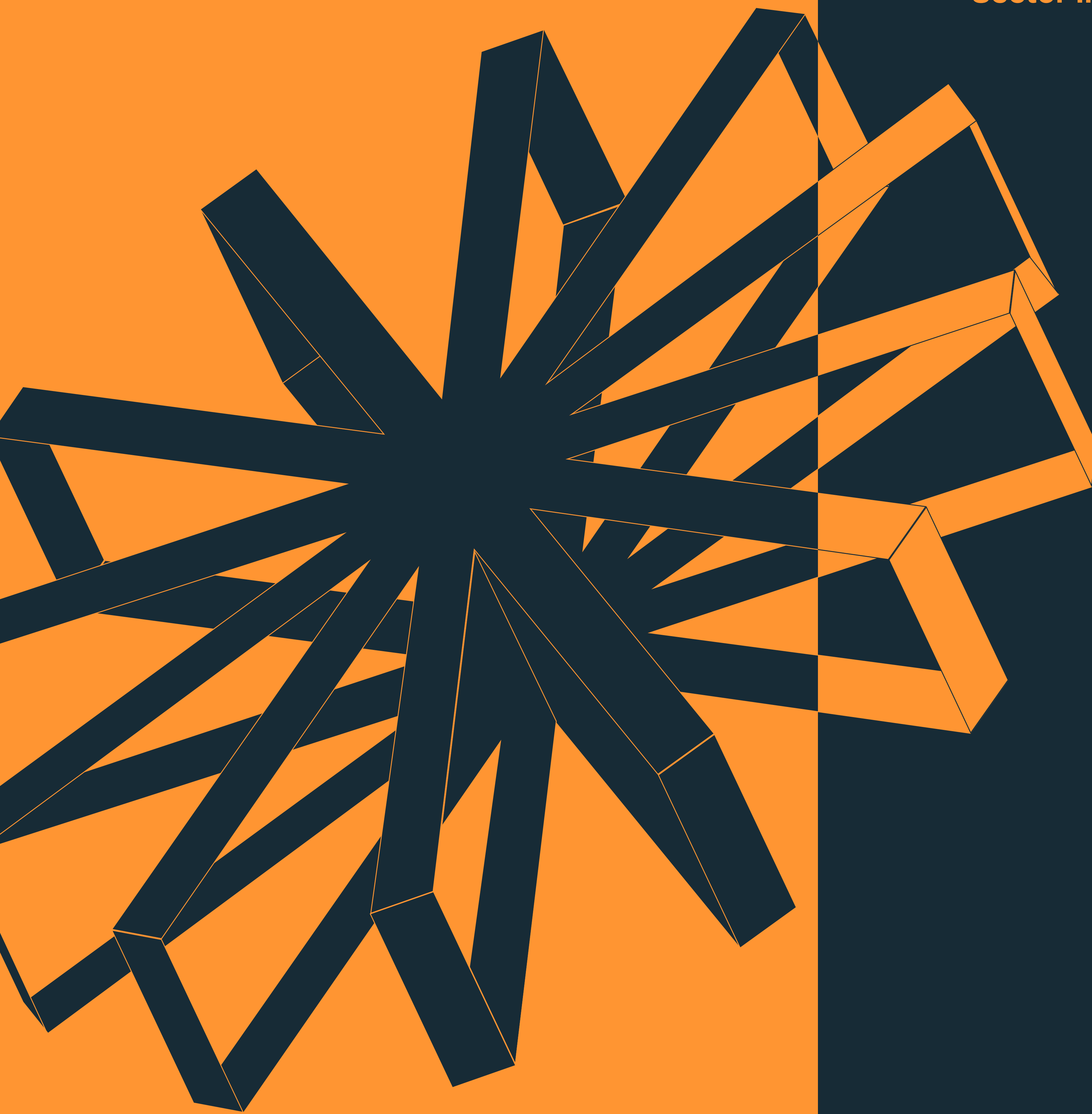
Sector Insights



Contribution and degree of adaptation to climate change of construction and buildings in Spanish cities

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alinnea
CATALYZING TRANSFORMATIVE IDEAS

This report was prepared for **alinnea** by the Centre for Sustainable Cities. The lead authors were Manuel Pérez Romero, PhD architect and researcher in co-evolutionary urban systems, and Ruxandra Iancu-Bratosin, urban researcher specialising in natural and digital systems applied to social strategies.

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1 Introduction

Until recently, perhaps no more than 20 years ago, words such as decarbonisation, energy efficiency, circularity, and nearly zero-energy or zero-emission buildings were foreign to the construction sector. They did not exist in its vocabulary, and buildings were designed using other terms and strategies. A need and a sense of urgency have emerged in this short period of time to introduce principles for addressing climate change, and today buildings can only be conceived and constructed including this new vocabulary.

This rapid shift toward making construction sustainable, when it is currently one of the sectors with the greatest impact on climate change, has been steered by a regulatory framework that is continually evolving and under constant review. Regulations have therefore been adapted in line with outcomes and technological advances.

The aim of this report is to provide a detailed analysis of current regulations and those pending publication that link the construction sector with climate action, from the European to the local level of government. This regulatory analysis provides the basis for identifying existing barriers to the implementation of measures in the construction sector, as well as its most influential stakeholders

Finally, the report outlines possible lines of action to help reduce the identified barriers. These conclusions are illustrated with examples of good practices at European level that have been monitored and proven in practice.

2 Methodology

The analysis of regulations, strategies and laws related to climate action in the construction and urban development sector was carried out across four levels of government. The process began at the European level and then moved progressively down to the national, regional and local levels. In this way, 10 European strategies and laws, 9 national strategies and laws, and 5 regional and autonomous strategies and laws were examined. This set of 24 regulations was also classified according to whether they are binding or non-binding. For each regulation, the approving body and date of adoption are indicated, together with its main objectives. In addition, the most relevant milestones are identified, structured chronologically into six periods: date of agreement, 2020–2025, 2025, 2030, 2040 and 2050.

