species loss can lead to ecosystem instability and dysfunction and have significant impacts on many other species in a cascading mechanism that is very difficult to predict.

In fact, the environment and the climate system are inherently complex and therefore non-linear systems, given the multiplicity and interdependence of the variables at play.
Biodiversity is important because, in many cases, it ensures the proper functioning of the ecosystem and the ecosystem services it provides and on which humans depend (Orusa&Viani, 2020, pp. 69-70).

BIOFUEL

The term biofuel refers to a fuel obtained from raw materials of natural origin through kinetically rapid processes.

For the production of biofuels, natural-origin products are processed within biorefineries, here biomasses are converted into a wide spectrum of high-value-added products, biofuels and energy, in a logic of strong synergy between processes, typical of traditional refineries.

By convention, it is usual to divide biofuels into three different generations:

- First generation: biofuels directly produced from biomass are also used for food purposes.
- Second generation: biofuels produced from biomass not used for food production (lignocellulosic products, municipal solid waste, plant waste from food production).
- Third generation: biofuels produced from algal biomass.

The main biofuels currently produced include:

- Bioethanol. This product is obtained from alcoholic fermentation processes of sugar-rich biomass such as cereals, sugar cultures or straw.
- Biodiesel. Biodiesel consists of a mixture of alkyl esters (typically methyl or ethyl) obtained through the transesterification reaction of triglycerides of plant or animal origin with methanol or ethanol.
- Biogas. A gas mixture with more than 50 per cent methane produced by the anaerobic fermentation of slurry containing high concentrations of organic compounds (civil and industrial wastewater, landfill leachate, livestock slurry, etc.).
- Syngas. A mixture of carbon monoxide and hydrogen (plus other minority components) is obtained from the partial combustion of plant biomass.

The environmental sustainability and not purely economic utility of biofuel production is a topic of intense debate. For large-scale biofuel production to be environmentally and socially sustainable it is essential that:

- Its use leads to a lower release of climate-altering gases (greenhouse gases) than the use of fossil fuels.
- Biomass production does not conflict with agricultural food production, which is ethically unacceptable and dangerous for the balance of food markets that could see imbalances in commodity prices and fluctuations in their availability.
- Let the production of biofuel in its entirety be evaluated with a careful product life cycle (see the "Life Cycle Analysis" item) that demonstrates the actual sustainability of the process in terms of environmental impact (carbon balance, impact on ecosystems, impact on water resources and biodiversity).

Biofuels are unlikely to play an important role in the energy transition mainly because the efficiency of the photosynthetic process leading to biomass production is very low (Minella, 2020, pp. 66-68).

CARBON CYCLE

The carbon cycle encompasses all the components (carbon reservoirs) and flows of carbon on Earth. It is typically understood as consisting of four primary carbon reservoirs that are interconnected through exchange pathways. These reservoirs include the atmosphere, terrestrial biosphere (which encompasses freshwater systems), oceans, and sediments (including fossil fuels). Carbon moves between these reservoirs on an annual basis through a combination of chemical, physical, geological, and biological processes. While the ocean holds the largest carbon pool near the Earth's surface, the majority of this pool does not undergo rapid exchange with the atmosphere [1].

[1] More details at: https://oceanservice.noaa.gov/facts/carbon-cycle.html#transcript

CARBON DIOXIDE

Carbon dioxide (or carbon monoxide) is a chemical compound consisting of one carbon atom and two oxygen atoms and is a trace element in the Earth's atmosphere.

Large releases of CO2 into the atmosphere associated with the use of fossil fuels for energy purposes have led to a gradual increase in the concentration of this gas.

Massive deforestation processes, which reduce forest cover and thus the biosphere's ability to sequester atmospheric CO2, contribute to a reduced capacity of the Earth's system to compensate for massive anthropogenic releases of CO2 (Minella, 2020, pp. 136-137).

CARBON FOOTPRINT

The Carbon Footprint (CFP) is a quantitative indicator that fits into the broader category of environmental footprints, which are useful for measuring the contribution of human activities to climate change by expressing it in terms of greenhouse gas emissions.

Specifically, the carbon footprint estimates the total amount of direct and indirect greenhouse gas emissions associated with an individual, a product, a service, an event, the activities of an organization, or an entire nation.

Fundamental to the calculation of a product's carbon footprint is the life-cycle concept: in order to obtain a meaningful result, emissions of climate-changing gases must be taken into account in all the phases that characterize the life-cycle of the product under analysis; therefore, all emissions generated in the phases of raw material and energy acquisition, transportation, production, consumption and end-of-life must be included in the count (Vesce *et al.*, 2020, pp. 211-212).

CARBON OFFSETTING

Carbon offsetting is a strategy used to counterbalance carbon footprint by investing in projects that reduce or remove emissions from the atmosphere. It is a way for individuals, organizations, and businesses to take responsibility for their carbon footprint and contribute to the fight against climate change.

The process of carbon offsetting typically involves various steps, such as calculating the emissions produced by a certain individual or entity - this may take into account factors such as energy consumption, transportation, waste generation, and other relevant activities, and selecting carbon offset projects to invest in. These projects can fall into various categories, such as renewable energy, energy efficiency, reforestation, afforestation, or methane capture from landfills. Each project is evaluated based on its ability to reduce or remove greenhouse gas emissions effectively.

Carbon offsetting is not a standalone solution to climate change but is often used as part of a broader climate action strategy. It provides a means to compensate for unavoidable emissions while efforts are made to reduce emissions internally through energy efficiency measures or transitioning to renewable energy sources.

It is important to note that carbon offsetting should not be considered a substitute for emission reduction efforts. The most effective approach to combating climate change is to prioritize emission reduction and energy efficiency measures within an organization or individual's operations while using carbon offsetting to address the remaining emissions that are challenging to eliminate [2].

Overall, carbon offsetting allows individuals and organizations to contribute to climate change mitigation by supporting projects that reduce or remove greenhouse gas emissions, helping to achieve a more balanced and sustainable carbon footprint.

Example: A good illustration of an offsetting mechanism is the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA). It is a global program established by the International Civil Aviation Organization (ICAO) to address greenhouse gas emissions from international civil aviation, with efforts such as technological improvements, operational improvements, and sustainable aviation fuels. It is to be implemented in three phases, from which a pilot one has been set for 2021-2023, followed by a first phase in 2024-2026. Up to 115 states have announced their intention to participate in CORSIA, including most EU member states.

CARBON SEQUESTRATION

Carbon sequestration refers to the process of capturing and storing carbon dioxide (CO2) from the atmosphere or preventing its release into the atmosphere, effectively removing it from the carbon cycle and reducing its contribution to climate change. There are various natural and artificial methods of carbon sequestration, such as through plants' and trees' photosynthesis (natural carbon sequestration), through industrial processes (geological carbon sequestration), through the oceans (oceanic carbon sequestration) and through soil (regenerative farming, etc.).

CIRCULAR ECONOMY

The circular economy is an economic model that aims to maximize resource efficiency and minimize waste by keeping products, materials, and resources in a continuous cycle of use and reuse. It aims to decouple economic growth from the consumption of finite resources and reduce the environmental impacts associated with the linear "take-make-dispose" model. In a circular economy, products and materials are designed for durability, repairability, and recyclability. The focus is on extending the lifespan of products through maintenance, repair, and refurbishment, and ensuring that materials can be recovered and reintroduced into the production process at the end of their useful life.

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[2] More details at: https://www.climatecouncil.org.au/resources/carbon-offsetting-worthwhile/

According to the 2021 Circularity Gap Report, the global rate of circularity, which measured the proportion of recovered materials compared to overall materials used, had decreased from 9.1% in 2018 to 8.6% in 2021. In the European Union (EU), the rate had shown some improvement, increasing from 8.3% in 2004 to 11.9% in 2019 [3].

