



MODULE 1: Pillars of sustainable thinking and circular economy



Image by [Freepik](#)



Co-funded by
the European Union

This project has been funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any errors which may be made of the information contained therein. Project Number [2021-1-EL01-1-220-VET-2021-1-EL01-KA220-VET-000033152]

Table of contents

1. Introduction	2
2. Key words	2
3. Learning Objectives	2
4. Pillars of sustainable development	4
5. Climate change and the need for sustainable development	6
6. Definition and principles of circular economy	9
7. Implementation of circular economy	12
8. Good practices	13
8.1 Municipality of Vari-Voula-Vouliagmeni	13
8.2 Municipality of Ioannina	14
8.3 Smart bins in Horn and Tulln, Austria	15
9. Summary	16
10. Questions for reflection	17
11. Useful References and Resources	17
12. Bibliography	17

Diagrams

Diagram 1. Pillars of Sustainable Development	6
Diagram 2. Linear economy	10
Diagram 3. Circular economy	10

1. Introduction

The European Union (EU), at the forefront of efforts to address actions against climate change, has formulated an ambitious Energy and Climate Strategy to achieve climate neutrality by 2050. More specifically, the EU energy policy seeks to facilitate the transition to an energy system independent from fossil fuels and going toward zero greenhouse gas emissions, by promoting sustainable development. What's more, over the last decade, there have been many initiatives on a global scale to promote a new sustainable development roadmap, such as the 17 United Nations Sustainable Development Goals. This global call to action aims to protect the planet and ensure the well-being of people worldwide by encouraging individuals, businesses, administrations, and countries to participate in sustainable development efforts. Based on the aforementioned, there is an imperative need to develop green skills among individuals as well as implement sustainable practices in corporate operations, in order to abide by the new guidelines concerning circular economy and sustainable development. In this module, the pillars of sustainable thinking will be introduced to provide information on developing these green skills and good practices focusing mainly on SMEs, VET teachers, and students.

2. Key words

Sustainability, circular economy, sustainable development, green skills, sustainable practices

3. Learning Objectives

By the end of this module, the learner will be able to build a sustainable mindset, understand the main characteristics of circular economy, and get to know the impact of climate change. More specifically, the learning objectives are captured below:



- The importance of sustainable development
- The concept of climate change and its relationship to sustainability
- The impact of circular economy
- Successful examples of sustainable practices

4. Pillars of sustainable development

Sustainable Development (SD) refers to development that meets the needs of the present without compromising the ability of future generations to meet their own needs. The concept of sustainable development is often described using three pillars: social, economic, and environmental. These pillars provide a framework for applying a solutions-oriented approach to complicated sustainability issues (Acciona, 2022).

The three pillars of sustainability are fundamental to many organizations, institutions, and government agencies today, including the United Nations (UN) and the European Union (EU). Although the three pillars have no clear origin, their widespread application has resulted in ongoing refinement of sustainability approaches over time (United Nations, 2022).

The definition of the three sustainability pillars may vary depending on social and economic factors. Below, we describe the European standards for each of these pillars:

- **Social Pillar**

The Social Pillar refers to the ability of a social system, such as an organization, a country, or a family, to function in a way that promotes equality and respect for individual rights, ensuring a defined level of social well-being and harmony. Achieving social sustainability requires protecting and developing different communities while preventing climate change. Situations of war, poverty, injustice, and low levels of education are characteristic of socially unsustainable systems (Allen, 2022).

Some of the UN Sustainable Development Goals aim to promote social well-being and sustainability. The Agenda 2030 is structured with an approach "to achieve inclusive, people-centered and sustainable development with no one left behind."

One of the main goals for social sustainability, according to the Agenda, is to end poverty and hunger, and to ensure that all human beings have equal and easy access to health care, food, and water. Additionally, providing easy access to education and technology for all, as well as ending violence in all forms, are considered fundamental goals for a sustainable future (United Nations, 2022).

