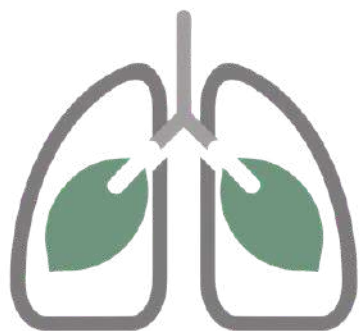




Feel Green

Fostering Energy Efficiency Leaders :
Empowering Youth to Start a
Green Revolution

ENERGY-EFFICIENCY RESEARCH
DATABASE

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Introduction to the FEEL GREEN Project

The FEEL GREEN project is a European Erasmus+ initiative developed to promote environmental awareness, energy efficiency, sustainability education, and green skills development among young people and youth workers across Europe. In response to the growing environmental and climate-related challenges affecting European societies, the project aims to strengthen the role of non-formal education and youth participation in supporting the green transition and encouraging more sustainable lifestyles and behaviors.

Climate change, environmental degradation, unsustainable consumption patterns, and increasing energy demands have become some of the most urgent global challenges of the 21st century. According to the European Commission and the United Nations, achieving climate neutrality and sustainable development requires not only technological innovation and policy reforms, but also long-term behavioral change, environmental education, and active citizen participation. Young people are expected to play a crucial role in this transformation as future professionals, decision-makers, consumers, and community leaders.

Within this context, the FEEL GREEN project was designed to support young people and youth workers in developing sustainability competences, energy-efficiency awareness, and practical green skills through educational resources, research activities, non-formal learning methodologies, and community participation initiatives. The project emphasises experiential learning, participatory education, digital tools, and practical engagement in order to make sustainability education more accessible, interactive, and impactful for diverse youth audiences.

A central objective of FEEL GREEN is to strengthen the capacity of youth workers and organisations to deliver high-quality environmental education activities and sustainability-related initiatives. Through the development of research databases, methodological guides, educational materials, digital learning resources, and practical training activities, the project aims to provide youth professionals with useful tools for engaging young people in climate action and sustainable development processes.



The project also promotes transnational cooperation and exchange of good practices between partner organisations from Greece, Slovakia, and Luxembourg. By analysing different national realities, environmental challenges, educational approaches, and sustainability initiatives, FEEL GREEN seeks to encourage collaborative learning and the transfer of innovative practices across different European contexts.

The present deliverable, titled Energy-Efficiency Research Database, constitutes one of the core outputs of the project's research and methodological activities. The document aims to provide youth workers, educators, organisations, and young people with reliable information, research findings, European statistics, and practical examples related to energy efficiency, sustainability awareness, green technologies, and environmental participation. It combines research-based knowledge with practical educational value in order to support the implementation of sustainability education activities and promote informed participation in the green transition.

The deliverable also contributes to broader European priorities connected to the European Union Green Deal, the Sustainable Development Goals (SDGs), climate action strategies, and the promotion of green competences within education and youth work. Through its research-oriented and educational approach, FEEL GREEN aims to encourage more environmentally responsible behaviors, strengthen youth participation, and contribute to the development of more sustainable and resilient communities across Europe.

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Executive Summary

The Energy-Efficiency Research Database was developed within the framework of the FEEL GREEN Erasmus+ project in order to provide youth workers, educators, organisations, and young people with a comprehensive research-based resource focused on energy efficiency, sustainability awareness, green skills development, and environmental participation. The deliverable forms part of the project's broader objective of supporting the green transition through non-formal education, youth engagement, and community-based sustainability initiatives across Europe.

The purpose of this deliverable is to collect, analyse, and present reliable information, European statistics, educational insights, and practical examples related to energy efficiency and environmental sustainability. The document aims to strengthen the capacity of youth workers and organisations to implement effective sustainability education activities and to support young people in developing environmentally responsible behaviors, green competences, and active participation in climate and sustainability actions.

The research presented within the database focuses on several key thematic areas connected to environmental sustainability and youth engagement. These include the concept and importance of energy efficiency, current environmental and energy-related challenges in Europe, youth awareness regarding sustainability and climate issues, green skills gaps, emerging green technologies, and real-world examples of successful environmental initiatives and innovative practices implemented across European communities. The deliverable also examines the relationship between sustainability education, behavioral change, and youth participation within the context of the European green transition.

Particular emphasis is placed on the role of young people within sustainability processes and on the educational challenges affecting environmental awareness and green competences development. Research findings from European institutions such as the European Commission, the OECD, UNESCO, and the European Environment Agency demonstrate that younger generations show increasing concern regarding climate change and environmental degradation while simultaneously facing significant educational and practical barriers related to sustainability participation and green skills development.

The research also highlights the growing importance of energy efficiency and green innovation within European sustainability strategies. Emerging technologies such as renewable energy systems, smart energy infrastructure, sustainable mobility solutions, and circular economy approaches are increasingly recognised as essential components of climate action and sustainable development policies. However, research findings indicate that improving technological solutions alone is not sufficient. Long-term sustainability also depends on environmental education, behavioral awareness, citizen participation, and the development of practical green competences among young people and local communities.

Several important findings emerge from the analysis presented in this deliverable. Research indicates that young people across Europe generally demonstrate high levels of concern regarding environmental challenges and climate change. At the same time, important gaps continue to exist in practical sustainability knowledge, energy-efficiency awareness, and access to non-formal environmental education opportunities. Financial limitations, lack of practical learning experiences, misinformation, and insufficient institutional support remain significant barriers affecting sustainable behavioral change and participation in environmental initiatives.

The report additionally demonstrates that participatory and experiential learning approaches are among the most effective methods for promoting environmental awareness and long-term sustainability engagement. Interactive workshops, community participation activities, gamification methods, sustainability campaigns, volunteering actions, and practical environmental projects contribute significantly to improving green competences, motivation, and active citizenship among young people.

For youth workers and organisations, the Energy-Efficiency Research Database provides a valuable educational and methodological resource that can support the planning and implementation of sustainability-related activities, workshops, awareness campaigns, and youth participation initiatives. The deliverable combines research evidence, European policy priorities, statistical data, educational insights, and practical examples in order to support more effective environmental education and green skills development within youth work and non-formal learning environments.

Ultimately, this deliverable contributes to the broader objectives of the FEEL GREEN project by supporting sustainability education, strengthening environmental awareness, promoting youth participation, and encouraging more sustainable and resilient communities across Europe.

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1.1 What is Energy Efficiency?

Energy efficiency refers to the optimisation of energy use in order to achieve the same or improved level of performance, service, or output while consuming less energy and reducing unnecessary energy losses. According to the International Energy Agency (IEA), energy efficiency is widely recognised as one of the most effective and economically viable strategies for addressing climate change, reducing greenhouse gas emissions, improving energy security, and supporting sustainable economic development.

In practical terms, energy efficiency involves the implementation of technologies, behaviors, systems, and practices that minimise energy consumption without negatively affecting quality of life, productivity, or operational effectiveness. Examples include energy-efficient buildings, LED lighting systems, renewable energy integration, smart energy technologies, efficient transportation systems, and responsible household energy consumption practices.

The concept of energy efficiency differs from energy conservation, although the two are closely connected. Energy conservation generally refers to reducing energy use through behavioral changes or decreased consumption, while energy efficiency focuses on improving the performance and effectiveness of energy use through technological innovation, optimisation, and sustainable practices. For example, switching off unused electrical devices represents energy conservation, whereas replacing traditional lighting with LED systems represents energy efficiency.

Energy efficiency has become a central component of international sustainability and climate policies because energy production and consumption remain among the largest contributors to greenhouse gas emissions globally. According to the International Energy Agency, the global energy sector accounts for approximately 73% of total greenhouse gas emissions worldwide, primarily due to fossil fuel consumption within electricity production, transport, industry, and buildings. Improving energy efficiency is therefore considered essential for achieving international climate goals and supporting the transition towards low-carbon and sustainable economies.

Within the European context, energy efficiency represents a major strategic priority connected to the European Green Deal and the European Union's objective of achieving climate neutrality by 2050. The European Commission identifies energy efficiency as a "first fuel" principle, recognising that reducing unnecessary energy demand is often more sustainable and cost-effective than increasing energy production capacity. According to European Commission estimates, improving energy efficiency could reduce greenhouse gas emissions significantly while also strengthening energy security and reducing economic dependence on imported fossil fuels.

The importance of energy efficiency became even more evident following recent global energy crises and geopolitical instability affecting energy markets and energy supply systems across Europe. Rising energy prices, energy insecurity, and environmental pressures have increased the need for more sustainable energy systems and responsible energy consumption practices among governments, industries, and citizens.

Energy efficiency is also closely connected to sustainable development and responsible consumption patterns. The United Nations Sustainable Development Goals (SDGs), particularly SDG 7 (Affordable and Clean Energy) and SDG 12 (Responsible Consumption and Production), emphasise the importance of efficient resource use, sustainable energy systems, and environmentally responsible lifestyles. Efficient energy use contributes not only to environmental protection but also to economic resilience, public health improvement, social wellbeing, and long-term sustainability.

Responsible energy consumption at individual and community level plays a particularly important role in achieving sustainability objectives. Everyday actions such as reducing unnecessary electricity use, improving household insulation, using public transportation, adopting sustainable mobility habits, and selecting energy-efficient appliances can collectively contribute to substantial reductions in energy demand and environmental impact. Research published by the European Environment Agency demonstrates that behavioral changes and responsible consumption practices can significantly support climate mitigation efforts when combined with technological innovation and policy implementation.





Young people are increasingly recognised as important actors within energy transition and sustainability processes. Environmental education, green skills development, and awareness regarding responsible energy consumption are therefore becoming essential priorities within both formal and non-formal education systems across Europe. According to OECD research, younger generations generally demonstrate high levels of environmental concern, although practical knowledge regarding energy efficiency and sustainable consumption often remains limited. This highlights the importance of strengthening sustainability education and providing young people with practical competences and opportunities for active participation in climate and energy-related initiatives.

In this context, energy efficiency should not be understood solely as a technological or economic issue, but also as a social, educational, and behavioral challenge requiring cooperation between institutions, communities, educators, youth workers, and citizens. Long-term sustainability transition depends not only on innovation and infrastructure but also on environmental awareness, responsible lifestyles, active citizenship, and collective participation in sustainable development processes.

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1.2 Why Energy Efficiency Matters

Energy efficiency is widely recognised as one of the most important pillars of sustainable development, climate mitigation, environmental protection, and long-term economic resilience. International organisations such as the International Energy Agency (IEA), the European Commission, the United Nations, and the OECD consistently identify energy efficiency as a key strategy for reducing environmental impact while supporting sustainable economic and social development.

The growing importance of energy efficiency is closely connected to the increasing environmental and climate-related pressures affecting contemporary societies. Global energy consumption continues to rise due to population growth, urbanisation, industrialisation, technological expansion, and increasing consumer demand. According to the International Energy Agency, energy production and consumption account for approximately three-quarters of global greenhouse gas emissions, making the energy sector one of the primary contributors to climate change and environmental degradation.

Improving energy efficiency therefore plays a critical role in reducing greenhouse gas emissions, limiting environmental damage, and supporting international climate objectives established through agreements such as the Paris Agreement and the European Green Deal. The International Energy Agency estimates that energy efficiency improvements alone could contribute more than 40% of the emissions reductions required to meet global climate targets by 2040. This demonstrates that energy efficiency is not simply a complementary sustainability strategy, but one of the central mechanisms required for achieving climate neutrality and reducing long-term environmental risks.



Environmental Protection and Resource Sustainability

One of the most significant benefits of energy efficiency is its contribution to environmental protection and the sustainable management of natural resources. High levels of energy consumption are associated with increased extraction and use of fossil fuels, deforestation, air pollution, water contamination, habitat destruction, and biodiversity loss. Energy-efficient systems reduce the demand for excessive energy production and therefore contribute to lower environmental pressure across multiple sectors.

Research published by the European Environment Agency indicates that improving energy efficiency within buildings, transportation, and industrial systems can significantly reduce air pollution levels and improve environmental quality within urban and rural communities. Reduced fossil fuel consumption also contributes to lower emissions of harmful pollutants such as sulphur dioxide, nitrogen oxides, and particulate matter, which are directly linked to respiratory diseases, cardiovascular conditions, and public health risks.

In addition, energy efficiency contributes to more sustainable resource management by reducing unnecessary energy waste and promoting responsible production and consumption patterns. Efficient energy use aligns closely with circular economy principles and supports the transition towards more sustainable and resilient economic systems.

Climate Mitigation and Energy Transition

Climate change remains one of the most urgent global challenges of the 21st century. Rising global temperatures, extreme weather events, biodiversity loss, sea-level rise, and ecosystem disruption increasingly affect environmental stability, economic systems, and social wellbeing worldwide. According to the Intergovernmental Panel on Climate Change (IPCC), limiting global warming requires rapid reductions in greenhouse gas emissions across all sectors of society.

Energy efficiency is considered one of the fastest and most cost-effective climate mitigation strategies because it reduces energy demand while supporting decarbonisation efforts and renewable energy integration. The European Union's "Energy Efficiency First" principle highlights the importance of prioritising demand reduction and efficient energy use before expanding energy supply systems.

The European Commission estimates that achieving the EU's climate neutrality targets will require substantial improvements in energy efficiency across buildings, transport, industry, and digital infrastructure. Buildings alone account for approximately 40% of energy consumption and 36% of greenhouse gas emissions within the European Union, making energy-efficient renovation and sustainable construction essential priorities for climate action.

Furthermore, energy efficiency strengthens the effectiveness of renewable energy systems by reducing overall energy demand and facilitating more stable and sustainable energy transition processes. Efficient energy systems can therefore accelerate the transition towards low-carbon economies while reducing dependence on fossil fuels and imported energy resources.



Economic Benefits and Energy Security

Beyond environmental and climate-related benefits, energy efficiency also generates significant economic advantages at individual, organisational, and national levels. Efficient energy use reduces operational costs, lowers household energy expenses, improves industrial productivity, and contributes to long-term economic resilience.

According to OECD and International Energy Agency research, investments in energy efficiency frequently generate strong economic returns through reduced energy costs, increased competitiveness, job creation, and technological innovation. Energy-efficient infrastructure and sustainable technologies also contribute to the growth of green economies and the expansion of labor market opportunities related to renewable energy, sustainable construction, environmental management, and green innovation sectors.

The economic importance of energy efficiency became particularly visible during recent energy crises affecting Europe, where rising energy prices and energy supply instability created significant social and economic pressures. Improving energy efficiency within households, public infrastructure, and industrial systems can reduce vulnerability to energy market fluctuations while strengthening national energy security and economic stability.

The European Commission additionally highlights that reducing energy dependency through efficiency measures contributes to greater geopolitical resilience and reduced reliance on imported fossil fuels. This is increasingly important within the context of global energy insecurity, resource competition, and geopolitical instability.



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Sustainable Lifestyles and Behavioral Change

Energy efficiency is not limited to technological systems and infrastructure. It is also strongly connected to sustainable lifestyles, responsible consumption behaviors, and environmental awareness. Everyday behavioral choices related to transportation, electricity use, heating, food consumption, and purchasing habits significantly influence energy demand and environmental impact.

Research published by the European Environment Agency demonstrates that behavioral changes combined with technological improvements can substantially reduce household energy consumption and carbon emissions. Sustainable mobility choices, reduced overconsumption, efficient use of household appliances, waste reduction, and conscious resource management all contribute to improved energy sustainability.

Young people are increasingly recognised as important drivers of sustainable lifestyle transformation and environmental behavioral change. According to Eurobarometer surveys, younger generations across Europe demonstrate high levels of concern regarding climate change and environmental sustainability, although important gaps remain regarding practical sustainability competences and energy-efficiency literacy. For this reason, environmental education and green skills development play a critical role in supporting long-term sustainability transition and responsible citizenship.

Ultimately, energy efficiency matters because it simultaneously addresses environmental, economic, social, and climate-related challenges. It supports climate mitigation, strengthens sustainability, improves public health, reduces economic vulnerability, and promotes more responsible consumption patterns. As societies continue facing increasing environmental and energy pressures, energy efficiency will remain one of the most important foundations for achieving sustainable development and building resilient communities across Europe and globally.

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1.3 Energy Efficiency and Sustainable Development

Energy efficiency is increasingly recognised as one of the fundamental pillars of sustainable development and a central mechanism for achieving global climate and environmental objectives. International institutions, including the United Nations, the European Commission, the International Energy Agency (IEA), and the OECD, consistently emphasise that improving energy efficiency is essential for reducing greenhouse gas emissions, strengthening economic resilience, promoting responsible resource use, and supporting long-term sustainability transition processes.

The relationship between energy efficiency and sustainable development extends across environmental, economic, and social dimensions. Efficient energy systems contribute to climate mitigation and environmental protection while simultaneously reducing energy costs, strengthening energy security, supporting innovation, and improving public wellbeing. For this reason, energy efficiency is considered a cross-sectoral priority within international sustainability frameworks and European climate policies.

Energy Efficiency and the Sustainable Development Goals (SDGs)

The connection between energy efficiency and sustainable development is strongly reflected within the United Nations Sustainable Development Goals (SDGs), adopted in 2015 as part of the UN 2030 Agenda for Sustainable Development. Several SDGs are directly linked to energy efficiency, sustainable energy systems, responsible consumption, and climate action.

Particularly important is SDG 7: Affordable and Clean Energy, which aims to ensure universal access to reliable, sustainable, and modern energy while substantially increasing the global rate of energy efficiency improvement. According to the United Nations SDG framework, improving energy efficiency is essential for reducing environmental pressure, limiting emissions, and supporting equitable access to sustainable energy resources.

Energy efficiency is also closely connected to:

- SDG 11: Sustainable Cities and Communities
- SDG 12: Responsible Consumption and Production
- SDG 13: Climate Action
- SDG 9: Industry, Innovation and Infrastructure

Research conducted by the International Energy Agency demonstrates that accelerated energy efficiency improvements could deliver more than one-third of the carbon dioxide emission reductions required globally by 2030 in pathways aligned with net-zero targets.

Furthermore, the IEA Sustainable Development Scenario highlights that energy efficiency could contribute over 40% of the emissions reductions required globally by 2040 in order to remain aligned with international climate objectives.

These findings demonstrate that sustainable development goals cannot realistically be achieved without significant improvements in energy efficiency across buildings, transport, industry, and everyday consumption practices.



The European Green Deal and Energy Efficiency

Within the European context, energy efficiency constitutes one of the core pillars of the European Union Green Deal, which represents the European Union's long-term strategy for achieving climate neutrality by 2050. The European Green Deal promotes the transition towards a low-carbon, resource-efficient, and competitive economy while aiming to reduce greenhouse gas emissions, strengthen biodiversity protection, and support sustainable economic transformation.

The European Commission identifies energy efficiency as a key principle of the Green Deal through the "Energy Efficiency First" approach, which prioritises reducing energy demand before increasing energy production capacity. This principle recognises that the cleanest and most sustainable energy is the energy that does not need to be consumed unnecessarily.

One of the most important sectors targeted within European energy-efficiency policies is the building sector. According to the European Commission, buildings in the European Union account for approximately 40% of total energy consumption and 36% of greenhouse gas emissions.

Research published in Energy and Buildings further highlights that the European building sector has the potential to achieve up to a 94% reduction in direct greenhouse gas emissions by 2050 if ambitious energy-efficiency and renewable-energy measures are implemented effectively.

For this reason, policies such as the Energy Performance of Buildings Directive (EPBD), the Renovation Wave Strategy, and the Fit for 55 package place strong emphasis on sustainable renovation, energy-efficient construction, smart energy systems, and decarbonisation of buildings and infrastructure.

Energy Efficiency and the Green Transition

The green transition refers to the broader transformation of economic, industrial, energy, and social systems towards sustainability, climate neutrality, and reduced environmental impact. Energy efficiency plays a fundamental role within this transition because it enables societies to reduce resource consumption and emissions while maintaining economic activity and quality of life.

The transition towards renewable energy systems alone is not considered sufficient to achieve climate neutrality if energy demand continues increasing unsustainably. According to the International Energy Agency, energy efficiency improvements remain one of the fastest, most accessible, and most cost-effective strategies for reducing emissions and supporting sustainable energy transition.

The green transition also creates increasing demand for green competences, sustainability literacy, and environmentally responsible behaviors among citizens and future professionals. Research conducted by the OECD demonstrates that labor markets increasingly require skills connected to energy management, renewable technologies, circular economy practices, environmental innovation, and sustainable production systems.

Young people are expected to play a particularly important role within this transition. Environmental education, non-formal learning, youth participation, and green skills development are therefore becoming strategic priorities within European youth and education policies.





Circular Economy and Responsible Resource Use

Energy efficiency is also strongly connected to circular economy principles and sustainable resource management. The circular economy model promotes reducing waste, extending product lifecycles, reusing materials, improving resource efficiency, and minimising environmental impact throughout production and consumption processes.

Traditional linear economic models based on “take-make-dispose” patterns contribute significantly to resource depletion, pollution, and excessive energy consumption. In contrast, circular economy systems aim to reduce unnecessary resource extraction and optimise material and energy use across economic sectors.

According to the European Commission Circular Economy Action Plan, improving energy efficiency and resource efficiency is essential for achieving sustainable production and consumption patterns within Europe. Energy-efficient manufacturing systems, sustainable construction methods, smart technologies, recycling systems, and waste reduction strategies all contribute to circular economy objectives.

Digital technologies and innovation also increasingly support circular economy and energy-efficiency practices through smart grids, intelligent energy monitoring systems, AI-supported optimisation technologies, and sustainable urban infrastructure. These technologies contribute to more efficient use of energy and resources while supporting sustainable economic transformation.

Ultimately, energy efficiency functions as a connecting element between climate action, sustainable development, circular economy strategies, and the broader green transition. Achieving long-term sustainability objectives requires not only technological innovation and policy implementation, but also responsible consumption, behavioral awareness, environmental education, and active citizen participation in sustainable development processes.

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1.4 The Role of Young People in Energy Transition

Young people are increasingly recognised as key actors within the global energy transition and broader sustainability transformation processes. International organisations, European institutions, researchers, and policy-makers consistently emphasise that younger generations will play a critical role in shaping future environmental, economic, technological, and social systems. Their participation is considered essential not only because they will experience the long-term consequences of climate change and environmental degradation, but also because they actively contribute to innovation, social mobilisation, behavioral transformation, and sustainability advocacy.

The transition towards sustainable energy systems and climate-neutral societies requires more than technological innovation and institutional regulation. It also depends heavily on behavioral change, environmental awareness, responsible consumption practices, and citizen participation. In this context, young people are increasingly viewed as important drivers of social change capable of influencing communities, educational environments, policy discussions, and everyday sustainability practices.

Research conducted by the European Commission demonstrates that younger generations across Europe show particularly high levels of concern regarding climate change, environmental sustainability, and energy-related issues. According to the 2025 Eurobarometer Youth Survey, environmental protection and climate change remain among the most important priorities identified by young Europeans aged 16–30. ([europa.eu](https://ec.europa.eu/eurobarometer))

At the same time, studies published by the OECD highlight that young people generally demonstrate strong environmental attitudes but often lack practical sustainability competences and opportunities for active participation in environmental decision-making and sustainability initiatives. This indicates that increasing awareness alone is not sufficient. Effective energy transition requires educational systems, youth organisations, and public institutions to actively support the development of green skills, sustainability literacy, and participatory opportunities for younger generations.