This focus on the time-related evolution of laws and strategies is rooted not only in the sustainability objectives set for 2030 and 2050, but also in the need for learning and adaptation to objectives that will inevitably change. The vast majority of these regulations establish several milestones and objective review mechanisms.

A number of conclusions were drawn from the comparative analysis of the regulatory framework, and the complexity and overlaps between regulations were examined in depth. Subsequently, the points of contact and relationships between construction sector regulations and the urban climate agenda were identified. This database made it possible to pinpoint barriers and their key stakeholders.

3 Regulatory analysis

The following section provides a chronological overview of the strategies and laws analysed, grouped by level of government: European (blue), national (cyan), and regional and local (magenta). For each, the main objectives are summarised together with the date of adoption, amendment or forthcoming publication.

Date of adoption

European Government Level	Objective	2019	2020	2021	2022	2024	2025	2026
European Green Deal	Climate-neutral European continent by 2050	■						
Circular Economy Strategy	Waste reduction and promotion of circularity		■					
Biodiversity Strategy	Halt biodiversity loss		■					
Renovation Strategy	Double the building renovation rate		■					
Sustainable Eco-design Regulation	Requirements for Eco-friendly and sustainable desi						□	
Construction Products Regulation	Uniform EU requirements for construction products						□	
Energy Efficiency Directive	Improve energy efficiency in construction	■						
Taxonomy Regulation	Guide and promote sustainable investments			■				
European Climate Law	European continent climate-neutral by 2050			■				
Housing Passport Regulation	Implement the digital housing passport						□	
Nature Restoration Regulation	Restore urban ecosystems					■		
European Plan for Affordable Housing	Double the rate of building renovation in the EU							□

Date of adoption

European Government Level	Objective	2019	2020	2021	2022	2024	2025	2026
Climate Change Adaptation Strategy	Reduce Spain’s vulnerability to the effects of climate change		■					
Technical Building Code	Basic energy efficiency requirements for buildings	■						
Energy Certification	Mandatory energy certification for all buildings						□	
State Housing Plan	Promote building renovation and urban regeneration				■			
Royal Decree on Energy Self-Consumption	Regulate self-consumption energy installations	■						
Building Energy Renovation Plan	Improve the energy efficiency of buildings		■					
Integrated Energy and Climate Plan	Energy and climate policies in line with the European Green Deal			■				
Climate Change and Energy Transition Law	Decarbonise the economy and achieve climate neutrality by 2050			■				
Circular Economy Law	Reduce waste generation and promote circularity						□	

Regional and Local Level	Objective	2019	2020	2021	2022	2024	2025	2026
		Date of adoption						
Madrid Circular Economy Strategy	Reduce waste generation and promote circularity		■					
Madrid360 Environmental Sustainability Plan	Reduce pollution and improve air quality; promote decarbonisation			■				
Sustainable Energy and Climate Action Plan	Reduce GHG emissions and strengthen climate resilience			■				
Local Sustainable Energy Action Plans	Reduce CO_2 emissions and increase energy efficiency	*According to each City Council adhering to the Plan*						
Regulation on Building Renovation in the Community of Madrid	Improve the energy efficiency of the building stock	*According to specific calls for proposals*						

European Strategies And Laws Related To Climate Change And Building Construction Eu Agreements And Strategies (Non-Binding)

	Agreement Date	Objectives and Milestones 2020-2025	2025	2030	2040	2050
European Green Deal. Objective: To make the European Union the first climate-neutral continent by 2050.	Adopted by the **European Commission** in **December 2019**. It is a **non-binding** plan of action or political framework strategy.	Promote the following regulations and laws: **European Climate Law, Biodiversity Strategy 2030 and Circular Economy Strategy.**	Implementation of advanced **circular-economy** systems.	Reduction of at least 55 % of **GHG emissions. Energy renovation** of at least 35 million buildings. Increase in **Renewable Energy.**	Mechanisms and technologies to withstand the **effects of climate change. Additional emission reductions**, exceeding 70 % below 1990 levels.	**Complete climate neutrality of the EU**, based on balancing GHG emissions with removals. 100 % renewable energy.
Circular Economy Strategy Objective: Reduce waste, promote resource reuse, improve product sustainability.	Adopted by the **European Commission** on **11 March 2020**, as part of the European Green Deal. It is a framework policy strategy, which is **non-binding**.	The strategy focuses on key sectors with high resource use, such as **construction**. More sustainable, durable and recyclable design. **Digital Passport for products** (in progress)	Specific **eco-design and sustainability-labelling** standards. Stricter standards for material recycling and waste reduction.	Recycled and sustainable materials in at least 50 % of products. Reuse of demolition and renovation materials.	Waste minimisation and an **extended circular economy.**	**Full circular economy.** Biodiversity protection. Full circular economy 100 % circular in design and materials. Fully sustainable, low-carbon supply chains.
Biodiversity Strategy 2030 Objective: To halt biodiversity loss and restore ecosystems.	Adopted by the **European Commission** on **20 May 2020**, as part of the European Green Deal. It is a framework policy strategy, which is **non-binding**.		The European Commission will propose the **Nature Restoration Regulation.**	Protect 30 % of land and seas and restore 20 % of degraded areas. Restrictions on project development and promotion of responsible land use. Promote rehabilitation and densification. Alignment with the circular economy and eco-design. Recycled and sustainable building materials. Promotion of urban agriculture and green roofs. Buildings with integrated green spaces. Requirement for Environmental Impact Assessments (EIA) before project approval.		
European Union Renovation Strategy. Objective: To double the rate of building renovation. Provide training in new construction technologies and techniques. Promote technological innovation.	Adopted by the **European Commission** on **14 October 2020**, as part of the European Green Deal. It is a political framework strategy, which is **non-binding**.		Sustainable renovation and improvement of energy efficiency in at least **15% of public buildings.** Financial tool: **Renovation Fund.**	Renovate at least 35 million buildings across the EU and reduce sectoral emissions by 55 % compared with 1990 levels. Ensure new buildings are NZEB. Reduce energy consumption in buildings by 60 % by 2030.	Deep energy renovations towards circular and sustainable standards. Climate adaptation of buildings.	**Fully decarbonised, carbon-neutral building sector.**
European Plan for Affordable Housing	Approval by the **European Commission** expected in the first quarter of 2026.			In addition to encouraging pilot projects and promoting cross-sector partnerships, this strategy aims to double renovation rates in the EU by removing long-standing barriers to energy- and resource-efficient renovation, as well as by improving reuse and recycling.		