- **Environmental Pillar**

The Environmental Pillar refers to laws, regulations, and other policy mechanisms developed to deal with environmental issues to preserve a defined level of environmental quality and natural resource extraction rates. These issues include air and water pollution, waste management, preservation of natural resources, maintenance of biodiversity, wildlife and endangered species. The European Union is focused on playing a pivotal role in achieving climate neutrality by implementing policies and agreements based on the protection of the environment. The Paris Agreement is one of the most promising agreements that provides an opportunity for countries to collaborate and respond to the threat of climate change and achieve climate neutrality, and the European Union is focused on playing a pivotal role in this effort by implementing policies and agreements based on the protection of the environment.

- **Economic Pillar**

The Economic Pillar focuses on promoting economic sustainability by defining strategies that maximize the utilization of socio-economic resources to their best advantage. Some of the goals that can create a sustainable future, according to the United Nations, include promoting sustainable economic growth, full and productive employment, and decent work for all. Economic growth can improve living standards and create better circumstances for technological development and education. Additionally, economic growth can ensure essential health services for all, which is crucial in today's societies, especially considering the global health emergency that occurred during the pandemic of Covid-19 (United Nations, 2022).

Green development is typically distinguished from sustainable development in that it values environmental sustainability over economic and cultural considerations. Following a path that includes inclusive green growth is a way to achieve sustainable rapid growth, in order to bring developing countries to the level of prosperity they aspire to and meet the needs for a better global environment.

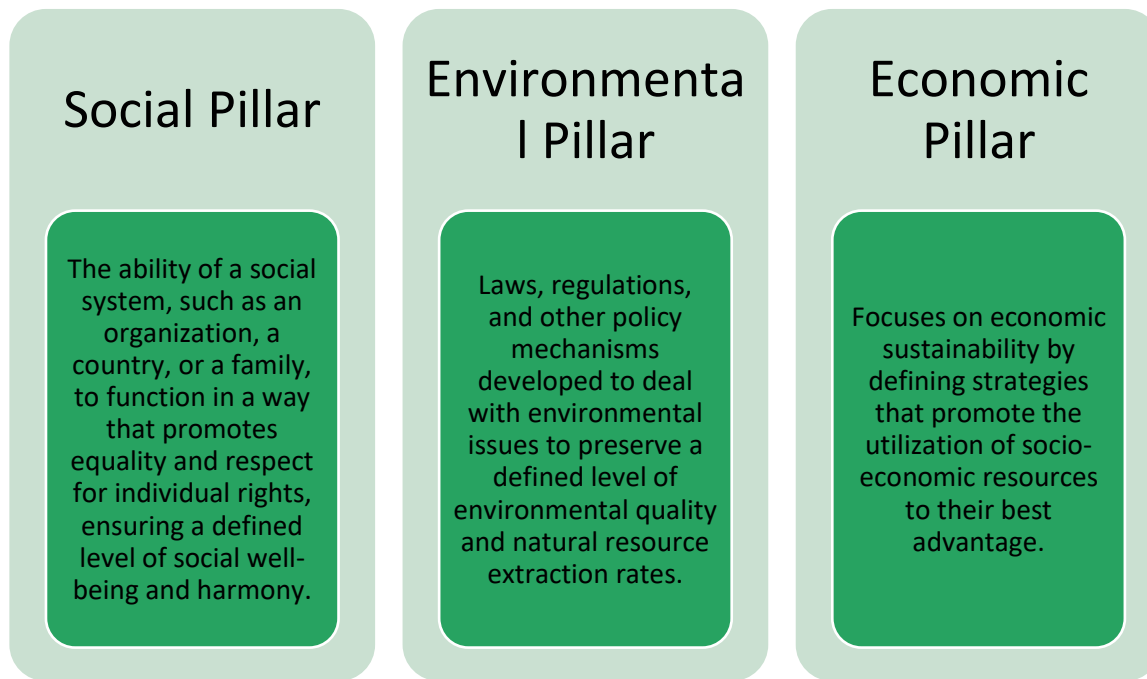


Diagram 1. Pillars of Sustainable Development

5. Climate change and the need for sustainable development

The term "climate change" refers to changes in average meteorological conditions, such as fluctuations in temperature and intensity and frequency of precipitation, over a period of at least 30 years. Climate change can be characterized as a physical phenomenon, with key indicators including changes in the Earth's orbit, solar radiation, and volcanic eruptions. However, anthropogenic activities have accelerated the spread and intensity of the phenomenon, making it one of the major environmental issues facing humanity worldwide (Intergovernmental Panel on Climate Change [IPCC], 2021).

