



INTERGRATION OF SUSTAINABLE DESIGN AND CIRCULAR ECONOMY  
CONCEPTS IN CIVIL ENGINEERING CURRICULA

## O5: GUIDELINES AND POLICY BRIEFING FOR RAISING AWARENESS

**D2: POLICY RECOMMENDATIONS FOR  
PROMOTING SUSTAINABLE DEVELOPMENT AND  
CIRCULAR ECONOMY IN THE INFRASTRUCTURE  
AND CONSTRUCTION SECTOR**



Co-funded by the  
Erasmus+ Programme  
of the European Union



TÜRKİYE ULUSAL AJANSI  
TURKISH NATIONAL AGENCY

# SUSTAIN-CE Project

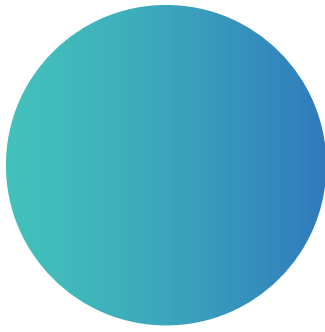
IO Number: 5 (Task 5.2)  
Output name: Guidelines and Policy  
Briefing for Raising Awareness

|                  |           |
|------------------|-----------|
| Submission Date: | June 2023 |
| Leading Partner: | SEERC     |

## Document Revision History

| Version | Date     | Comment       | Author(s) |
|---------|----------|---------------|-----------|
| 1.0     | 30.06.23 | Final Version | SEERC     |

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# Table of Contents

|   |           |
|---|-----------|
| <b>1. INTRODUCTION</b> .....  | <b>4</b>  |
| <b>2. EU POLICY FRAMEWORKS, DIRECTIVES, AND INITIATIVES</b> .....   | <b>4</b>  |
| <b>2.1. EU GREEN DEAL AND CIRCULAR ECONOMY ACTION PLAN</b> .....  | <b>5</b>  |
| <b>2.2. POLICIES AND INITIATIVES AT THE NATIONAL LEVELS</b> .....   | <b>7</b>  |
| <b>3. GAPS/BARRIERS IN THE POLICY SETTINGS FOR SUSTAINABLE DEVELOPMENT AND CIRCULAR ECONOMY TRANSITION IN THE CONSTRUCTION AND INFRASTRUCTURE SECTORS</b> ..... | <b>8</b>  |
| <b>4. POLICY RECOMMENDATIONS</b> .....  | <b>9</b>  |
| <b>4.1. POLICY RECOMMENDATIONS FOR INTERPRETATION</b> .....   | <b>9</b>  |
| <b>4.2. RECOMMENDATIONS FOR DECISION</b> .....  | <b>10</b> |
| <b>4.3. RECOMMENDATIONS FOR ACTION</b> .....  | <b>10</b> |
| <b>5. CONCLUSION</b> .....  | <b>12</b> |
| <b>REFERENCES</b> .....   | <b>13</b> |

## List of Figures

Figure 1 – Approach to Implementing SDGs and delivering the 2030 Agenda-6





# 1. Introduction

The European Union (EU) has long recognized the importance of sustainable development (SD) and has been actively involved in promoting policies and frameworks that align with this goal. The EU's commitment to achieving sustainable development while ensuring the needs of future generations are met is evident in its various policy initiatives and frameworks. One such framework that addresses sustainability in the construction and infrastructure sectors is the Green Public Procurement (GPP) framework, which guides public authorities in selecting environmentally friendly products, services, and works to contribute to sustainable production and consumption.