	Agreement Date	Objectives and milestones 2020-2025	2025	2030	2040	2050
Eco-design Regulation Objective: To establish require-ments for eco-design throughout the entire life cycle.	Adopted by the **European Parli-ament** and **the Council of the European Union on 21 October 2009.**	Initially applicable to energy-consuming products and subsequently extended to energy-related products such as windows, climate systems and lighting. Includes durability and disassembly criteria.	Future amendment and replacement by the **Eco-design Regulation for Sustainable Products.** Extends sustainability requirements to sectors such as construction and introduces mandatory labelling.			
Construction Products Regula-tion (CPR) Objective: To establish uniform requirements throughout the EU for the marketing of construction products and CE marking.	Adopted by the **European Parli-ament and the Council of the European Union** on **9 March 2011**. Currently under review to align with the European Green Deal.	Revision of the Regulation within the framework of the **Circular Economy Strategy.** Incorpo-rates information on the **full life cycle** and new **sustainability requirements.**				
Energy Perfor-mance of Buildings Directive (EPBD) Objective: To improve energy efficiency in the construction sector and reduce emissions.	Adopted by the **European Parli-ament and the Council of the European Union in 2010, revised in 2018 and 2024.**	Establishes minimum **energy-efficiency** requirements (2010) and **NZEB compli-ance from 2021.**	Requires Member States to adopt policies promoting the energy renovation of buildings and the **integration of smart technologies and management systems.**	All new buildings must be zero-emi-ssion from 2030 (public buildings from 2028). 16 % minimum reduction of average primary energy consumption in residential buildings by 2030 and between 20 % and 22 % by 2035. Renovation of 16 % of the worst-perfor-ming non-residential buildings by 2030 and 26 % of the worst-performing buildings by 2033. Complete phase-out of fossil-fuel boilers by 2040. Establishment of one-stop shops for building-energy efficiency.	Deep energy renovations. Deployment of advanced and renewable technolo-gies.	Carbon-neutral buildings. **Only highly efficient, low-emission buildings.**
EU Taxonomy Regulation Objective: To guide and promote sustainable invest-ment in line with the European Green Deal and the UN Sustain-able Development Goals.	Adopted by **the European Parli-ament and the Council of the European Union on 18 June 2021; under review in 2025.**	**Defines six environmental objectives:** **• Climate-change mitigation** **• Climate-change adaptation** **• Sustainable use of water resources** **• Circular-economy transition** **• Pollution preven-tion and control** **• Biodiversity protection**	Obligation for companies and financial institutions to report on the degree of alignment of their activities with the six environmental objectives. Key sectors: construction, energy and industry.	Full implementation of the six environ-mental objectives; mandatory reporting by companies. **Green finance to support sustainable construction projects.**	The majority of investments are expected to meet the sustainability criteria introduced. The aim is for the taxonomy to serve as a system for **evaluating and classifying invest-ments**, to be used by both investors and companies.	
European Climate Law Objective: To establish a legal obligation for the European Union to become the first climate-neutral continent by 2050.	Adopted by the **European Parli-ament and the Council of the European Union on 24 June 2021.**	Creates a **binding commitment** to achieve climate neutrality by 2050.		**55 % minimum reduction** in net GHG emissions compared with 1990 levels. Promotion of renewable energy, energy efficiency and low-emission technologies.	**Interim target** for emissions reduction to be set by the European Commi-ssion	**Total climate neutrality** by eliminating or offsetting all GHG emissions. Full circular economy. Use of natural carbon sinks and carbon-cap-ture and storage technologies.
Housing Passport Regulation (in progress) Objective: Implemen-tation of a Digital Housing Passport.	Approval by the **European Commi-ssion** expected in 2025.	Its purpose is to collect and centralise all information on the life cycle of buildings, including energy efficiency, materials, emissions and certifications. It will enable the planning of energy improvements and renovations. Information on embedded carbon will be included, and the circular economy will be promoted by recording materials used and their potential recyclability at the end of the building's useful life. This digital passport will facilitate access to grants and subsidies.				

	Agreement Date	Objectives and milestones 2020-2025	2025	2030	2040	2050
Nature Restoration Regulation	Adopted by **the European Parliament and the Council of the European Union on 24 June 2021.**	Between now and 31 December 2030, Member States must ensure there is no net loss in the total national area of urban green space or urban tree cover in urban-ecosystem areas.				
Circular Economy Act (in progress) Objective: To reduce waste generation, improve resource-use efficiency and promote the circular economy.	Currently under development at EU level.	Expected publication in 2026. The main objectives of this initiative are to boost the supply and demand of secondary raw materials (including critical ones), create a genuine single market for waste and secondary raw materials, and simplify procedures and reduce administrative burdens.				

National Strategies Related To Climate Change And Building Construction Strategies – Spain (Non-Binding)

	Agreement Date	Objectives and milestones 2021 - 2030	2040	2050
National Strategy for Adaptation to Climate Change 2021–2030 *(ENACC)* Objective: To reduce Spain's vulnerability to the effects of climate change.	Adopted by the **Council of Ministers in September 2020.** Developed by the Ministry for Ecological Transition and the Demographic Challenge.	Resilient construction and adaptation to extreme climatic conditions (heat waves, storms, floods, etc.). Use of sustainable, high-strength construction materials and techniques. Incorporation of nature-based solutions (NbS) in urban planning and building design. Improved water efficiency in urban planning and construction projects. Use of renewable energy and improvement of energy efficiency. Revision of building codes, including possible updates to the Technical Building Code (CTE).		