CLIMATE

Climate in the narrow sense is defined as the average weather or, more strictly, as the statistical description in terms of mean and variability of relevant quantities such as temperature, precipitation, humidity, wind intensity and direction, and others, over a period ranging from months to thousands or millions of years. The classical period for calculating the mean (generally the statistic) of these variables is 30 years, as defined by the World Meteorological Organization (WMO).

In a broader and more general sense, the climate is the state of the climate system (including its statistical description), i.e. the complex and dynamic system in which various components - the atmosphere, oceans, sea and land ice, living things, animals and plants, soil - interact continuously on a variety of spatial and temporal scales, all of which are interconnected (Cassardo *et al*., 2020, p. 93).

CLIMATE CHANGE

The term "climate change" refers to a change in the state of the climate that persists over an extended period of time (usually decades or more) and that is identifiable (e.g., through the use of statistical tests) by changes in the mean and/or variability of its properties.

Climate change can be due to internal natural processes or to external forcings of natural origin, such as modulations in solar cycles, volcanic eruptions, changes in the characteristics of the Earth's orbit around the Sun and its tilt axis, or anthropogenic, such as increases in greenhouse gases in the atmosphere from human activities or changes in land use.

To understand whether climate change has occurred or is occurring, it is necessary to analyze long data sets and assess whether significant changes have occurred in the statistical distribution, i.e., the mean, variability, or extremes, of the fundamental variables that describe climate, such as air temperature and precipitation. The data on current global warming and the resulting climate changes, such as the shrinking of the terrestrial and marine cryosphere, the rise in mean sea level, and the intensification of extreme meteorological events, are indisputable (Cassardo *et al.*, 2020, pp. 75-76).

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[3] More details at: https://www.circularity-gap.world/2021

CLIMATE CHANGE ADAPTATION POLICIES

Adaptation policies are complementary to mitigation policies because they aim to respond to the impacts of climate change.

Adaptation policies implemented in the Community, from the level of the Member States to the sub-national and municipal levels, have in common the objective of making territories more resilient, identifying vulnerabilities, addressing them and taking action to reduce risks and exploit any new opportunities. To this end, the adoption of strategies and action plans at various scales is promoted, involving stakeholders with a coordinated approach to the different environmental and socio-economic sectors and the relationships between them.

The European Union plays a role in promotion and coordination by providing support in various ways, including guidelines, funding programmes, and exchange of data and information, including through a dedicated European platform (Climate-ADAPT) (Bagliani&Pietta, 2020, pp. 355-357).

CLIMATE CHANGE IMPACTS

The term "climate change impacts" defines the consequences of climate change and extreme weather events. In general, impacts refer to the effects suffered by natural and human systems, from human lives to natural ecosystems, from housing to infrastructure and services, and from economies to societies and cultures, due to the interaction of the hazardous climate change or climate event for a given period of time and the vulnerability of the exposed system.

Impacts may be "physical" in nature, including the average increase in atmospheric temperature on a global scale (global warming) and the effects on the weather system, such as increased droughts or more intense precipitation, leading to floods, soil erosion, landslides, etc.

Such physical effects also include sea level rise due to thermal expansion (in turn caused by increased ocean temperatures) and cryospheric melting.

The acidifying effect of the oceans is also a consequence of their increased absorption of carbon dioxide (CO2). Importantly, it turns out that rising temperatures are not uniform across the planet, so the effects of climate change may differ at local scales.

As the physical impacts affect both ecological and human systems, the effects can be reflected and observed in natural systems, such as impacts on marine and terrestrial ecosystems, fires and loss of biodiversity, and socio-economic systems, including impacts on human health and damage to infrastructure.

Climate change also has psychological impacts, through symptoms or syndromes of mild or severe psychological distress due to awareness of climate change and its impact on the person and society, as well as the uncertainty inherent in this. Many of these phenomena can be traced back to disorders of the psychological sphere.

It is possible to trigger consequences that undermine the individual's state of health and well-being, related to the alteration in the person's relationship with his or her place, precisely because of locally induced changes in place by global climate change processes.

In this regard, the term "solastalgia" has been coined, which describes the phenomenon of a person, an inhabitant of a particular place, who no longer recognizes that place as habitual and as "his or her own," due to conspicuous changes, or disruptions, that have occurred due to climate change processes. Climate change, in fact, may have locally induced specific alterations which then triggered local processes of transformation at the expense of watercourses, vegetation, animal life forms, man-made built elements, etc.

The phenomenon of solastalgia can be considered different but interconnected to eco-anxiety, as the latter is an anticipatory anxiety, directed at events that have yet to occur, while solastalgia represents one of the possible pathological consequences of local transformations induced by global climate change. Scientific research has developed tools for measuring solastalgia (self-report measurement scale), but there are no standard protocols shared by the scientific community for its management and treatment. It is also important to emphasize the role that the media (mass and social) play in such complex phenomena since climate anxiety can be managed as an appropriate response to danger and thus as a resource that can mobilize energies, human and material, to intervene on the causes of global climate change (mitigation), or on the manifestations at the local level (adaptation) (Pezzoli&Quagliolo, 2020, pp. 209-210).

According to World Health Organization, more than 24% of adults residing in the European region experience different allergies, including severe asthma, with the percentage among children in the region standing at 30-40% and showing an upward trend [4].

CLIMATE CHANGE MITIGATION POLICIES

Mitigation policies aim at reducing and possibly eliminating the underlying causes of climate change, i.e. reducing the radiative forcings acting at the planetary level.

These are specifically the reduction of anthropogenic greenhouse gas emissions and deforestation.

[4] More details at: https://www.who.int/europe/news-room/fact-sheets/item/climate-change

Since these forcings act at the global level, the preferred scale of reference for mitigation policies is the international one, which allows, through the adoption of treaties, the identification of truly effective targets and commitments. Such policies also defer to national and subnational commitments, which must reject the same global targets in order to become operational (Bagliani&Pietta, 2020, pp. 357- 359).

CLIMATE COMMONS

A commons can be understood as one or a collection of natural or cultural resources available to all society members. Such resources include air, water, or habitable land. These resources are managed commons, that is, they are not privately appropriated. A commons can also be seen as a natural resource that is managed by a group of people (communities, cooperatives, user groups) for their individual and collective benefit.

Sustainable management of global commons such as the atmosphere is a new challenge for the future of socio-economic systems. Although everyone could benefit from the sustainable use of such commons, there are still situations in which harmful free-riding (i.e., indiscriminate use for individual purposes) is manifested, undermining the possibility of realizing the forms of cooperation that are essential to cope with climate change.

In the case of global warming, the common good is a specific composition of the atmosphere. This composition keeps the climate, and therefore the biosphere on Earth, within the parameters to which we have adapted and to which we have adapted our way of life, our culture, our economic activities, and so on. In principle, all species living on Earth are involved, although only humans can contribute to preserving the atmosphere.

The composition of atmospheric gases and their impact on the biosphere and humanity is a "common pool resource". No one can be excluded from benefiting from its positive effects.

Sustainable management of global commons such as the atmosphere is a new challenge for the future of socio-economic systems. Even if everyone could benefit from the sustainable use of such commons, there are still situations in which harmful "free-riding" behavior (i.e., indiscriminate use for individual purposes) damages the possibilities of realizing the forms of cooperation that are indispensable to cope with a changing climate. (Padovan, 2020, pp. 96-97).

CLIMATOLOGY

Climatology, or climate science, is the scientific study of the climate, defined as the statistical analysis of the meteorological conditions considered over a reasonable period of time, usually not less than thirty years. (WMO).

The major current research topics are the study of climate variability and the natural and anthropogenic forcings that influence climate, the mechanisms of climate change, and the role of human activities in relation to modern climate change (Cassardo, 2020, pp. 99-100).