To enhance energy efficiency and environmental goals, the EU has introduced two key directives: the Energy Performance of Buildings Directive and the Energy Efficiency Directive. These directives aim to achieve highly energy-efficient and decarbonized buildings, develop investment strategies, and provide consumers and businesses with knowledge on energy-saving choices. The directives set mandatory measures such as long-term renovation strategies, cost-optimal energy performance requirements, and targets for nearly Zero Energy Buildings (nZEB). In addition to its efforts within the EU, the organization has also embraced the global Sustainable Development Goals (SDGs) outlined in the 2030 Agenda. The EU is fully committed to implementing these goals and the 2030 Agenda, which emphasize economic, environmental, and social aspects of sustainable development. The European Commission has developed various initiatives, including the European Green Deal and the Circular Economy (CE) Action Plan, which directly impact the construction and infrastructure sectors.

Despite these positive steps, there are still gaps and barriers that hinder the full implementation of sustainable development and circular economy principles in the construction and infrastructure sectors. These include insufficient funding and incentives, inadequate regulations for material reuse, lack of infrastructure for recycling and waste management, overlapping policies and measures, lack of standardization, limited stakeholder engagement, and data availability challenges. To address these gaps and barriers, this report proposes several policy recommendations that policymakers could consider implementing.

## 2. EU Policy Frameworks, Directives, and Initiatives

Sustainable development has always been at the core of framework and policy development within the European Union (EU). To achieve a development that conforms to the existing needs of people, without jeopardizing the needs of future generations, the EU, and the European Commission (EC) are actively involved in the implementation and the promotion of SD and CE across various sectors within the Union, including the construction and infrastructure sectors, by introducing and putting in action various frameworks and policy settings. One such framework that accounts for the sustainability of the infrastructure and construction sectors is the Green Public Procurement (GPP) framework, which is construction to play a vital role in achieving sustainable development, as well as reaching a higher resource-efficient economy.

The GPP framework is a guidance for public authorities on how to use their purchasing power to select environmentally friendly products, services and works, in order to contribute to sustainable production and consumption (European Commission, 2023a). The GPP was first introduced in 2008, and it is a voluntary instrument that member countries can decide the extent to which the instrument will be implemented (European Commission, 2008). The construction sector is one among the many sectors that the GPP accounts for, and it specifically refers to office buildings and are covering aspects such as: selection of experienced project managers, architects and engineers in sustainable construction designs; defining the minimum energy standards in accordance to the Energy Performance of Buildings Directive (EPBD); prioritizing designs with high-efficiency or renewable energy systems; application of life-cycle analysis assessment to reduce the environmental impact and resource use when selecting materials etc. (European Commission, 2016).

The construction and infrastructure sectors are essential in the achievement of energy and environmental goals of the EU, therefore, to enhance the energy performance of buildings and constructions the EU introduced a legislative framework that consists of two directives Energy Performance of Buildings Directive (2010), and Energy Efficiency Directive (2012). Both directives include policies that are aiming at achieving a highly energy efficient and decarbonised buildings by 2050; developing a steady environment that will assist the investment decisions to be made; provide consumers and business with the appropriate knowledge on the choices to make to save energy and money.

The legislative framework consisting of the two directives has certain measures that are compulsory for all member states to apply, such as, establishing strong long-term renovation strategies; setting cost-optimal minimum energy performance requirements for new buildings; as of 2021, all buildings must be nearly Zero Energy Buildings (nZEB), whereas since 2019 all new public buildings must be nZEB. Lastly, under the Energy Efficiency Directive, the member states of the EU must perform energy efficient renovations to at least 3% of the total floor area of governmental buildings annually (European Commission, 2018).

To contribute even further to the sustainable development of the Union, in September 2015 at the United Nations General Assembly, the EU, together with other countries signed up to the 2030 Sustainable Development Agenda, as well as the 17 Sustainable Development Goals (SDGs) which are an integral part of the 2030 Agenda. The 2030 Agenda is regarded as international framework that promotes global cooperation to delivering sustainable development, while taking into account its economic, environmental, social and global impact (European Commission, 2023b). The EC is fully committed to delivering the 2030 Agenda and the 17 SDGs, as the full implementation of the agenda is vital in strengthening the resilience of the Union, but also to facilitate the transition to a greener and more digital world. The Commission's approach to implementing the SDGs and delivering the 2030 Agenda is presented in Figure 1. In the process of delivering the SDGs, the Commission has developed various initiative tackling all sectors, including the European Green Deal and the Circular Economy Action Plan which are directly impacting the construction and infrastructure sectors (European Commission, 2023c).