Over the past few decades, climate change has affected human and natural systems in a variety of ways across all continents. As the Earth's temperature continues to rise, further short-term

impacts are expected in the coming years. Many terrestrial, freshwater, and marine species have already shifted their geographical ranges and migration patterns in response to climate change (Parmesan & Yohe, 2021).

The pace of climate change is faster than that of any other time period, putting an even greater strain on the survival of species. As a result, global warming is expected to play a catalytic role in the increasing rate of species extinction. Changes in the intensity and frequency of precipitation, snowfall, and consistency of glaciers have major impacts on hydrological systems, affecting the quality and quantity of water resources in many regions globally. Glaciers are shrinking across the globe, and the seasonal decrease of Arctic sea ice is increasing at unprecedented rates during summer (NASA, 2022).

In terms of human societies, the negative effects of climate change often exacerbate existing critical situations and social issues, such as poverty, lack of adequate food and drinking water, environmental degradation, and conflicts, which mainly affect the poorest and most vulnerable countries. Extreme weather events such as storms, hurricanes, heat waves, droughts, and wildfires have already caused direct harm to living conditions, including flooding, desertification, reduction of arable land, and destruction of infrastructure (IPCC, 2021).

As collateral consequences of climate change, an increase in immigration and a rise in food prices have been defined. The further increase in the planet's temperature increases the possibility of significant, extensive, and non-easily reversible effects. Given the proven increase in global temperature, estimated to be on average about 1°C higher than pre-industrial times, the upcoming impacts are seen as inevitable, with the phenomenon becoming more pronounced in the medium term, i.e., over the coming decades. Due to a lack of substantial measures and legislation globally aimed at reducing greenhouse gas emissions, the average temperature of the planet may increase by at least 4°C by the end of the 21st century, with subsequent significant and extensive impacts mainly on vulnerable ecosystems. This may lead to catastrophic loss of biodiversity and serious threats to food adequacy for a large part of the population, especially in densely populated areas. The combination of temperature and humidity raise will make life in some parts of the planet unbearable due to the prevalence of excessive humidity and heat conditions (United Nations, 2022).

As mentioned above, the prominent consequence of climate change is the phenomenon of sea-level rise due to the melting of the planet's ice caps. Between 1994 and 2017, the largest losses in volume occurred in the Arctic Sea and the ice floes near Antarctica. A rise in mean sea level will reshape the habitability of coastal areas globally (Intergovernmental Panel on Climate Change, 2019).

The future consequences of climate change will vary greatly from region to region due to various factors. For example, coastal areas and small Pacific islands will face wide-ranging impacts from sea level rise. However, geographical location is not the only factor. Countries with greater wealth and power are less vulnerable to upcoming disasters and can defend themselves more effectively due to their resources, technology, and know-how. In contrast, many developing countries will be highly affected, as they rely directly on local agricultural production and are therefore considered more vulnerable to the effects of climate change and the disruption of hydrological cycles (IPCC, 2022).

In conclusion, climate change threatens economic stability and affects lives in every country on every continent by causing changes in weather patterns, such as sea level rise and worsening extreme weather events. Although the COVID-19 pandemic caused a decline in greenhouse emissions in 2020 by around 6%, as a result of travel bans and economic slowdowns, this drop is temporary, with emissions gradually returning to higher levels. Therefore, communities are urged to take urgent action to address climate change (United Nations, 2022). Sustainable development can be used as an approach to support the efforts towards mitigating and adapting to climate change.