CLIMATE DENIAL

Climate change denialism refers to the set of behaviours aimed at denying the evidence of climate change or its anthropogenic cause.

For a more specific discussion of the modes of denialism and the processes at work at the individual and collective levels, see also the entries "Infodemia", "Climate Change Denialism", "Climate Populism", and "Techniques of Denialism" (Bagliani&Latini, 2020, p. 325).

CLIMATE MIGRATIONS

One of the most dramatic impacts of climate change is increased human migration (displacement).

Projections indicate that more and more people will be on the move in the coming decades due to more frequent and intense climate-related disasters, such as precipitation and temperature extremes, which ultimately affect the availability of livelihoods.

Projected environmental migration can take many forms:

- Very complex: forced or voluntary, temporary or permanent
- Internal
- International.

The most vulnerable people may be those who are unable to move (trapped populations). Environmental migration should not be seen as either negative or positive; migration can both exacerbate existing vulnerabilities and enable people to build resilience.

Migration is currently seen as a form of adaptation to changing climatic conditions (Padovan, 2020, pp. 306-307).

CLIMATE MOVEMENTS

Faced with the momentous challenge posed by the climate crisis, many movements and associations have emerged or reorganized to address it. Fridays For Future (FFF) is a global movement that recognizes the climate emergency and demands a safe path for governments to keep the global average temperature increase below 1.5 degrees Celsius compared to the pre-industrial era.

The movement is primarily student-led: in fact, it is based on climate strikes by students every Friday. Hence the name Fridays for the Future. The Climate Strikes began in the late summer of 2018 with Greta Thunberg's demonstrations in the square in front of the Swedish Parliament, which encouraged millions of other students around the world to strike against politicians' indifference and inaction towards the climate crisis. FFF's goal is to build a climate- and socially sustainable society, where anthropogenic carbon dioxide (CO2) emissions are zero and the principle of climate justice is central (Pollo&Chiantore, 2020, pp. 319-320).

CLIMATE RESILIENCE

Climate resilience is defined as the ability of a system, in the face of hazardous events (shocks) and stresses (perturbations) by reorganizing itself to maintain its essential functions, while retaining the capacity to adapt, learn and transform.

This implies the need to develop an approach capable of going beyond the current piecemeal adaptation policies to specific climate hazards, by considering resilience as a concept that encompasses three essential elements:

- Reducing the fragility of systems in the face of climate impacts and limiting the cascading effects of a specific risk by strengthening systems;
- Building the capacity of social actors (e.g. households, communities, civil society, businesses, public sector) to anticipate and develop adaptation responses;
- Strengthening and addressing institutions (social rules and norms) that are critical for orienting and linking agents and the system (Pezzoli *et al.*, 2020, pp. 386-387).

CONSUMPTION AND CLIMATE CHANGE

Consumption, by definition, is a process of adaptation of the human species to changing environmental and social conditions. Since it is an indispensable process for all living systems, consumption should not cause so many problems. But it is the cause of climate change. Every activity implies the "consumption of nature", i.e. of matter and energy, and this energy, whether endosomatic or exosomatic, comes from nature (or rather from the sun), transforming itself into different material carriers (vectors): oil, coal, gas, but also biomass, wind, tides.

The combustion of fossil sources produces climate-altering gases which, in high concentrations, increase the natural greenhouse effect and cause the modern global warming of the planet. The critical factor is that in the current economic system, the consumption of energy and matter, although a universal activity, tends to grow continuously to produce consumer goods and generate economic profits.

The consumption that contributes to global warming is that required by the processes of extraction of raw materials and other energy, which is then expended in the expanded processes of production, circulation and consumption of final goods.

The "interdependence of production and consumption" is probably the most important modern explanation of climate change: without consumption, there is no production, without consumption, depletion, destruction of matter, energy and final goods there are no possibilities for the production (growth) of goods (Padovan, 2020, pp. 111-112).

DEFORESTATION

Deforestation refers to the deliberate or widespread removal or clearance of forests or trees from a land area, leading to the conversion of forested land into non-forest land. It is the opposite of afforestation, which involves the establishment of new forests.

Deforestation can occur in various scenarios, like agriculture, logging, infrastructure development, mining or urbanization. However, the results of deforestation have significant environmental and social impacts:

1. Loss of biodiversity - forests are home to a vast array of plant and animal species. Deforestation disrupts ecosystems and habitats, leading to the loss of biodiversity and endangering numerous species.
2. Climate change - forests play a crucial role in mitigating climate change by absorbing and storing carbon dioxide (CO2) from the atmosphere. When trees are cut down or burned, the stored carbon is released, contributing to greenhouse gas emissions and global warming.
3. Soil erosion and degradation- forests help maintain soil health and prevent erosion. Deforestation can lead to soil erosion, reduced soil fertility, and increased vulnerability to landslides and floods.
4. Water cycle disruption - forests play a vital role in regulating water cycles by capturing and releasing water through transpiration. Deforestation can disrupt local and regional water cycles, affecting water availability, quality, and hydrological patterns.
5. Socio-economic impacts - deforestation can have negative socio-economic consequences for local communities and indigenous populations who rely on forests for their livelihoods, food, and cultural practices.

According to FAO, nearly 420 million hectares of forest were lost globally due to deforestation between 1990-2020 [5]. In 2020, the EU's consumption accounted for close to 10% of global deforestation.

[5] More details at: https://www.europarl.europa.eu/news/en/headlines/society/20221019STO44561/deforestation-causes-and-how-the-eu-is-tackling-it

DESERTIFICATION

Desertification is land degradation in arid, semi-arid, and sub-humid dry areas attributable to environmental characteristics and natural phenomena, but also due to unsustainable exploitation and management of natural resources.

Desertification is one of the most significant current challenges, in fact, land degradation (usually irreversible) and the loss of its productive capacities are phenomena present on all continents, with different aspects and causes.

Desertification threatens the survival of millions of people, particularly that of the poorest people in developing countries.

Desertification can be prevented or mitigated by policy strategies aimed at reducing the vulnerability of the land, implementing interventions that affect the causes and effects of the phenomenon and adapting to it (Fratianni&Baronetti, 2020, pp. 135-136).

According to the World Atlas of Desertification, over 75% of the Earth's land area is already degraded, and over 90% could become contaminated by 2050 [6].

DISASTER

Disaster describes severe changes in the normal functioning of a community or society due to risky events that interact with the conditions of vulnerability, exposure and adaptive capacity of the affected system. The consequences of disasters can be human, material, economic and environmental impacts or losses, and are immediate and localized. Disaster damages are measurable in physical units (e.g. square kilometres of houses) and describe the partial or total destruction in the area (Pezzoli&Quagliolo, 2020, p. 139).

DISEASES AND CLIMATE CHANGE

Today, climate change is, unequivocally, an issue at the centre of numerous discussions and scientific evidence in many disciplines, and in the very last few years, discussions and research on climate change are connecting and intersecting with a number of diseases of both physical and psychological nature.

Over the past decades, due to irrational and unscrupulous consumption of natural resources, compression of increasingly limited environmental space, and pressure on ecosystems, the impacts of climate change have triggered variations that are still largely unknown.

[6] More details at: https://ec.europa.eu/commission/presscorner/detail/en/IP_18_4202

New climatic conditions and pressure on ecosystems appear to have triggered an increase and onset of new diseases of both biotic and abiotic nature in both humans and animals in recent decades, as evidenced by numerous studies in the medical and veterinary fields.

Recent research in the veterinary field has highlighted how, in recent decades, species jumped between different animals and between animals and humans, i.e., spillover-as for example in the case of dangerous viruses (MERS, SARS-CoV, Hendra, Ebola, etc.) has increased, as has the ability to spread to previously unknown ranges (in part as a result of poor prophylaxis and globalized consumerism) (Orusa&Bollo, 2020, pp. 298-320).