**Figure 1 – Approach to Implementing SDGs and delivering the 2030 Agenda**



Source: European Commission, 2023

## 2.1. EU Green Deal and Circular Economy Action Plan

To tackle the challenges imposed by the climate change and the environmental degradation, the EU introduced the European Green Deal, which aims to lead to a modern, resource-efficient and competitive economy, while also achieving no net emissions of greenhouse gases (GHG) by 2050; economic decoupling from resource use; as well as no person and no place left behind (European Commission, 2019a). The European Green Deal was introduced in December 2019, and it accounts for various sectors, including the construction and infrastructure sectors. Specifically for these sectors the European Green Deal focuses primarily to the renovation of existing buildings, and it will finance over EUR 72.2 billion over a period of 7 years for private buildings' renovation, zero and low emission mobility, as well as income support. On top of this, it imposes regulations for mandatory renovation of public buildings in a way that they would utilise an increased amount of renewable energy, as well as to become more energy efficient.

The EC proposal as part of the Green Deal is in line with the aforementioned legislative framework that consists of the Energy Performance Building Directive and the Energy Efficiency Directive, where member states are required to renovate annually 3% of the total floor area of public buildings, benchmark setting of 49% of renewable in buildings by 2030, and setting a requirement for member states to upsurge the consumption of renewable energy in heating and cooling by 1.1 percentage points annually until the year 2030 (European Commission, 2019b).

As part of the European Green Deal, in order to inform and raise awareness among all stakeholders about climate change, to propose, develop, and implement solutions for tackling climate change, as well as to connect with stakeholders towards maximising and exploiting the full potential of these solutions, the EC introduced the European Climate Pact (ECP). The ECP has various priority topics, that encompass various sectors, hence one of the priority topics involves the construction sector, and specifically the development of green buildings. Moreover, to achieve the objective of creating green and sustainable buildings, the Commission introduced several initiatives, including: a Renovation Wave initiative, the New European Bauhaus Initiative, the BUILD UP initiative, the EU Building Stock Observatory, as well as various funding opportunities for investments in energy efficiency are provided (European Union, 2023).

The main purpose of introducing the Renovation Wave initiative is to scale-up the energy efficiency in the construction sector by encouraging building renovations to achieve emissions reduction, higher energy efficiency, as well as to further increase the creation of green jobs within the construction and infrastructure sectors. The focus areas of the initiative are tackling energy poverty and worst-performing buildings, public buildings and social infrastructure, and decarbonising heating and cooling (European Commission, 2020a). Alongside with the Renovation Wave initiative, in 2020, the EC introduced the New European Bauhaus (NEB) Initiative, which primarily provides a forum through which the stakeholders can co-create together, and share ideas on achieving sustainable and climate-friendly constructions (NEB, 2020).






The aim of the NEB is creating an ecosystem that provides access to sustainable, circular, and less carbon-intensive goods, that maintain nature's regeneration and that protect biodiversity to all stakeholders. To achieve the aim of the initiative, in the development phase, the EC combined relevant EU initiatives, as well as has set the agenda of proposed novel actions and funding opportunities that cover: creation of NEB lab, that will serve as a tool to expand the initiative's community, and to plan policy actions; prepare funding programmes in the EU Member for cutting-edge NEB projects; provide for funding projects in the social housing that are in line with the values and objectives with the NEB initiative; advance the Commission's own building strategy; as well as co-designing and co-creating with stakeholders to identify new pathways in achieving the green and circular transition in the construction sector (European Commission, 2021).