Behavioral Change and Sustainable Lifestyles

Behavioral change represents one of the most important dimensions of energy transition and climate mitigation efforts. Household energy consumption, transportation choices, food systems, waste generation, and consumption habits significantly influence overall energy demand and greenhouse gas emissions. Research published by the International Energy Agency demonstrates that behavioral changes and lifestyle adjustments could contribute substantially to reducing global emissions and improving energy efficiency outcomes.

Young people frequently act as early adopters of sustainability-oriented lifestyles and environmentally responsible practices. Sustainable mobility choices, reduced overconsumption, digital sustainability awareness, ethical purchasing decisions, and support for renewable energy initiatives are increasingly associated with younger generations across Europe.



Research conducted by the European Investment Bank Climate Survey indicates that younger Europeans are more likely to support climate policies, renewable energy development, and sustainable mobility measures compared to older age groups. (eib.org)

Behavioral change is also strongly influenced by peer learning, social norms, educational environments, and community participation. For this reason, non-formal education, youth work, and participatory sustainability activities play an essential role in supporting long-term sustainable habits and responsible energy consumption practices among young people.

Youth Participation and Climate Action

Youth participation has become one of the most visible aspects of contemporary environmental and climate movements. Across Europe and globally, young people increasingly participate in climate campaigns, sustainability projects, environmental volunteering activities, community initiatives, and policy advocacy actions. Youth-led movements and community-based environmental initiatives have significantly contributed to increasing public awareness regarding climate change, renewable energy, environmental justice, and sustainable development.

The European Union increasingly promotes youth participation within sustainability and climate governance frameworks. Programs such as Erasmus+, the European Climate Pact, and the European Solidarity Corps encourage young people to engage actively in sustainability education, volunteering, community action, and environmental innovation projects.

Research published by the UNESCO highlights that meaningful youth participation strengthens democratic engagement, active citizenship, social responsibility, and long-term environmental awareness. Participatory educational approaches also improve motivation and encourage young people to perceive themselves as capable contributors to sustainability solutions rather than passive recipients of environmental policies.

However, several barriers continue to affect youth participation in energy transition processes. According to OECD and UNICEF studies, financial insecurity, limited access to sustainability education, insufficient institutional support, and feelings of climate anxiety may reduce participation opportunities and long-term engagement among young people. Addressing these barriers therefore requires inclusive educational policies, accessible participation opportunities, and supportive community environments.





Green Citizenship and Environmental Responsibility

The concept of green citizenship refers to the active participation of citizens in environmental protection, sustainable development, and responsible resource management through both individual behaviors and collective social action. Green citizenship combines environmental awareness with civic participation, ethical responsibility, and social engagement.

Young people are increasingly recognised as emerging green citizens because of their growing involvement in sustainability initiatives, climate advocacy, environmental volunteering, and community participation activities. Green citizenship also involves critical thinking regarding environmental justice, social inequalities, consumption systems, and sustainability policies.

According to research conducted by the European Environment Agency, environmental citizenship is strongly connected to educational participation, community engagement, and opportunities for collaborative action. Schools, youth organisations, NGOs, and local communities therefore play an important role in supporting the development of environmentally responsible citizenship among younger generations.

Green citizenship additionally contributes to social cohesion and democratic resilience by encouraging participation, cooperation, and collective responsibility regarding shared environmental challenges. As environmental crises increasingly affect societies globally, active environmental citizenship is becoming an essential component of sustainable democratic societies.

Sustainability Awareness and Green Skills Development

Sustainability awareness and green skills development are increasingly important priorities within European education and youth policies. The transition towards climate-neutral and resource-efficient economies requires citizens who possess not only environmental knowledge, but also practical competences related to sustainability, critical thinking, collaboration, innovation, and responsible decision-making.

According to OECD reports on green competences and future labor market trends, green jobs and sustainability-related professions are expected to grow significantly during the coming decades. Young people will therefore require new competences connected to renewable energy systems, sustainable production, energy management, circular economy practices, and environmental innovation.

Research published by UNESCO additionally demonstrates that sustainability education contributes positively to environmental awareness, behavioral change, civic participation, and long-term social resilience. Experiential learning, participatory education, gamification methods, community projects, and practical sustainability activities are considered particularly effective approaches for developing green competences among young people.



At the same time, sustainability awareness should not be limited to technical environmental knowledge alone. It also includes ethical responsibility, critical reflection, social participation, emotional resilience, and understanding of the interconnected relationship between environmental, economic, and social systems.

Ultimately, young people represent one of the most important driving forces of the energy transition and broader sustainability transformation processes. Their behaviors, participation, values, and competences will significantly influence future environmental outcomes, democratic participation, and the success of climate and sustainability strategies across Europe and globally. Supporting young people through education, participation opportunities, community engagement, and green skills development therefore remains essential for achieving long-term sustainable development and building resilient societies for future generations.

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2. Current Environmental and Energy Challenges

2.1 Climate Change and Environmental Degradation

Climate change and environmental degradation represent some of the most urgent and complex global challenges of the 21st century. Scientific evidence published by international organisations such as the Intergovernmental Panel on Climate Change (IPCC), the United Nations Environment Program (UNEP), the European Environment Agency (EEA), and the OECD demonstrates that human activities are driving accelerating environmental pressures affecting ecosystems, biodiversity, public health, economic systems, and social stability worldwide.

The current environmental crisis is increasingly described by international institutions as a “triple planetary crisis” consisting of:

- climate change,
- biodiversity loss,
- and pollution.

According to OECD environmental outlook reports, these interconnected crises reinforce one another and threaten both ecological systems and human wellbeing on a global scale.

Global Warming and Climate Change

Climate change refers to long-term alterations in global temperatures, weather patterns, and climate systems primarily caused by anthropogenic greenhouse gas emissions resulting from fossil fuel combustion, industrial activities, deforestation, and unsustainable production and consumption practices.

According to the IPCC Sixth Assessment Report, human-induced global warming has already reached approximately 1.1°C above pre-industrial levels, with global temperatures continuing to rise at an alarming rate.

Scientific evidence indicates that continued warming beyond 1.5°C could significantly increase the frequency and severity of:

- extreme heatwaves,
- droughts,
- floods,
- wildfires,
- sea-level rise,
- food insecurity,
- and ecosystem collapse.

The IPCC additionally warns that climate-related risks intensify substantially with each additional increment of global warming, particularly affecting vulnerable populations, coastal regions, biodiversity hotspots, and economically disadvantaged communities.

Recent climate data further demonstrate the accelerating nature of environmental change. According to the Climate Risk Index 2025, between 1993 and 2022, extreme weather events caused more than 765,000 deaths globally and generated approximately USD 4.2 trillion in economic losses worldwide.

The European continent is also increasingly vulnerable to climate impacts. Research published by the European Environment Agency identifies Europe as the fastest-warming continent globally, experiencing increasing droughts, heatwaves, water stress, and ecosystem degradation.

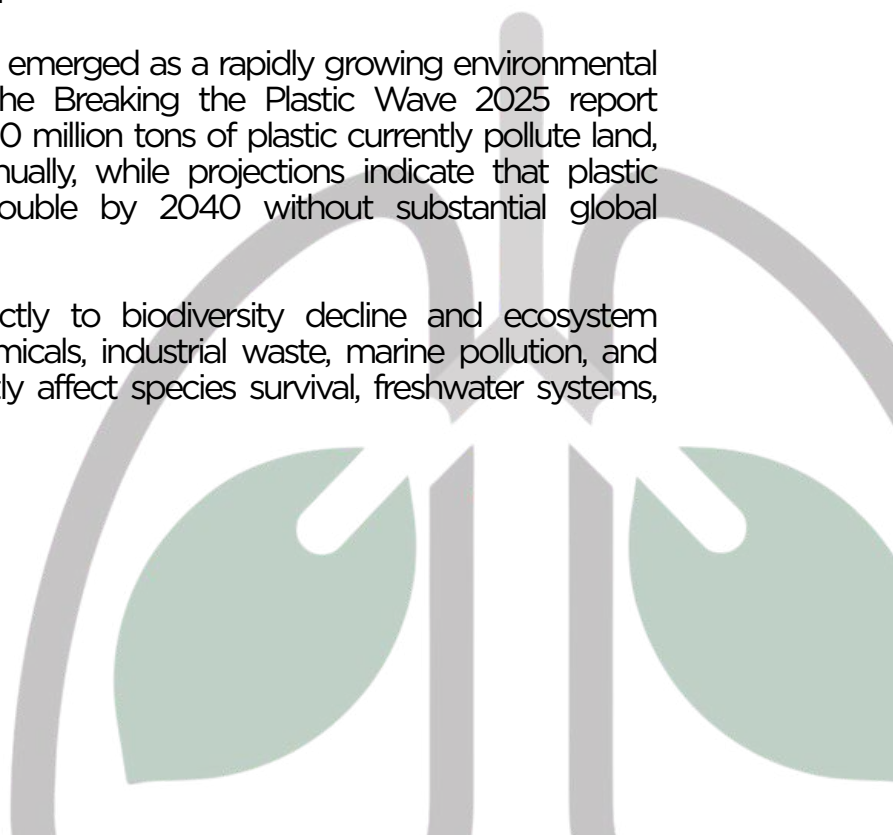
Pollution and Environmental Health Risks

Pollution remains one of the most severe environmental threats affecting ecosystems, biodiversity, and human health worldwide. Air pollution, water contamination, soil degradation, chemical pollution, and plastic waste significantly contribute to environmental deterioration and public health crises. According to World Bank and OECD environmental assessments, approximately 90% of the global population is exposed to environmental risks linked to polluted air, degraded land, and water stress.

Air pollution alone is responsible for millions of premature deaths annually and contributes significantly to respiratory diseases, cardiovascular illnesses, and reduced quality of life. Fossil fuel combustion within energy production, transport, and industrial sectors remains one of the primary sources of harmful emissions and particulate matter.

Plastic pollution has additionally emerged as a rapidly growing environmental crisis. Research published in the Breaking the Plastic Wave 2025 report estimates that approximately 130 million tons of plastic currently pollute land, air, and water ecosystems annually, while projections indicate that plastic pollution could more than double by 2040 without substantial global intervention.

Pollution also contributes directly to biodiversity decline and ecosystem destabilisation. Agricultural chemicals, industrial waste, marine pollution, and urban contamination significantly affect species survival, freshwater systems, soil quality, and food security.





Biodiversity Loss and Ecosystem Degradation

Biodiversity loss is increasingly recognised as one of the most critical environmental emergencies globally. Ecosystems across terrestrial, freshwater, and marine environments are experiencing accelerating species decline, habitat destruction, and ecological destabilisation driven by climate change, pollution, overconsumption, intensive agriculture, and unsustainable resource exploitation.

Research conducted by scientists from the Swiss Federal Institute of Aquatic Science and Technology and the University of Zurich analysing nearly 100,000 global sites found that human activities have reduced local biodiversity by approximately 20% in affected ecosystems worldwide.

The study additionally identified pollution, habitat destruction, climate change, invasive species, and resource exploitation as major drivers of global biodiversity decline. Particularly severe losses were observed among reptiles, amphibians, and mammals due to ecosystem disruption and habitat fragmentation.

The European Environment Agency similarly reports that more than 80% of protected habitats within Europe are currently classified as being in poor or bad condition due to pollution, overexploitation, invasive species, and environmental degradation.

Climate change is also increasingly accelerating biodiversity collapse. Scientific evidence published by the IPCC and biodiversity research institutes demonstrates that changing temperatures, ocean warming, altered rainfall patterns, and prolonged droughts are disrupting ecological interactions, migration patterns, food chains, and species survival rates.

Insect populations, which play essential roles within pollination systems and ecosystem functioning, are declining dramatically across multiple regions globally. Long-term ecological studies indicate reductions of up to 75% in flying insect populations in some monitored European ecosystems over recent decades.

Scientists increasingly warn that continued environmental degradation may contribute to what is commonly described as the “sixth mass extinction,” with long-term consequences for ecosystem stability, food systems, public health, and economic resilience.

The Climate Crisis as a Social and Economic Challenge

The environmental crisis is not limited to ecological impacts alone. Climate change and environmental degradation increasingly affect economic systems, public infrastructure, food production, labor productivity, migration patterns, social inequalities, and public health.

According to OECD and World Bank analyses, environmental degradation and climate-related disasters generate growing economic costs through infrastructure damage, reduced agricultural productivity, health-related expenditures, and resource scarcity.

Research additionally demonstrates that environmental risks disproportionately affect vulnerable populations, low-income communities, and younger generations who are expected to face increasing climate-related uncertainty throughout their lifetimes. Climate anxiety and eco-anxiety among young people have therefore emerged as growing social and psychological challenges connected to environmental instability and uncertainty regarding the future.

The interconnected nature of climate change, biodiversity loss, and pollution demonstrates that environmental sustainability requires integrated solutions combining climate action, energy transition, responsible consumption, environmental education, sustainable governance, and active citizen participation.

Addressing current environmental and energy challenges therefore requires coordinated international cooperation, evidence-based policy-making, technological innovation, behavioral change, and long-term investment in sustainability education and green transition strategies.

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2.2 Energy Consumption Trends in Europe

Energy consumption patterns within Europe have become a central focus of environmental, economic, and geopolitical discussions due to their direct connection with climate change, greenhouse gas emissions, energy security, and sustainable development. The European Union remains one of the world's largest energy-consuming regions, with energy demand strongly influenced by industrial activity, transportation systems, household consumption, digitalisation, urbanisation, and economic growth.

According to the Eurostat and the European Environment Agency, Europe's energy systems continue to depend significantly on fossil fuels despite increasing investments in renewable energy and energy-efficiency measures. Fossil fuels, including oil, natural gas, and coal, still account for approximately 70% of the European Union's gross inland energy consumption, contributing substantially to greenhouse gas emissions and environmental degradation. (ec.europa.eu)

At the same time, Europe faces increasing challenges related to energy affordability, energy security, climate neutrality targets, and energy system resilience. Recent geopolitical instability and energy market disruptions have further highlighted the vulnerability of energy-dependent economies and the urgent need for accelerated energy transition and energy-efficiency strategies.

Overall Energy Consumption Trends in the European Union

The European Union's total final energy consumption reflects the combined energy use of households, industry, transportation, services, and other economic sectors. Although EU climate policies and efficiency measures have contributed to gradual improvements in energy intensity over recent decades, total energy demand remains high due to economic activity and consumption patterns.

According to Eurostat data, the European Union consumed approximately 58 million terajoules (TJ) of energy in recent years, with transport, households, and industry representing the largest energy-consuming sectors. (ec.europa.eu)

Research published by the International Energy Agency (IEA) highlights that although Europe has improved energy efficiency significantly since the early 2000s, energy demand reductions remain insufficient to fully align with long-term climate neutrality objectives established under the European Green Deal and Paris Agreement commitments. ([iea.org](https://www.iea.org))

The European Union's "Fit for 55" package and REPowerEU strategy therefore place strong emphasis on:

- reducing energy demand,
- improving energy efficiency,
- accelerating renewable energy adoption,
- and decreasing dependence on imported fossil fuels.

According to European Commission estimates, achieving the EU's climate targets requires reducing final energy consumption by at least 11.7% by 2030 compared to projected baseline scenarios. (commission.europa.eu)



Household Energy Use and Residential Consumption

Households represent one of the largest energy-consuming sectors within Europe. Residential energy use includes electricity consumption, heating, cooling, cooking, lighting, digital devices, and domestic appliances. According to Eurostat, households account for approximately 26% of final energy consumption within the European Union. (ec.europa.eu)

Heating and cooling systems alone represent the largest share of residential energy demand. Research published by the European Commission indicates that approximately 80% of household energy consumption in Europe is related to space heating, water heating, and cooling systems. (commission.europa.eu)

This demonstrates the importance of energy-efficient buildings, insulation systems, smart heating technologies, and sustainable housing renovation programs within European climate and energy policies. The European building stock remains particularly problematic because approximately 75% of buildings in the European Union are considered energy inefficient. (commission.europa.eu)

Energy poverty additionally remains a growing social challenge within Europe. According to the European Energy Poverty Observatory, millions of European citizens struggle to afford adequate heating, cooling, and electricity services due to rising energy costs and inefficient housing conditions. Vulnerable households are disproportionately affected by energy market instability and increasing energy prices.

Behavioral patterns also significantly influence household energy demand. Studies conducted by the European Environment Agency indicate that sustainable consumption behaviors, efficient appliance use, reduced overconsumption, and conscious energy-saving practices can substantially reduce household energy use and associated emissions.

Transport Emissions and Mobility Challenges

The transport sector remains one of the most energy-intensive and environmentally damaging sectors within Europe. Transportation systems rely heavily on fossil fuels and contribute significantly to greenhouse gas emissions, air pollution, noise pollution, and urban environmental degradation.

According to the European Environment Agency, transport accounts for approximately 25% of total greenhouse gas emissions within the European Union, making it one of the largest contributors to climate change across Europe. (eea.europa.eu) Road transport represents the dominant source of transport emissions, accounting for nearly 72% of transport-related greenhouse gas emissions within the EU. Passenger cars alone contribute approximately 60% of total road transport emissions. (ec.europa.eu)

Air transport and shipping emissions have also increased significantly over recent decades due to growing international mobility and trade activity. According to the European Aviation Environmental Report, aviation emissions in Europe increased by more than 30% between 2013 and 2019 prior to temporary pandemic-related reductions.





Transport emissions create substantial public health and environmental challenges, particularly within urban areas. Air pollution from transport systems contributes to respiratory diseases, cardiovascular conditions, and reduced quality of life. The World Health Organization estimates that air pollution contributes to hundreds of thousands of premature deaths annually across Europe.

For this reason, sustainable mobility strategies have become a major priority within European climate and urban planning policies. The European Union increasingly promotes:

- public transportation systems,
- cycling infrastructure,
- electric vehicles,
- sustainable urban mobility plans,
- and low-emission transport solutions.

Research conducted by the International Transport Forum further demonstrates that combining sustainable mobility infrastructure with behavioral change policies could significantly reduce urban emissions and energy demand within European cities.

Energy Dependency and Energy Security

Energy dependency remains one of the most significant strategic challenges affecting Europe's economic stability and geopolitical resilience. The European Union imports a substantial proportion of its fossil fuel resources from external suppliers, making European economies vulnerable to global market instability, price fluctuations, and geopolitical tensions.

According to Eurostat, the European Union imports approximately 55–60% of its total energy needs, with particularly high dependency on imported oil and natural gas. (ec.europa.eu)

Recent geopolitical crises and disruptions to energy supply chains highlighted the strategic risks associated with excessive fossil fuel dependency. Rising energy prices and supply insecurity significantly affected households, businesses, and public institutions across Europe, increasing economic pressures and social vulnerability.

The REPowerEU strategy and European Green Deal therefore place strong emphasis on:

- reducing fossil fuel dependency,
- strengthening renewable energy production,
- improving energy efficiency,
- diversifying energy sources,
- and increasing energy system resilience.



According to the International Energy Agency, energy efficiency improvements represent one of the fastest and most cost-effective methods for reducing energy dependency while simultaneously supporting climate objectives and lowering energy costs.

The transition towards more sustainable and resilient energy systems therefore requires coordinated investment in renewable energy technologies, energy-efficient infrastructure, sustainable transportation systems, circular economy approaches, and responsible consumption practices.

At the same time, research consistently demonstrates that technological innovation alone is insufficient. Long-term sustainability and energy security also depend on behavioral change, environmental awareness, active citizenship, and the development of green competences among younger generations and local communities.

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2.3 Carbon Emissions and Environmental Impact

Carbon emissions and energy-related environmental impacts represent some of the most critical sustainability challenges facing contemporary societies. The continued dependence on fossil fuels for electricity generation, transportation, industrial production, and heating systems remains the primary driver of global greenhouse gas emissions and climate change. According to international scientific consensus, limiting environmental degradation and avoiding the most severe consequences of climate change requires rapid and large-scale reductions in carbon emissions across all sectors of society.

The energy sector is currently responsible for the majority of anthropogenic greenhouse gas emissions worldwide. Research conducted by the International Energy Agency (IEA) indicates that energy production and energy use account for approximately 73% of total global greenhouse gas emissions. Fossil fuel combustion for electricity, heat, transport, and industrial activity remains the dominant source of carbon dioxide (CO₂) emissions globally. ([iea.org](https://www.iea.org))

Carbon dioxide is considered the most significant long-lived greenhouse gas associated with human activity. The accumulation of CO₂ and other greenhouse gases in the atmosphere intensifies the greenhouse effect, contributing to rising global temperatures, climate instability, ecosystem disruption, and increasing frequency of extreme weather events.

Global CO₂ Emissions Trends

Global carbon emissions continue to remain at historically high levels despite increasing international climate commitments and renewable energy investments. According to the Global Carbon Budget 2025, fossil fuel-related carbon dioxide emissions exceeded 37 billion tonnes globally in recent years, reflecting continued dependence on oil, coal, and natural gas across global economies. (globalcarbonbudget.org)

Scientific assessments conducted by the Intergovernmental Panel on Climate Change (IPCC) demonstrate that current global emissions trajectories remain inconsistent with the objective of limiting global warming to 1.5°C above pre-industrial levels established under the Paris Agreement. According to the IPCC, achieving climate stabilisation requires immediate and sustained reductions in greenhouse gas emissions combined with accelerated energy transition and large-scale energy-efficiency improvements. ([ipcc.ch](https://www.ipcc.ch))

The United Nations Environment Program Emissions Gap Report additionally warns that current climate policies remain insufficient to achieve internationally agreed climate targets. The report estimates that global greenhouse gas emissions would need to decline by approximately 42% by 2030 compared to current trajectories in order to maintain a realistic pathway towards limiting warming to 1.5°C. ([unep.org](https://www.unep.org))



CO₂ Emissions within the European Union

Although the European Union has achieved significant progress in reducing greenhouse gas emissions compared to previous decades, emissions levels remain substantial across energy production, transport, buildings, and industrial sectors.

According to the European Environment Agency, total greenhouse gas emissions in the European Union have decreased by approximately 31% since 1990. However, the EU still faces major challenges in achieving climate neutrality objectives by 2050. (eea.europa.eu)

Energy-related sectors continue to represent the largest contributors to emissions within Europe. Electricity and heat production, transportation systems, industrial activities, and residential energy use account for the majority of European greenhouse gas emissions.

Transport emissions remain particularly problematic because, unlike several other sectors, transport-related emissions have increased significantly over recent decades. According to European Commission data, transport currently contributes approximately one-quarter of total EU greenhouse gas emissions. Road transport alone accounts for nearly 72% of transport-related emissions. (climate.ec.europa.eu)

Buildings additionally represent a major emissions source due to inefficient heating systems, poor insulation, and fossil fuel dependency. The European Commission estimates that buildings are responsible for approximately 36% of greenhouse gas emissions and 40% of total energy consumption within the European Union. (commission.europa.eu)

Energy-Related Pollution and Public Health Impacts
Energy production and fossil fuel combustion generate not only greenhouse gas emissions but also significant environmental pollution affecting ecosystems, biodiversity, and public health. Coal-fired power plants, industrial processes, transport systems, and household heating contribute to the release of pollutants such as:

- sulphur dioxide (SO₂),
- nitrogen oxides (NO_x),
- particulate matter (PM_{2.5} and PM₁₀),
- methane (CH₄),
- and volatile organic compounds (VOCs).