National Laws Related To Climate Change And Building Construction Laws – Spain (Binding)

	Agreement Date	Objectives and milestones 2020-2025	2025	2030	2040	2050
Spanish Technical Building Code (CTE - *Código Técnico de la Edificación*). Objective: Establishes basic requirements for safety, habitability and energy efficiency in all buildings.	Adopted by the **Council of Ministers of Spain on 17 March 2006.** It has been amended several times, most recently in 2019. Revised in August 2025	**2019 – Revision and reinforcement of energy-efficiency requirements and the use of renewable energy.**	Progressive implementation of **Nearly Zero-Energy Building (NZEB)** standards. Mandatory integration of **Renewable Energy** sources. Promotion of the **Circular Economy.** Improvement of Air **Quality. Building and materials passport.** Calculation and declaration of **embedded carbon.**	To understand the evolution of the CTE, the following data show how the thermal transmission coefficient (U) for walls has improved from 2006 to the current amendment pending approval in 2025: **2006**: 0.40–0.70 W/m²·K (depending on the climate zone). **2013**: 0.30–0.55 W/m²·K (improvement of up to 25 %). **2019**: 0.22–0.38 W/m²·K (improvement of up to 40 %). **2024–2025 (estimated)**: 0.15–0.25 W/m²·K (improvement of up to 60 % compared with 2006). Translating these values to a traditional façade section with two layers of brick and an intermediate cavity, the required thermal insulation would have the following characteristics: **2006**: 4–5 cm of rock wool (0.50–0.70 W/m²·K) **2013**: 6–8 cm of rock wool (0.30–0.55 W/m²·K) **2019**: 10–12 cm of rock wool or PIR (0.22–0.38 W/m²·K) **2024–2025 (estimated)**: 14–16 cm of rock wool, or 8–10 cm of ETICS (0.15–0.25 W/m²·K)		
Royal Decree 235/2013 on Energy Certification of Buildings Requires all buildings to obtain an energy certificate rating their energy performance on a scale from A (maximum) to G (minimum).	Adopted by the **Council of Ministers on 5 April 2013**. Several subsequent revisions and additional requirements, most recently by Royal Decree in 2021	From 2021 – Mandatory to obtain or update an energy certificate for major renovations or refurbishments.	Possible revision in 2024–2025 **Inclusion of embedded carbon and life-cycle assessment. Evaluation of the total environmental impact of the building[1].**	Greater transparency in the real estate market and higher valuation of efficient, sustainable buildings. Clear information on energy consumption. Incentives and subsidies for improving energy ratings. Raise awareness and promote a culture of sustainability in buildings.		
State Housing Plan 2018-2021 2022-2025 Objective: Financial aid programme to promote access to housing, building renovation and urban regeneration.	Adopted by the **Council of Ministers on 9 March 2018.**	Provides subsidies and grants for **building renovation and improvements** in energy efficiency. Also promotes the **regeneration of urban and rural areas.**	The plan was extended through the State Plan for Access to Housing 2022–2025, adopted by the Council of Ministers on 18 January 2022. The previous lines of subsidies and grants were maintained.			

1. http://www.pas-e.es/book/pas-e_es.html

	Fecha Acuerdo	Objetivos e hitos. 2020-2025	2025	2030	2040	2050
Royal Decree 244/2019 on Energy Self-Consumption Objective: Regulation of the installation and use of energy self-consumption systems.	Adopted by the **Council of Ministers in April 2019.**	Establishes two **types of self-consumption:** with and without surplus energy. Includes both individual and collective consumption models. **Simplifies administrative procedures.**	Future amendment 2024–2025: Further simplification of administrative procedures, review of surplus-compensation mechanisms and **promotion of battery-storage systems.**			
Building Energy Renovation Plan (PREE) *[Plan de Rehabilitación Energética de Edificios]* Objective: To improve the energy efficiency of existing buildings.	Adopted by the **Council of Ministers on 4 August 2020.** Developed by the Ministry for Ecological Transition and the Demographic Challenge through the Institute for Energy Diversification and Saving (IDAE).	Establishes aid and subsidies for the energy renovation of buildings. Reinforces the thermal insulation of the building envelope. Reduces energy demand. Installation of renewable-energy systems. Subsidies may cover between 35 % and 50 % of total project costs and may reach up to 75 % where a reduction of at least 30 % in non-renewable primary energy consumption is demonstrated.				
National Integrated Energy and Climate Plan (PNIEC) *[Plan Nacional Integrado de Energía y Clima]* Objective: To guide Spain's energy and climate policies in line with the European Green Deal.	Adopted by the **Council of Ministers in March 2021.** Developed by the Ministry for Ecological Transition and the Demographic Challenge. Updated in 2024	Objectives are evaluated and adjusted periodically in accordance with progress towards national energy and climate targets. Includes financial incentives and subsidies for energy efficiency and renewable energy.	27% of final energy consumption from renewable sources. 20% improvement in the energy efficiency of buildings. Implementation of building energy renovation plans.	**Reduction of GHG emissions by at least 32%** compared with 1999 levels. 48% of **final energy consumption** and **81% of electricity generation** from renewable sources. **43% improvement in energy efficiency.**	Transition to an energy system based entirely on renewable sources. Circular-economy approach to minimise resource use.	Fully renewable energy sector.
Climate Change and Energy Transition Law Objective: Establishes the legal framework for decarbonising the Spanish economy and achieving climate neutrality by 2050.	Adopted by the **Congress of Deputies and the Senate on 21 May 2021.** Defines short, medium, and long-term objectives.	By 2023, all public administration buildings must have a **decarbonisation plan.** Non-residential buildings must include electric vehicle charging points.		The updated PNIEC (September 2024) sets new intermediate targets. See previous line.	**Full electrification of all activities in the construction sector**, from machinery use to building climate systems.	Climate neutrality through zero GHG emissions in all buildings.