To further expand knowledge and to promote the sustainable and circular transition in the building construction sector, the EC developed the BUILD UP portal, which serves as a tool to inform and provide knowledge to the public and the stakeholders on energy efficiency and renewable energy in the building and construction sector, as well as to bring together the interests of the practitioners and professionals that work in the sector. The portal provides case studies, best practices, news latest developments in the sectors (both practical and technical), as well as it provides information on the policy legislation and related financial matters (BUILD UP Portal, 2023).





Lastly, as part of the EU Green Deal, in 2016, the Commission developed the EU Building Stock Observatory (BSO) that is a webtool that aims to deliver information related to the energy performance of the building and construction sector across the EU, by providing reliable, consistent, and comparable data. The main objective of developing the webtool is to provide transparent and reliable information about the EU's building stock, to provide support in monitoring the current energy policies and measures across the EU's territory, hence to provide contribution in the policy decision and making process (EU BSO, 2016).

**As a main extension of the European Green Deal and the new agenda for sustainable growth of the EU, in March 2020, the EC adopted the New Circular Economy Action Plan (CEAP). The transition towards circular economy in the EU is projected to reduce the pressure imposed on natural resources, as well as it is expected to generate sustainable growth and job creation. On top of this, the transition to CE is considered to be the main enabler to achieve the 2050 neutrality target and to close the biodiversity loss within the EU. The CEAP consists of initiatives throughout the entire life cycle of goods, as well as it deals with products design, encourages the adoption of CE processes and sustainable consumption, while it also aims to prevent waste and keep resources within EU's economy as long as possible (European Commission, 2020b). As part of CEAP the EC will introduce a new comprehensive Strategy for a Sustainable Build Environment, that is expected to help in exploiting the full potential to increase the efficiency of materials, while reducing the climate impacts.**

Besides ensuring coherence between relevant policy areas (i.e., climate, energy and resource efficiency, the overall management of construction and demolition waste etc.), it will be likewise promoting the principles of circularity throughout buildings' lifecycle by promoting actions that are aligned with the principles of CE for building design that will improve the resilience and adaptability of built assets; addressing the sustainability performance of construction products, as well incorporating the possible inclusion of recycled content requirements for certain construction products, while accounting for their safety and functionality; and last but not least by revising the targets for material recovery for construction and demolition waste (European Commission, 2020c; Ragonnaud, 2023).

In order to facilitate the application and adoption of the developed frameworks in terms of promoting SD and CE in the construction and infrastructure sector, the EC developed the Level(s) framework for sustainable buildings, which is used to assess and report on the sustainability performance of buildings and is based on the CE principles. The framework is built upon six micro-objectives, and each micro-objective is focusing on specific sustainability indicators (sixteen indicators in total), thus each micro-objective sets the parameters on how to improve the performance of buildings to be in line with the discussed frameworks and directives in terms of energy, material consumption and waste, water, indoor air quality and climate change resilience (European Commission, 2023d).

## 2.2. Policies and Initiatives at the National Levels

It is evident that the EU and EC are taking a lot of actions to promote and achieve the transition towards SD and CE in all sectors, including the construction and infrastructure sectors, however in order to have a successful transition, it is important for such actions to take place at the national level. Therefore, to identify the level of efforts that are undertaken at the national levels, as part of the SUSTAIN-CE projects, interviews were conducted with representatives from governmental and non-governmental organisations in three countries Turkey, Portugal Greece. The respondents were asked if there are any policies or relevant initiatives that are set in place in the construction and infrastructure sectors, that promote the implementation of SD and CE practices, and in the three countries the responses were positive. From the responses it is evident that the transition towards SD and CE in the construction sectors is important, however this transition is still at an infant stage, and there is a long way to go to be fully achieved. Nevertheless, according to the responses that were provided by the interviewed participants, it can be confidently said that even though there are still some setbacks, Portugal has an active involvement in this transition as according to the responses that were received from the participants there are various policies and initiatives that are set in place. For instance, the first responded stated the following:

**R1:** *"Most recently, the Circular Economy Roadmap set out actions and measures to transition towards a more circular economy and directed focus to waste management, resource efficiency, and promoting circular business models and practices. In the same line, the National Strategy for Sustainable Development outlined the country's long-term vision and goals for sustainability and the Portugal 2030 programme also highlighted Climate Action and Sustainability, Innovation and Digital Transition, establishing priorities such as monitoring the climate emergency and incorporating the targets of decarbonization by supporting innovation and the circular economy, thereby benefiting sustainable production methods. Still, in what concerns the sector of construction there seems to still have a long way to go. Regarding initiatives and projects, it can be noted Circular Economy Portugal (CEP) – a platform that promotes the transition to a circular economy developing actions of capacity building and projects in the areas of repair and reuse. The Portuguese government also promoted Eco.nomia, a portal that results from the plan of action of ministry of environment as a space of knowledge to get to know funding opportunities and collaborative projects on circular economy. On the other hand, projects like Smart Waste Portugal can be mentioned, an initiative, like many others, that aims to improve waste management practices and promote the circular economy in the waste sector."*

Similarly, another respondent from Portugal mentioned the following policies:

**R2:** *"Since 2014, a number of policies have been put in place revealing a concern about the sustainability of the construction sector. Most recently are in place the National Strategy for Sustainable Development 2020-2030 and the Plan of Action for the circular economy 2017-2020 - two examples of strategic frameworks that guide the country's sustainability and circularity efforts. There are also in place a number of relevant policies considering waste management such as National Waste Management Plan, Strategic Plan for Urban Waste and National Program for the Territorial Planning Policy."*

As well as the following initiatives and projects that were set in place in the country:

**R2:** *"Recently, circularidade.builtcolab published a report on the state of the art of constrains and opportunities to implement circular economy on the construction sector, in collaboration with various stakeholders. This document was elaborated in support the Plan of Action for Circularity in Construction and counts as an initiative of great importance aimed to support the decision making of the Portuguese government. Similar initiatives can be found, specifically directed at research and innovation."*

In this field we found great efforts of regional agendas and collaborative laboratories that have been pushing innovation in construction sector. For instance, Projeto SR\_Ambiente, a collaboration between Fibrenamics and Regional Civil Engineering Laboratory of Açores, aims to launch a platform for the promotion and articulation of different the different entities involved on waste recovery. Project Circular 2b is another example, uniting University of Porto and University of Trás-os-Montes e Alto Douro along with SINTEF, working on the development of sustainable materials including the incorporation of residues in modular construction. Circular Build, Circular EcoBIM, CirMAT, Closer, (Des)construir, Edifícios circulares, Growing circle, Rebuild17, UAveiroGreenBuildings and Project 3R-2CD-Reduce-Reuse-Recycle-Three roads to circular economy are also great examples of institutional collaboration as the majority of them tag Universities along with private and government organisations to work on the implementation of sustainability principles and circular economy principles on the industry sector. It is also worth mentioning a few civil engineering practical initiatives that were designed having sustainable development and circular economy in mind, like Circular Economy Village in Montijo that promotes circular economy principles in urban development; and Casas em Movimento, located in Águeda, an innovative housing project that incorporates sustainable and energy-efficient features.”

### 3. Gaps/Barriers in the policy settings for sustainable development and circular economy transition in the construction and infrastructure sectors

The previous section demonstrated that the EU has an active involvement in promoting sustainable development and circular economy in the construction and infrastructure sector, thus that it is undertaking numerous actions to support the transition. Nevertheless, research shows that there are still shortcomings and gaps that exist in the policy setting in this area that need attention, thus there is still a need for improvement. For instance, research performed by the OECD (2020), has identified that gaps exist in the funding schemes and incentives for companies, where a lack of financial resources are allocated specifically to incentivise organisation to move from linear to circular economy, which consequently causes delay in implementing sustainable and circular economy practices in the sector. Moreover, shortcomings exist in the regulation processes, specifically regulations for material reuse, stressing out the fact that waste categorisation guidelines are still needed, as the national legislation in certain countries might prohibit the reuse of materials from other goods, as they are classified as waste and cannot be reinserted back in the production process. According to this research, in some EU regions there a lack of adequate infrastructure for recycling and waste management, which is a major barrier in the transition. Another gap that exists at the EU level is the overlap in policies and measures related to sustainable development and circular economy, which is a result of a lack of an integrated approach in the introduction of policies and measure, as well as lack of enforcement of policies and regulations at the national levels in EU countries (Feleki, 2021; OECD, 2020).