DROUGHT

The term drought denotes a period of abnormal conditions of water scarcity long enough to cause stress; in this sense, it occurs as a sporadic phenomenon that can also affect non-dry areas.

Drought is a normal and recurring feature of the hydrological cycle, which can occur in both arid and humid regions, and is assessed in terms of the local balance between precipitation and evapotranspiration in relation to the time interval in which it occurs.

It differs from aridity, which is limited to geographic areas with low precipitation and is therefore a permanent feature of the climate. Drought is one of the most important consequences of climate variability, affecting natural and socio-economic systems.

Because it occurs after long periods of rainfall deficiency, it is difficult to objectively quantify its characteristics in terms of onset, duration, and cessation (Fratianni&Baronetti, 2020, p. 412).

According to the UN, droughts represent 15% of natural disasters but took the largest human toll, with approximately 650,000 deaths from 1970-2019 [7].

ECOLOGICAL FOOTPRINT

The Ecological Footprint is an environmental accounting system that estimates the amount of ecological resources and ecosystem services that a population uses to meet its needs, in terms of resource consumption and the absorption of all emissions and wastes that the population produces to live.

This estimate is expressed by calculating the corresponding area of productive land, which quantifies the total area of ecosystems required to sustainably produce (directly and indirectly) all the resources consumed and to sustainably reabsorb all the emissions produced by that population.

[7] More details at: https://www.undrr.org/explainer/the-invisible-toll-of-disasters-2022

If the Ecological Footprint of production is less/greater than the biocapacity, there is a situation of erosion/accumulation of local natural capital, while if the Ecological Footprint of consumption is less/greater than the biocapacity, it can be said that the population to which the calculation refers uses more/less than the territory can offer to produce the natural resources and absorb the emissions and wastes and that the territory is therefore in a situation of ecological deficit/surplus (Vesce *et al.*, 2020, pp. 212-214).

ECOSYSTEM SERVICES

Ecosystem functions are defined as the ability of natural processes and components to provide goods and services that directly or indirectly meet human needs and support the life of all species.

The functions of an ecosystem can be divided into four categories:

- Supporting: These functions aggregate all those services necessary for the production of all other ecosystem services and contribute to the conservation (in situ) of biological and genetic diversity and evolutionary processes;
- Regulating: in addition to maintaining the health and functioning of ecosystems, regulating functions capture many other services that provide direct and indirect benefits to humans (such as climate stabilization, and waste recycling) that are usually unrecognized until they are lost or degraded;
- Provisioning: These functions capture all those resource provisioning services that natural and semi-natural ecosystems produce (oxygen, water, food, etc.);
- Cultural: Natural ecosystems provide an essential "counselling" function and contribute to the maintenance of human health by providing opportunities for reflection, spiritual enrichment, cognitive development, recreation, and aesthetic experiences.

These ecosystem functions encapsulate the goods and services that human society uses to satisfy its well-being. On the basis of these functions, the (potentially) beneficial aspects of natural ecosystems for humankind in the form of goods and services are defined under the general term "ecosystem services" (Orusa, 2020, pp. 410-411).

EMISSIONS

Emissions refer to the release or discharge of gases, particles, or substances into the atmosphere, often as a byproduct of human activities. Emissions can have various environmental and health impacts, particularly when they contribute to air pollution and climate change.

The most common types of emissions include:

- Greenhouse gas emissions;
- Air pollutants;
- Industrial emissions;
- Emissions from transportation.

EMISSIONS TRADING SCHEME (ETS)

The EU's Emissions Trading System (ETS) is designed to curtail carbon emissions from industries by requiring companies to possess a permit for every tonne of CO2 they release, which they acquire through auctions. Various incentives are in place to foster innovation within the sector.

The European ETS is known as the world's inaugural and largest carbon market. It oversees approximately 40% of the EU's total greenhouse gas emissions and encompasses roughly 10,000 power stations and manufacturing plants within the EU. In order to align with the emission reduction objectives outlined in the European Green Deal, the scheme underwent an update in April 2023, following approval from the Parliament. These reforms involve targeting a reduction of emissions in sectors covered by the Emissions Trading System to 62% by 2030, relative to 2005 levels [8].

ENERGY EFFICIENCY

Energy efficiency refers to the efficient utilization of energy resources to accomplish a desired task or achieve a specific outcome while minimizing energy waste. It involves using less energy to perform the same function or obtaining more output from the same amount of energy input.

Energy efficiency can be applied across various sectors, including residential, commercial, industrial, and transportation. It encompasses a range of measures and practices aimed at reducing energy consumption, optimizing energy use, and maximizing the overall efficiency of energy systems. Some key aspects of energy efficiency include [9]:

1. Energy conservation, which involves reducing energy demand by adopting behaviours and practices that minimize energy use. Example: turning off lights when not in use, energy-efficient appliances, insulating buildings to reduce heating and cooling needs, and optimizing transportation routes to minimize fuel consumption.
2. Energy-efficient technologies - using energy-efficient technologies and equipment that significantly reduce energy consumption. Example: energy-efficient lighting, appliances, heating and cooling systems, industrial machinery, and transportation vehicles that are designed to use energy more efficiently.
3. Building design and insulation. Example: constructing buildings with energy-efficient designs, insulation, and windows. It reduces the need for heating and cooling, thereby minimizing energy usage.
4. Energy management and monitoring, which involves implementing energy management systems and monitoring energy consumption can help identify areas of inefficiency and allow for better energy optimization. Example: energy monitoring devices, smart meters, and energy management software to track and analyze energy usage.

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[8] More details at: https://www.europarl.europa.eu/news/en/headlines/society/20180305STO99003/reducing-carbon-emissions-eu-targets-and-policies

[9] More details at: https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficiency-targets-directive-and-rules/energy-efficiency-directive_en

ENERGY TRANSITION

The term transition refers to the change from one situation (or phase, or state) to another that has significantly different characteristics from the previous one. The term "energy transition" can be understood as the transition from a situation in which energy is produced by a certain energy mix, i.e. in which there is a certain distribution of the relative weight of different energy sources, to another situation in which energy is produced by a different mix. In the field of environmental and energy policy, the term is now used to refer to the (expected and/or pursued) transition from an energy mix composed predominantly of non-renewable sources such as fossil fuels to one composed predominantly, or at least to a much greater extent than today, of renewable sources (Tartaglino *et al.*, 2020, pp. 456- 458).

ENVIRONMENTAL CONSCIOUSNESS

Environmental consciousness can be seen as a multi-dimensional function that includes knowledge, experience, awareness, concerns and values, in an integrated view that owes much to the phenomenological perspective.

The affective and evaluative aspects of consciousness are captured by the concepts of awareness & concern. Awareness is like an early stage of alertness, necessary to activate psychological and behavioural responses. It is a process that combines cognition and evaluation; it does not simply enumerate facts but evaluates and recognizes them as environmental problems.

Environmental concerns, on the other hand, more properly identify negative affective dimensions, which can refer either to specific aspects (I am concerned about the erosion of my favourite beach) or to general orientations (I am concerned about rising seas).

Consciousness can include environmental values, the basic guiding principles that provide the basis for evaluations, concerns, and behaviours and that "refer to individual and shared community or societal beliefs about the meaning, importance, and well-being of the natural environment and how the natural world should be viewed and treated by humans (Sarrica, 2020, pp. 116-117).

EUROPEAN CLIMATE LAW

The European Climate Law is a legislative framework that establishes the European Union's (EU) commitment to addressing climate change and achieving climate neutrality by 2050. It was adopted by the European Parliament and the Council of the EU in April 2021.

The European Climate Law enshrines the EU's climate target of reaching net-zero greenhouse gas emissions by 2050. This means that by 2050, the EU aims to balance the amount of greenhouse gases emitted with the amount removed from the atmosphere, effectively achieving climate neutrality.