Sustainable development is a crucial concept that involves long-term decision-making, an integrated approach across various disciplines, and proactive involvement in both societies and ecosystems. The United Nations member states developed and adopted the "2030 Agenda for Sustainable Development," which includes 17 Sustainable Development Goals aimed at promoting peace and prosperity for humans and the planet (United Nations, 2022).

Climate change and sustainable development are interrelated. Climate change impacts natural and human living conditions, which are fundamental to societal and economic development,

while sustainable development priorities affect both the Greenhouse Gas (GHG) emissions responsible for climate change and vulnerability to its effects. The effectiveness of climate policies can be improved by integrating them into broader strategies that promote sustainable development on national and regional levels, given the impact of climate change and variability, climate policy responses, and associated socio-economic development on the ability of countries to achieve sustainable development goals (IPCC, 2022).

6. Definition and principles of circular economy

Circular economy constitutes a model of sustainable economic development, which is based on new ways of producing and consuming goods and focuses on extending product life, reusing and recycling existing materials and products. The basic principles of circular economy include the conservation of natural resources and their optimization, through the control of stocks and the balancing of renewable materials flows.

More specifically, circular economy is considered as an alternative option against the dominant, until recently, model of linear economy. Following the industrial revolution, the route of raw materials within the production process, integrates the stages of production, the use-exploitation of the product and finally its disposal, with minor deviations. This model is defined as a linear model and is based on the assumption that resources are abundant and available and their waste disposal is cheap (European Parliament, 2022, p. 4).

Circular economy refers to an industrial economy that is restorative or regenerative by value and design, aiming to utilize renewable energy, to minimize, monitor and eliminate the use of toxic chemicals, and manage waste in the most effective way. The design of the circular economy model aims to reconstruct and preserve the materials that circulate and contribute to the economy, in contrast to the existing model of production, which is characterized by manufacture and disposal of products.

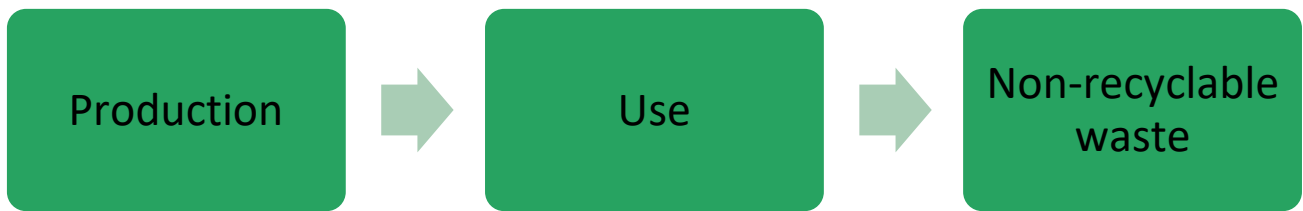


Diagram 2. Linear economy

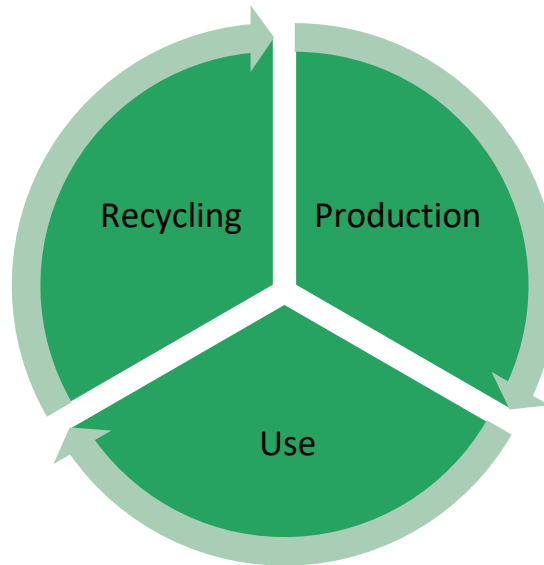


Diagram 3. Circular economy

In the past, reuse and lifetime extension of products were often used as strategies in situations of scarcity or poverty, resulting in low-quality products. Currently, they are signs of good management of resources and intelligent utilization of them. The main principles that the circular economy is based on are described below:

- **Waste planning:** Waste is not understood as such when the biological and technical components (or "nutrients") of a product are designed with the intention of entering a biological or technical cycle of materials, designed for disassembly and renovation. Organic nutrients are non-toxic and can simply be composted. Synthetic nutrients, polymers, alloys, and other artificial materials are designed to be reused with minimal energy and high-quality retention (whereas recycling results in products with reduced quality, which are injected back into the process as raw materials) (European Circular Economy Stakeholder Platform [ECESP], 2022).

- **Building resilience through diversity:** Adaptability and flexibility are particular attributes that must be prioritized in an uncertain and rapidly evolving world. Diverse systems with many connections and scales are more resilient against external jolts than systems built simply for efficiency, the maximization of which can lead to fragility. Natural systems support resilient abundance by adapting to their environment with an infinite combination of diversity, uniformity, and complexity. The industrial revolution and globalization focused on uniformity, so our systems are often unstable. To deal with this, products with the same intelligence for durability using successful natural systems as models can be produced (Ellen Macarthur Foundation, 2022).
- **Energy from renewable sources as the main basis.** Circular systems should aim to ultimately exploit renewable energy sources. Every circular story should begin by assessing the energy involved in the production process, with human labor falling into the same category. Shifting taxation from labor to energy and material consumption will accelerate the adoption of more circular business models, while ensuring effective pressure is put on the direction of rational management of resources consumed by society and the economy (Ellen Macarthur Foundation, 2022).
- **Waste contains nutrients.** Regarding bionutrients, the ability to reintroduce products and materials back into the biosphere, through non-toxic, restorative loops, is at the core of the concept. From a technical nutritional value standpoint, it is also possible to improve quality, known as upcycling. For technical nutrients, the circular economy chain includes stages such as maintenance, reuse/redistribution, renovation/reconstruction, and recycling, which are reintroduced along the production process, respectively. Biological nutrients include the biochemical substrate that is either returned as raw material at the beginning of the process, returned directly to the consumer for a different use, or subjected to appropriate treatment to be sent for aerobic or anaerobic digestion (with biogas production). Moreover, it includes the restoration of the biosphere and the stage of cultivation and harvesting of organisms that have been regenerated in the biosphere. Biochemical components, having completed the appropriate stages, return as secondary matter to the beginning of the process (Kirchherr, Reike, & Hekkert, 2017).

7. Implementation of circular economy

Applying the circular economy concept is a challenging task due to the existing linear perception in both industry and society. While the environmental benefits of the circular economy are straightforward and easily understood, predicting the economic benefits is considered complex. Despite the successful applications of circular economy, its full implementation requires a radical change in the operation of businesses.

The European Commission emphasizes the need to consider all stages of a company's value chain when shifting towards a circular production model. Circular economy must be applied from production to consumption and reuse of remanufactured products, from waste management to secondary raw materials entering the economy.

The manufacturing phases of a product include:

- Production
- Planning
- Production methods
- Consumption
- Management of produced waste
- Life cycle extension.

In order to implement circular economy, a common line of interests and priorities among stakeholders is crucial. Public institutions and industry must approach the issue collectively and develop a coordinated consciousness regarding environmental problems. Strict control frameworks need to be established to regulate companies' actions in relation to the environment. It is imperative to reconcile the interests of public bodies and industrial actors to prevent prioritization of environmental benefits at the expense of economic development and vice versa.

The main arguments put forward by public bodies for the transition to a circular economy are resource scarcity, environmental impact, future employment, and competitiveness. Social awareness is considered extremely important and can be implemented through educational programs, public campaigns, and seminars. A shift in the mindset of consumers is also

necessary to focus on the performance of products resulting from the circular economy rather than whether they are new or second-hand (Kirchherr, Reike, & Hekkert, 2017).