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These pollutants contribute to air pollution, acid rain, water contamination, soil degradation, respiratory illnesses, and ecosystem disruption. According to the World Health Organization (WHO), air pollution represents one of the largest environmental health risks globally and is responsible for approximately 7 million premature deaths annually. (who.int)

Within Europe, the European Environment Agency estimates that exposure to fine particulate matter contributed to more than 250,000 premature deaths annually across EU member states. (eea.europa.eu)

Research also demonstrates that vulnerable populations, including children, elderly individuals, and low-income communities, are disproportionately affected by environmental pollution and poor air quality. Pollution therefore represents not only an environmental issue, but also a major public health and social justice challenge.

Climate Targets and International Commitments

In response to growing environmental and climate risks, governments and international institutions have established multiple climate targets and policy frameworks aimed at reducing emissions and accelerating sustainability transition processes.

The Paris Agreement, adopted in 2015 under the United Nations Framework Convention on Climate Change (UNFCCC), established the objective of limiting global warming to “well below 2°C” while pursuing efforts to limit warming to 1.5°C above pre-industrial levels. Achieving these targets requires substantial reductions in greenhouse gas emissions and accelerated decarbonisation across all sectors of society.

Within Europe, the European Climate Law legally commits the European Union to achieving climate neutrality by 2050. Interim climate targets additionally aim to reduce net greenhouse gas emissions by at least 55% by 2030 compared to 1990 levels under the “Fit for 55” policy package. (climate.ec.europa.eu)

To support these objectives, the European Union promotes:

- renewable energy expansion,
- energy-efficiency improvements,
- sustainable transport systems,
- circular economy practices,
- green innovation,
- and low-carbon industrial transformation.

However, scientific institutions such as the IPCC and UNEP continue warning that current global mitigation efforts remain insufficient to fully align with climate targets and avoid severe climate risks. Delays in emissions reductions significantly increase long-term environmental, economic, and social costs associated with climate change.



The Role of Energy Efficiency in Emission Reduction

Energy efficiency is increasingly recognised as one of the fastest and most cost-effective strategies for reducing greenhouse gas emissions and supporting climate objectives. According to the International Energy Agency, energy-efficiency improvements could contribute more than 40% of the emissions reductions required globally to meet net-zero targets. ([iea.org](https://www.iea.org))

Reducing unnecessary energy demand decreases fossil fuel consumption and lowers emissions across buildings, transport, industry, and household systems. Combined with renewable energy deployment and sustainable behavioral change, energy efficiency can substantially accelerate climate mitigation efforts and improve long-term environmental sustainability.

At the same time, research consistently demonstrates that technological solutions alone are insufficient. Achieving long-term climate targets also requires environmental awareness, behavioral transformation, responsible consumption practices, active citizenship, and widespread public participation in sustainability transition processes.

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2.4 Sustainability Challenges Affecting Young People

Young people across Europe and globally are increasingly experiencing the direct and indirect consequences of climate change, environmental degradation, energy insecurity, and sustainability-related socio-economic transformations. While younger generations are often identified as important actors within the green transition, research demonstrates that they are simultaneously among the groups most psychologically, socially, and economically affected by environmental instability and uncertainty regarding the future.

Climate change and environmental crises no longer represent distant or abstract threats for younger generations. Instead, they increasingly shape perceptions regarding personal wellbeing, economic security, education, employment opportunities, social stability, and future quality of life. International organisations including the UNICEF, the OECD, UNESCO, and the European Environment Agency increasingly recognise that environmental sustainability challenges also represent major youth wellbeing and social justice challenges.

Climate Anxiety and Psychological Impact

One of the most visible sustainability-related challenges affecting younger generations is the growing phenomenon commonly described as “climate anxiety” or “eco-anxiety.” Climate anxiety refers to feelings of fear, stress, helplessness, uncertainty, and emotional distress associated with climate change, environmental degradation, and concerns regarding the future of the planet.

A landmark international survey published in The Lancet Planetary Health involving 10,000 young people aged 16–25 across ten countries found that:

- 59% of respondents reported being “very” or “extremely” worried about climate change,
- 84% reported at least moderate concern,
- while more than 45% stated that climate-related distress negatively affected their daily lives and functioning.

The same study revealed that many young people experience feelings of:

- sadness,
- anxiety,
- anger,
- powerlessness,
- and betrayal by governments and institutions perceived as failing to address climate risks effectively.

Research conducted by UNICEF additionally demonstrates that climate-related stress disproportionately affects young people living in vulnerable communities or regions exposed to environmental instability, extreme weather events, and socio-economic insecurity. Climate-related uncertainty increasingly influences young people’s perceptions regarding family planning, career choices, education pathways, and long-term life expectations.



The psychological impacts of environmental crises became particularly visible following recent climate disasters, heatwaves, wildfires, and floods affecting Europe and other global regions. According to the European Environment Agency, increasing exposure to environmental risks and climate disasters is likely to intensify mental health pressures among younger populations during the coming decades.

At the same time, researchers increasingly emphasise that climate anxiety should not automatically be interpreted as a pathological condition. In many cases, it reflects rational emotional responses to scientifically documented environmental threats and uncertainty regarding future sustainability conditions.

Environmental Insecurity and Future Uncertainty

Young people are increasingly experiencing what researchers describe as “environmental insecurity,” referring to uncertainty and instability caused by climate risks, environmental degradation, resource scarcity, and ecological disruption.

Environmental insecurity affects perceptions regarding:

- future living conditions,
- public health,
- access to resources,
- food and water security,
- housing stability,
- and economic resilience.

According to UNICEF’s Children’s Climate Risk Index, approximately one billion children and young people worldwide live in countries considered at extremely high risk from climate and environmental hazards. ([unicef.org](https://www.unicef.org))

Within Europe, younger generations increasingly report concerns regarding:

- extreme weather events,
- rising temperatures,
- droughts,
- biodiversity loss,
- pollution,
- and declining environmental quality.

Research conducted through the European Investment Bank Climate Survey found that younger Europeans demonstrate significantly higher levels of concern regarding climate risks and environmental instability compared to older age groups. ([eib.org](https://www.eib.org))

Environmental insecurity also interacts with broader social and economic inequalities. Young people from lower-income backgrounds or marginalised communities are often more exposed to environmental risks while simultaneously possessing fewer financial and institutional resources for adaptation and resilience.

The OECD additionally warns that climate-related inequalities may intensify social fragmentation and reduce long-term opportunities for younger generations if sustainability transitions are not implemented inclusively and equitably.



Future Employment Challenges and Green Labor Market Transformation

The green transition is expected to transform labor markets significantly during the coming decades. While sustainability transition processes are projected to create millions of new green jobs globally, they also generate uncertainty regarding future employment structures, skills requirements, and economic adaptation.

According to the International Labor Organization (ILO), the transition towards environmentally sustainable economies could create approximately 24 million new jobs globally by 2030. However, this transformation also requires substantial reskilling and adaptation processes across labor markets. (ilo.org)

Research conducted by the OECD and the European Center for the Development of Vocational Training (CEDEFOP) indicates that younger generations increasingly require competences connected to:

- renewable energy systems,
- sustainable construction,
- circular economy practices,
- green innovation,
- digital sustainability,
- and environmental management.

At the same time, studies reveal that many young people feel insufficiently prepared for emerging green labor market demands due to limited sustainability education, inadequate vocational preparation, and lack of practical green-skills training opportunities. A Eurobarometer survey on youth and green skills found that many young Europeans believe educational systems are not yet adequately preparing them for sustainability-oriented employment sectors and future environmental challenges. (europa.eu)

Automation, economic instability, and climate-related disruptions may additionally intensify employment insecurity for younger generations. Climate-related economic impacts affecting agriculture, tourism, energy systems, and industrial sectors may disproportionately affect youth employment opportunities in vulnerable regions.

For this reason, European policies increasingly emphasise the importance of:

- green-skills development,
- sustainability education,
- vocational training,
- lifelong learning,
- and youth participation within green innovation sectors.

Social Impact and Youth Inequalities

Environmental degradation and climate change also generate substantial social impacts affecting quality of life, social inclusion, public health, mobility, education, and community resilience.

Young people increasingly experience sustainability-related inequalities connected to:

- energy poverty,
- housing insecurity,
- environmental injustice,
- unequal access to green infrastructure,
- and limited participation opportunities.

Research conducted by the European Environment Agency demonstrates that vulnerable social groups, including low-income youth populations, are often disproportionately exposed to pollution, poor housing conditions, urban heat stress, and environmental health risks.



Energy poverty remains a particularly important challenge within Europe. Rising energy prices and inefficient housing conditions significantly affect younger populations, students, and economically vulnerable households. According to European Commission estimates, millions of Europeans struggle to maintain adequate heating and cooling conditions due to increasing energy costs and inefficient buildings.

Environmental crises additionally affect educational opportunities, community participation, and social cohesion. Climate disasters and environmental instability increasingly disrupt schools, public infrastructure, local economies, and community wellbeing.

At the same time, sustainability movements and environmental participation initiatives have also strengthened social engagement, solidarity, and youth activism across Europe. Many young people increasingly participate in:

- environmental volunteering,
- climate advocacy campaigns,
- sustainability projects,
- community initiatives,
- and green entrepreneurship activities.

Research published by UNESCO highlights that meaningful participation in sustainability activities can improve resilience, strengthen active citizenship, and positively influence young people's psychological wellbeing and social engagement.

The Importance of Education and Participation

Research consistently demonstrates that environmental education, non-formal learning, youth participation, and green-skills development play a fundamental role in addressing sustainability challenges affecting younger generations.

Participatory education approaches, community engagement, experiential learning, and practical sustainability activities help young people:

- develop resilience,
- strengthen environmental awareness,
- improve green competences,
- and transform climate concern into constructive participation and social action.

For this reason, European youth and education policies increasingly emphasise the importance of sustainability education, climate literacy, green citizenship, and inclusive participation opportunities as essential components of long-term social resilience and sustainable development.

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2.5 European Policies and Environmental Priorities

The growing environmental and climate-related challenges affecting Europe and the global community have led to the development of extensive international and European policy frameworks focused on sustainability transition, climate mitigation, energy efficiency, and environmental protection. Over recent decades, environmental sustainability has evolved from a sector-specific concern into a central strategic priority influencing European economic policy, industrial transformation, energy systems, education, labor markets, and social development.

The European Union increasingly positions itself as a global leader in climate governance and sustainable transition through comprehensive environmental strategies, regulatory frameworks, and long-term climate objectives. Policies such as the European Green Deal, the Fit for 55 package, and the implementation of the United Nations Sustainable Development Goals (SDGs) form the foundation of the EU's climate neutrality and sustainability agenda. These frameworks aim not only to reduce greenhouse gas emissions and environmental degradation, but also to promote economic resilience, social inclusion, innovation, energy security, and sustainable development across European societies.

The European Green Deal

The European Green Deal represents the European Union's overarching sustainability and climate strategy designed to transform Europe into the world's first climate-neutral continent by 2050. Introduced by the European Commission in 2019, the Green Deal establishes a comprehensive roadmap for achieving sustainable economic transformation while simultaneously reducing environmental impact and promoting social and economic resilience.



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The strategy addresses multiple interconnected policy areas including:

- climate action,
- energy transition,
- biodiversity protection,
- circular economy,
- sustainable mobility,
- agriculture and food systems,
- industrial decarbonisation,
- and sustainable finance.

The European Green Deal is based on the recognition that environmental sustainability and economic growth must be pursued simultaneously through innovation, technological transformation, and responsible resource management.

According to the European Commission, the Green Deal aims to reduce greenhouse gas emissions, improve resource efficiency, protect ecosystems, and decouple economic growth from excessive resource consumption. (commission.europa.eu)

A major component of the Green Deal is the “Energy Efficiency First” principle, which emphasises reducing energy demand and improving efficiency before expanding energy production systems. This reflects growing recognition that energy efficiency represents one of the fastest and most cost-effective climate mitigation strategies.

The European Green Deal also highlights the importance of ensuring a “just transition,” meaning that sustainability transformation should remain socially inclusive and should support vulnerable communities, workers, and younger generations affected by economic and industrial changes associated with decarbonisation processes.



Fit for 55 Package

The Fit for 55 package represents one of the European Union's most ambitious legislative frameworks for climate action and emissions reduction. Introduced in 2021, the package consists of a broad set of legislative proposals and policy reforms designed to align European laws with the EU's climate target of reducing net greenhouse gas emissions by at least 55% by 2030 compared to 1990 levels.

The package covers multiple sectors including:

- energy production,
- transportation,
- buildings,
- industry,
- taxation,
- emissions trading,
- renewable energy,
- and energy efficiency.

According to the European Commission, achieving the 55% emissions reduction target requires accelerated investment in renewable energy systems, sustainable infrastructure, low-carbon technologies, and large-scale energy-efficiency improvements across all sectors of society. (consilium.europa.eu)

One of the key components of the Fit for 55 package is the revised Energy Efficiency Directive, which establishes stronger legally binding targets for reducing final energy consumption within the European Union.

The package additionally promotes:

- expansion of renewable energy sources,
- stricter vehicle emissions standards,
- sustainable aviation and shipping policies,
- carbon pricing mechanisms,
- and climate-focused industrial transformation.

Research published by the European Environment Agency suggests that the successful implementation of Fit for 55 policies could significantly accelerate Europe's transition towards climate neutrality while simultaneously improving public health, air quality, and energy security.



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However, policy analysts also highlight important implementation challenges, including economic inequalities, industrial adaptation pressures, energy affordability concerns, and the need for large-scale behavioral transformation and public participation. Sustainable Development Goals (SDGs)

The United Nations Sustainable Development Goals (SDGs) provide the broader international framework connecting environmental sustainability with social inclusion, economic development, and global cooperation. Adopted in 2015 as part of the UN 2030 Agenda for Sustainable Development, the SDGs consist of 17 interconnected goals addressing global challenges such as poverty, inequality, environmental degradation, climate change, education, health, and sustainable economic development.

Several SDGs are directly connected to energy efficiency, environmental sustainability, and climate action, including:

- SDG 7: Affordable and Clean Energy
- SDG 11: Sustainable Cities and Communities
- SDG 12: Responsible Consumption and Production
- SDG 13: Climate Action
- SDG 9: Industry, Innovation and Infrastructure

According to the United Nations, achieving the SDGs requires integrated approaches combining environmental sustainability, economic resilience, social justice, and international cooperation. (sdgs.un.org)

The SDGs additionally emphasise the importance of sustainability education, youth participation, gender equality, and inclusive governance as key elements supporting long-term sustainable development.

Research conducted by UNESCO demonstrates that sustainability education and environmental literacy are essential for supporting SDG implementation because behavioral change and citizen participation remain critical components of sustainable transformation processes.

At the European level, the SDGs increasingly influence policymaking, educational priorities, funding programs, and sustainability strategies connected to climate action and green transition initiatives. Erasmus+ and European youth programs also increasingly integrate SDG priorities within education, training, and non-formal learning activities.





Climate Neutrality Targets and Net-Zero Transition

Climate neutrality refers to achieving a balance between greenhouse gas emissions produced and emissions removed from the atmosphere through natural or technological carbon absorption mechanisms. Achieving climate neutrality, often described as reaching “net-zero emissions,” represents one of the central objectives of international climate governance.

The European Climate Law legally commits the European Union to becoming climate-neutral by 2050. (climate.ec.europa.eu)

This target reflects scientific recommendations published by the Intergovernmental Panel on Climate Change (IPCC), which emphasise that achieving net-zero emissions globally around mid-century is necessary for limiting global warming and avoiding catastrophic climate impacts.

The European Union’s climate neutrality objectives require substantial reductions in emissions across:

- energy systems,
- transport,
- buildings,
- agriculture,
- manufacturing,
- and consumption patterns.

According to the International Energy Agency Net Zero Roadmap, achieving climate neutrality requires rapid expansion of renewable energy, electrification of transport systems, energy-efficiency improvements, sustainable industrial innovation, and behavioral changes related to consumption and mobility practices. ([iea.org](https://www.iea.org))

At the same time, climate neutrality strategies increasingly recognise the importance of social participation, environmental awareness, and youth engagement. Long-term climate objectives cannot be achieved solely through technological solutions and institutional regulations. Public participation, responsible lifestyles, sustainability education, and active citizenship remain essential components of successful sustainability transition processes.



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Research additionally demonstrates that delays in climate mitigation significantly increase future environmental, economic, and social costs. According to UNEP Emissions Gap Reports, current global climate policies remain insufficient to fully align with the 1.5°C climate target established under the Paris Agreement. Accelerated implementation of sustainability policies and emissions reduction measures is therefore considered urgent by scientific and policy institutions worldwide.

The Role of Young People within European Sustainability Policies

European sustainability and climate policies increasingly recognise young people as important stakeholders within the green transition process. Youth participation is promoted through educational initiatives, climate dialogues, volunteering programs, environmental campaigns, and sustainability-related innovation projects supported by European institutions.

Initiatives such as Erasmus+, the European Climate Pact, the European Solidarity Corps, and EU Youth Goals encourage active participation of younger generations in sustainability action and environmental citizenship.

The European Union additionally emphasises the importance of green skills development, sustainability literacy, and climate education as essential components of future resilience and labor market transformation. As younger generations will experience the long-term impacts of climate change most directly, their involvement in sustainability governance and environmental participation processes is increasingly viewed as a strategic necessity rather than an optional policy dimension.

Ultimately, European environmental policies and sustainability priorities aim to create a comprehensive framework supporting climate mitigation, energy transition, environmental protection, social inclusion, and long-term resilience. Achieving these objectives requires coordinated action across governments, institutions, industries, communities, educational systems, and citizens, with young people playing a particularly important role in shaping future sustainability outcomes across Europe.

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3. Energy Efficiency Awareness Among Young People

3.1 Environmental Awareness Levels Among European Youth

Environmental awareness among young people has increased significantly during recent decades as climate change, biodiversity loss, pollution, and sustainability challenges have become increasingly visible within public discourse, education systems, digital media, and political agendas. Research conducted by European institutions, international organisations, and academic studies consistently demonstrates that younger generations across Europe show high levels of concern regarding environmental degradation and climate-related risks.

At the same time, studies also reveal important differences between general environmental concern and practical sustainability literacy, behavioral engagement, and energy-efficiency knowledge. While many young people demonstrate strong environmental values and support for climate action, gaps often remain regarding practical green competences, sustainable consumption behaviors, and understanding of energy-related systems and policies.

The growing visibility of climate-related crises, combined with increased digital access to environmental information and youth participation in climate movements, has contributed to the emergence of a generation that is generally more environmentally conscious than previous generations. However, research additionally indicates that young people frequently feel insufficiently supported by institutions and educational systems in translating environmental concern into meaningful participation and long-term behavioral change.

Environmental Concern Among European Youth

According to the 2025 European Commission Eurobarometer Youth Survey, climate change and environmental protection remain among the most important political and social concerns identified by young Europeans aged 16–30. Approximately one-third of respondents identified environmental sustainability and climate action as priority areas requiring stronger European intervention and policy action. ([europa.eu](https://ec.europa.eu/eurobarometer))

The survey additionally demonstrates that younger generations increasingly associate environmental sustainability with broader issues including:

- public health,
- quality of life,
- social justice,
- economic resilience,
- and future employment opportunities.

Environmental awareness among young Europeans is also strongly connected to concerns regarding extreme weather events, pollution, biodiversity decline, and energy insecurity. Research findings suggest that younger age groups generally perceive climate change as an urgent and immediate challenge rather than a distant future risk.

A separate Eurobarometer survey on climate action found that more than 90% of young Europeans consider climate change to be a serious problem, while a majority support stronger climate policies and sustainability regulations at both national and European levels. (climate.ec.europa.eu)

The increasing visibility of youth climate movements, environmental campaigns, and sustainability activism across Europe further reflects growing environmental awareness among younger generations. Participation in climate strikes, community sustainability projects, volunteering activities, and environmental advocacy initiatives has become increasingly common among European youth populations over recent years.

OECD Findings on Youth Sustainability Competences

Research conducted by the OECD provides important insights regarding environmental literacy and sustainability competences among young people. OECD studies indicate that many students across OECD countries demonstrate relatively strong awareness regarding environmental issues such as pollution, climate change, deforestation, and biodiversity decline.

According to the OECD report *Young People's Environmental Sustainability Competence*, approximately:

- 84% of students reported awareness of air pollution issues,
- 75% demonstrated awareness regarding deforestation and ecosystem degradation,
- while 72% expressed awareness of water scarcity and environmental resource challenges. ([oecd.org](https://www.oecd.org))



However, OECD findings additionally reveal significant disparities between environmental concern and practical sustainability competences. Many young people demonstrate theoretical awareness regarding environmental problems while lacking practical knowledge related to:

- energy efficiency,
- sustainable consumption,
- circular economy practices,
- renewable energy systems,
- and climate adaptation strategies.

The OECD additionally identifies socio-economic background, educational opportunities, and access to sustainability-oriented learning environments as important factors influencing environmental awareness and green competences development among young people.

Students who participate more actively in environmental education programs, extracurricular sustainability initiatives, and participatory learning activities generally demonstrate stronger sustainability literacy and greater confidence regarding environmental problem-solving.

European Environment Agency (EEA) Perspectives

The European Environment Agency (EEA) emphasises that environmental awareness and public participation represent essential components of successful sustainability transition and climate mitigation strategies. According to EEA assessments, behavioral change and citizen engagement are increasingly recognised as critical factors influencing Europe's ability to achieve climate neutrality and environmental sustainability objectives.

EEA research indicates that younger generations often display greater openness towards:

- sustainable lifestyles,
- renewable energy adoption,
- sustainable mobility practices,
- ethical consumption,
- and climate-related behavioral changes.

Younger populations are also generally more supportive of sustainability-oriented policies such as low-emission transport systems, renewable energy expansion, and circular economy measures.

At the same time, the EEA warns that awareness alone does not necessarily guarantee behavioral transformation. Structural barriers including financial limitations, insufficient infrastructure, lack of institutional support, and limited sustainability education opportunities may reduce the capacity of young people to adopt environmentally sustainable behaviors consistently.

Research additionally demonstrates that environmental awareness levels vary significantly across regions, educational backgrounds, and socio-economic groups. Young people living in urban areas or participating in higher levels of education often report greater environmental engagement compared to more vulnerable or marginalised populations with fewer sustainability learning opportunities.



Youth Surveys on Climate Anxiety and Sustainability Participation

Youth-focused climate and sustainability surveys increasingly demonstrate that environmental awareness among younger generations is closely connected to emotional responses, social participation, and future concerns.

A major international survey published in The Lancet Planetary Health involving 10,000 young people aged 16–25 found that:

- 75% considered the future “frightening” due to climate change,
- 56% believed humanity was “doomed,”
- and 39% reported hesitation regarding having children because of environmental concerns. (thelancet.com)

These findings demonstrate that environmental awareness among younger generations increasingly extends beyond ecological understanding and affects emotional wellbeing, social perceptions, and long-term life planning.