On top of this, there is a lack of coherence among the current and future sustainable development and circular economy projects, which results in isolated projects that deliver short-term actions, and are overseeing long-term vision and solutions, thus in many cases these projects deliver overlapping outputs.

**Furthermore, a lack of leadership was identified, which leads to disintegrated sustainability and circular economy initiatives, which consequently leads to weak accountability (OECD, 2021). Another shortcoming is the lack of standardisation of policies and regulations for construction and demolition waste and prefabrication, including lack of standardised processes, lack of best practices demonstration, lack of information, and lack of guidelines on practices that should be adopted in reusing components that would assist designers in the design and procurement processes. A major setback in the transition is that is that research showed that in some EU countries building inspectors are discouraging the recycling and reuse of construction and demolition waste. Likewise, a lack still exists in terms of recertification, legal warranties, and residual performance analysis of recycled construction materials. Additionally, there is a limited engagement between policymakers and stakeholder in the development of policies related to sustainable development and circular economy, as well as there is a limited collaboration between the public and the private sector in the implementation process of the policies. Lastly, there is limited data availability that causes difficulties to measure progress and to identify areas where further policy action is needed (Charef, Morel and Rakhshan, 2021).**



## 4. Policy Recommendations

This section provides policy recommendations for policy makers on how to improve and better promote the transition towards sustainable development and circular economy in the construction and infrastructure sectors. The policy recommendations emerged based on the findings from the identified gaps in the current policy settings discussed in the previous sections, as well as through interviews that were performed as part of the SUSTAIN-CE project, with academicians and policy makers. The recommendations are separated into three main groups: policy recommendations for interpretation, policy recommendations for decision, and policy recommendations for action. By implementing these policy recommendations, the EU can further advance sustainable development and circular economy practices in the construction and infrastructure sectors, contributing to a greener and more resilient future.

### 4.1. Policy Recommendations for Interpretation

Based on the findings, the following recommendations for interpretation were devised:

- » Encourage the use of recycled materials: Governments can provide incentives for construction companies to use recycled materials such as concrete, steel, and glass in their projects. This can include tax breaks, subsidies, or grants for companies that use a certain percentage of recycled materials in their projects.
- » Promote design for disassembly: Governments can encourage the design of buildings and infrastructure with disassembly in mind. This means designing structures that can be easily taken apart and the materials reused or recycled at the end of their life.
- » Introduce extended producer responsibility: Governments can introduce extended producer responsibility (EPR) policies that require manufacturers to take responsibility for their products at the end of their life. This can include setting up collection and recycling programs for products such as insulation, roofing, and piping.



- » Foster a culture of sharing and reuse: Governments can promote the sharing and reuse of materials and equipment through the establishment of online platforms or physical exchange centres. This can include initiatives such as tool libraries, material exchanges, and rental schemes.
- » Develop circular procurement guidelines: Governments can develop circular procurement guidelines for public sector construction projects. This means accounting for the entire life cycle of a product or service, including its environmental impact and its potential for reuse or recycling.