The law is to be complemented by a range of specific measures and initiatives, such as the European Green Deal, which encompasses various policies and initiatives to drive the EU's sustainable and climate-friendly transformation across sectors like energy, transportation, agriculture, and industry.

EUROPEAN GREEN DEAL

The European Green Deal (also known as the Green New Deal)is a strategic plan of the European Commission that aims to combine economic growth and environmental sustainability. Presented by the European Commission on December 11, 2019, the plan has as its goal the transformation of the EU into a low-emission continent by 2030 and climate neutral by 2050. With the Green New Deal, the EU intends to contribute to the goals set by the Paris Agreement (see also the "2030 Agenda" item) of keeping the temperature within 1.5°C of the pre-industrial era.

The Plan includes the following actions:

- Reduce greenhouse gas emissions by at least 50 per cent (aiming for 55 per cent) by 2030 compared to 1990 levels and achieve to climate neutrality by 2050.
- Significantly increase the use of renewable energy so that we have clean as well as cheap and safe sources of energy.
- Mobilize industry for a clean and circular economy.
- Construct and renovate buildings in energy-efficient ways resources.
- Accelerate the transition to sustainable mobility and smart.
- Increase in agriculture business models "producer to consumer."
- Preserve and restore ecosystems and biodiversity (Corazza et al., 2020, pp. 202-203).

EUROPEAN POLICIES ON CLIMATE AND ENERGY TOWARDS 2030-2050

In 2014, the European Union's efforts to make the regional economy more competitive by strengthening the security and sustainability of its energy system intensified with the adoption of the Energy and Climate Framework 2030.

It is a set of policies covering the period 2020-2030 that aims to promote the competitiveness, sustainability and security of the energy system by boosting research, development and innovation, increasing demand for efficient and low-carbon technologies and reducing dependence on imports.

The targets, with a deadline of 2030, are:

- Reduce the region's domestic greenhouse gas emissions to at least 40 per cent below 1990 levels. This will allow for a reduction of 80-95 per cent (relative to 1990 levels) by 2050. In fact, it is estimated that a reduction of less than 40 per cent by 2030 would increase the long-term costs of decarbonizing the economy (EC, 2014);
- Increase renewable energy to at least 27% of EU energy consumption;
- Increasing energy savings to 27 per cent (with a redefinition towards 30 per cent in 2020) (Bagliani&Pietta, 2020, pp. 378-379).

FAIR TRADE

Fair Trade is a global movement and a market-based approach that aims to promote equitable and sustainable trading practices between producers in developing countries and buyers in wealthier nations. It seeks to ensure that producers, particularly small-scale farmers and workers in marginalized communities, receive fair prices for their products, improve their working conditions, and have access to better economic opportunities.

FOOD SECURITY

Food security is identified as "the situation where all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food to ensure their food needs and preferences to lead active and healthy lives.

Food security encompasses within it 4 main dimensions:

- The availability of sufficient quantities of food of adequate quality (food availability);
- Access-in terms of both purchasing power and the right to use common resources-to adequate resources for acquiring appropriate food for a nutritious diet (food accessibility);
- The use of food for the attainment of a state of well-being nutrition in which all needs are met physiologically (food utilization);
- The stability of an individual, family or population in accessing to adequate nutrition over time (food stability) (Tecco, 2020, pp. 413-414).

FOOD SOVEREIGNTY

Contextualizing food sovereignty within the global warming debate-its causes, challenges, consequences, and possible solutions-immediately sharply defines its meaning and highlights its political connotations.

Food sovereignty advocates a model "in which peoples have the right to nutritious and culturally appropriate food, produced in a sustainable and environmentally sound manner, and exercise the right to choose their own food and production systems.

Food sovereignty is based on the recognition of certain fundamental rights, starting with the right to the food itself, including the right of access to food resources, land, seeds and livestock breeds, water and fish resources, basic credit services and skills to promote an alternative production model to the current food regime, capable of responding and adapting to the current challenges of the agri-food scenario, including the climate crisis, through local/territorial resilience strategies (Tecco, 2020, pp. 418-419).

FOOD WASTE

Food waste refers to discarded or uneaten food that is no longer suitable for human consumption. It occurs at various stages of the food supply chain, including production, processing, distribution, and consumption. Food waste can encompass edible items that are discarded due to overproduction, spoilage, expiration, improper storage, cosmetic imperfections, or consumer behaviour. Food waste is a significant global issue with serious economic, social, and environmental consequences. When food is wasted, all the resources used to produce, process, transport, and store it, such as water, energy, and land, are also wasted. Moreover, the disposal of food waste in landfills leads to the emission of greenhouse gases, contributing to climate change.

According to the inaugural pan-European monitoring of food waste, in 2020, the average amount of food waste per person in the European Union was 131 kilograms. Within this total, households were responsible for 53% of the food waste, amounting to approximately 70 kg per person. The remaining 47% of food waste originated from the upstream sections of the food supply chain [10].

FLOOD

The term flood refers to flooding events caused by the overflow of rivers or other water bodies (e.g. lakes, sea) beyond their normal limits or even as a result of a period of very heavy rainfall. The extent of flooding follows a dynamic propagation and depends on the amount of water discharged, the velocity of the flow, and the morphology of the surrounding area. Flooding refers to the accumulation of standing water in areas that are not normally submerged. In this case, it may occur as a result of sewer overflows in an urban environment, for example after heavy rainfall.

The terms flood and inundation are combined here because the English term flood does not make such a distinction and includes both (Pezzoli&Quagliolo, 2020, p. 44).

[10] More details at: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Food_waste_and_food_waste_prevention_-_estimates

FOSSIL FUEL

Fossil fuels are natural energy resources formed from the remains of ancient plants and organisms that lived millions of years ago. They are non-renewable resources because their formation takes millions of years, and their extraction and consumption occur at a much faster rate than their replenishment

The three primary types of fossil fuels are [11]:

1. Coal - formed from the remains of plants that lived in swamps and forests hundreds of millions of years ago. It is the most carbon-intensive fossil fuel.
2. Oil - formed from the remains of marine plants and animals that accumulated on the ocean floor and were subjected to heat and pressure over millions of years.
3. Natural gas - formed through similar processes as oil but usually in deeper geological formations.

In 2019, close to 64% of global electricity came from fossil fuels [12]. However, their combustion releases significant amounts of carbon dioxide (CO2) and other greenhouse gases, contributing to climate change and air pollution.

GLOBAL WARMING

"Global warming" refers to the observed and/or projected future increase in global surface temperature in response to changes in radiative forcing caused by anthropogenic greenhouse gas emissions.

Indeed, human activities are now responsible for the emission of large quantities of greenhouse gases such as carbon dioxide (CO2), methane (CH4), and nitrous oxide (N2O) that have long enough atmospheric lifetimes to accumulate. The increase of greenhouse gases in the atmosphere has caused an amplification of the natural greenhouse effect, resulting in an anthropogenic one that has led to the warming of the planet (Palazzi&Cassardo, 2020, pp. 398-399).

Between 1991 and 2021, temperatures across Europe experienced a notable increase, with an average rate of approximately +0.5 °C per decade [13].

[11] More details at: https://ocean.si.edu/conservation/gulf-oil-spill/what-are-fossil-fuels
[12] More details at: https://ourworldindata.org/fossil-fuels
[13] More details at: https://www.undrr.org/explainer/the-invisible-toll-of-disasters-2022

GREENHOUSE GASES - GHG

Greenhouse gases are gaseous species in the atmosphere that can activate the phenomenon known as the greenhouse effect. These gases, due to their molecular structure, are capable of absorbing the thermal IR radiation emitted from the Earth's surface and are transparent (i.e., they do not absorb) the solar radiation entering the Earth's system.