At the same time, youth surveys also demonstrate growing willingness among young people to participate in sustainability actions and environmental initiatives. According to the European Investment Bank Climate Survey, younger Europeans are significantly more likely than older generations to support behavioral changes connected to sustainability, including reduced consumption, sustainable transport use, and climate-focused lifestyle adjustments. (eib.org)

However, surveys also indicate that many young people feel frustrated regarding perceived institutional inaction and lack of meaningful participation opportunities. Feelings of powerlessness, mistrust, and insufficient political responsiveness frequently emerge within climate-related youth studies.

Barriers Affecting Environmental Awareness and Participation

Despite increasing environmental concern, several barriers continue to affect sustainability awareness and environmental engagement among young people. Research conducted by European institutions identifies factors such as:

- misinformation and greenwashing,
- insufficient sustainability education,
- economic insecurity,
- limited access to participation opportunities,
- digital misinformation,
- and lack of practical green-skills training

as major obstacles limiting effective sustainability engagement among younger generations.

Educational inequalities additionally influence environmental literacy levels significantly. Young people with greater access to environmental education programs, sustainability-oriented schools, and participatory learning environments generally demonstrate higher sustainability competences and more environmentally responsible behaviors.

For this reason, the European Union increasingly promotes sustainability education, green-skills development, and youth participation within both formal and non-formal education systems. Programs such as Erasmus+, the European Climate Pact, and sustainability-oriented youth initiatives aim to strengthen environmental literacy and support active citizenship among younger generations.



The Importance of Sustainability Education

Research consistently demonstrates that environmental awareness is strongly influenced by educational experiences and participatory learning opportunities. According to UNESCO and OECD studies, experiential learning approaches such as workshops, simulations, gamification, volunteering, and community participation activities are particularly effective in strengthening sustainability competences and promoting long-term behavioral change among young people.

Environmental education therefore plays a crucial role not only in increasing awareness regarding environmental problems, but also in supporting:

- critical thinking,
- responsible citizenship,
- practical green skills,
- collaborative problem-solving,
- and resilience regarding sustainability challenges.

As Europe continues advancing towards climate neutrality and sustainability transition, strengthening environmental awareness among younger generations remains essential for achieving long-term climate objectives and building socially resilient and environmentally responsible communities.

References

- [Eurobarometer Youth Survey 2025](#)
- European Commission – Climate Action Survey
- [OECD – Young People's Environmental Sustainability Competence](#)
- [European Environment Agency](#)
- The Lancet Planetary Health – Climate Anxiety Survey
- [European Investment Bank Climate Survey](#)
- [UNESCO – Education for Sustainable Development](#)



3.2 Everyday Sustainability Behaviors

Everyday sustainability behaviors play a fundamental role in addressing environmental challenges, reducing greenhouse gas emissions, and supporting long-term sustainable development. Individual choices related to consumption, transportation, waste management, and energy use significantly influence overall environmental impact and resource demand. Although large-scale policy reforms and technological innovation remain essential for achieving climate objectives, research increasingly demonstrates that behavioral change at household and community level represents a critical component of sustainability transition processes.

Young people are often identified as one of the social groups most willing to adopt environmentally responsible behaviors and sustainability-oriented lifestyles. At the same time, studies reveal important differences between environmental attitudes and actual behavioral practices. Factors such as economic conditions, social norms, infrastructure availability, educational opportunities, and institutional support significantly influence the extent to which sustainability awareness is translated into everyday action.

Research conducted by the European Environment Agency (EEA), the OECD, Eurobarometer surveys, and sustainability behavior studies consistently indicate that younger generations across Europe increasingly engage in sustainability-related practices connected to recycling, sustainable mobility, responsible consumption, and energy-saving habits. However, behavioral adoption remains uneven across regions and socio-economic groups.

Recycling and Waste Reduction Practices

Recycling represents one of the most widespread and visible sustainability behaviors among European citizens and younger generations. Waste separation, recycling participation, plastic reduction, and support for circular economy practices are increasingly promoted through public policies, educational campaigns, and environmental awareness initiatives across Europe.

According to Eurobarometer surveys on environmental attitudes, a majority of European citizens report regularly participating in recycling activities and reducing waste as part of their daily environmental practices. Younger respondents generally demonstrate particularly strong support for recycling policies, single-use plastic reduction, and sustainable waste management systems. ([europa.eu](https://europea.eu))

The European Union has also implemented ambitious recycling and circular economy targets in response to growing concerns regarding resource depletion and waste generation. According to Eurostat data, municipal waste recycling rates within the European Union have increased significantly during recent decades, although important differences remain between member states. Some countries recycle more than 60% of municipal waste, while others continue relying heavily on landfill systems. (ec.europa.eu)



Research conducted by the OECD indicates that younger generations generally show stronger awareness regarding the environmental consequences of overconsumption and waste generation compared to previous generations. Many young people increasingly support:

- reusable products,
- waste reduction strategies,
- ethical consumption,
- second-hand markets,
- and sustainable packaging solutions.

At the same time, studies reveal that recycling behaviors are strongly influenced by local infrastructure availability, public awareness campaigns, convenience, and trust in waste management systems. Lack of accessible recycling infrastructure and inconsistent environmental policies may reduce participation rates despite high levels of environmental concern.

Sustainable Mobility and Transportation Behaviors

Mobility and transportation choices represent another important dimension of everyday sustainability behavior. The transport sector remains one of the largest contributors to greenhouse gas emissions within Europe, making sustainable mobility practices essential for achieving climate and energy objectives.

Research conducted by the European Environment Agency demonstrates that younger generations increasingly support low-emission transportation systems and sustainable mobility solutions such as:

- public transportation,
- cycling,
- walking,
- electric mobility,
- and shared mobility services.
-

According to the European Investment Bank Climate Survey, younger Europeans are significantly more likely than older age groups to support restrictions on high-emission transport systems and to adopt environmentally conscious mobility behaviors. ([eib.org](https://www.eib.org))

Urban youth populations in particular increasingly prioritise sustainability-oriented mobility choices due to environmental awareness, economic considerations, and changing lifestyle preferences. Cycling infrastructure, pedestrian-friendly urban planning, and improved public transportation systems have contributed to increasing sustainable mobility participation across many European cities.

At the same time, important structural barriers continue to affect mobility behaviors. Limited public transportation availability, insufficient cycling infrastructure, economic inequalities, and regional accessibility differences may reduce opportunities for sustainable transportation adoption, particularly in rural or economically disadvantaged areas.

Research additionally demonstrates that mobility behaviors are influenced not only by environmental awareness but also by affordability, convenience, safety, and urban planning conditions. Sustainability transition therefore requires both behavioral change and systemic infrastructure improvements supporting low-carbon mobility options.





Responsible Consumption and Lifestyle Choices

Consumption patterns significantly influence environmental sustainability because production systems, supply chains, food systems, and consumer behavior collectively contribute to greenhouse gas emissions, waste generation, biodiversity loss, and resource depletion.

Research published by the OECD and the European Environment Agency indicates that younger generations increasingly demonstrate awareness regarding the environmental impact of consumer choices. Sustainable consumption behaviors among young people often include:

- reducing overconsumption,
- supporting ethical brands,
- avoiding fast fashion,
- purchasing second-hand products,
- reducing food waste,
- and choosing environmentally responsible products.

According to Eurobarometer environmental surveys, younger Europeans increasingly associate sustainable consumption with personal responsibility and climate action. Many respondents report attempting to reduce plastic use, avoid unnecessary purchases, and support local or environmentally responsible products whenever possible. (europa.eu)

However, studies also reveal a persistent “attitude-behavior gap,” where individuals expressing strong environmental concern do not always adopt consistent sustainable consumption practices. Financial limitations, social pressures, marketing influences, accessibility issues, and lack of affordable sustainable alternatives frequently affect consumer behavior.

Fast fashion and digital consumer culture remain particularly important sustainability challenges affecting younger populations. Research demonstrates that social media trends, online consumption habits, and short product lifecycles contribute significantly to overconsumption and environmental pressure.

For this reason, sustainability education increasingly emphasises responsible consumption, critical thinking, circular economy awareness, and ethical consumer behavior as important components of environmental citizenship and sustainability literacy.

Energy-Saving Habits and Household Behaviors

Household energy use and everyday energy-saving practices play a major role in reducing environmental impact and improving energy efficiency. Simple behavioral actions such as reducing unnecessary electricity use, adjusting heating systems, limiting water consumption, and using energy-efficient appliances can collectively contribute to substantial reductions in household emissions and energy demand.

Research conducted by the International Energy Agency (IEA) suggests that behavioral changes related to household energy use could contribute significantly to reducing global emissions and supporting energy transition objectives. (iea.org)

According to Eurobarometer surveys, many European citizens increasingly report adopting energy-saving practices due to both environmental concerns and rising energy costs. Younger generations in particular frequently express support for:

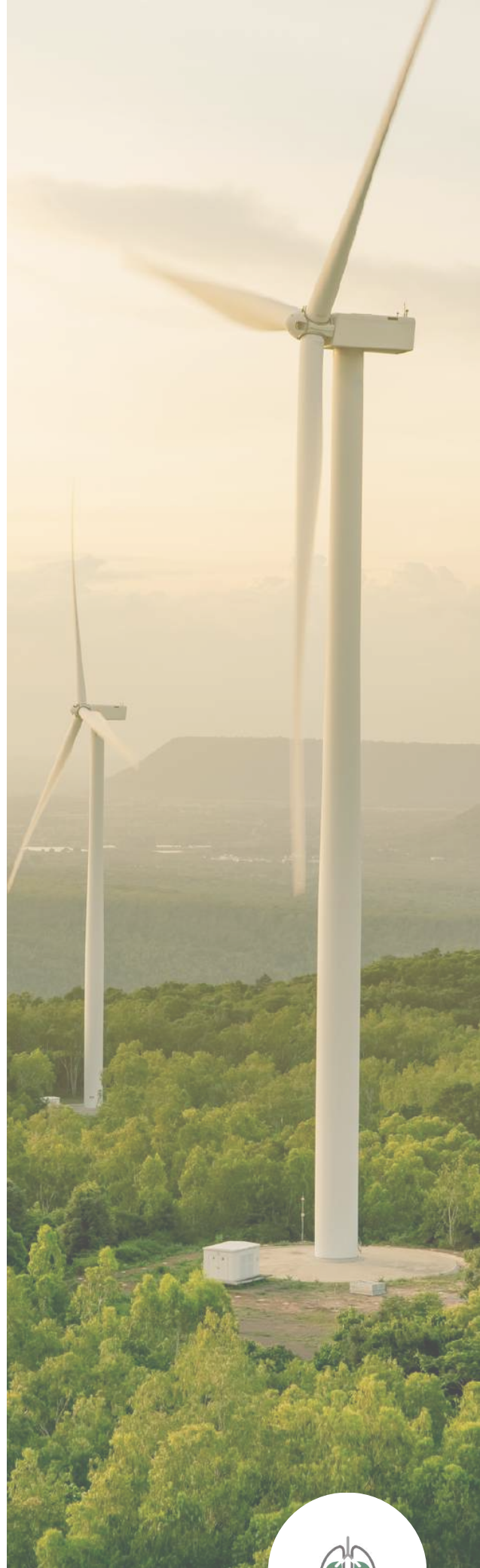
- renewable energy use,
- energy-efficient technologies,
- reduced energy waste,
- and smart energy solutions.

Common energy-saving behaviors among young people include:

- switching off unused electrical devices,
- reducing heating and cooling consumption,
- using LED lighting,
- limiting water waste,
- and selecting energy-efficient appliances.

The recent European energy crisis additionally contributed to increased public awareness regarding energy dependency, energy affordability, and the importance of efficient energy use. Rising energy prices motivated many households to adopt more energy-conscious behaviors and sustainability-oriented consumption practices.

However, studies indicate that long-term behavioral change requires more than temporary economic incentives. Sustainable energy behaviors are more likely to persist when supported by environmental education, community participation, accessible infrastructure, and broader sustainability culture.





Social Influences and Behavioral Change

Everyday sustainability behaviors are strongly influenced by social environments, peer networks, educational experiences, and cultural norms. Research in behavioral science demonstrates that individuals are more likely to adopt environmentally responsible practices when sustainability behaviors are socially visible, culturally supported, and institutionally encouraged.

Young people are particularly influenced by:

- peer learning,
- digital media,
- educational institutions,
- youth organisations,
- and online sustainability communities.

Participatory sustainability activities, volunteering initiatives, climate campaigns, and experiential learning approaches can therefore significantly strengthen environmental engagement and encourage long-term behavioral transformation.

At the same time, behavioral change alone cannot fully address environmental challenges without systemic policy support. Sustainable lifestyles require supportive infrastructure, accessible public services, affordable sustainable alternatives, and coordinated environmental governance.

Ultimately, everyday sustainability behaviors represent an essential component of the broader sustainability transition. Recycling practices, sustainable mobility choices, responsible consumption habits, and energy-saving behaviors collectively contribute to reducing environmental impact while strengthening environmental awareness, active citizenship, and long-term sustainability culture among younger generations and wider society.

References

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- [Eurostat – Municipal Waste Statistics](#)
- [European Environment Agency – Sustainable Consumption and Production](#)
- [European Investment Bank Climate Survey](#)
- [OECD – Young People’s Environmental Sustainability Competence](#)
- [International Energy Agency – Energy Efficiency and Behavioral Change](#)

3.3 Green Skills Awareness and Knowledge Gaps

The transition towards climate-neutral and sustainable societies increasingly requires the development of green skills, sustainability literacy, and environmental competences across all sectors of society. Governments, international organisations, educational institutions, and labor market actors increasingly recognise that achieving long-term sustainability objectives depends not only on technological innovation and environmental policies, but also on citizens' knowledge, competences, behaviors, and capacity to participate effectively in sustainability transition processes.

Young people are expected to play a particularly important role within the emerging green economy and sustainable labor market transformation. However, research conducted by European and international institutions demonstrates that important gaps continue to exist regarding sustainability literacy, practical green competences, digital sustainability skills, and access to environmental education opportunities.

The growing demand for green skills reflects broader economic and social changes associated with decarbonisation, renewable energy expansion, circular economy systems, sustainable mobility, environmental governance, and green technological innovation. According to the OECD and the European Center for the Development of Vocational Training (CEDEFOP), labor markets increasingly require workers capable of adapting to sustainability-oriented industries and environmentally responsible economic systems.

At the same time, studies consistently reveal that educational systems often struggle to provide young people with sufficient practical sustainability competences and interdisciplinary environmental understanding necessary for participating effectively within the green transition.

Sustainability Literacy and Environmental Competences

Sustainability literacy refers to the knowledge, skills, values, attitudes, and critical understanding required for individuals to engage responsibly with environmental, social, and economic sustainability challenges. Sustainability literacy extends beyond theoretical environmental awareness and includes the capacity to make informed decisions, evaluate environmental impacts, adopt sustainable behaviors, and participate actively in sustainability processes.

Research published by UNESCO identifies sustainability literacy as a key component of Education for Sustainable Development (ESD), emphasising that individuals must develop not only environmental knowledge but also competences related to critical thinking, systems thinking, collaboration, ethical responsibility, and problem-solving. (unesco.org)

According to OECD research on environmental sustainability competences among young people, many students across Europe demonstrate relatively high awareness regarding climate change and environmental degradation, but significantly lower confidence regarding practical sustainability problem-solving and environmental decision-making. (oecd.org)

The OECD additionally highlights that sustainability literacy often remains fragmented and inconsistent across educational systems. Environmental education is frequently integrated unevenly within curricula, while practical sustainability competences are often underdeveloped compared to theoretical environmental knowledge.



Research conducted through the Program for International Student Assessment (PISA) further demonstrates that students with stronger environmental literacy are more likely to adopt environmentally responsible behaviors and participate actively in sustainability initiatives. However, disparities linked to socio-economic background, educational quality, and access to sustainability-oriented learning opportunities continue to influence competence levels significantly.

Digital Green Skills and Technological Transformation

The rapid expansion of digitalisation and green technological innovation has created growing demand for digital green skills combining technological competences with sustainability-oriented knowledge and environmental awareness. Digital green skills increasingly include competences related to:

- smart energy systems,
- renewable energy technologies,
- environmental data analysis,
- sustainable digital infrastructure,
- AI-supported sustainability solutions,
- circular economy innovation,
- and sustainable resource management technologies.

According to the European Commission's Digital Education and Green Transition frameworks, digital and green transitions are increasingly interconnected and mutually reinforcing. Sustainable technological innovation is expected to play a major role in reducing emissions, improving energy efficiency, and supporting climate-neutral economic systems.

Research published by CEDEFOP indicates that many future professions will require hybrid competences combining environmental awareness with digital and technological skills. Green sectors such as renewable energy, sustainable construction, environmental engineering, smart mobility, and climate technology increasingly demand workers capable of adapting to both digital transformation and sustainability objectives. (cedefop.europa.eu)

However, studies also reveal substantial gaps in digital green competences among younger generations. Although many young people demonstrate strong general digital literacy, they often lack understanding regarding the environmental impacts of digital technologies and the sustainability dimensions of digital transformation processes.

Research conducted by the European Training Foundation (ETF) highlights that digitalisation itself contributes significantly to energy demand, electronic waste generation, and resource consumption. Sustainability education therefore increasingly requires integrating environmental awareness within digital education frameworks. (etf.europa.eu)

The European Union increasingly promotes digital green-skills development through initiatives connected to the Digital Education Action Plan, the European Skills Agenda, and sustainability-focused vocational training programs. Nevertheless, important inequalities remain regarding access to digital infrastructure, sustainability education, and green technological learning opportunities.





Educational Challenges and Systemic Gaps

Educational systems play a central role in supporting sustainability awareness and green-skills development. However, multiple studies indicate that current educational structures frequently face difficulties integrating sustainability competences effectively across formal and non-formal learning environments.

According to UNESCO and OECD analyses, environmental education often remains:

- fragmented,
- theory-oriented,
- insufficiently interdisciplinary,
- and disconnected from practical sustainability application.

Many schools and educational institutions continue to treat sustainability as a secondary topic rather than a cross-cutting educational priority integrated across curricula and learning environments.

Research conducted by the European Commission additionally demonstrates that educators and youth workers frequently report insufficient training, methodological support, and educational resources related to sustainability education and green competences development. (education.ec.europa.eu)

Key educational challenges identified by European and international studies include:

- limited practical sustainability learning opportunities,
- insufficient experiential learning methods,
- lack of interdisciplinary environmental education,
- unequal access to sustainability-oriented programs,
- limited teacher training in sustainability competences,
- and insufficient integration of green skills within vocational education systems.

Research additionally demonstrates that traditional educational approaches focused primarily on theoretical information are often less effective in promoting long-term behavioral change and sustainability participation. Participatory learning methods, experiential education, gamification, community engagement, and project-based sustainability activities are generally considered more effective for developing practical green competences among young people



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Green Skills and Future Employment

The increasing importance of green skills is also strongly connected to future labor market transformation. According to the International Labor Organization (ILO), the transition towards sustainable economies is expected to create millions of new jobs globally within sectors connected to renewable energy, sustainable infrastructure, environmental management, circular economy systems, and green innovation. (ilo.org)

At the same time, workers lacking sustainability competences may face increasing vulnerability within transforming labor markets. CEDEFOP research indicates that environmental transition will affect nearly all professions to varying degrees, requiring continuous reskilling and lifelong learning processes connected to sustainability adaptation.

Young people therefore increasingly require not only environmental awareness but also practical competences connected to:

- sustainable entrepreneurship,
- renewable energy systems,
- environmental project management,
- green innovation,
- sustainable consumption,
- and digital sustainability technologies.

Research additionally demonstrates that younger generations themselves increasingly recognise the importance of green competences for future employability. Eurobarometer surveys indicate growing interest among European youth regarding sustainability-oriented careers and environmentally responsible professions.

The Importance of Non-Formal Education and Youth Work

Non-formal education and youth work are increasingly recognised as important mechanisms for addressing green-skills gaps and supporting sustainability literacy development. Workshops, youth exchanges, volunteering initiatives, experiential learning activities, simulations, community projects, and gamification methods can provide practical sustainability competences often missing from traditional educational environments.

The Erasmus+ program and other European youth initiatives increasingly prioritise sustainability education, climate participation, and green-skills development within non-formal learning contexts. Youth workers and community organisations therefore play a particularly important role in supporting environmental awareness, active citizenship, and practical sustainability engagement among younger generations.

Research published by UNESCO demonstrates that participatory and experiential sustainability education approaches are particularly effective in strengthening motivation, behavioral engagement, and long-term environmental responsibility among young people.



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Ultimately, addressing green-skills awareness gaps and educational challenges requires coordinated action across educational systems, labor markets, policy frameworks, and youth participation structures. Strengthening sustainability literacy, digital green competences, and practical environmental education remains essential for supporting the green transition and ensuring that younger generations are prepared to participate actively within sustainable and climate-resilient societies.

References

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- [UNESCO – Education for Sustainable Development](#)
- [European Commission – Green Education and Sustainability](#)
- [CEDEFOP – Green Skills and Labor Market Transition](#)
- European Training Foundation – Green Skills and Sustainability Competences
- International Labor Organization – Green Jobs and Future Employment

3.4 Barriers to Sustainable Behavior

Although environmental awareness and public support for sustainability initiatives have increased significantly across Europe during recent decades, research consistently demonstrates that awareness alone does not automatically result in sustainable behavioral change. Many individuals, including young people, continue facing practical, economic, social, and structural barriers that limit their ability to adopt environmentally responsible lifestyles and participate actively in sustainability transition processes.

The gap between environmental concern and actual sustainable behavior is widely recognised within sustainability research and behavioral science as the “attitude-behavior gap.” Studies conducted by the OECD, the European Environment Agency (EEA), and European Commission research frameworks indicate that individuals frequently express strong support for climate action and environmental sustainability while simultaneously encountering obstacles that prevent consistent implementation of sustainable practices in daily life.

These barriers are often interconnected and influenced by educational inequalities, economic conditions, infrastructure limitations, institutional support, social norms, political trust, and access to sustainability-oriented opportunities. Understanding these barriers is essential for developing effective environmental education strategies, sustainability policies, and youth participation initiatives capable of supporting long-term behavioral transformation.

Lack of Awareness and Sustainability Literacy

One of the most frequently identified barriers to sustainable behavior is insufficient environmental awareness and limited sustainability literacy. Although climate change and environmental issues receive increasing media attention, research demonstrates that many individuals still lack practical understanding regarding:

- energy efficiency,
- sustainable consumption,
- renewable energy systems,
- circular economy principles,
- and the environmental impact of everyday behaviors.



According to OECD studies on environmental sustainability competences, many young people demonstrate general concern regarding environmental problems while lacking confidence in their ability to apply sustainability knowledge in practical contexts. ([oecd.org](https://www.oecd.org)) Research additionally indicates that sustainability knowledge is often fragmented and inconsistent across educational systems. Environmental topics may be addressed theoretically without providing sufficient opportunities for experiential learning, critical reflection, or practical sustainability application.

The European Commission highlights that environmental education remains unevenly integrated across European educational systems, with significant differences regarding curriculum quality, teacher training, and access to sustainability-oriented learning opportunities. (education.ec.europa.eu)

A lack of awareness may also affect understanding regarding the broader systemic dimensions of sustainability challenges. Individuals often underestimate the environmental impact of transportation systems, digital technologies, overconsumption patterns, food systems, and energy use. Research in environmental psychology demonstrates that behavioral change is more likely when individuals understand both the environmental consequences of their actions and the practical alternatives available to them.