## 4.2. Recommendations for Decision

Based on the findings, the following recommendations for decision were devised:

- » Set targets for circularity: Governments can set targets for circularity in the construction and infrastructure sector, such as a percentage of materials to be reused or recycled, or a percentage of buildings to be designed for disassembly. These targets can be included in building codes or procurement policies to incentivize circular practices.
- » Develop regulations to encourage circular practices: Governments can develop regulations that encourage circular practices in the construction and infrastructure sector. For example, regulations can require the use of recycled materials in certain types of construction or mandate the design of buildings for disassembly.
- » Establish a circular economy fund: Governments can establish a fund to finance circular economy initiatives in the construction and infrastructure sector. This can include financing for research and development of circular materials and technologies, as well as financing for circular projects.
- » Implement green public procurement policies: Governments can implement green public procurement policies that prioritize circular products and services. This can include requiring the use of recycled materials in public construction projects, or setting up procurement criteria that prioritize circular products.
- » Provide financial incentives: Governments can provide financial incentives for circular practices in the construction and infrastructure sector. This can include tax breaks, subsidies, or grants for companies that use recycled materials or design for disassembly.



- »» Develop partnerships and networks: Governments can develop partnerships and networks with stakeholders in the construction and infrastructure sector to promote circular practices. This can include collaborations with industry associations, research institutions, and circular economy hubs.
- »» Conduct research and development: Governments can invest in research and development to develop new circular materials and technologies for the construction and infrastructure sector. This can include research on new construction materials, circular supply chains, and circular business models.

### 4.3. Recommendations for Action

Based on the findings, the following recommendations for action were devised:

- »» Conduct a waste audit: Conducting a waste audit in the construction and infrastructure sector can help identify opportunities for circular practices, such as identifying waste streams that can be reused or recycled.
- »» Encourage material reuse: Governments can encourage material reuse through initiatives such as deconstruction and salvage programs, material banks, and construction waste exchanges.
- »» Promote design for circularity: Governments can promote the design for circularity by encouraging the use of modular construction, designing for disassembly, and using materials with high circular potential.
- »» Develop circular business models: Governments can support the development of circular business models in the construction and infrastructure sector, such as product-as-a-service models, circular supply chains, and material recovery and recycling.
- »» Provide training and education: Governments can provide training and education on circular economy principles and practices for construction and infrastructure sector workers, designers, and engineers.
- »» Implement circular procurement practices: Governments can implement circular procurement practices by specifying the use of recycled or refurbished materials in construction and infrastructure projects, and by evaluating bids based on circularity criteria.
- »» Establish circular economy hubs: Governments can establish circular economy hubs that bring together businesses, researchers, and policymakers to collaborate on circular economy initiatives. These hubs can act as centres for research and development, education, and networking.

## 5. Conclusion

In conclusion, the European Union (EU) has been actively involved in promoting sustainable development and circular economy in the construction and infrastructure sectors. The EU has implemented various frameworks, directives, and initiatives to achieve these goals. The Green Public Procurement (GPP) framework plays a vital role in promoting sustainable production and consumption by guiding public authorities on selecting environmentally friendly products, services, and works. The Energy Performance of Buildings Directive and the Energy Efficiency Directive set mandatory measures for member states to improve the energy performance of buildings and promote energy-efficient renovations.

The EU has also committed to the 2030 Sustainable Development Agenda and the 17 Sustainable Development Goals (SDGs), which aim to deliver sustainable development globally. The European Green Deal and Circular Economy Action Plan are key initiatives of the EU, focusing on achieving a resource-efficient and competitive economy with no net emissions of greenhouse gases by 2050. These initiatives emphasize the renovation of existing buildings, financing for energy-efficient renovations, and regulations for public building renovations.

Despite these efforts, there are still gaps and barriers in the policy settings for sustainable development and circular economy in the construction and infrastructure sectors. To address these gaps, several policy recommendations are proposed. These include incentivizing the use of recycled materials, promoting design for disassembly, improving waste categorization guidelines, enhancing recycling infrastructure, ensuring policy coherence, fostering leadership and accountability, standardizing policies and regulations, promoting stakeholder engagement, and improving data collection and analysis. Lastly, while the EU has made significant efforts to promote sustainable development and circular economy in the construction and infrastructure sectors, there are still challenges to overcome.



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Co-funded by the  
Erasmus+ Programme  
of the European Union