The greenhouse effect is an essential process for life to exist and persist on Earth; in fact, without it, the average temperature of the Earth would be such (about -18°C) as to prevent the development of any form of life.

The major greenhouse gases are water vapour (present in high concentrations), carbon dioxide (CO2), methane (CH4), and nitrous oxide (N2O).

A gas's ability to contribute to the greenhouse effect is measured by its Global Warming Potential (GWP), which is the amount of infrared radiation it absorbs over a given period of time.

Greenhouse gases are therefore both gases naturally present in the atmosphere as well as compounds of exquisite anthropogenic origin, such as the chlorofluorocarbons mentioned above, which are characterized, among other things, by a high chemical inertness even in highly reactive contexts such as the Earth's atmosphere. These gases are also called "climate-altering gases" because of their ability to affect the climate (Minella, 2020, p. 192).

EU-27 greenhouse gas emissions in 2019 declined by 24 % compared to 1990 levels [14].

GREENWASHING

The term greenwashing thus encompasses all those linguistic and extralinguistic practices - such as the use of the colour green - that are typical of corporate communications that exploit environmental sustainability but are actually aimed at deliberately increasing sales in order to make a profit. The language of greenwashing is thus characterized by deliberate alterations of the truth disseminated through the mass media by large corporations, usually multinational corporations, which pretend or boast that they are or have become-eco-sustainable and wish to present themselves as such to consumers.

In essence, greenwashing is a company's attempt to appear more environmentally sustainable than it actually is. On the other hand, the main purpose of greenwashing is to make the public aware of environmental problems and to motivate them to take (more) concrete action to protect the environment (Furiassi, 2020, pp. 204-205).

[14] More details at: https://ec.europa.eu/commission/presscorner/detail/en/ip_20_2182

HEAT WAVES

A heat wave is a prolonged period of atmospheric weather during which temperatures exceed the average temperatures normally recorded in a given region.

The term heat wave has no objective meaning, as it is related to a specific geographic area (local climate) and time of year.

In fact, average temperatures in one area may be considered a heat wave in another area. For example, the average daily temperature recorded in the Mediterranean would result in a heat wave in northern Europe. Heat waves can have numerous socio-economic and environmental impacts, such as wildfires (often when the heat wave is associated with drought), sporadic power outages due to excessive use of air conditioning, damage to infrastructure (roads, highways, and water pipes), damage to crops, and increased mortality due to hyperthermia (Fratianni *et al.*, 2020, p. 327).

INDIRECT EMISSIONS

Indirect emissions related to a building, home, or business are greenhouse gas emissions that arise from the production and/or consumption of electricity used in that particular establishment. These emissions are referred to as "indirect" because they originate from the power plant responsible for generating the electricity, rather than from the building itself that consumes the electricity.

INTENSIVE AGRICULTURE

Intensive agriculture has a significant impact on soil such as acidification, nitrification, desertification, the decline in organic matter in soil, soil contamination (e.g., by heavy metals and agrochemicals), soil compaction, and erosion. Fertilizers used in intensive farming increase emissions of greenhouse gases.

Extensive and intensive livestock production both contributes to and is affected by climate change. Animal agriculture is responsible for at least 14.5% of global greenhouse gas emissions and causes significant environmental degradation, from biodiversity loss to deforestation. By 2030, the livestock sector is projected to account for almost half of the world's emissions budget for 1.5C unless things change.

IPCC

The Intergovernmental Panel on Climate Change (IPCC) is the leading international body for assessing climate change. The IPCC is an intergovernmental body to all member countries of the UN and the WMO to provide governments around the world with a clear and coherent scientific view of the current state of knowledge on climate change and its potential environmental and socio-economic impacts. Currently, 194 countries are members of the IPCC (Orusa&Bagliani, 2020, pp. 223-224).

KYOTO PROTOCOL

The Kyoto Protocol is one of the most important steps in climate change policy. Signed during COP3 in Kyoto in 1997, it aims to stabilize the emissions of the nations that have historically been most responsible.

The Kyoto Protocol provides for both "on-the-ground" decarbonization measures, i.e. measures related to the production system of developed countries, and the use of the aforementioned flexibility mechanisms. The use of these instruments theoretically allows countries and companies that emit more than they are allowed to buy the right to the excess allowances on the market, while those that have stayed under their limit can sell the remaining allowances.

This gave rise to emissions markets that allow different parties to choose the least expensive option between reducing emissions and paying other parties to do it for them.

LAND USE AND LAND USE CHANGE

Soil is a limited resource that generally takes a very long time to form, but despite its resilience can be physically destroyed or chemically and biologically altered in a very short time, to the point of losing its functions. It is a key land resource component of human, and agricultural development and environmental sustainability, on the different types of soil depend on the entire terrestrial primary productivity and the stability of the food chain. Its management is crucial as it is an important driver (influencing factor) in the climate system.

Land use, on the other hand, reflects the interactions between humans and the land cover, and is thus a description of how land is used in human activities. Land use change consists of a change in land use that may or may not be accompanied by a change in land cover, which may or may not affect the actual state (chemical, physical and biological) of the land. Land use change causes adverse effects when it irreversibly alters its functions and capacity to provide ecosystem services and its biodiversity.

Increasing anthropogenic pressures, and increased demand for food (especially meat) associated with population growth, have resulted in a major conversion of many soils that were formerly forests, shrublands and wetlands to agricultural soils with a pronounced anthropogenic footprint with significant impacts on the physical and chemical properties of soils (Borgogno Mondino&Orusa, 2020, pp. 465-466).

LANDFILL

A landfill is a designated area where solid waste is disposed of and buried in the ground. It is a common method of waste management used to handle non-hazardous municipal solid waste and some types of industrial waste. While landfills are a common waste disposal method, they may take up land space and may cause air, water and soil pollution.

LIFE CYCLE ANALYSIS (LCA)

LCA is "a process of collecting and evaluating the input and output streams and the potential environmental impacts of a product system throughout its life cycle.

A study is called "cradle to grave" (literally, from beginning to end) when it considers all stages of the product life cycle, from raw material production to disposal of the finished product; instead, it is called "gate to gate" when some of the cycle stages are excluded from the study a priori.

One of the results that can be obtained by conducting a Life Cycle Assessment (LCA) of a product is the identification of "hot spots", i.e. those process steps that need to be addressed in order to achieve significant environmental improvements in terms of impact reduction (Evola&Vesce, 2020, pp. 294-296).

METEOROLOGY

Meteorology is the science that studies the Earth's atmosphere and the phenomena of various kinds (dynamic, thermodynamic, optical, electrical, etc.) that occur in it.

With narrower meaning, the area of aero-physics that deals with the dynamic and thermodynamic phenomena of the atmosphere (movements of air masses, precipitation, winds, etc.), is limited to the regions closest to the ground; in particular, descriptive meteorology, which deals with the observation, description and classification of meteorological phenomena (clouds, winds, precipitation), also making use of technical means such as radar, radiogoniometers, etc. (Cassardo *et al*., 2020, p. 304).

MICROPLASTIC

Microplastics are tiny particles of plastic that are smaller than 5 millimetres (0.2 inches) in size. They are formed through the degradation and fragmentation of larger plastic items, such as plastic bottles, bags, and packaging, as well as from the shedding of microfibers from synthetic textiles. Microplastics can be found in various environmental compartments, including the oceans, freshwater bodies, soil, and even in the air.

MICRO-CLIMATE AND URBAN HEAT ISLAND

Urban microclimate refers to the climatic variations in the typical environment of cities and urban areas. This phenomenon occurs due to various factors, such as increased human activities, heat storage by the built environment, lack of ventilation, the presence of vegetative cover, etc.