8. Good practices

The term "good practices" is used in many areas of human activity. They are actually instructions, techniques, or methodologies that arise as a result of research and study, and their application has been proven to safely and reliably lead to a desired result. Good practice can be defined as a standard, a guideline, an application, as well as the result of a statistical and benchmarking process, which can take the form of either an advisory action (hints, recommendations, and reports) or an example to follow (specific techniques, methodologies developed in-house) and which ultimately leads to the reduction of environmental impacts. It should be noted that what is defined as good practice may differ from country to country and from environment to environment.

Certain criteria are taken into account to determine a "good practice", such as innovation and sustainability reflected through the use of new technologies, improving the environment and quality of life, as well as enhancing the productivity of a sector. In the following sections, some good examples of sustainability and circular economy practices taking place in Greek and Austrian communities are presented.

8.1 Municipality of Vari-Voula-Vouliagmeni

The Municipality of Vari-Voula-Vouliagmeni is a pioneer in the reuse of biodegradable waste, such as prunings and food residues, as soil improvement material with organic certification for use in nurseries and crops. The municipal authority collaborated with the National Kapodistrian University of Athens and the Department of Chemistry for the know-how, with the private sector to secure the composting field, and with the local community that embraced the brown recycling bin program. The revenue from the sale of the soil additive, in accordance with the legislation, returns to the waste management sector, naturally covering a large part of the costs

invested by the Municipality of Vari-Voula-Vouliagmeni for the adoption and implementation of this large program, providing a part of the soil additive to citizens.

However, the greatest benefit concerns the environment, as the Municipality has managed 12,500 tons of waste in a way that produces reusable quality certified materials, in contrast to other municipalities in the country where waste is sent to landfills. The financial benefit for the Municipality from each ton of recycling results from the savings on burial costs, which currently reach 55 euros per ton of waste for the municipalities in Attica that do not recycle (Municipality of Vari-Voula-Vouliagmeni, 2022).

8.2 Municipality of Ioannina

The Municipality of Ioannina, in the context of its development towards a sustainable future, has adopted innovative technologies, keeping up with current technological trends, and has implemented an innovative system to optimize waste collection and save resources and fuel. By utilizing the fleet management system, it is possible to monitor the location of the vehicles and waste bins online at any time, control the fuel supply, and identify the bins with the use of RFID tags to automatically record the quantity of waste during the collection process. Moreover, through the municipality's online portal, citizens are able to create a "green account," learn about recycling issues through interactive games (knowledge quizzes, articles, etc.), and earn reward points.

Through a list of questions related to citizens' awareness of cleanliness principles in the city, their responsibility for cleaning the sidewalks, and how municipal fees are calculated, citizens become aware of new methods that motivate them to adopt ecological behavior. In addition, for each correct choice, citizens are rewarded with a number of points that can be redeemed for discounts at local stores. They can also earn points by separating materials at home and disposing of them in special recycling points set up by the municipality. They are then registered on a special platform, where they choose the bin they used or note the specific number of the coupon they received.

The municipal authority of Ioannina aims to become part of the international network of innovation and cooperation that works towards the goals set for sustainable development.

Ioannina will be part of a network of cities with a tradition in technologies and will acquire expertise and adopt strategies that can become a point of reference and transfer the specific example to other cities (Municipality of Ioannina, 2022).

8.3 Smart bins in Horn and Tulln, Austria

Artificial intelligence (AI) can be used to reduce CO₂ emissions and protect the environment in several ways. Towards this goal, two communities in Austria, Horn and Tulln, are participating in an innovative project that uses AI to manage household waste disposal in an environmentally-friendly way. The project utilizes the latest technologies to analyze and scan mis-sorted items that may be put in the wrong bin. It also raises awareness by sending personal messages to the smartphones of the tested customers, informing them of the mis-sorted items and providing directions on how to sort waste correctly to protect the environment. The project uses a recyclables scanner equipped with sensors and cameras to identify the mis-sorted items and prevent the loss of important secondary raw materials, which can reduce harmful gases. The project was developed in collaboration with Saubermacher AG, Graz University of Technology, the Know-Center, Joanneum Research, and the startup SLOC. This practice could have a significant impact on reducing CO₂ in Austria, as it is estimated that reducing the total number of items mis-sorted as residual waste across Austria could save around 350,000 tons of CO₂ per year (WEKA Industrie Medien, 2021).