Regional And Local Strategies And Laws On Climate Change And Building Construction Laws – Regional And Local
(Binding And Non-Binding)

	Agreement Date	Objectives and milestones 2020-2025	2025	2030	2040	2050
Circular Economy Strategy of the Community of Madrid 2021–2030 Objective: To reduce waste generation, encourage recycling and promote sustainable practices	Adopted by the **Governing Council of the Community of Madrid in December 2020.** Promoted by the Regional Ministry of the Environment, Spatial Planning and Sustainability. Non-binding.	Waste reduction and increased recycling. Promotion of sustainable materials and resource efficiency. Support for eco-design and the circular economy. Promotion of energy self-consumption.	Increase use of recycled materials in sectors such as construction. Evaluate the strategy's impact.	Increase the share of recycled materials in construction.		
Local Sustainable Energy Action Plans (SEAPs) Objective: To reduce CO_2 emissions and increase the energy efficiency of municipalities.	SEAPs are initiatives adopted and implemented by city councils and local administrations in municipalities that have joined the **Covenant of Mayors for Climate and Energy in Europe.**	Development of a **Baseline Emission Inventory** (BEI) identifying the main sources of GHG emissions. Identification of key intervention areas such as buildings.		Reduction of CO_2 emissions by at least 40 %.		
Regulations on Building Renovation in the Community of Madrid Objective: To improve the energy efficiency of the building stock.	The Community of Madrid manages PREE grants through the Regional Ministry of the Environment, Housing and Agriculture. Specific calls for applications are issued.	Financial aid and subsidies for improving energy efficiency in existing buildings, in line with the objectives set by the Building Energy Renovation Plan (PREE). Window and Boiler Replacement Plan. Incentives for the installation of renewable energy systems. Comprehensive building renovation. Mechanisms for monitoring energy-efficiency objectives.				

	Agreement Date	Objectives and milestones 2020-2025	2025	2030	2040	2050
Madrid 360 Environmental Sustainability Plan Objective: To reduce pollution, improve air quality and achieve decarbonisation targets.	Adopted by the Madrid City Council in September 2019. Strategic framework; non-binding.	Reduction of NO_2 and GHG emissions. Energy efficiency and building renovation. Expansion of green areas and urban greening. Promotion of self-consumption.	Enlargement of low-emission zones.	Full compliance with EU air-quality standards. At least 30% of the energy consumed in the city to come from renewable sources.		
Roadmap to Climate Neutrality by 2050 for the City of Madrid Objective: To set targets for reducing GHG emissions and improving the city's resilience to climate change.	Adopted by the Madrid City Council in 2024. Part of the City Council's commitment to the European Green Deal. Strategic document; non-binding.	Promotion of energy efficiency in buildings and energy renovation. Promotion of renewable energies and self-consumption.		Reduction of city-wide emissions by 65 % by 2030 compared with 1990 levels. Achievement of climate neutrality by 2050.		

3.1. Conclusions from the Regulatory Analysis

Some initial conclusions can be drawn from the list of regulations:

- The 24 strategies and laws have been adopted or amended over a period of approximately five years.
- Although some regulations, such as the Spanish Technical Building Code - CTE [Código Técnico de la Edificación] and the Royal Decree on Energy Certification of Buildings, were adopted more than 10–15 years ago, they have since been revised or are pending modification in the coming year.
- This large number of regulations directly or indirectly related to construction highlights both the growing interest in and the urgent need for a coherent legal framework to promote sustainable policies for combating climate change.
- At the same time, regulations are effectively filtered through the different levels of government. Thus, non-binding strategies adopted by the European Commission, such as the Green Deal, stimulate binding laws that are subsequently adopted by the European Parliament and the Council of the European Union. The Spanish Government then adopts complementary laws that consolidate a legal framework extending down to the regional and local levels.

An analysis of the 24 strategies and laws at the European, national, regional and local levels shows that, although this patchwork of legislation is complex, there is a clear hierarchical relationship. At the top of this structure is the European Commission, which proposes regulations and directives such as the Green Deal or the Circular Economy, Biodiversity and Renovation Strategies. These strategies are debated, amended and adopted by the European Parliament and the Council of the European Union so that they acquire legal force and Member States are required to comply with them. This process results in laws, regulations, directives and standards such as the Renovation Strategy or the Energy Efficiency Directive for Buildings.

Member States are then required to pass national legislation transposing the directives adopted by the European Parliament and the Council of the European Union. In the case of Spain, amendments to the CTE, the building energy renovation plans, and the forthcoming circular economy law are examples of this process.

At the regional and local levels, the system continues to cascade downwards from the European and national levels, materialising in regional instruments such as the Building Renovation Plan of the Community of Madrid and, at the municipal level, in Local Sustainable Energy Action Plans.

The monitoring of the objectives established by these laws must invert this hierarchical relationship, from the European level to the local level, and foster feedback and adaptation of the regulatory framework based on the results achieved.

To clarify and emphasise the above, let us take as an example the case of the renovation and energy rehabilitation of a building in Madrid. Sixteen regulations have been identified that directly or indirectly affect this process, from the European level down to the local level:

EUROPEAN LEVEL	
Energy Performance of Buildings Directive (EPBD)	Requires new and renovated buildings to meet nearly zero-energy building (NZEB) standards.
Eco-design Directive	Establishes requirements for materials and products to improve energy efficiency and reduce environmental impact.
European Green Deal	Promotes building renovation to reduce their carbon footprint and improve energy efficiency.
Circular Economy Strategy	Promotes circular practices in building renovation.
Renovation Strategy	Aims to renovate buildings in Europe to achieve carbon neutrality by 2050.
Taxonomy Regulation	Defines sustainable criteria for assessing corporate practices and financing activities.

NATIONAL LEVEL	
Spanish Technical Building Code (CTE) [Código Técnico de la Edificación]	Compliance with the Energy Saving (DB-HE) and Safety of Use and Accessibility (DB-SUA) standards for energy renovation.
Climate Change and Energy Transition Law	Promotes decarbonisation and sets energy-efficiency targets for building renovation.
National Integrated Energy and Climate Plan (PNIEC)	Defines energy-efficiency and emission-reduction targets in the construction and renovation sector up to 2030.
State Plan for Access to Housing	Promotes aid for energy renovation.
Building Energy Renovation Plan (PREE)	Provides specific subsidies to improve the thermal envelope and install renewable climate systems.
Royal Decree on Energy Certification of Buildings	Requires all buildings to obtain an energy certificate.