At the same time, information overload and complex sustainability terminology may create confusion and disengagement, particularly among younger populations exposed to large volumes of digital content and conflicting environmental narratives.

Financial Limitations and Economic Inequalities

Economic factors represent one of the most significant barriers affecting sustainable behavior and participation in sustainability transition processes. Although environmentally responsible lifestyles are often promoted publicly, sustainable products, energy-efficient technologies, and low-carbon alternatives may remain financially inaccessible for many individuals and households.

Research conducted by the European Environment Agency demonstrates that low-income populations and vulnerable households frequently face greater difficulty adopting sustainable practices due to financial insecurity, limited access to sustainable infrastructure, and higher exposure to environmental risks. (eea.europa.eu)

Young people are particularly affected by economic barriers connected to sustainability participation. Rising housing costs, employment insecurity, inflation, and energy price increases significantly influence the capacity of younger generations to invest in sustainable products, green technologies, or environmentally friendly mobility options.

For example, electric vehicles, energy-efficient housing renovations, organic products, and renewable energy systems often require substantial financial investment that may not be affordable for economically vulnerable populations. Sustainable consumption behaviors may therefore become associated with socio-economic privilege rather than universally accessible practices.

Research published by the European Investment Bank Climate Survey indicates that younger Europeans strongly support climate action but frequently express concerns regarding the affordability of sustainability transition measures. (eib.org)





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Energy poverty additionally remains a growing challenge across Europe. According to European Commission estimates, millions of Europeans struggle to maintain adequate heating and cooling conditions due to rising energy costs and inefficient housing infrastructure. Energy insecurity therefore limits the ability of many households to prioritise long-term sustainability investments.

The OECD warns that sustainability transitions perceived as economically unfair or socially unequal may reduce public trust and participation in environmental policies. For this reason, many European sustainability strategies increasingly emphasise the importance of a “just transition” ensuring that climate policies remain socially inclusive and economically accessible.

Misinformation, Greenwashing, and Digital Challenges

Misinformation and misleading environmental communication increasingly represent major barriers affecting sustainability awareness and behavioral engagement. The expansion of digital media environments and social media platforms has significantly increased public exposure to inaccurate, polarised, or manipulative environmental information.

Research published by UNESCO and the European Digital Media Observatory demonstrates that climate misinformation and environmental disinformation can weaken public trust in scientific evidence, reduce climate engagement, and contribute to confusion regarding sustainability priorities. (unesco.org)

Young people are particularly exposed to digital misinformation environments due to high levels of social media use and digital content consumption. Conflicting narratives regarding climate science, sustainability policies, renewable energy systems, and environmental responsibility may reduce confidence in institutional information sources and scientific consensus.

Another important issue is “greenwashing,” referring to misleading marketing or communication practices through which companies, institutions, or organisations exaggerate or falsely present their environmental sustainability credentials. Research conducted by the European Commission indicates growing concerns regarding misleading environmental claims and insufficient transparency within sustainability-related commercial communication. (commission.europa.eu)

Greenwashing may reduce public trust in sustainability initiatives and create uncertainty regarding genuinely sustainable consumption choices. Studies demonstrate that consumers, particularly younger generations, increasingly demand reliable environmental information and transparent sustainability standards from institutions and businesses.

Digital misinformation also contributes to climate scepticism, political polarisation, and reduced support for sustainability policies. Researchers therefore increasingly emphasise the importance of media literacy, critical thinking, and evidence-based sustainability education within both formal and non-formal learning environments.



Lack of Opportunities and Structural Barriers

Sustainable behavior is strongly influenced by external conditions and structural opportunities available within communities and societies. Even individuals demonstrating high levels of environmental awareness may struggle to adopt sustainable practices when supportive infrastructure, institutional support, or participation opportunities are lacking.

Research conducted by the European Environment Agency highlights that sustainability behaviors depend heavily on:

- transportation infrastructure,
- access to recycling systems,
- availability of public transport,
- affordable sustainable products,
- community participation opportunities,
- and supportive public policies.

For example, sustainable mobility adoption is significantly more difficult in regions with limited public transportation systems or inadequate cycling infrastructure. Similarly, waste reduction and recycling behaviors are strongly influenced by the accessibility and effectiveness of local waste management systems.

Young people additionally report limited opportunities for meaningful participation in environmental decision-making processes and sustainability governance. Eurobarometer youth surveys indicate that many young Europeans feel excluded from policy discussions affecting climate and environmental futures. ([europa.eu](https://ec.europa.eu/eurobarometer/))

Educational inequalities also create participation gaps. Young people with greater access to sustainability-oriented schools, extracurricular programs, volunteering opportunities, and youth organisations generally demonstrate stronger sustainability engagement and practical environmental competences.

At the same time, rural communities, economically disadvantaged populations, and marginalised groups may experience fewer opportunities for environmental participation and sustainability education. These inequalities may reinforce broader social and environmental disparities over time.



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Behavioral Complexity and Social Norms

Sustainability behaviors are additionally influenced by habits, routines, cultural expectations, peer influence, and social norms. Behavioral science research demonstrates that individuals often prioritise convenience, affordability, and social acceptance over long-term environmental considerations.

Unsustainable consumption patterns are frequently reinforced by:

- advertising systems,
- fast-consumption culture,
- digital consumerism,
- social pressures,
- and highly carbon-intensive economic structures.

Research additionally shows that behavioral transformation is more likely when sustainable practices become socially normalised and institutionally supported. Community participation, peer learning, role models, and collaborative sustainability initiatives can therefore significantly strengthen environmental engagement and long-term behavioral adoption.

According to the International Energy Agency, combining behavioral change with policy support and technological innovation can significantly reduce emissions and accelerate sustainability transition processes. ([iea.org](https://www.iea.org))

The Importance of Inclusive Sustainability Strategies

Addressing barriers to sustainable behavior requires comprehensive and inclusive approaches combining education, economic accessibility, infrastructure development, policy support, and public participation. Research consistently demonstrates that sustainability transitions are more effective when environmental policies remain socially fair, economically accessible, and participatory.

Environmental education, non-formal learning, youth participation, and community engagement play a particularly important role in strengthening sustainability awareness and reducing behavioral barriers among younger generations. Participatory approaches, experiential learning activities, and practical sustainability opportunities help transform environmental concern into active engagement and long-term behavioral change.

Ultimately, overcoming barriers to sustainable behavior requires recognising that sustainability is not solely an individual responsibility, but also a systemic and societal challenge involving institutions, governments, educational systems, industries, and communities collectively.

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- European Commission – Green Claims and Greenwashing
- [International Energy Agency – Energy Efficiency and Behavioral Change](#)



3.5 Youth Participation in Climate and Sustainability Actions

Youth participation has emerged as one of the most significant driving forces within contemporary climate action and sustainability movements. Across Europe and globally, young people increasingly engage in environmental activism, volunteering initiatives, sustainability campaigns, community-based projects, and climate advocacy activities aimed at addressing environmental degradation, promoting social responsibility, and supporting sustainability transition processes.

International institutions including the European Commission, UNESCO, the United Nations, and the European Environment Agency increasingly recognise youth participation as essential for achieving long-term climate and sustainability objectives. Young people are viewed not only as future beneficiaries of sustainability policies but also as active contributors capable of influencing environmental awareness, behavioral transformation, public discourse, and community resilience.

Research consistently demonstrates that participation in environmental initiatives contributes positively to sustainability literacy, active citizenship, social engagement, democratic participation, and long-term environmental responsibility among younger generations. At the same time, participatory sustainability activities help transform environmental concern and climate anxiety into constructive social action and collective problem-solving.

Youth Volunteering and Environmental Engagement

Environmental volunteering has become one of the most common forms of youth participation in sustainability action across Europe. Young people increasingly participate in activities such as:

- environmental clean-up campaigns,
- tree planting initiatives,
- biodiversity conservation projects,
- recycling programs,
- climate awareness campaigns,
- sustainable mobility actions,
- and community sustainability projects.

According to Eurobarometer surveys on youth participation, younger Europeans demonstrate growing willingness to engage in voluntary activities connected to environmental sustainability and social responsibility. ([europa.eu](https://ec.europa.eu/eurobarometer))

Research conducted by UNESCO indicates that volunteering activities contribute significantly to:

- environmental awareness,
- practical green-skills development,
- intercultural cooperation,
- leadership competences,
- and community resilience.

Participatory environmental activities additionally strengthen young people's sense of agency and collective responsibility regarding climate and sustainability challenges. Studies demonstrate that young people involved in volunteering initiatives are more likely to adopt long-term sustainable behaviors and participate actively in broader civic and environmental processes.



European programs such as Erasmus+, the European Solidarity Corps, and the European Climate Pact increasingly support youth volunteering and sustainability participation through funding opportunities, mobility projects, environmental initiatives, and non-formal learning activities.

The European Solidarity Corps, for example, supports volunteering projects connected to environmental protection, biodiversity conservation, sustainable communities, and climate awareness, encouraging young people to engage directly in local and international sustainability initiatives. (youth.europa.eu)

Climate Activism and Youth Movements

Climate activism has become one of the most visible dimensions of youth participation during recent years. Young people across Europe and globally increasingly participate in climate demonstrations, advocacy campaigns, awareness movements, digital activism, and policy-oriented environmental initiatives.

Youth-led climate movements such as Fridays for Future and other grassroots environmental campaigns significantly contributed to increasing global visibility of climate issues and public pressure regarding environmental policies. These movements helped place climate change and sustainability transition at the center of public debate and political agendas across many countries.

Research published by the European Parliament and OECD demonstrates that younger generations generally express stronger support for climate policies and sustainability reforms compared to older age groups. (europarl.europa.eu)

Climate activism among young people is often motivated by:

- concerns regarding future environmental conditions,
- perceived institutional inaction,
- social justice concerns,
- intergenerational responsibility,
- and growing awareness of climate-related risks.

At the same time, research demonstrates that youth climate activism extends beyond protests and demonstrations. Many young people increasingly engage in:

- policy discussions,
- sustainability entrepreneurship,
- environmental innovation projects,
- digital awareness campaigns,
- educational initiatives,
- and local community sustainability actions.

Digital platforms and social media additionally play a major role in facilitating environmental activism and sustainability participation among younger generations. Online communities, digital campaigns, and social networks enable rapid dissemination of climate information and increase opportunities for mobilisation and collaborative participation.

However, studies also identify challenges affecting youth climate activism, including:

- climate anxiety and emotional burnout,
- political polarisation,
- misinformation and online hostility,
- limited institutional responsiveness,
- and participation fatigue.



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For this reason, researchers increasingly emphasise the importance of supportive participation environments and constructive engagement opportunities capable of transforming climate concern into sustainable long-term civic participation.

Youth Organisations and Sustainability Education

Youth organisations, NGOs, educational institutions, and community groups play a particularly important role in supporting environmental participation and sustainability engagement among young people.

Non-formal education environments often provide more participatory and experiential learning opportunities compared to traditional educational structures. Workshops, youth exchanges, environmental camps, sustainability simulations, community projects, and peer-learning activities can significantly strengthen environmental awareness and practical sustainability competences.

According to UNESCO and Erasmus+ research, youth organisations contribute substantially to:

- sustainability literacy,
- intercultural dialogue,
- social inclusion,
- active citizenship,
- and green-skills development.

Many youth organisations across Europe increasingly integrate sustainability priorities within their educational activities and strategic objectives. Environmental NGOs, youth-led initiatives, and climate networks provide opportunities for young people to engage directly with environmental governance, sustainability advocacy, and local climate action. The Erasmus+ program increasingly prioritises environmental sustainability and climate participation within youth projects, educational mobility activities, and non-formal learning initiatives. Sustainability has become one of the program's key horizontal priorities, encouraging organisations to integrate green practices and climate education across project activities. (erasmus-plus.ec.europa.eu)

Research additionally demonstrates that participation in youth organisations strengthens social capital, collaborative problem-solving, and democratic participation among younger generations. Young people involved in environmental organisations are often more likely to continue engaging in sustainability-related activities and civic participation later in life.

Community Participation and Local Sustainability Action

Community participation represents another important dimension of youth engagement within sustainability transition processes. Local communities increasingly serve as spaces where environmental awareness, collective action, and sustainability practices are implemented through collaborative participation and shared responsibility.

Young people participate in local sustainability actions through:

- community gardens,
- local recycling initiatives,
- sustainable mobility campaigns,
- energy-saving projects,
- biodiversity protection activities,
- and neighbourhood environmental actions.



Research conducted by the European Environment Agency indicates that community-based participation contributes significantly to behavioral change and sustainability engagement because local actions are often more visible, accessible, and socially meaningful for participants.

Participatory community projects also strengthen:

- social cohesion,
- environmental responsibility,
- democratic engagement,
- and local resilience.

The OECD highlights that local participation opportunities are particularly important for younger generations because they provide practical experience and strengthen confidence regarding environmental problem-solving and collective action. At the same time, opportunities for community participation remain unevenly distributed across regions and socio-economic groups. Young people living in economically disadvantaged or rural areas may face fewer opportunities for environmental engagement and sustainability participation due to infrastructure limitations, funding shortages, or limited institutional support. For this reason, European policies increasingly emphasise inclusive participation frameworks and accessible sustainability opportunities capable of engaging diverse youth populations across different social and regional contexts.

The Role of Participation in Sustainability Transition

Research consistently demonstrates that youth participation is not simply a complementary aspect of sustainability transition, but a necessary condition for achieving long-term climate and environmental objectives.

Participation contributes to:

- environmental awareness,
- behavioral transformation,
- democratic resilience,
- innovation,
- community engagement,
- and social adaptation to environmental change.

The European Commission increasingly promotes youth participation within sustainability governance frameworks through initiatives connected to the European Youth Goals, the European Climate Pact, and sustainability-focused educational policies. At the same time, researchers emphasise that participation must remain meaningful, inclusive, and supported institutionally. Young people are more likely to engage sustainably when they perceive their participation as impactful, recognised, and connected to real social and environmental outcomes. Ultimately, youth participation in climate and sustainability actions represents one of the most important foundations for building environmentally responsible, socially resilient, and climate-conscious societies. Supporting volunteering, activism, youth organisations, and community participation therefore remains essential for strengthening sustainability culture and ensuring long-term engagement in climate action across Europe and globally.

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4. Emerging Green Technologies

4.1 Renewable Energy Technologies

Renewable energy technologies play a central role in the global transition towards sustainable development, climate neutrality, and low-carbon energy systems. As governments and international institutions intensify efforts to reduce greenhouse gas emissions and dependence on fossil fuels, renewable energy sources are increasingly recognised as essential components of future energy security, environmental sustainability, and economic resilience.

According to the International Energy Agency (IEA), renewable energy capacity worldwide is expanding at unprecedented speed, driven by technological innovation, declining production costs, policy support, and growing environmental awareness. Renewable energy technologies contribute not only to emissions reduction but also to energy diversification, job creation, improved air quality, and reduced environmental degradation. ([iea.org](https://www.iea.org))

The European Union increasingly prioritises renewable energy expansion through strategies such as the European Green Deal, REPowerEU, and Fit for 55, aiming to accelerate decarbonisation and strengthen Europe's energy independence. According to the European Commission, renewable energy is expected to become the backbone of the European energy system during the coming decades. (commission.europa.eu)

Renewable energy systems differ from conventional fossil-fuel energy production because they utilise naturally replenishing resources such as sunlight, wind, water flows, and biological materials. These technologies generally produce significantly lower greenhouse gas emissions and reduced environmental pollution compared to coal, oil, and natural gas systems.

Solar Energy Technologies

Solar energy represents one of the fastest-growing renewable energy sectors globally. Solar technologies convert sunlight into electricity or thermal energy through systems such as photovoltaic (PV) panels and concentrated solar power (CSP) installations. According to the International Energy Agency, solar photovoltaic technology became the world's fastest-growing electricity source during recent years and is projected to dominate future renewable electricity expansion globally. ([iea.org](https://www.iea.org))

The rapid expansion of solar energy has been driven by substantial reductions in technology costs. Research published by the International Renewable Energy Agency (IRENA) indicates that the cost of electricity generated from utility-scale solar photovoltaic systems has declined by approximately 85% since 2010. ([irena.org](https://www.irena.org))

Solar energy technologies provide several environmental and economic advantages, including:

- low greenhouse gas emissions,
- reduced air pollution,
- decentralised energy production opportunities,
- improved energy access,
- and lower long-term operating costs.

Within Europe, countries such as Germany, Spain, Greece, and the Netherlands have significantly expanded solar infrastructure during recent years. Rooftop solar systems, community energy projects, and large-scale photovoltaic parks increasingly contribute to Europe's renewable electricity generation.

At the same time, solar technologies also face important challenges connected to:

- energy storage limitations,
- intermittency of sunlight availability,
- land-use pressures,
- and material supply chain sustainability.

Research increasingly focuses on improving solar panel efficiency, battery storage systems, recycling technologies, and smart-grid integration to enhance long-term sustainability and reliability.

Wind Energy Technologies

Wind energy represents another major component of the renewable energy transition. Wind turbines convert kinetic energy from moving air into electricity and are increasingly deployed both onshore and offshore across Europe and globally.

According to the Global Wind Energy Council, wind energy capacity worldwide continues to expand rapidly, with Europe remaining one of the leading regions for offshore wind development. (gwec.net)

Wind energy technologies produce electricity without direct carbon emissions during operation and contribute significantly to reducing dependence on fossil fuels. Offshore wind farms in particular are increasingly viewed as strategic components of Europe's long-term energy transition because they can generate large amounts of renewable electricity with relatively high efficiency.



The European Union has invested heavily in offshore wind infrastructure, especially within countries such as Denmark, Germany, the Netherlands, and Belgium. According to the European Commission, offshore renewable energy could become one of Europe's largest electricity sources by mid-century. (energy.ec.europa.eu)

Wind energy additionally contributes to:

- energy diversification,
- local economic development,
- employment creation,
- and reduced greenhouse gas emissions.

Research conducted by the International Renewable Energy Agency estimates that the renewable energy sector already supports millions of jobs globally, with wind energy representing one of the largest renewable employment sectors.

However, wind energy systems may also generate environmental and social concerns connected to:

- landscape impact,
- biodiversity disruption,
- bird and marine ecosystem effects,
- noise pollution,
- and local community opposition.

For this reason, sustainable planning and environmental impact assessments remain important components of wind energy development strategies.

Hydropower and Water-Based Energy Systems

Hydropower is one of the oldest and most established forms of renewable electricity generation. Hydroelectric systems generate energy by converting the kinetic force of flowing or falling water into electricity through turbine systems.

According to the International Hydropower Association, hydropower currently provides approximately 15% of global electricity production and remains the world's largest source of renewable electricity generation overall. ([hydropower.org](https://www.hydropower.org))

Hydropower systems offer several important advantages including:

- stable electricity generation,
- high efficiency rates,
- long infrastructure lifespan,
- and support for grid stability and energy storage.

Unlike solar and wind systems, hydropower can often provide continuous electricity production and help balance fluctuations within renewable energy grids. Pumped-storage hydropower systems additionally contribute to energy storage and grid flexibility. Many European countries rely significantly on hydropower generation, particularly countries with mountainous geography and extensive water resources such as Norway, Austria, and Switzerland.

However, hydropower infrastructure may also create substantial environmental and ecological impacts. Large dams and water diversion systems can affect:

- river ecosystems,
- fish migration patterns,
- biodiversity,
- sediment transport,
- and local communities.

Climate change additionally creates increasing uncertainty regarding water availability and hydrological stability, affecting the long-term reliability of hydropower systems in some regions. Research therefore increasingly focuses on sustainable hydropower planning, ecosystem restoration, and balancing renewable electricity production with biodiversity protection objectives.

Bioenergy and Biomass Technologies

Bioenergy refers to energy generated from biological materials such as agricultural waste, forestry residues, organic matter, and specially cultivated energy crops. Biomass can be converted into electricity, heat, liquid biofuels, or biogas through various technological processes.

According to the International Energy Agency, bioenergy currently represents one of the largest sources of renewable energy globally, particularly within heating, transport, and industrial sectors. (iea.org)

Bioenergy technologies contribute to:

- reducing fossil fuel dependence,
- utilising organic waste streams,
- supporting circular economy systems,
- and increasing energy diversification.

Biogas systems, for example, convert organic waste materials into renewable gas through anaerobic digestion processes. These technologies are increasingly used within agriculture, waste management, and local energy systems across Europe.

Advanced biofuels additionally play an important role in decarbonising sectors where direct electrification remains difficult, particularly aviation, shipping, and certain industrial activities.



However, bioenergy also remains one of the most debated renewable energy sectors due to concerns regarding:

- deforestation,
- land-use competition,
- food security impacts,
- biodiversity loss,
- and lifecycle emissions.

Environmental organisations and researchers increasingly emphasise the importance of sustainable biomass sourcing and careful environmental assessment regarding large-scale bioenergy expansion. Research published by the European Environment Agency demonstrates that bioenergy can contribute positively to sustainability objectives when based on genuinely sustainable feedstocks and circular resource management practices. However, unsustainable biomass production may generate significant environmental pressures if poorly regulated.

Renewable Energy and the Green Transition

Renewable energy technologies are increasingly viewed as fundamental components of the global green transition and climate-neutral economy. According to the International Energy Agency Net Zero Roadmap, renewable electricity generation must expand substantially during the coming decades in order to achieve international climate targets. ([iea.org](https://www.iea.org))

At the same time, research demonstrates that renewable energy expansion alone is insufficient without parallel improvements in:

- energy efficiency,
- energy storage systems,
- sustainable infrastructure,
- smart-grid technologies,
- behavioral change,
- and responsible energy consumption.

The renewable energy transition additionally creates growing demand for green skills and sustainability competences related to engineering, energy management, environmental assessment, digital technologies, and sustainable innovation. Young people are therefore expected to play an important role both as future professionals within renewable energy sectors and as active participants in sustainability transition processes.

Ultimately, renewable energy technologies represent one of the most important foundations for reducing greenhouse gas emissions, strengthening energy security, and supporting long-term environmental sustainability. Continued investment in innovation, education, infrastructure, and inclusive sustainability policies remains essential for ensuring that renewable energy systems contribute effectively to climate neutrality and sustainable development objectives.

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4.2 Smart Energy Systems and Energy Innovation

The rapid development of digital technologies, artificial intelligence, and interconnected infrastructure systems is transforming the way energy is produced, distributed, monitored, and consumed globally. Smart energy systems and digital energy innovations are increasingly recognised as essential components of the green transition because they improve energy efficiency, optimise resource management, reduce emissions, and strengthen the integration of renewable energy within modern energy networks.

Traditional energy systems were primarily based on centralised electricity generation and one-directional energy distribution models. However, the growing complexity of renewable energy integration, decentralised electricity production, and increasing energy demand has accelerated the transition towards more intelligent, flexible, and data-driven energy systems. According to the International Energy Agency (IEA), digitalisation has become one of the most important drivers of energy transition and sustainability innovation. Digital technologies increasingly support energy optimisation, predictive analysis, demand management, and emissions reduction across households, industries, transportation systems, and urban infrastructure. ([iea.org](https://www.iea.org))

At the same time, smart energy systems also create new sustainability challenges connected to cybersecurity, electronic waste, digital energy consumption, and ethical governance of data-driven technologies. For this reason, researchers increasingly emphasise the importance of combining technological innovation with sustainable governance, digital responsibility, and inclusive environmental policies.