9. Summary

Sustainable development is centered on meeting current needs while ensuring that future generations can meet their own needs. The three pillars of sustainability - social, economic, and environmental - offer a framework for addressing complex sustainability issues through a solution-oriented approach.

Climate change has impacted both human beings and natural systems in various ways. The pace of climate change is currently faster than ever, endangering the survival of species and the well-being of human societies. This has caused social and economic issues such as a lack of basic nutrition needs, health problems for the majority of the population, and poverty, primarily affecting the poorest and most vulnerable countries.

One effective way to tackle these problems is through the implementation of a circular economy. The fundamental principle of this practice is to use resources efficiently and recycle materials that are no longer useful. It emphasizes the use of renewable energy sources, minimizes the use of toxic chemicals, and manages waste in the most effective way possible. The circular economy model is aimed at recycling and preserving materials that contribute to the economy, rather than manufacturing and disposing of products. Several communities, such as Vari-Voula-Vouliagmeni, Ioannina, Horn, and Tulln in Greece and Austria, have already adopted such practices and are working towards creating a more sustainable future.



10. Questions for reflection

- 1) Which are the main pillars of sustainable development?
- 2) What is the relation between sustainable development and climate change?
- 3) How does climate change affect the environment?
- 4) Which are the principles of circular economy?
- 5) Is circular economy an effective solution to environmental problems?

11. Useful References and Resources

1. Towards a climate-neutral economy: https://single-market-economy.ec.europa.eu/industry/sustainability/climate-neutral-economy_en
2. European Sustainability Academy: <https://www.eurosustainability.org/>
3. Europe Sustainable Development Report 2021: <https://eu-dashboards.sdgindex.org/>
4. European Sustainable Development Network: <https://www.esdn.eu/>

12. Bibliography

- Acciona. (2022, October 31). Sustainable Development. https://www.acciona.com/sustainable-development/?_adin=02021864894
- Allen, L. (2022, October 31). What Are the Three Pillars of Sustainability? Treehugger. <https://www.treehugger.com/what-are-the-three-pillars-of-sustainability-5189295>
- Ellen Macarthur Foundation. (2022). Towards the circular economy Vol. 1: an economic and business rationale for an accelerated transition. Ellen Macarthur Foundation.

- European Circular Economy Stakeholder Platform. (2022, October 31). Circularity Gap Report 2022: five years of analysis by Circle Economy. <https://circulareconomy.europa.eu/platform/en/knowledge/circularity-gap-report-2022-five-years-analysis-circle-economy#:~:text=The%202022%20report%20by%20impact,huge%20impact%20on%20climate%20change>.
- European Parliament. (2022, October 31). Circular economy: definition, importance and benefits. <https://www.europarl.europa.eu/news/en/headlines/economy/20151201STO05603/circular-economy-definition-importance-and-benefits>
- IPCC. (2022, October 31). The Intergovernmental Panel on Climate Change. <https://www.ipcc.ch/>
- Kirchherr, J., Reike, D., & Hekkert, M. (2017, December). Conceptualizing the circular economy: An analysis of 114 definitions. *Resources, Conservation and Recycling*, 221-232.
- Municipality of Ioannina. (2022, October 31). <https://www.ioannina.gr/?lang=en>
- Municipality of Vari-Voula-Vouliagmeni. (2022, October 31). <https://www.vvv.gov.gr/>
- NASA. (2022, October 31). Vital signs of the planet: Global climate change. <https://climate.nasa.gov/>
- United Nations. (2022, October 31). Sustainable Development. Department of Economic and Social Affairs. <https://sdgs.un.org/goals>