REGIONAL LEVEL (Community of Madrid)	
Building Energy Renovation Plan (PREE)	Adaptación del Plan PREE para ofrecer ayudas a través de la Comunidad de Madrid.
Circular Economy Strategy of the Community of Madrid	Fomenta el uso de materiales sostenibles y la reducción de residuos.
LOCAL LEVEL (Madrid City Council)	
Madrid 360 Environmental Sustainability Plan	Promotes energy efficiency, building renovation and self-consumption.
Sustainable Energy and Climate Action Plan (SECAP)	Promotes energy efficiency and renovation in buildings, as well as renewable energy and self-consumption.

This analysis indicates that there are overlaps and duplications among different regulations and directives, both within the same level of government and across the various levels. As one moves upward through the administrative hierarchy (local, regional, national and European), the scope of these plans becomes broader and more far-reaching.

One of the main challenges is ensuring coordination among the different levels of government, each with its own criteria and requirements. Moving from the European framework to the local level also calls for specific strategies adapted to each context. Rather than a source of redundancy, this overlap can be understood as complementarity between regulations. Local diversity and specific conditions must, however, remain aligned with the overall frameworks established at the national and European levels.

Administrative complexity can hinder the implementation of these standards and limit access to the related aid and subsidies. To address this, the 2024 revision of the Energy Performance of Buildings Directive introduced a “one-stop shop” intended to centralise all administrative procedures.

4 Relationship between the building scale and the urban scale

Just as there is no single document encompassing all climate actions in the construction sector, there is also no single reference framework for the urban agenda. The latter is articulated through several strategic documents, summarised below. Among them, the Covenant of Mayors for Climate and Energy most closely resembles an urban agenda model.

- **European Green Deal.** Sets out targets for decarbonisation and emission reduction in cities and promotes more sustainable urban environments.

- **Renovation Strategies.** Establish guidelines for the renovation not only of buildings but also of neighbourhoods and urban areas.

- **Covenant of Mayors for Climate and Energy.** Covers objectives linked to both building and urban strategies. For the latter, it defines measures to strengthen cities' adaptation and resilience to climate change, particularly in the face of extreme events such as heat waves or floods. To this end, it promotes the creation of drainage areas through green spaces and nature-based solutions. The Covenant also emphasises citizen participation and fosters sustainable mobility systems.

- **Sustainable Mobility Strategy.** Aims to transform current urban transport systems into a more sustainable model.

- **Climate Change Adaptation Strategy.** Provides guidelines to help cities cope with extreme weather events and other phenomena resulting from climate change.

- **Nature Restoration Regulation.** Establishes requirements to ensure that there is no net loss in the total national area of urban green space or urban tree cover in urban ecosystem zones.

Climate action measures are deeply interconnected at the building and urban scales. Distinguishing between them is not only difficult but could also prove strategically counterproductive. The boundaries separating the two scales are diffuse, and their interactions constant. Nevertheless, for methodological and operational reasons, it can be useful to differentiate them, as long as their points of connection and overlap are maintained.

Many objectives defined at the building scale are directly reassigned to the urban scale. Building renovation, for example, can be clearly transposed to the neighbourhood level through urban-renovation initiatives. These measures extend beyond technical aspects to include social dimensions such as citizen participation. Similarly, strategies on waste and circularity apply across both scales through urban waste-management and recycling systems.

Although some issues may appear specific to the urban scale, such as air quality or public health, the building scale continues to play a pivotal role. Decarbonisation of the construction sector has a direct positive impact on air quality. Ultimately, the urban scale requires a holistic approach based on the principle that the whole is greater than the sum of its parts.

5 Potential barriers and key stakeholders

The various obstacles that may arise in implementing climate action measures can be grouped into five categories: technical, financial, regulatory, social and time-related.

5.1. Technical barriers

The main technical barriers stem from the lack of synchronisation between technological progress and existing regulations, as well as from the inertia from the traditionally conservative construction sector.

- **Lack of standardisation or guidelines for applying sustainable techniques.** The adoption of sustainable construction methods and technologies is not yet supported by a standardised system or a set of recommendations for their application. While standardisation offers clear advantages, it must be balanced with sufficient flexibility to allow adaptation to specific contexts. The new Sustainable Eco-design Regulation and the Circular Economy Strategy are consistent with this approach.
- **Difficulties in renovating buildings and accessing advanced technologies.** Installing energy-efficiency systems such as external thermal insulation in older buildings or integrating renewable-energy technologies into roofs and façades, can be complex and costly. The Energy Performance of Buildings Directive promotes these measures, but in cities with ageing infrastructure, implementation remains a significant challenge.
- **Shortage of qualified personnel in sustainable construction techniques.** Although this barrier is both technical and social, there is a clear shortage of professionals trained in sustainable construction systems. This limitation can hinder the implementation of innovative initia-

tives such as circularity strategies or energy-renovation programmes.

The following **key stakeholders** have been identified as influencing technical barriers:

5.1.1. Sector privado

- European Commission. Supports Member States in transposing and implementing the Energy Performance of Buildings Directive and other relevant regulations (Taxonomy Regulation, Nature Restoration Regulation, etc.).
- Ministry for Ecological Transition and the Demographic Challenge. Develops standards and technical requirements in the construction sector.
- Institute for Energy Diversification and Saving (IDAE). Provides training and technical support to professionals.
- Local councils. Deliver training and promote technical awareness at the local level.

5.1.2. Private Sector

- Construction companies. Develop and implement new sustainable technologies and techniques in construction.
- Manufacturers of materials and systems. Innovate in construction materials and systems with a low environmental impact.
- Energy-efficiency and renewable-technology providers. Offer solutions that reduce energy consumption and promote renewable energy use.

Universidades y centros de investigación. Investigan y desarrollan soluciones técnicas en construcción.Cooperativas de vivienda, co-living, viviendas en derecho de uso.

5.1.3. Social Sector

- Professional associations. Provide training and support to professionals in the sector.
- Universities and research centres. Conduct research and develop technical solutions for the construction sector.
- Housing cooperatives, co-living initiatives and right-of-use housing organisations.