Smart Grids and Intelligent Energy Networks

Smart grids represent one of the most important innovations within contemporary energy systems. Unlike traditional electricity networks, smart grids use digital communication technologies, sensors, automation systems, and real-time data monitoring to improve electricity distribution, optimise energy consumption, and integrate renewable energy sources more efficiently.

According to the European Commission, smart grids are essential for supporting Europe's transition towards climate-neutral and decentralised energy systems. (energy.ec.europa.eu)

Smart grid technologies allow energy systems to:

- monitor electricity demand in real time,
- improve grid stability and efficiency,
- integrate renewable energy sources,
- reduce transmission losses,
- optimise electricity distribution,
- and support flexible energy consumption patterns.



One of the key advantages of smart grids is their ability to facilitate the integration of renewable energy systems such as solar and wind power, which often produce variable electricity output depending on weather conditions. Intelligent grid systems can respond dynamically to fluctuations in supply and demand, improving overall energy-system reliability and resilience. Research published by the International Energy Agency suggests that digital grid technologies could substantially improve energy efficiency and reduce operational emissions within electricity networks globally. Smart-grid systems additionally support energy storage integration and distributed energy production models such as community solar systems and household renewable-energy generation.

Smart meters represent another important component of intelligent energy networks. These digital devices allow households and consumers to monitor electricity consumption more accurately and improve awareness regarding energy-use behaviors. Studies conducted by the European Commission indicate that smart metering systems can contribute to energy savings by encouraging more conscious energy consumption patterns. At the same time, smart-grid development requires substantial investment in infrastructure modernisation, cybersecurity protection, digital interoperability, and technological standardisation. Concerns regarding data privacy, digital vulnerabilities, and unequal technological access additionally remain important policy considerations within smart energy governance.

Smart Homes and Energy-Efficient Living

Smart-home technologies are increasingly transforming household energy management and sustainability practices. Smart homes utilise interconnected digital systems and automated technologies to optimise energy use, improve efficiency, and reduce unnecessary energy consumption.

According to the International Energy Agency, buildings account for approximately 30% of global final energy consumption and a significant share of greenhouse gas emissions, making residential energy optimisation a major sustainability priority. (iea.org)

Smart-home technologies commonly include:

- intelligent heating and cooling systems,
- smart lighting,
- automated energy management systems,
- connected household appliances,
- occupancy sensors,
- and real-time energy monitoring applications.

These systems allow households to reduce unnecessary electricity use and optimise energy performance based on behavioral patterns and environmental conditions. Research demonstrates that smart-home technologies can significantly reduce residential energy demand and improve energy efficiency outcomes.

For example, intelligent thermostats can automatically regulate heating and cooling systems according to occupancy patterns and weather conditions, while smart lighting systems reduce electricity consumption by adjusting illumination levels dynamically. The European Union increasingly promotes smart-building technologies through sustainability strategies connected to the Energy Performance of Buildings Directive (EPBD) and the European Green Deal.



According to the European Commission, improving building energy performance remains one of the most cost-effective pathways for reducing emissions and supporting climate neutrality objectives. (commission.europa.eu)

However, researchers also highlight important accessibility challenges connected to smart-home adoption. High installation costs, digital inequalities, technological complexity, and lack of awareness may limit access to smart energy technologies for lower-income households and vulnerable populations.

Artificial Intelligence and Energy Efficiency

Artificial intelligence (AI) is increasingly being applied within energy systems to improve efficiency, optimise resource management, and support sustainability transition processes. AI technologies analyse large volumes of energy-related data and use predictive algorithms to identify patterns, forecast demand, optimise consumption, and improve operational efficiency across energy infrastructures.

According to research published by the International Energy Agency, AI applications could significantly improve energy efficiency across sectors such as:

- electricity distribution,
- industrial production,
- transport systems,
- smart buildings,
- renewable energy forecasting,
- and urban infrastructure management. ([iea.org](https://www.iea.org))

AI technologies are increasingly used to:

- predict electricity demand fluctuations,
- optimise renewable energy integration,
- improve battery storage management,
- reduce industrial energy waste,
- monitor emissions,
- and automate energy-saving processes.

Within smart cities, AI-supported systems can optimise traffic flows, public transportation systems, waste management, water distribution, and urban energy consumption. Research demonstrates that intelligent urban systems can significantly reduce emissions and improve sustainability performance when implemented effectively.

AI also contributes to predictive maintenance systems within renewable energy infrastructure. Wind turbines, solar installations, and industrial energy systems increasingly use AI-based monitoring technologies to detect operational inefficiencies and reduce maintenance costs.

However, the growing use of artificial intelligence additionally raises important sustainability concerns. Large-scale AI systems and data centers require substantial electricity consumption and digital infrastructure resources. According to the International Energy Agency, global data-center electricity demand continues increasing rapidly due to expanding digitalisation and AI applications.



Researchers therefore increasingly emphasise the importance of “sustainable AI” approaches that minimise environmental impact while maximising energy-efficiency benefits. Ethical governance, transparency, cybersecurity, and responsible digital infrastructure development also remain important policy priorities within AI-supported sustainability systems.

Digital Sustainability and Green Digital Transition

Digital sustainability refers to the integration of digital technologies and sustainability objectives in ways that support environmental protection, efficient resource use, and climate mitigation while minimising negative environmental impacts associated with digitalisation itself.

The European Union increasingly recognises the strong interconnection between the digital transition and the green transition. According to the European Commission, digital technologies can significantly contribute to achieving climate-neutrality objectives through improved efficiency, environmental monitoring, and sustainable infrastructure management. (digital-strategy.ec.europa.eu)

Digital sustainability initiatives include:

- smart-city systems,
- digital environmental monitoring,
- sustainable cloud infrastructure,
- intelligent transportation systems,
- precision agriculture technologies,
- circular-economy platforms,
- and energy-optimisation applications.

Research conducted by the European Environment Agency demonstrates that digital technologies can support emissions reduction and environmental management if implemented responsibly and combined with sustainability-focused governance frameworks.

However, digitalisation also contributes to growing environmental pressures through:

- increasing electricity demand,
- electronic waste generation,
- critical raw material extraction,
- and resource-intensive digital infrastructure production.

The production and disposal of electronic devices create significant sustainability challenges linked to rare-earth mineral extraction, waste management, and lifecycle emissions. According to the Global E-Waste Monitor, electronic waste generation continues increasing rapidly worldwide, while recycling rates remain insufficient in many regions. (ewastemonitor.info)

For this reason, digital sustainability increasingly emphasises:

- responsible technology design,
- energy-efficient digital systems,
- circular electronics production,
- sustainable data infrastructure,
- and environmentally responsible digital consumption practices.



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Smart Energy Systems and the Future Green Transition

Smart energy systems and digital innovations are expected to play a major role in achieving long-term sustainability and climate objectives across Europe and globally. According to the International Energy Agency Net Zero Roadmap, digitalisation and smart infrastructure will be essential for integrating renewable energy, improving efficiency, and supporting low-carbon energy systems. ([iea.org](https://www.iea.org))

At the same time, researchers consistently emphasise that technological innovation alone is insufficient for achieving sustainability transition objectives. Effective green transition additionally requires:

- behavioral change,
- sustainability education,
- digital literacy,
- ethical governance,
- inclusive access to technologies,
- and public participation.

The expansion of smart energy systems also creates increasing demand for green digital skills and sustainability competences among younger generations. Future labor markets are expected to require professionals capable of combining environmental awareness with technological and digital expertise.

Ultimately, smart energy systems and digital sustainability innovations represent powerful tools capable of improving energy efficiency, reducing emissions, and supporting climate resilience. However, ensuring that these technologies contribute effectively to sustainable development requires responsible governance, inclusive access, environmental awareness, and long-term integration between digital innovation and sustainability objectives.

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4.3 Sustainable Mobility and Green Transportation

The transportation sector plays a central role in global sustainability and climate transition strategies because it remains one of the largest contributors to greenhouse gas emissions, fossil fuel consumption, air pollution, and urban environmental degradation. Across Europe and globally, governments and international institutions increasingly recognise that achieving climate neutrality and environmental sustainability requires substantial transformation of mobility systems, transportation infrastructure, and everyday travel behaviors.

Sustainable mobility refers to transportation systems designed to minimise environmental impact while remaining accessible, efficient, inclusive, and economically viable. Sustainable transportation strategies promote low-emission mobility solutions, energy-efficient transport systems, reduced dependence on fossil fuels, and environmentally responsible urban planning.

According to the European Environment Agency (EEA), transportation currently accounts for approximately 25% of total greenhouse gas emissions within the European Union, making it one of the most environmentally intensive sectors across Europe. Road transportation alone contributes nearly 72% of transport-related emissions. (eea.europa.eu)

The European Union therefore increasingly prioritises sustainable mobility within major policy frameworks such as the European Green Deal, the Sustainable and Smart Mobility Strategy, and the Fit for 55 package. These policies aim to reduce transport emissions, improve urban sustainability, strengthen energy efficiency, and accelerate the transition towards low-carbon transportation systems.

At the same time, sustainable mobility is increasingly connected not only to environmental objectives but also to public health, urban quality of life, social inclusion, technological innovation, and economic resilience.

Electric Vehicles and Low-Emission Mobility

Electric vehicles (EVs) have become one of the most visible and rapidly expanding components of the global green transportation transition. Unlike conventional internal combustion engine vehicles, electric vehicles use battery-powered electric motors and produce no direct tailpipe emissions during operation.

According to the International Energy Agency (IEA), global electric vehicle sales reached record levels during recent years, with Europe representing one of the largest EV markets worldwide. ([iea.org](https://www.iea.org))

The expansion of electric mobility is driven by several factors including:

- climate policies,
- declining battery costs,
- stricter emissions regulations,
- technological innovation,
- and increasing public environmental awareness.

Electric vehicles contribute to sustainability objectives by reducing greenhouse gas emissions, improving urban air quality, and decreasing dependence on fossil fuels, particularly when combined with renewable electricity generation systems.

Research conducted by the European Environment Agency demonstrates that electric vehicles generally produce significantly lower lifecycle emissions compared to conventional petrol and diesel vehicles, especially within electricity systems increasingly powered by renewable energy sources. (eea.europa.eu)

The European Union increasingly supports EV adoption through:

- public charging infrastructure development,
- emissions standards for vehicles,
- incentives for low-emission transport,
- and investment in battery innovation and clean mobility systems.

Countries such as Norway, the Netherlands, Germany, and Sweden have become global leaders in electric mobility adoption due to supportive policy frameworks and extensive charging infrastructure networks.

However, researchers also identify important sustainability challenges connected to electric mobility systems. Battery production requires critical raw materials such as lithium, cobalt, and nickel, raising concerns regarding:

- mining impacts,
- resource extraction,
- labor conditions,
- geopolitical dependency,
- and environmental sustainability of supply chains.

Battery disposal and recycling additionally represent emerging sustainability challenges requiring circular economy approaches and responsible resource management systems.





Public Transportation and Sustainable Urban Mobility

Public transportation systems represent one of the most effective strategies for reducing urban emissions, traffic congestion, energy consumption, and environmental pollution. Sustainable public transport networks contribute significantly to climate mitigation while simultaneously improving accessibility, social inclusion, and urban quality of life.

Research conducted by the European Commission demonstrates that shifting from private car dependency towards sustainable public transportation can substantially reduce greenhouse gas emissions and improve energy efficiency across urban areas. (transport.ec.europa.eu)

Sustainable public transportation systems commonly include:

- electric buses,
- metro and tram systems,
- rail infrastructure,
- low-emission urban mobility networks,
- and integrated multimodal transportation systems.

Many European cities increasingly invest in public transport electrification and sustainable urban planning strategies aimed at reducing private vehicle dependence and promoting environmentally responsible mobility behaviors.

Cities such as Copenhagen, Amsterdam, Vienna, and Paris have implemented large-scale sustainable mobility initiatives combining public transportation improvements, cycling infrastructure expansion, low-emission zones, and pedestrian-friendly urban design.

Research additionally demonstrates that accessible and affordable public transportation contributes positively to:

- social inclusion,
- public health,
- economic participation,
- and community resilience.

At the same time, sustainable transport adoption remains strongly influenced by infrastructure quality, affordability, accessibility, and public trust in transportation systems. Rural regions and economically disadvantaged communities often face greater mobility inequalities due to limited transport infrastructure and fewer sustainable mobility alternatives.

The European Green Deal and Sustainable and Smart Mobility Strategy therefore emphasise the importance of creating inclusive and accessible transport systems capable of supporting both environmental sustainability and social cohesion.

Cycling Infrastructure and Active Mobility

Cycling and active mobility systems have become increasingly important components of sustainable urban development and low-carbon transportation strategies. Cycling represents one of the most energy-efficient and environmentally sustainable transport modes because it produces virtually no direct emissions while contributing positively to public health and urban liveability.

According to the European Cyclists' Federation, investments in cycling infrastructure can significantly reduce urban emissions, improve air quality, and strengthen sustainable mobility participation across cities. (ecf.com)

Research conducted by the European Environment Agency indicates that active mobility systems such as cycling and walking additionally contribute to:

- reduced traffic congestion,
- improved physical health,
- lower noise pollution,
- and increased urban sustainability.

Many European cities increasingly prioritise cycling infrastructure development through:

- protected bicycle lanes,
- bike-sharing systems,
- traffic-calming measures,
- pedestrian-friendly design,
- and integrated sustainable mobility planning.

Cities such as Copenhagen and Amsterdam are internationally recognised for extensive cycling infrastructure networks and high rates of bicycle use within everyday transportation systems. In Copenhagen, bicycles are used for a substantial proportion of daily commuting trips due to long-term investments in safe cycling infrastructure and mobility-oriented urban planning.

Research additionally demonstrates that cycling infrastructure development contributes positively to public health outcomes by encouraging physical activity and reducing exposure to air pollution associated with car-intensive urban environments.



However, active mobility adoption is strongly influenced by factors such as:

- infrastructure safety,
- urban design,
- weather conditions,
- social norms,
- and accessibility.

Inadequate infrastructure and traffic safety concerns often remain significant barriers limiting cycling participation in many cities and regions.

Mobility Innovation and Smart Transportation Systems

Technological innovation increasingly shapes the future of sustainable mobility through the development of intelligent transportation systems, digital mobility platforms, shared mobility services, and low-emission transportation technologies. According to the European Commission's Sustainable and Smart Mobility Strategy, digital innovation and smart mobility technologies will play a major role in reducing emissions and improving transportation efficiency across Europe. ([transportec.europa.eu](https://transport.ec.europa.eu))

Emerging mobility innovations include:

- autonomous electric vehicles,
- smart traffic management systems,
- shared mobility platforms,
- mobility-as-a-service (MaaS) systems,
- AI-supported transportation optimisation,
- and connected urban mobility infrastructure.

Shared mobility systems such as bike-sharing, electric scooters, and car-sharing services increasingly contribute to reducing private car ownership and improving urban transport efficiency.

Artificial intelligence and digital data systems are additionally used to optimise:

- traffic flows,
- route planning,
- public transport scheduling,
- and energy-efficient transportation management.

Research demonstrates that smart mobility technologies can significantly reduce congestion and transport-related emissions when integrated effectively within broader sustainability strategies.

However, researchers also emphasise important concerns connected to:

- digital inequalities,
- cybersecurity risks,
- data privacy,
- infrastructure costs,
- and unequal access to technological innovation.

The environmental sustainability of digital transport systems additionally depends on renewable energy integration, responsible technology production, and long-term infrastructure planning.

Sustainable Mobility and the Green Transition

Sustainable mobility is increasingly recognised as a key pillar of the broader green transition and climate neutrality agenda. According to the International Energy Agency Net Zero Roadmap, transport emissions must decline substantially during the coming decades through a combination of electrification, behavioral change, public transport expansion, and sustainable urban planning. ([iea.org](https://www.iea.org))

At the same time, research consistently demonstrates that technological innovation alone is insufficient to achieve sustainable mobility objectives. Long-term transformation additionally requires:

- behavioral adaptation,
- sustainable urban development,
- public participation,
- infrastructure investment,
- environmental education,
- and policy coordination.

Young people increasingly play an important role within sustainable mobility transition processes because they generally demonstrate stronger support for low-emission transportation systems, active mobility practices, and environmentally responsible urban lifestyles compared to previous generations. Sustainable mobility also contributes to broader sustainability goals connected to public health, social inclusion, energy efficiency, climate resilience, and urban wellbeing. For this reason, transportation transition increasingly represents not only an environmental issue but also a major social, technological, and economic transformation process shaping future sustainable societies.

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4.4 Circular Economy and Green Innovation

The circular economy has emerged as one of the most important sustainability frameworks supporting the transition towards environmentally responsible, resource-efficient, and climate-resilient societies. Unlike traditional linear economic models based on “take-produce-dispose” patterns, circular economy systems aim to minimise waste generation, extend product lifecycles, optimise resource use, and promote sustainable production and consumption practices.

The increasing global demand for natural resources, combined with growing waste generation, environmental degradation, and climate pressures, has intensified the need for economic systems capable of reducing resource extraction and improving material efficiency. According to the European Commission, the circular economy represents a fundamental component of the European Green Deal and Europe’s broader sustainability transition strategy. (environment.ec.europa.eu)

Research conducted by international organisations including the OECD, the United Nations Environment Program (UNEP), and the European Environment Agency demonstrates that current global consumption patterns remain highly resource-intensive and environmentally unsustainable. Global material extraction has more than tripled during the last five decades, while waste generation and environmental pollution continue increasing rapidly.

Circular economy systems therefore aim to decouple economic growth from excessive resource consumption and environmental degradation through innovation, sustainable design, recycling technologies, and responsible production systems.

Circular Economy Principles and Sustainability Transition

The circular economy is based on several interconnected principles designed to improve sustainability and reduce environmental impact throughout product and resource lifecycles. Key circular economy principles include:

- reducing resource consumption,
- reusing materials and products,
- repairing and extending product lifecycles,
- recycling waste materials,
- regenerating natural systems,
- and minimising environmental pollution.

According to the Ellen MacArthur Foundation, circular economy approaches can contribute substantially to reducing greenhouse gas emissions, improving resource security, and supporting sustainable economic development. (ellenmacarthurfoundation.org)

The European Union increasingly integrates circular economy principles within industrial policy, waste management systems, sustainable product design regulations, and environmental innovation strategies. The Circular Economy Action Plan specifically promotes:

- sustainable product lifecycles,
- resource-efficient manufacturing,
- repairability and recyclability standards,
- waste reduction systems,
- and sustainable consumer practices.



Research published by the European Commission estimates that circular economy implementation could significantly reduce greenhouse gas emissions while simultaneously generating economic growth opportunities and supporting employment within sustainability-oriented sectors.

At the same time, researchers emphasise that achieving circularity requires systemic transformation involving industries, governments, consumers, educational systems, and technological innovation processes collectively.

Recycling Technologies and Resource Recovery Systems

Recycling technologies represent one of the most visible and widely implemented components of circular economy systems. Recycling aims to recover valuable materials from waste streams and reintroduce them into production processes, reducing demand for virgin raw materials and limiting environmental pollution.

According to Eurostat data, municipal waste recycling rates within the European Union have increased significantly during recent decades, although important differences remain between member states. Some European countries recycle more than 60% of municipal waste, while others continue relying heavily on landfill disposal systems. (ec.europa.eu)

Modern recycling technologies increasingly use advanced sorting systems, robotics, artificial intelligence, and automated material recovery processes to improve recycling efficiency and resource recovery rates. Emerging recycling innovations include:

- AI-supported waste sorting systems,
- chemical recycling technologies,
- plastic depolymerisation methods,
- electronic waste recovery systems,
- and automated material separation technologies.

Research published by the OECD indicates that improving recycling systems and material recovery infrastructure is essential for reducing environmental pressures linked to resource extraction, waste generation, and industrial emissions.

Electronic waste (e-waste) management has become particularly important due to rapid digitalisation and increasing consumption of electronic devices. According to the Global E-Waste Monitor, more than 60 million tonnes of electronic waste are generated globally each year, while recycling and recovery rates remain insufficient in many regions. (ewastemonitor.info)

Electronic devices contain valuable materials including rare-earth elements, copper, lithium, and precious metals, making efficient recycling systems increasingly important both economically and environmentally.

However, researchers also highlight limitations of recycling systems alone. Many products remain difficult to recycle due to complex material composition, poor product design, and inadequate collection infrastructure. For this reason, sustainability experts increasingly emphasise that reducing consumption and improving product durability are equally important components of circular economy strategies.



Sustainable Production and Eco-Innovation

Sustainable production systems aim to minimise environmental impact throughout manufacturing and industrial processes by improving energy efficiency, reducing waste generation, lowering emissions, and optimising resource use. According to the United Nations Industrial Development Organization (UNIDO), sustainable industrial production is essential for achieving climate objectives and long-term resource security. (unido.org)

Green innovation and eco-innovation increasingly support sustainable production through the development of:

- low-carbon manufacturing systems,
- biodegradable materials,
- sustainable packaging solutions,
- renewable industrial energy systems,
- resource-efficient production methods,
- and circular product design models.

Eco-design principles aim to create products that are:

- durable,
- repairable,
- recyclable,
- energy-efficient,
- and environmentally sustainable throughout their lifecycle.

The European Union increasingly promotes sustainable product policies requiring improved durability, repairability, and recyclability standards for consumer goods and electronic products.

Research additionally demonstrates that sustainable production can contribute positively to:

- emissions reduction,
- energy efficiency,
- reduced operational costs,
- innovation competitiveness,
- and sustainable employment creation.

Circular economy systems also increasingly encourage industrial symbiosis approaches, where waste materials from one industrial process become resources for another production system. Such approaches contribute to resource optimisation and reduced environmental pressure. However, transitioning towards sustainable production systems often requires substantial investment, technological adaptation, policy support, and supply-chain transformation. Small and medium-sized enterprises may face particular difficulties implementing advanced circular economy technologies due to financial and technical limitations.



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Waste Reduction Systems and Zero-Waste Strategies

Waste reduction represents a central objective of circular economy and sustainability transition strategies. Current global waste generation levels create significant environmental pressures linked to landfill expansion, pollution, greenhouse gas emissions, and ecosystem degradation. According to the World Bank, global municipal solid waste generation is expected to increase dramatically during coming decades if current consumption patterns continue unchanged. (worldbank.org)

Waste reduction systems therefore increasingly focus on preventing waste generation rather than managing waste after disposal. Common waste reduction approaches include:

- reusable product systems,
- sustainable packaging reduction,
- food waste prevention,
- repair and reuse initiatives,
- sharing economy models,
- and zero-waste community strategies.

Food waste has become a particularly important sustainability challenge. According to UNEP Food Waste Index reports, approximately one-third of food produced globally is lost or wasted annually, generating substantial environmental and economic impacts. (unep.org)

Waste prevention strategies increasingly integrate digital technologies and smart-management systems capable of improving resource monitoring, waste collection optimisation, and circular resource management. Smart bins, sensor-based collection systems, and AI-supported waste analysis technologies are increasingly used within urban sustainability systems.

The European Union additionally promotes “zero-waste” approaches encouraging communities, institutions, and businesses to reduce unnecessary consumption and prioritise reuse, repair, and sustainable product design.