The urban geometries of open spaces can be the main parameters responsible for the variation of microclimates in cities. A characteristic phenomenon in this context is the formation of urban heat islands (UHI). This phenomenon refers to the development of an increase in air temperature in the central (more built-up) areas of the city, compared to the surrounding or rural areas. Urban geometries and building materials can influence the increase or decrease in temperature, wind speed and intensity.

The consequences of heat islands can be defined as positive or negative, depending on the climatic macro-area in which the city is located. In cities with harsh climates and very cold seasons, one can either talk about the benefits and thermal comfort in open spaces; for cities with hot and humid climates, there is increased thermal stress associated with thermal discomfort.

In cities with hot and humid climates, there is increased thermal stress associated with thermal discomfort, especially when the urban microclimate maintains high temperatures even at night (Pezzoli&Quagliolo, 2020, p. 305).

OCEAN ACIDIFICATION

Ocean acidification is the ongoing process of a decrease in the pH of the Earth's oceans, primarily caused by the absorption of carbon dioxide (CO2) from the atmosphere. When CO2 dissolves in seawater, it reacts with water molecules to form carbonic acid, which increases the concentration of hydrogen ions (H+), consequently lowering the pH of the water.

The main factors contributing to ocean acidification are the burning of fossil fuels, deforestation, and other human activities that release large amounts of CO2 into the atmosphere. The oceans act as a sink for atmospheric CO2, absorbing approximately one-third of the carbon dioxide emitted by human activities [15].

OZONE

Ozone is a gas that occurs naturally in the Earth's atmosphere. Ozone is a species with oxidizing properties; it is toxic to humans because it reacts readily with all compounds containing carbon-carbon double bonds.

At the level of the lungs, it leads to the formation of peroxides, which are precursors of free radicals. Ozone plays an essential role because it can block the UV-B fraction of sunlight by absorbing it, preventing it from reaching the earth's surface. An increase in UV-B radiation would result in reduced plant production, a significant decrease in the population of phytoplankton (essential for maintaining oceanic food chains), as well as significant damage to human health, such as an increase in skin cancers.

[15] More details at: https://oceanservice.noaa.gov/facts/acidification.html

Ozone is continuously produced and destroyed in the stratosphere by a series of highly interacting processes. Ozone is not a primary pollutant; in fact, there are essentially no emitting sources of this gas. Its presence is due to the establishment of photochemical smog processes in which atmospheric oxidants (including ozone) and particulate matter are combined (Minella, 2020, pp. 330-331).

PARIS AGREEMENT

The Paris Agreement (PA) is a climate change agreement reached on December 12, 2015, during the 21st COP (Conference of Parties) of the UNFCCC. The agreement was considered a success because it was supported by all participating countries, including the United States and China. The European Commission called it "the first universal and legally binding agreement on climate change." To date, there are 189 countries that have ratified or acceded to the agreement - known as parties to the agreement - while there are 195 signatories - representing 97% of emissions.

With the Paris Agreement, there has been a significant shift in international climate policy from a top-down to a bottom-up model. Under this model, each country sets its own targets and commits to them based on a "pledge and review" mechanism. In order to ensure transparency in the process, the agreement stipulates that starting in 2023, global stocktakes or reviews of the targets will be prepared every five years. These reports will have to report on the actual targets achieved by each country and how they will be implemented in the future. However, there are no sanction mechanisms for non-compliance. The monitoring of countries' performance would therefore be based solely on the "naming and shaming" mechanism and would be carried out by non-governmental organizations, mainly NGOs, which would prepare periodic reports on countries' compliance (or non-compliance) with their commitments. The Paris Agreement was therefore seen as a diplomatic success, given its broad membership, but also as an environmental defeat.

One of the most important, but also most controversial, aspects of the agreement is the cap on global warming. The PA talks about staying below 2°C and making every effort not to exceed 1.5°C.

However, this solution implicitly involves accepting a number of consequences that a "tolerated" temperature rise will entail.

Moreover, the measures currently envisaged by governments do not guarantee that these limits can be met; on the contrary, some projections seem to show that the 2°C threshold will be exceeded by a wide margin if a change of direction is not made as soon as possible.

The Paris Agreement was finally operationalized with the Katowice Package, agreed at COP24 in 2018, which sets out the rules, procedures and guidelines for the Parties (Bonati, 2020, pp. 35-36).

PERCEPTION OF CLIMATE CHANGE

Perception consists of becoming aware of facts or phenomena through sensory stimuli that are analyzed and interpreted through intuitive, psychic, and intellectual processes. Climate change manifests itself as an increase in average temperatures, an increase in the frequency of punctual extreme weather events, and changes in the composition (duration, sequence, and intensity) of seasonal weather patterns and events.

The perception of climate change may involve both the ability to recognize climatic and meteorological anomalies on a purely sensory level - for example, that last summer's temperatures were higher than those of summers in an earlier period - and the ability (or inclination) to inscribe climatic and meteorological facts and phenomena, whether personally experienced or indirectly experienced, within the interpretive framework that supports the actual existence of climate change (Arrobbio, 2020, pp. 339-340).

PERMAFROST

Permafrost refers to a type of soil or ground that remains permanently frozen for at least two consecutive years. It consists of a combination of soil, rock, sediment, and ice that remains below the freezing point (0°C or 32°F) throughout the year, even during the summer months. Permafrost plays a crucial role in shaping the landscape and regulating various environmental processes. It acts as a foundation for structures, roads, and infrastructure in cold regions. It also affects hydrology, by acting as a barrier to groundwater flow and influencing the formation of lakes, wetlands, and rivers [16].

PRODUCTION AND CLIMATE CHANGE

The production of goods involves the consumption of matter and energy. This is consumption production. It is the production of goods that directly consumes matter and energy that causes climate change. The more that is produced, the more greenhouse gases are emitted.

The possibility of reducing the material intensity of produced objects is being explored, that is, whether it is possible - to produce a table, a car, or a house - to reduce the amount of matter and energy used in their production.

The question remains whether it is possible not so much to reduce the material intensity of the products, but to reduce the material intensity of the process, for example by using energy-saving technologies (which save energy) or by changing the energy mix, using complex production machines powered by renewable energy sources. In addition, the problem of the production of goods is closely linked to the economic revenue they promise: consequently, the problem of material intensity is put in relation to the economic output and not to the material output (objects, services, devices, etc.) (Padovan, 2020, p. 367).

[16] More details at: https://www.biologicaldiversity.org/programs/climate_law_institute/the_arctic_meltdown/slideshow_text/thawing_permafrost.html

PROSUMPTION

Prosumption is a term that combines the words "production" and "consumption" and refers to the phenomenon where individuals or entities both produce and consume goods or services. It describes a blurring of the traditional boundaries between producers and consumers, as individuals engage in activities that involve both creating and using products and services.

Examples of prosumption can be seen in various domains, especially in renewable energy. With the advent of technologies like solar panels and wind turbines, individuals can generate their own electricity and become prosumers by producing and consuming energy.

RECYCLING

Recycling is the process of converting waste materials into new products or raw materials, with the aim of reducing the consumption of fresh resources, energy usage, and environmental impacts associated with the extraction and production of new materials. It involves collecting, sorting, processing, and transforming discarded materials into usable materials that can be used in the manufacturing of new products. In 2020, the recycling rate in the EU was 46% [17].

REFORESTATION

Reforestation is the deliberate and planned process of replanting and regrowing forests in areas where they have been depleted or completely removed. It involves the restoration of forest cover and the establishment of new forests through the planting of trees or the natural regeneration of forests. The primary goal of reforestation is to restore the ecological functions and benefits that forests provide. These include carbon sequestration, biodiversity conservation, soil protection, water regulation, and the provision of habitats for various plant and animal species.