5.2. Financial Barriers

The European Union's Taxonomy Regulation should act as a driving force not only for assessing sustainable investments, but also for helping to overcome the following financial barriers:

- **High initial investment – social barrier.** In general, sustainable construction requires a higher initial investment than conventional construction. Although these investments clearly pay off in the medium and long term, economically through reduced energy consumption, and socially through improvements in health and the urban environment, there is still little public awareness or education highlighting these benefits.
- **Difficulties in accessing finance.** Although the higher upfront costs can be supported through programmes such as PREE and Next Generation EU funds, the total investment, even with subsidies, can still be very high. Moreover, accessing these funds and grants is often complex and may require the services of companies specialising in aid management, which itself represents a barrier.
- **Lack of stable tax incentives.** Tax incentives for sustainable construction are not always permanent or clearly defined.

The following **key stakeholders** have been identified as influencing financial barriers:

5.2.1. Public Sector

- European Commission and European Investment Bank (EIB) to mobilise European projects and funds.
- Central and regional governments. Channel European and national funds and establish tax incentives.
- Official Credit Institute (ICO) [Instituto de Crédito Oficial]. Provides credit lines for sustainable projects.
- Local councils. May grant property tax rebates and subsidies.

5.2.2. Private Sector

- Financial institutions. Develop specific financial products to support sustainable projects.
- Investors and sustainability-focused investment funds. Promote and finance sustainable initiatives.
- Energy service companies (ESCOs). Offer financing models for energy efficiency.
- Property managers. Act as demand aggregators and manage administrative procedures.

5.2.3. Social Sector

- Consumer associations. Help raise awareness of financing opportunities.
- Neighbourhood communities and associations. Manage and disseminate information on aid and financing programmes.
- Third-sector organisations.

5.3. Regulatory barriers

As indicated above, the complexity of administrative procedures and the tangle of overlapping rules and laws pose a major barrier to implementation:

- **Regulatory fragmentation and overlap.** The network of laws, directives, strategies, regulations and plans (European, national, regional and local), together with their binding and non-binding nature, creates confusion about the requirements that buildings must meet. For example, the CTE and the PREE, and the corresponding local regulations, may establish similar objectives but differ in their requirements.
- **Rigidity in urban planning and construction regulations.** The standardisation and rigidity of certain regulations make it difficult to apply them to the wide variety of cases presented by existing buildings.
- **Slow processing of licences, grants and subsidies.** The procedures for applying for both licences and possible grants and subsidies are complex and very slow, which delays projects and, in many cases, discourages investment.

The following **key stakeholders** have been identified as influencing regulatory barriers:

5.3.1. Public Sector

- European Commission, in particular the Directorates-General under the Commissioner for Energy and Housing, such as DG Energy.
- Ministry for Ecological Transition and the Demographic Challenge. Leads national strategies on energy efficiency and the circular economy.
- Ministry of Transport, Mobility and the Urban Agenda. Responsible for updating the CTE and drafting regulations.
- Autonomous communities. Adapt national and European

regulations at the regional level
- City councils. Responsible for implementing urban-planning ordinances and regulations at the local level.

5.3.2. Private Sector

- Construction business associations. Influence regulatory processes and advocate for legislative improvements.
- Consulting and administrative-management companies. Assist with regulation interpretation and processing.

5.3.3. Social Sector

- Professional associations. Collaborate in adapting and disseminating regulations.
- Citizen and neighbourhood organisations. Advocate for more flexible and context-appropriate regulations.

5.4. Social Barriers

- **Resistance to change. Conservative sector.** Although the benefits of sustainable measures may be clear, the construction sector remains highly conservative and resistant to change. There is a lack of initiatives to promote training and education within the sector, particularly for those stakeholders who are reluctant to engage in the ecological transition.

The following key stakeholders have been identified as influencing social barriers:

5.4.1. Public Sector

- Comisión Europea: European Commission. Finances projects with an educational and awareness-raising dimension linked to the European Green Deal and the ecological and just transition through multiple funding programmes.
- Ministry of Social Rights and Agenda 2030. Collaborates in raising awareness of the objectives set out in Agenda 2030.
- IDAE (Institute for Energy Diversification and Saving). Provides educational resources and informational materials.
- City councils and regional ministries of the environment. Ensure the monitoring of completed interventions (energy efficiency, energy certification, etc.) and promote awareness through campaigns and programmes.

5.4.2. Private Sector

- Real-estate developers' associations. Promote the importance of investing in sustainable construction.
- Property managers. Serve as potential information sources on the advantages of sustainable practices.

5.4.3. Social Sector

- Consumer and user associations. Disseminate information on the benefits of sustainable construction.

5.5. Neighbourhood offices to raise awareness and support citizens. Time-related barriers

Time plays a central role in climate action, not only because of the urgency required but also because of the profound technological and strategic changes that will take place in the coming years. This will require the continuous adaptation and revision of rules and laws. At the same time, monitoring progress towards established objectives will necessitate regular regulations updates and implementation.

- **Possible information overload within a short period.** The 24 regulations analysed have emerged over a period of roughly five years. This represents a substantial volume of information in a very short timeframe that must be assimilated and integrated across all levels. Moreover, the milestones they set demand a rapid response from all stakeholders involved in the construction process.
- **Obsolescence of standards.** Many of the solutions and strategies currently being implemented will eventually become obsolete and replaced by new ones as technology and climate-action approaches evolve. This requires strong adaptive capacity on the part of public administrations to revise laws and update objectives.

5.5.1. Public Sector

- European Commission. Holds legislative initiative within the EU and proposes directives and regulations to the European Parliament and the Council of the EU, as well as non-binding strategies and plans.
- Ministry for Ecological Transition and the Demographic Challenge and Ministry of Transport, Mobility and the Urban Agenda. Responsible for drafting and processing laws in the construction sector.
- Autonomous communities. Adapt national and European regulations at the regional level.
- City councils. Responsible for implementing urban-planning ordinances and regulations at the local level.

5.5.2. Private Sector

- Construction business associations. Contribute to accelerating the implementation of regulations.
- Consultancies. Monitor and review objectives.