Circular Economy and Green Employment

The circular economy transition is expected to create substantial opportunities for green innovation, sustainable entrepreneurship, and environmentally focused employment sectors. According to European Commission estimates, circular economy initiatives could create hundreds of thousands of new jobs within Europe related to recycling, repair services, renewable materials, sustainable logistics, and environmental innovation.

Young people are increasingly expected to play an important role within circular economy transformation processes as future professionals, entrepreneurs, consumers, and sustainability innovators. Green skills connected to resource management, eco-design, digital sustainability, waste reduction systems, and circular business models are becoming increasingly important within evolving labor markets.

Educational systems and non-formal learning environments therefore increasingly integrate circular economy concepts within sustainability education and green-skills development programs.



Circular Economy and the Future of Sustainability

Research consistently demonstrates that achieving long-term sustainability and climate objectives requires moving beyond linear economic systems towards more regenerative and resource-efficient development models. Circular economy approaches contribute significantly to:

- reducing emissions,
- improving resource efficiency,
- strengthening resilience,
- minimising waste,
- and supporting sustainable innovation.

However, researchers also emphasise that technological solutions alone are insufficient without broader behavioral and systemic transformation. Responsible consumption, sustainability education, environmental awareness, and supportive policy frameworks remain essential for ensuring successful circular economy implementation.

The transition towards circular systems therefore requires cooperation between governments, industries, educational institutions, communities, and citizens collectively. Young people, in particular, increasingly represent important actors capable of supporting circular economy innovation, sustainable lifestyles, and long-term environmental responsibility across Europe and globally.

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4.5 Future Trends in Green Technology

The accelerating climate crisis, growing environmental pressures, rapid digital transformation, and increasing global demand for sustainable development are driving significant innovation within green technologies and sustainability-oriented industries. Governments, research institutions, businesses, and international organisations increasingly recognise that future economic resilience and environmental sustainability will depend heavily on technological innovation capable of reducing emissions, improving resource efficiency, supporting renewable energy systems, and strengthening climate adaptation capacities.

Green technologies are therefore expected to play a fundamental role in shaping future sustainable societies, transforming industries, urban systems, mobility networks, energy infrastructures, production models, and everyday lifestyles. According to the International Energy Agency (IEA), clean energy technologies alone are projected to become one of the largest global economic sectors during the coming decades. ([iea.org](https://www.iea.org))

At the same time, future sustainability transitions are increasingly understood as multidimensional processes combining technological innovation with social transformation, behavioral adaptation, environmental governance, and economic restructuring. Emerging green technologies therefore aim not only to improve environmental performance but also to support resilience, inclusiveness, public wellbeing, and long-term sustainable development.



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Innovation Trends in Green Technology

Green innovation continues to expand rapidly across sectors including renewable energy, transportation, digital infrastructure, agriculture, construction, manufacturing, and environmental monitoring systems. Technological development increasingly focuses on reducing emissions, improving efficiency, strengthening circular economy systems, and supporting climate adaptation strategies.

According to the International Energy Agency and the International Renewable Energy Agency (IRENA), investment in clean-energy technologies has reached historically high levels due to increasing climate commitments and growing demand for sustainable infrastructure. ([irena.org](https://www.irena.org))

Several major innovation trends are expected to shape future sustainability systems, including:

- advanced renewable energy systems,
- energy-storage technologies,
- hydrogen energy solutions,
- smart-grid infrastructure,
- carbon capture technologies,
- artificial intelligence applications,
- sustainable materials innovation,
- and climate-adaptation technologies.

Battery innovation represents one of the fastest-developing sectors within green technology due to the rapid expansion of electric mobility and renewable energy systems. Research increasingly focuses on improving battery efficiency, reducing critical material dependency, increasing recycling rates, and developing safer and more sustainable storage systems.

Green hydrogen technologies are also attracting significant international attention as potential solutions for decarbonising industries and transportation sectors that are difficult to electrify directly. According to the European Commission Hydrogen Strategy, renewable hydrogen may become a key component of Europe's climate-neutral energy system. (energy.ec.europa.eu)

Artificial intelligence and digital sustainability technologies additionally continue expanding within environmental management systems, renewable energy optimisation, precision agriculture, smart infrastructure, and climate monitoring applications.

At the same time, researchers increasingly emphasise that technological innovation must remain aligned with sustainability principles and ethical governance frameworks. Green technologies may also generate environmental pressures connected to resource extraction, energy demand, electronic waste, and social inequalities if implemented without adequate sustainability planning.



Green Entrepreneurship and Sustainable Business Innovation

Green entrepreneurship has emerged as one of the most dynamic sectors within the sustainability transition and green economy transformation. Green entrepreneurs develop products, services, technologies, and business models aimed at addressing environmental challenges while simultaneously generating economic value and supporting sustainable development objectives.

According to the Organisation for Economic Co-operation and Development (OECD), sustainable entrepreneurship plays a crucial role in accelerating climate innovation, supporting low-carbon industries, and promoting circular economy systems. (oecd.org)

Green start-ups and sustainability-oriented enterprises increasingly focus on areas such as:

- renewable energy solutions,
- circular economy platforms,
- sustainable mobility services,
- waste-reduction technologies,
- sustainable fashion and production,
- environmental consulting,
- climate-tech innovation,
- and eco-design products.
-

Research published by the World Economic Forum suggests that green innovation and sustainable business sectors are expected to generate substantial economic growth and employment opportunities during the coming decades. (weforum.org)

Young people increasingly participate in sustainability entrepreneurship through climate-tech initiatives, environmental social enterprises, digital sustainability projects, and green innovation networks. The European Union increasingly supports youth entrepreneurship connected to sustainability through programs such as Erasmus for Young Entrepreneurs, Horizon Europe, and climate-focused innovation funding mechanisms.

At the same time, green entrepreneurs often face important challenges connected to:

- limited funding access,
- regulatory complexity,
- market uncertainty,
- technological adaptation costs,
- and competition with established high-emission industries.

Research additionally demonstrates that sustainability entrepreneurship requires interdisciplinary competences combining environmental awareness, digital literacy, innovation skills, and business-management capabilities.

Sustainable Cities and Smart Urban Development

Urban areas are expected to play a particularly important role within future sustainability transition processes because cities currently account for a large share of global emissions, energy consumption, waste generation, and resource demand. According to the United Nations, approximately 70% of global greenhouse gas emissions are linked to urban activities and infrastructure systems. (un.org)

Sustainable cities aim to reduce environmental impact while improving quality of life, resilience, accessibility, and social inclusion through integrated sustainability planning and green innovation.

Future urban sustainability strategies increasingly include:

- smart energy systems,
- low-emission transportation networks,
- green buildings,
- urban renewable energy systems,
- circular waste-management infrastructure,
- climate-resilient urban planning,
- and digital environmental monitoring technologies.

According to the European Commission's Smart Cities Marketplace initiative, digital innovation and sustainability integration are essential for creating climate-neutral and resource-efficient urban environments. (smart-cities-marketplace.ec.europa.eu)

Many cities across Europe increasingly implement "smart city" systems combining digital technologies with sustainability objectives. Examples include:

- intelligent traffic-management systems,
- sensor-based environmental monitoring,
- smart public transportation,
- AI-supported energy management,
- and digitally integrated public services.

Nature-based urban solutions additionally represent an increasingly important sustainability trend. Green roofs, urban forests, biodiversity corridors, sustainable drainage systems, and climate-adaptive public spaces contribute to reducing urban heat stress, improving air quality, and strengthening urban resilience against climate impacts.

Research published by the European Environment Agency demonstrates that sustainable urban transformation requires not only technological innovation but also community participation, inclusive governance, and socially equitable planning approaches.

Future Sustainability Solutions and Climate Innovation

Future sustainability solutions increasingly combine environmental science, technological innovation, digital systems, and behavioral transformation in order to address interconnected climate and sustainability challenges.

Several emerging sustainability technologies are expected to play important roles during coming decades, including:

- carbon capture and storage systems (CCS),
- direct air carbon removal technologies,
- sustainable aviation fuels,
- advanced recycling systems,
- biodegradable materials,
- vertical farming and precision agriculture,
- ocean-based renewable energy systems,
- and climate-resilient infrastructure technologies.



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Carbon capture technologies aim to reduce industrial emissions by capturing carbon dioxide before it enters the atmosphere and storing or reusing it within industrial systems. Although still developing, such technologies are increasingly included within international climate mitigation scenarios.

Precision agriculture technologies also represent important sustainability innovations because they improve water efficiency, reduce pesticide use, optimise crop management, and support food-system resilience through AI-supported environmental monitoring systems.

According to UNEP and OECD research, climate adaptation technologies will become increasingly important as societies experience more frequent climate-related risks such as droughts, floods, extreme heat events, and biodiversity loss.

However, researchers consistently warn that future sustainability solutions cannot rely exclusively on technological innovation. Environmental challenges are deeply connected to consumption systems, social inequalities, governance structures, and behavioral patterns. For this reason, sustainability transitions increasingly require integrated approaches combining:

- technology,
- education,
- public participation,
- policy reform,
- ethical governance,
- and sustainable lifestyles.

Green Skills and Future Workforce Transformation

The expansion of green technologies is expected to transform labor markets significantly and create growing demand for green skills and sustainability competences. According to the International Labor Organization (ILO), the green transition could generate millions of new jobs globally across renewable energy, sustainable infrastructure, environmental management, and climate innovation sectors. (ilo.org)

Future professionals will increasingly require interdisciplinary competences combining:

- environmental literacy,
- digital skills,
- innovation capacities,
- sustainability management,
- technological adaptation,
- and systems thinking.

Young people are therefore expected to play a particularly important role both as future sustainability professionals and as active participants shaping environmentally responsible lifestyles, innovation cultures, and sustainable economic systems.

Educational systems, youth organisations, and non-formal learning initiatives increasingly integrate sustainability education and green-skills development in order to prepare younger generations for emerging green economies and climate-transition labor markets.



The Future of Green Technology and Sustainable Societies

Green technologies and sustainability innovations are expected to become increasingly central to economic development, environmental governance, and social resilience during the coming decades. Renewable energy systems, smart infrastructure, sustainable mobility, circular economy technologies, and climate adaptation innovations all contribute to reducing environmental impact and strengthening long-term sustainability capacities.

At the same time, researchers consistently emphasise that technology alone cannot solve environmental challenges without broader social transformation and behavioral change. Achieving sustainable futures requires collaboration between governments, industries, educational systems, communities, researchers, and citizens collectively.

Ultimately, future sustainability transitions will depend on the ability of societies to combine technological innovation with environmental responsibility, social inclusion, ethical governance, and active citizen participation. Supporting green innovation, sustainability education, and youth engagement therefore remains essential for building resilient and climate-neutral societies across Europe and globally.

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5. Real-World Success Stories and European Best Practices

5.1 Energy-Efficiency Success Stories in Europe

Across Europe, numerous cities, communities, organisations, and local authorities have implemented innovative sustainability initiatives and energy-efficiency strategies demonstrating that environmental transition can produce measurable environmental, economic, and social benefits. These real-world success stories provide valuable examples of how energy efficiency, renewable energy systems, sustainable urban planning, and community participation can contribute to climate mitigation and long-term sustainability objectives.

European best practices additionally demonstrate that successful sustainability transition depends not only on technological innovation, but also on cooperation between local governments, citizens, businesses, educational institutions, and community organisations. Many of the most effective sustainability initiatives combine infrastructure development with behavioral change, public participation, digital innovation, and inclusive governance approaches.

The following examples highlight successful European initiatives connected to community energy systems, green urban transformation, and smart sustainable infrastructure. These case studies illustrate practical pathways towards climate neutrality and provide valuable inspiration for youth workers, educators, organisations, and local communities interested in promoting sustainability and energy efficiency.





Copenhagen is internationally recognised as one of Europe's leading examples of sustainable urban transformation and climate-focused city planning. The city has implemented extensive sustainability policies aimed at becoming the world's first carbon-neutral capital city.

The Copenhagen Climate Plan integrates multiple sustainability sectors including:

- energy-efficient buildings,
- renewable energy systems,
- sustainable transportation,
- district heating networks,
- cycling infrastructure,
- and smart urban planning.



One of the city's most successful initiatives involves its extensive cycling infrastructure system. According to the City of Copenhagen, more than 60% of residents commute daily by bicycle, significantly reducing transport emissions and improving urban air quality. (kkdk)

The city additionally invested heavily in district heating systems powered increasingly by renewable and waste-to-energy technologies. District heating currently supplies the majority of Copenhagen households and contributes significantly to reducing fossil-fuel dependence.

Smart traffic-management systems, green urban spaces, energy-efficient construction regulations, and offshore wind energy integration also form important components of the city's sustainability strategy.

Activities Implemented

- Expansion of protected cycling infrastructure
- Smart mobility systems and low-emission transport policies
- Renewable district-heating systems
- Energy-efficient building standards
- Urban climate adaptation projects
- Green public-space development

Results and Impact

- Significant reduction in urban CO₂ emissions
- High levels of cycling participation and sustainable mobility adoption
- Improved air quality and urban liveability
- Increased renewable-energy integration
- International recognition as a sustainability innovation leader

Key Lessons Learned

- Sustainable mobility infrastructure strongly influences behavioral change
- Community participation and long-term policy consistency are essential
- Integrated urban planning improves both sustainability and quality of life
- Climate strategies are more effective when linked to public wellbeing and accessibility



Best Practice 2: Freiburg – Sustainable Energy and Eco-District Development



Freiburg, often referred to as Germany's "Green City," represents one of Europe's most influential examples of sustainable urban development and community-based energy transition.

The city became internationally recognised for combining renewable energy expansion, sustainable transportation systems, energy-efficient housing, and participatory environmental governance. Freiburg's sustainability transformation accelerated particularly after the development of the Vauban eco-district during the late 1990s and early 2000s.

Vauban was designed as a low-energy and largely car-free residential district integrating:

- passive-energy housing,
- solar-energy systems,
- sustainable public transportation,
- pedestrian-focused urban design,
- and extensive green public spaces.



According to the City of Freiburg, many buildings within the district produce more energy than they consume due to advanced solar technologies and energy-efficient construction methods. (freiburg.de) The city additionally invested heavily in renewable energy research and solar innovation, becoming an important center for environmental technology and sustainability-oriented economic development.

Activities Implemented

- Development of low-energy residential districts
- Solar-panel integration within public and private buildings
- Expansion of tram and cycling networks
- Community participation in urban sustainability planning
- Renewable-energy innovation partnerships

Results and Impact

- Reduced household energy consumption
- Increased renewable energy generation
- Lower urban transport emissions
- Growth of local green economy and sustainability employment
- Strong international visibility as a sustainable city model

Key Lessons Learned

- Sustainable neighbourhood planning can significantly reduce emissions
- Citizen participation improves long-term sustainability engagement
- Renewable energy and urban planning should be integrated strategically
- Green innovation can support both environmental and economic development

Best Practice 3: Amsterdam – Circular Economy and Smart City Innovation



Amsterdam has become one of Europe's leading examples of circular economy implementation and smart urban sustainability innovation. The city adopted an ambitious circular economy strategy aiming to reduce resource consumption, minimise waste generation, and transition towards sustainable urban systems.

The Amsterdam Circular Strategy focuses on sectors such as:

- construction and housing,
- food systems,
- consumer goods,
- waste reduction,
- and sustainable mobility.

The city additionally developed extensive smart-city initiatives integrating digital technologies with sustainability objectives. According to the Amsterdam Smart City program, collaborative innovation partnerships between local authorities, businesses, educational institutions, and citizens support experimentation with sustainable urban solutions. (amsterdamsmartcity.com)

Amsterdam also invested heavily in cycling infrastructure, electric mobility systems, and low-emission urban logistics. Circular construction projects increasingly reuse building materials and promote sustainable architecture practices.

Activities Implemented

- Circular economy urban policies
- Smart-city digital sustainability projects
- Circular construction initiatives
- Sustainable mobility and cycling infrastructure
- Community innovation labs and urban experimentation

Results and Impact

- Reduced material waste and improved recycling practices
- Increased citizen participation in sustainability innovation
- Expansion of low-emission transportation systems
- Strengthened circular-economy business ecosystem
- International leadership in urban sustainability innovation

Key Lessons Learned

- Circular economy systems require cross-sector cooperation
- Digital technologies can strengthen sustainability management
- Community participation accelerates innovation adoption
- Urban sustainability requires long-term systemic planning



Best Practice 4: Malmö – Renewable Energy and Climate-Neutral Urban Development



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Malmö represents one of Scandinavia's most important examples of sustainable urban regeneration and renewable-energy-based city development. Following industrial decline during the late 20th century, Malmö transformed large former industrial areas into environmentally sustainable urban districts focused on renewable energy, energy efficiency, and climate resilience.

The Western Harbour (Västra Hamnen) district became internationally recognised for operating largely on renewable energy systems and sustainable urban infrastructure.

The district integrates:

- renewable electricity generation,
- energy-efficient buildings,
- green roofs,
- sustainable drainage systems,
- waste-management innovation,
- and climate-adaptive urban planning.

According to the City of Malmö, sustainability principles were integrated throughout urban planning, transportation, architecture, and public infrastructure systems. (malmose)

The city additionally promotes climate-neutral mobility systems, biodiversity protection, and environmental education initiatives connected to community participation and sustainability awareness.

Activities Implemented

- Renewable-energy urban districts
- Energy-efficient building systems
- Climate-adaptive infrastructure planning
- Sustainable water-management systems
- Environmental education and citizen participation initiatives
-

Results and Impact

- Significant emissions reductions within redevelopment areas
- Improved urban sustainability and resilience
- Increased renewable energy integration
- International recognition for sustainable city transformation
- Enhanced environmental quality and public wellbeing

Key Lessons Learned

- Sustainable urban regeneration can revitalise former industrial areas
- Renewable energy integration improves long-term resilience
- Climate adaptation should be integrated within urban planning
- Environmental sustainability and social wellbeing are closely connected

Overall Lessons from European Energy-Efficiency Success Stories

These European success stories demonstrate that effective sustainability transition requires integrated approaches combining technological innovation, sustainable infrastructure, community participation, and long-term policy commitment. Although each city operates within different social, economic, and geographic contexts, several common factors contribute consistently to successful sustainability outcomes.

Key lessons emerging from these case studies include:

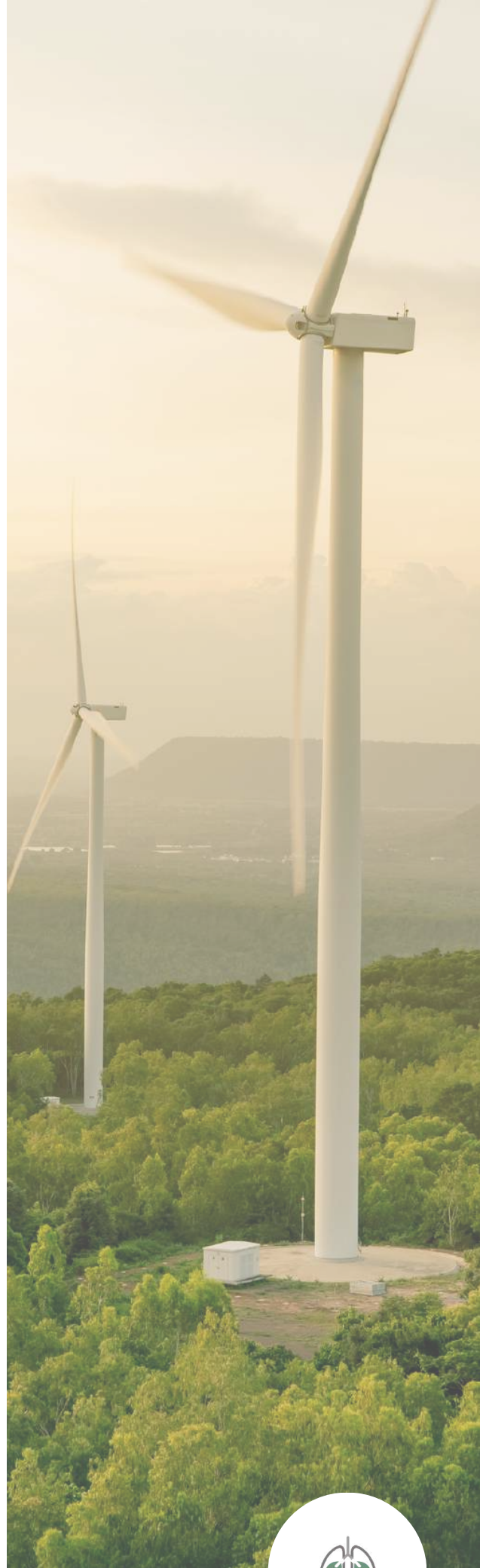
- Long-term sustainability planning is essential for achieving measurable climate outcomes
- Citizen participation and community engagement strengthen behavioral transformation
- Sustainable mobility and energy-efficient infrastructure significantly reduce emissions
- Renewable energy integration supports energy security and climate resilience
- Smart technologies and digital innovation improve sustainability management
- Green transition policies are more effective when linked to social inclusion and quality of life improvements

These examples additionally demonstrate that sustainability transition is not solely an environmental challenge but also a social, economic, technological, and cultural transformation process requiring cooperation between governments, communities, industries, educational institutions, and citizens collectively.

For youth workers and organisations, these best practices provide valuable inspiration for promoting environmental awareness, sustainability education, community participation, and green innovation among younger generations. They also demonstrate that local action and community engagement can contribute meaningfully to broader European climate and sustainability objectives.

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- [International Energy Agency – Net Zero by 2050](#)





5.2 Youth-Led Sustainability Initiatives

Young people increasingly play a central role in sustainability transition processes through the development of environmental campaigns, climate-action initiatives, social innovation projects, and community-based sustainability activities. Across Europe and globally, youth-led initiatives have become important drivers of environmental awareness, climate advocacy, sustainable innovation, and civic participation.

Youth participation within sustainability actions extends beyond symbolic activism and increasingly contributes to practical environmental solutions, policy discussions, community resilience, and behavioral transformation. Through volunteering, social entrepreneurship, digital campaigns, educational projects, and grassroots environmental movements, young people actively contribute to promoting sustainability culture and climate responsibility within their communities.

International organisations including the European Commission, UNESCO, and the United Nations increasingly recognise youth-led sustainability initiatives as essential mechanisms for strengthening climate participation, democratic engagement, and environmental literacy among younger generations.

The following examples highlight successful youth-led sustainability initiatives demonstrating how young people contribute actively to environmental innovation, climate awareness, and community sustainability across Europe and internationally.

Best Practice 1: Fridays for Future – Global Youth Climate Mobilisation



Fridays for Future represents one of the most influential youth-led climate movements of recent years. Initiated in 2018 through student climate strikes, the movement rapidly expanded into a global youth mobilisation campaign advocating stronger climate policies, sustainability action, and environmental accountability from governments and institutions.

The movement gained international visibility through coordinated climate demonstrations, educational campaigns, public awareness activities, and digital mobilisation strategies involving millions of young people worldwide. Fridays for Future activities focused on increasing public pressure regarding climate inaction and strengthening societal awareness concerning climate science and sustainability transition.