RENEWABLE ENERGY SOURCES

Renewable sources of energy are all those sources that are opposed to traditional energies obtained from fossil fuels, both because they are potentially unlimited and because they have less impact on the environment. They are:

- solar energy
- wind energy
- geothermal energy
- biomass energy (agricultural-livestock waste and forest biomass)
- hydropower
- energy using wave motion (Orusa&Tartaglino, 2020, pp. 185-186).

[17] More details at: https://www.eea.europa.eu/ims/waste-recycling-in-europe

The share of renewable energy in the EU's energy consumption decreased from 22.1% in 2020 to 21.8% in 2021. However, the share of renewable energy more than doubled between 2004 and 2021 [18].

SEA SURFACE TEMPERATURE

Sea surface temperature refers to the measurement of the temperature of the uppermost layer of the ocean's surface. It represents the temperature of the water that directly interacts with the atmosphere and is primarily influenced by solar radiation and heat exchange between the ocean and the atmosphere. It plays a significant role in influencing climate patterns, weather systems, and the distribution of marine life. It serves as a critical indicator of the thermal energy stored in the oceans and helps in understanding and monitoring various environmental processes and phenomena.

SUSTAINABLE DEVELOPMENT

Although it is a widely used concept that has become almost synonymous with the development model itself, there is no single definition of sustainable development.

On the contrary, it is a dynamic concept that has evolved significantly and not without controversy from its first formalization - which took place at the first UN Conference on the Environment in 1972 and was later defined in the Brundtland Report (1987) as "development that enables the present generation to meet its own needs without compromising the ability of future generations to meet their own needs" - to its adoption as the foundation of the 2030 Agenda.

From a vision that focused primarily on environmental aspects, sustainable development has gradually evolved into a broader meaning that takes into account not only environmental but also economic and social dimensions. These models are united by the dimensions considered - environment, society, economy - and are distinguished by the relationship between them, taking an increasingly integrated and systemic view over time (Maggiolini&Tecco, 2020, pp. 436-438).

SUSTAINABLE DEVELOPMENT GOALS (SDGS)

The Sustainable Development Goals (SDGs) are a set of global goals adopted by the United Nations (UN) member states in 2015 as part of the 2030 Agenda for Sustainable Development. The SDGs provide a framework for addressing the world's most pressing social, economic, and environmental challenges, with the aim of achieving sustainable development by the year 2030.

[18] More details at: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Renewable_energy_statistics

The SDGs consist of 17 interconnected goals and 169 targets that cover a wide range of issues, including poverty eradication, zero hunger, quality education, gender equality, clean water and sanitation, affordable and clean energy, decent work and economic growth, climate action, and sustainable cities and communities, among others.

Progress towards the SDGs is monitored through a global indicator framework that tracks key metrics and targets. Governments, international organizations, and other stakeholders regularly review and report on their efforts to achieve the SDGs, fostering transparency and accountability.

SUSTAINABLE MOBILITY

"Sustainable mobility is the ability to meet society's needs for freedom of movement, access, communication, trade and relationships without sacrificing other essential human and environmental values, now and in the future".

Making people's mobility more sustainable requires action in the transport sector, which has the potential to improve the lives and livelihoods of billions of people.

The EU's Transport, Telecommunications and Energy Council, which includes EU transport ministers, defines a sustainable transport system as one that "enables the basic access and development needs of individuals, businesses and society to be met in a way that is safe and compatible with human and ecosystem health, and that promotes equity within and between generations".

As part of the Green Deal, the European Commission also aims to reduce greenhouse gas emissions from transport by 90 per cent by 2050 and to boost electric mobility. The Commission also unveiled a "Sustainable and Intelligent Mobility Strategy" which lays the groundwork for making the EU's transport system greener, more digital and more resilient (Scagni&Maggiolini, 2020, pp. 311-312).

TOURISM AND CLIMATE CHANGE

Defining the relationship between climate change and tourism is very complex for two reasons. The first is that the term "tourism" covers a very heterogeneous range of activities and actors, both in terms of the type of environment affected and therefore of destination (mountains, sea, cities of art) and in terms of the supply chain (transport, hospitality, services, catering, events).

Secondly, the relationship is twofold: on the one hand, the tourism sector contributes to climate change and, on the other, it suffers its consequences, which in certain cases can lead to a rediscussion of the economic and environmental sustainability of the destinations themselves. Tourism is now one of the most important economic sectors at the global level, contributing about 10 per cent of the world's gross domestic product.

In terms of its contribution to climate change, the latest published data show that in 2016, emissions related to tourism transport alone contributed 5 per cent of total anthropogenic emissions. One example is mountain tourism, both winter and summer. Ski resorts in alpine valleys have been forced for several years to resort to adaptation strategies, in particular snowmaking, as a result of the decrease in natural snowfall, which has led researchers, national and local governments, and associations to understand the economic and environmental implications of such practices. In addition, extreme weather events exacerbate slope instability, leading to landslides, mudslides, rock falls and floods. These phenomena lead to increased maintenance costs for already heavily degraded areas and reduce the usability of facilities and trails during the summer for activities such as trekking, mountain biking, and downhill skiing (Beltramo&Duglio, 2020, pp. 462-463).

VULNERABILITY

Vulnerability is defined as the propensity of exposed elements of a system (people, buildings, infrastructure, economic activities, etc.) to be negatively altered and damaged as a result of hazardous events. The intensity of climate change impacts is highly dependent on the level of vulnerability and exposure to these events. Vulnerability represents the degree of susceptibility to damage as a function of exposure to stresses, combined with the inability to cope with or adapt to a phenomenon (Pezzoli&Quagliolo, 2020, p. 467).

WASTE AND CLIMATE CHANGE

The term waste refers to any substance or object that the holder discards or intends or is required to discard. It coincides with the disposal stage of matter, which may be solid or liquid, resulting from a domestic, agricultural or industrial process. Waste is divided into municipal and special waste according to the activity from which it is generated, and into hazardous and non-hazardous waste according to its nature.

Waste management has various impacts on air quality and, to some extent, on climate change. Depending on the nature of the waste and the final disposal systems, air quality impacts can be manifested through various gases and particulates.

The main component of the link between municipal waste (or organic or wet waste) and climate change is that related to methane (CH_4) in landfills. At present, waste management practices can provide effective mitigation of emissions: in fact, a wide range of technologies is available to reduce the impairment of public health, taking into account environmental protection and sustainable development.

These include, first, technologies that directly reduce greenhouse gas emissions (through gas recovery and improved landfill and wastewater management practices) and avoid significant generation (through controlled composting of organic waste or incineration). Second, there are a number of measures that indirectly reduce GHG emissions, such as waste reduction, recycling and reuse, which help conserve raw materials, improve energy and resource efficiency, and eliminate the use of fossil fuels.

Life Cycle Assessment (LCA) is an essential tool for considering both the direct and indirect impacts of technologies and waste management policies (Beltramo&Mollo, 2020, pp. 391-393).

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More information can be found at:

- National Ocean Service: https://oceanservice.noaa.gov/facts/carbon-cycle.html#transcript
- Climate Council: https://www.climatecouncil.org.au/resources/carbon-offsetting-worthwhile/
- Circularity Gap Reporting Initiative: https://www.circularity-gap.world/2021
- World Health Organization: https://www.who.int/europe/news-room/fact-sheets/item/climate-change
- European Parliament:

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- United Nations Office for Disaster Risk Reduction (UNDRR): https://www.undrr.org/explainer/the-invisible-toll-of-disasters-2022
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- Our World in Data: https://ourworldindata.org/fossil-fuels
- National Ocean Service: https://oceanservice.noaa.gov/facts/acidification.html
- Center for Biological Diversity: https://www.biologicaldiversity.org/programs/climate_law_institute/the_arctic_meltdown/slideshow_text/thawing_permafrost.html
- European Environment Agency (EEA): https://www.eea.europa.eu/ims/waste-recycling-in-europe

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