5.5.3. Social Sector

- Professional associations. Help accelerate the implementation of regulations through dissemination and training.
- Foundations. Anticipate technological advances and urban strategies to facilitate their rapid assimilation by different levels of government.

6 Areas for Action and Strategic Measures

We propose the following areas for action to address the barriers described above:

a. Improve technical training and flexible standardisation of sustainable solutions

- Develop technical training programmes on sustainable construction for professionals in the sector. This would require the involvement of official bodies such as the IDAE, universities and research centres.
- Establish a flexible system for standardising sustainable materials and technologies through technical guidelines and specific standards. The rigidity of certain regulations and procedures can hinder not only the implementation of the proposed strategies but also their adaptation to the diverse conditions of the building stock.

b. Simplify access to administrative procedures and expand incentives and rebates.

- As stipulated in the latest reform of the Energy Performance of Buildings Directive, which Spain must transpose into its national regulatory framework, there is a need to create one-stop shop platforms to centralise the administrative processing of both licences and available grants and subsidies. Licensing requirements could be integrated into a single platform that includes local and regional procedures, environmental reports and other documentation. Similarly, the requirements for aid and subsidies could be linked to licensing procedures and integrate EU funds, PREE support and local rebates, with the aim of reducing administrative complexity.
- Expand tax incentives and bonuses. This is an area with significant potential that requires creative solutions. In this regard, cross-cutting urban-planning regulations could be developed to link traditional urban-planning parameters with rebates for the implementation of sustainable measures. These could take the form of increases in buildable area or consumption rebates. Stable tax deductions and a varied system of incentives would make investment in sustainability more attractive and achievable.
- Develop specific financial products for sustainable development, such as green credits and low-interest loans. Entities such as the ICO, private banks and sustainable investment funds can promote these types of products.

c. Regulatory coordination and harmonisation

- Simplify and coordinate regulations across national, regional and local legislation to reduce overlaps and contradictions. Harmonisation will facilitate compliance and help to remove regulatory barriers.
- Make regulations more flexible to allow adaptation to the wide variety of local conditions and contexts.

d. Public awareness and participation

- Develop awareness campaigns on the benefits of sustainable construction. Campaigns led by local councils and consumer associations are essential to changing perceptions regarding the benefits and challenges of sustainability.

e. Time-based development and monitoring of objectives

- The previous sections illustrated how the thermal resistance requirements for walls established under the CTE have increased by 60 % compared to the levels set in 2006. This is just one example of how sustainable development goals have evolved over time. Technological advances will continue to demand new strategies and measures. For all these reasons, a system for monitoring and reviewing objectives is essential. Creating a legal framework is as important as ensuring ongoing control and monitoring, so that regulations can be revised and adapted as needed.
- The pace of legal and regulatory change must be accompanied by training and incentive policies for the public, private and social sectors.

7 Best Practices

Implementing strategies and technologies for climate action in the construction sector involves multiple dimensions, including decarbonisation, resource efficiency (in terms of both energy and materials) and the circularity of the construction process, among others. We have grouped the following success stories and best practices by theme, and only included those that have been proven or monitored:

Certifications

- **Passivhaus[2] Certification and Standard.** Originating in Germany, the Passivhaus certification establishes rigorous standards for energy efficiency in buildings. The standard has been extensively monitored and has proven effective in reducing carbon emissions. Initially designed for latitudes similar to Germany, a specific Passivhaus version has since been developed for Mediterranean countries.

- **BREEAM certification programme in the United Kingdom and the European Union[3]:** BREEAM (Building Research Establishment Environmental Assessment Method) is a widely used sustainability certification system in Europe that ensures buildings meet high standards of energy, materials and water efficiency. BREEAM monitors and verifies the performance of buildings over time and has proven effective in reducing carbon emissions and natural resource consumption.

Renovation and refurbishment

- **Energiesprong energy-renovation project in the Netherlands[4]**: Energiesprong, launched in the Netherlands, is a renovation approach that converts residential buildings into “zero-energy” or “net-zero-energy” homes. The technique employs prefabricated panels to improve insulation, renewable-energy systems and advanced technologies to minimise energy consumption. The initiative has been monitored in several pilot projects and has demonstrated significant reductions in carbon emissions and energy use.

Decarbonisation

- **Use of low-carbon materials in Scandinavia[5]:** In Norway and Sweden, timber construction projects (in medium and high-rise buildings) have been strongly promoted and monitored to reduce carbon footprint. Examples such as the Mjøstårnet building in Norway (18 storeys) demonstrate how low-carbon materials can replace concrete.
- **Symbiose eco-residential neighbourhood in Switzerland[6]**. The building envelope is made of compacted earth blocks (a renewable, low-carbon material) and insulation based on natural fibres such as sheep’s wool (very low carbon content).

Efficient use of materials

- **Holedeck[7] System**. A formwork system that optimises and reduces the volume of concrete used in floor slabs. It also integrates service installations, thereby reducing floor-to-floor heights and generating proportional savings in façades and interior partitions.

Circularity

- **Madaster project in the Netherlands[8]:** Madaster is a “material passport” platform that enables builders and owners to monitor and manage the materials used in buildings. This digital passport facilitates the efficient reuse or recycling of materials at the end of a building’s life. The system has been tested in multiple construction and renovation projects in the Netherlands.

- **Circular construction in the Reuse Housing project, Freiburg, Germany[9]:** In the city of Freiburg, a circular construction pilot project was carried out in which structural components from demolished buildings were dismantled and reused in the construction of new homes. The project was monitored to assess the feasibility of component and material reuse.

Renewable and alternative energies

- **Geothermal energy and zero-emission districts in Iceland[10]:** Although Iceland’s local conditions differ from those of most of Europe due to the abundance of geothermal resources, it provides a good example of the development of geothermal infrastructure and of residential and commercial districts with net-zero emissions. Reykjavik, for instance, has become a pioneer in the use of geothermal energy for building heating projects, which have been extensively monitored.

- **Hammarby Sjöstad district, Stockholm, Sweden[11]**. This urban development features a shared energy and heat-recovery system. Waste heat from wastewater treatment plants is captured and used to heat buildings, while biogas generated from organic waste is utilised in heating and transport systems.

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