According to research published by the European Parliament and climate participation studies, youth climate strikes significantly influenced public discourse regarding climate policy and sustainability priorities across Europe. (europarl.europa.eu)



Activities Implemented

- Youth climate demonstrations and strikes
- Digital environmental awareness campaigns
- Climate education and advocacy initiatives
- Public discussions and policy engagement activities
- Community mobilisation and youth participation events

Results and Impact

- Increased public awareness regarding climate change
- Stronger visibility of youth perspectives in climate discussions
- Expansion of environmental participation among young people
- International mobilisation involving millions of participants
- Increased pressure for stronger climate policies

Key Lessons Learned

- Youth participation can significantly influence public discourse
- Digital mobilisation strengthens environmental engagement
- Young people increasingly demand active participation in climate governance
- Climate activism contributes to sustainability awareness and civic engagement



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Best Practice 2: European Solidarity Corps – Youth Environmental Volunteering Projects



The European Solidarity Corps (ESC) supports youth volunteering and solidarity initiatives across Europe, including numerous sustainability and environmental projects focused on climate action, biodiversity protection, community resilience, and environmental education.

Young participants engage in practical sustainability activities such as:

- environmental restoration projects,
- reforestation initiatives,
- biodiversity protection programs,
- sustainable community development,
- recycling campaigns,
- and environmental awareness workshops.

According to the European Commission, the program promotes active citizenship, social inclusion, intercultural dialogue, and sustainability participation among younger generations. (youth.europa.eu)

Environmental volunteering projects implemented through ESC programs additionally support practical green-skills development and strengthen participants' environmental responsibility and community engagement capacities.

Activities Implemented

- Community environmental volunteering projects
- Biodiversity conservation actions
- Youth sustainability workshops and training sessions
- Local climate-awareness campaigns
- International environmental mobility activities

Results and Impact

- Increased youth participation in sustainability activities
- Development of practical green skills and environmental competences
- Strengthened intercultural cooperation and community resilience
- Improved local environmental awareness
- Enhanced civic participation among young people

Key Lessons Learned

- Volunteering strengthens sustainability awareness and active citizenship
- Community participation supports long-term behavioral change
- Experiential learning increases environmental engagement
- Youth mobility programs can strengthen international sustainability cooperation



Best Practice 3: The Ocean Cleanup – Youth Innovation and Environmental Technology



The Ocean Cleanup initiative represents an important example of youth-driven environmental innovation and sustainability entrepreneurship. Founded by young innovator Boyan Slat, the project focuses on developing technological solutions for reducing plastic pollution in oceans and rivers.

The initiative combines environmental engineering, digital innovation, sustainability awareness, and large-scale environmental action. The project developed advanced systems designed to collect plastic waste from marine environments and prevent additional pollution from entering oceans through river-cleaning technologies.

According to project reports, The Ocean Cleanup successfully removed substantial quantities of plastic waste from marine ecosystems while simultaneously increasing global awareness regarding ocean pollution and environmental sustainability. (theoceancleanup.com)

The initiative additionally inspired broader youth engagement within environmental entrepreneurship and sustainability innovation sectors.

Activities Implemented

- Development of environmental cleanup technologies
- Ocean and river plastic-removal operations
- Public awareness and environmental education campaigns
- Youth engagement in environmental innovation
- International sustainability communication initiatives

Results and Impact

- Removal of plastic waste from marine environments
- Increased global awareness regarding ocean pollution
- Promotion of sustainability-oriented technological innovation
- Encouragement of youth entrepreneurship and environmental creativity
- Expansion of public participation in ocean protection initiatives

Key Lessons Learned

- Young innovators can contribute significantly to sustainability solutions
- Technology and environmental awareness can operate together effectively
- Environmental entrepreneurship supports sustainability transition
- Innovation projects strengthen youth engagement and public participation

Best Practice 4: Youth Climate Leaders – Climate Leadership and Green Skills Development



Youth Climate Leaders is an international initiative supporting climate leadership, sustainability education, and environmental innovation among younger generations. The program focuses on empowering young people through sustainability training, climate education, leadership development, and community-based environmental action.

The initiative provides educational programs and workshops connected to:

- climate literacy,
- green entrepreneurship,
- sustainability communication,
- climate leadership,
- environmental advocacy,
- and community sustainability projects.

Participants engage in collaborative sustainability initiatives and develop practical competences related to environmental problem-solving and social innovation. According to program reports, Youth Climate Leaders initiatives contributed to strengthening youth participation in climate discussions and sustainability-oriented social innovation activities across multiple countries. (youthclimateleaders.org)

Activities Implemented

- Climate leadership workshops and training programs
- Sustainability innovation labs
- Green entrepreneurship mentoring activities
- Youth climate communication campaigns
- Community-based sustainability projects

Results and Impact

- Increased sustainability literacy and climate leadership competences
- Strengthened youth participation in environmental initiatives
- Development of practical green skills and innovation capacities
- Expansion of sustainability-oriented youth networks
- Enhanced environmental awareness and civic engagement

Key Lessons Learned

- Leadership development strengthens long-term sustainability participation
- Non-formal education supports practical environmental competences
- Youth collaboration encourages innovation and creativity
- Sustainability education benefits from participatory and experiential approaches





Overall Lessons from Youth-Led Sustainability Initiatives

These examples demonstrate that young people increasingly represent active contributors to sustainability transition processes rather than passive recipients of environmental policies. Youth-led initiatives contribute significantly to environmental awareness, climate participation, community resilience, sustainability innovation, and behavioral transformation across Europe and globally.

Several common themes emerge across these initiatives:

- Participatory approaches strengthen environmental engagement and active citizenship
- Youth innovation contributes meaningfully to sustainability solutions
- Community participation improves long-term sustainability outcomes
- Digital platforms and social media facilitate environmental mobilisation
- Non-formal education and volunteering support practical green-skills development
- Youth leadership strengthens climate awareness and democratic participation

The success of these initiatives additionally demonstrates that sustainability transition requires inclusive and participatory approaches allowing younger generations to contribute actively to environmental governance, social innovation, and community development.

For youth workers and organisations, these case studies provide valuable examples of how environmental participation, sustainability education, volunteering, and youth-led innovation can be integrated into educational activities and community initiatives. They also highlight the importance of empowering young people as active agents of sustainability transition capable of shaping more resilient and environmentally responsible societies.

References

- European Parliament – Climate Change and Youth Participation
- [European Solidarity Corps](#)
- [The Ocean Cleanup](#)
- Youth Climate Leaders
- [UNESCO – Education for Sustainable Development](#)
- [European Environment Agency](#)



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5.3 Sustainable Mobility and Energy Projects

Sustainable mobility and energy-transition projects increasingly represent essential components of European climate strategies and urban sustainability policies. Across Europe, governments, municipalities, transport authorities, research institutions, and community organisations implement innovative projects aimed at reducing greenhouse gas emissions, improving energy efficiency, strengthening renewable energy integration, and transforming transportation systems into more sustainable and resilient models.

These projects demonstrate

how technological innovation, public participation, policy coordination, and infrastructure investment can contribute to practical sustainability outcomes and measurable environmental improvements. Sustainable mobility and energy initiatives additionally provide important examples of how local and regional actions can support broader European climate-neutrality objectives.

The following case studies highlight innovative European programs and public initiatives focused on sustainable transportation systems, renewable-energy integration, smart mobility infrastructure, and low-carbon urban transformation. These examples illustrate practical strategies for addressing environmental challenges while simultaneously improving urban quality of life, energy resilience, and community sustainability.



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Best Practice 1: Oslo – Electric Mobility and Zero-Emission Urban Transport





Oslo has become internationally recognised as one of the world's leading cities in electric mobility adoption and sustainable urban transportation transformation. Norway's strong national climate policies, combined with extensive public investment and local sustainability planning, enabled Oslo to accelerate the transition towards low-emission transportation systems.

The city implemented comprehensive policies supporting electric mobility, including:

- expansion of EV charging infrastructure,
- low-emission urban zones,
- electric public transportation,
- reduced vehicle emissions policies,
- and incentives for electric vehicle adoption.

According to the Norwegian Road Federation and European Environment Agency data, Norway achieved the highest electric vehicle market penetration globally, with electric cars representing the majority of new vehicle sales in recent years. (ofv.no)

Oslo additionally introduced electric buses, climate-friendly ferries, and sustainable mobility planning strategies aimed at reducing fossil-fuel dependency and improving urban air quality.

Activities Implemented

- Large-scale EV charging infrastructure deployment
- Electrification of public transport systems
- Low-emission transport zones
- Sustainable urban mobility planning
- Public awareness campaigns promoting electric mobility

Results and Impact

- Significant reduction in transport-related emissions
- Increased adoption of zero-emission vehicles
- Improved urban air quality
- Reduced fossil-fuel dependency
- International recognition as a leader in sustainable transport transition

Key Lessons Learned

- Public incentives strongly influence sustainable mobility adoption
- Infrastructure availability is essential for behavioral change
- Integrated transport policies improve long-term sustainability outcomes
- Electric mobility transition requires both policy support and public engagement

Best Practice 2: Vienna – Integrated Public Transport and Smart Urban Mobility



Vienna represents one of Europe's most successful examples of integrated sustainable public transportation and urban mobility planning. The city consistently ranks among Europe's most liveable cities due partly to its efficient, affordable, and environmentally sustainable transportation infrastructure.

Vienna's mobility strategy prioritises:

- high-quality public transportation systems,
- reduced private car dependency,
- pedestrian accessibility,
- cycling infrastructure,
- and climate-friendly urban development.

According to the Vienna City Administration, more than one-third of all urban trips are completed using public transport systems, significantly reducing urban emissions and traffic congestion. (wien.gv.at)
The city additionally invested in smart mobility technologies and integrated digital transport systems improving accessibility and efficiency across metro, tram, bus, and cycling networks.

Vienna's public transportation model emphasises affordability and accessibility through low-cost annual transport passes encouraging widespread public participation in sustainable mobility systems.

Activities Implemented

- Expansion of metro and tram infrastructure
- Affordable public transportation policies
- Smart-ticketing and digital mobility systems
- Cycling and pedestrian infrastructure development
- Climate-friendly urban transport planning

Results and Impact

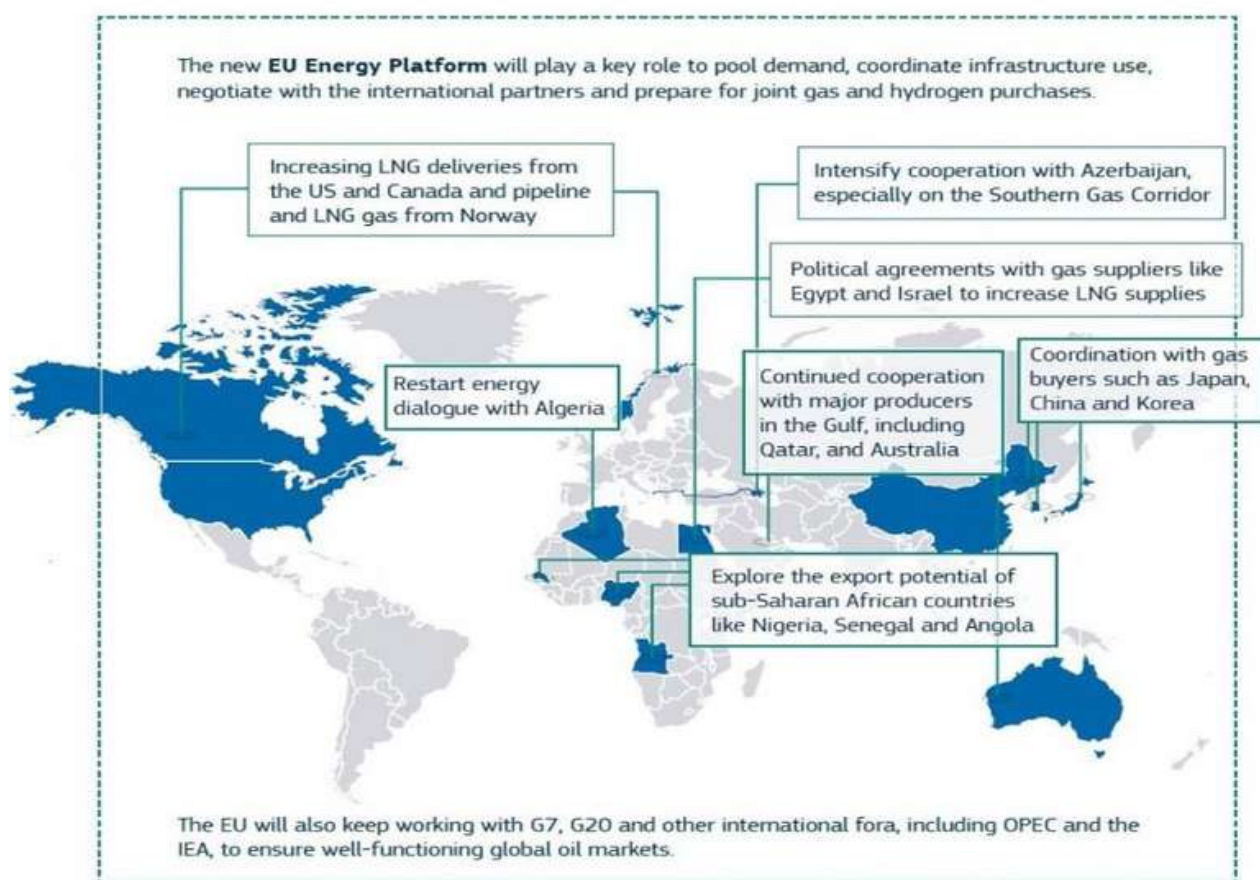
- Reduced private car dependency
- Lower urban transport emissions
- Increased public transport participation
- Improved urban mobility accessibility
- Enhanced quality of life and urban sustainability

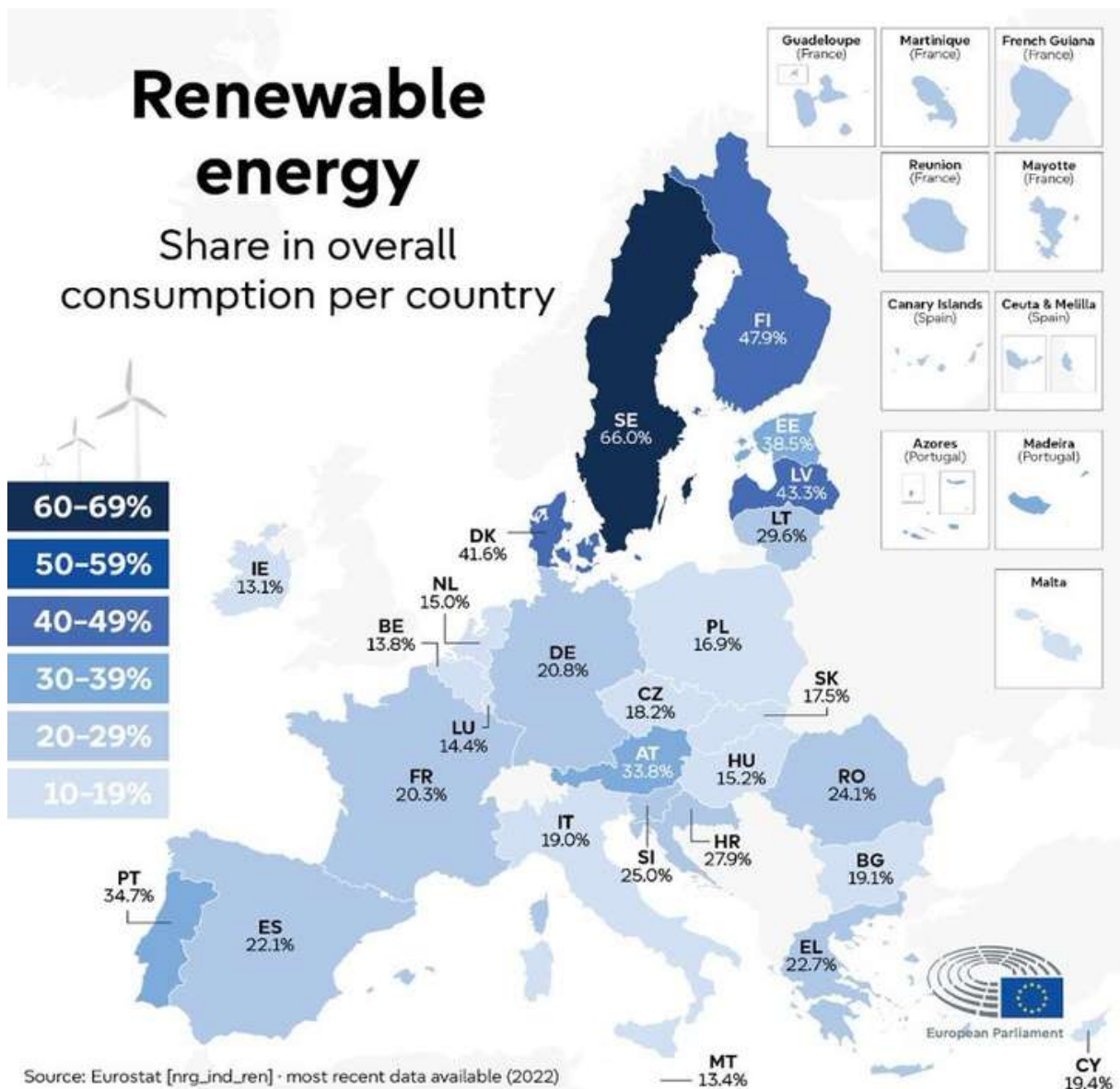
Key Lessons Learned

- Affordable public transportation supports sustainable mobility adoption
- Integrated transport systems improve environmental outcomes
- Urban planning strongly influences mobility behavior
- Accessibility and convenience are essential for transport transition success



Best Practice 3: REPowerEU – European Energy Independence and Renewable Transition





REPowerEU represents one of the European Union's largest recent energy-transition initiatives focused on accelerating renewable energy expansion, improving energy efficiency, and reducing dependence on imported fossil fuels.

Introduced in 2022 following growing energy-security concerns, the initiative combines climate objectives with strategic energy resilience and sustainability priorities. According to the European Commission, REPowerEU aims to accelerate renewable energy deployment while simultaneously strengthening Europe's energy independence and climate-neutrality objectives. (commission.europa.eu)

Key areas of the initiative include:

- large-scale solar and wind energy expansion,
- energy-efficiency improvements,
- hydrogen-energy investment,
- sustainable infrastructure modernisation,
- and smart energy-system integration.

REPowerEU additionally promotes rooftop solar systems, heat-pump adoption, and energy-saving measures across households, industries, and public institutions.



Activities Implemented

- Renewable-energy infrastructure investment
- Solar and wind energy expansion programs
- Energy-efficiency improvement initiatives
- Sustainable energy innovation funding
- Smart-grid and hydrogen technology support

Results and Impact

- Accelerated renewable energy deployment across Europe
- Improved energy resilience and diversification
- Increased investment in green technologies
- Strengthened climate-transition infrastructure
- Reduced dependence on imported fossil fuels

Key Lessons Learned

- Energy security and sustainability objectives are closely interconnected
- Policy coordination accelerates renewable-energy transition
- Public investment supports large-scale sustainability transformation
- Energy-efficiency measures remain essential for climate resilience



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Best Practice 3: REPowerEU – European Energy Independence and Renewable Transition



Superblock Barcelona

SUPERBLOCKS 2015-2020



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Barcelona's "Superblocks" initiative represents one of Europe's most innovative urban mobility and sustainability projects focused on reclaiming urban space for pedestrians, reducing traffic emissions, and improving urban liveability. The Superblocks model reorganises city blocks to limit vehicle traffic within designated neighbourhood areas while prioritising:

- pedestrian access,
- cycling infrastructure,
- green public spaces,
- community interaction,
- and low-emission urban mobility.

According to the Barcelona City Council and urban sustainability studies, the initiative contributes to reducing noise pollution, improving air quality, increasing public space accessibility, and encouraging sustainable mobility behaviors. (ajuntament.barcelona.cat)

The project additionally integrates climate adaptation and urban resilience objectives through expanded green areas and reduced vehicle congestion.



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Activities Implemented

- Traffic-reduction urban planning
- Expansion of pedestrian and cycling areas
- Urban greening and public-space redesign
- Sustainable mobility infrastructure improvements
- Community participation in urban transformation

Results and Impact

- Reduced urban traffic emissions
- Improved air quality and public health indicators
- Increased pedestrian accessibility and urban liveability
- Greater use of sustainable transport modes
- Enhanced community engagement within urban spaces

Key Lessons Learned

- Urban design strongly affects environmental behavior
- Public-space transformation improves sustainability outcomes
- Sustainable mobility supports public health and social wellbeing
- Community-centered planning strengthens environmental participation

Overall Lessons from Sustainable Mobility and Energy Projects

These European projects demonstrate that sustainable mobility and energy transition require integrated approaches combining infrastructure investment, technological innovation, public participation, and long-term policy commitment. Successful sustainability initiatives consistently combine environmental objectives with improvements in accessibility, public wellbeing, urban quality of life, and energy resilience.

Several common lessons emerge across these case studies:

- Infrastructure accessibility significantly influences behavioral change
- Public participation strengthens sustainability adoption and social acceptance
- Renewable energy and sustainable mobility systems are closely interconnected
- Smart technologies improve efficiency and sustainability management
- Climate-neutral urban planning requires integrated long-term strategies
- Inclusive and affordable systems support broader sustainability participation

These examples additionally demonstrate that sustainable transportation and energy systems contribute not only to emissions reduction but also to healthier, more resilient, and socially inclusive communities.

For youth workers and organisations, these projects provide valuable examples of practical sustainability implementation and demonstrate how local initiatives, public policy, technological innovation, and citizen participation can contribute meaningfully to European climate and sustainability objectives. They also illustrate the growing importance of green skills, environmental awareness, and active citizenship within future sustainable societies.

References

- Norwegian Road Federation – Electric Vehicle Statistics
- City of Vienna – Climate Protection and Sustainable Transport
- [European Commission – REPowerEU Initiative](#)
- [Barcelona Superblocks Initiative](#)
- [European Environment Agency – Transport and Mobility](#)
- [International Energy Agency – Net Zero by 2050](#)



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5.4 Lessons Learned from European Best Practices

The European best practices presented throughout this section demonstrate that successful sustainability transition is not based on a single technological solution or isolated environmental initiative. Instead, effective sustainability transformation requires integrated approaches combining policy coordination, technological innovation, behavioral change, community participation, environmental education, and long-term strategic planning.

Although the initiatives analysed originate from different countries, institutional contexts, and socio-economic environments, several common patterns and transferable lessons emerge consistently across successful European sustainability projects. These lessons provide valuable guidance for youth workers, educational organisations, local authorities, NGOs, and community groups interested in promoting energy efficiency, climate participation, sustainable lifestyles, and green-skills development among young people and wider society.

The examined projects additionally demonstrate that sustainability initiatives are most effective when they remain inclusive, participatory, practical, and closely connected to the everyday realities of communities and citizens. Long-term environmental transformation depends not only on infrastructure investment and technological innovation but also on social engagement, public trust, and active citizen participation.

Transferable Approaches and Replicable Sustainability Models

One of the most important lessons emerging from European sustainability best practices is the importance of transferable and adaptable approaches. Successful initiatives are often characterised by flexible models that can be adjusted according to local needs, resources, cultural contexts, and institutional capacities.

Research conducted by the European Environment Agency demonstrates that sustainability transition strategies are generally more successful when local communities are allowed to adapt broader climate objectives into context-specific solutions responding to local environmental, social, and economic realities. (eea.europa.eu)

For example:

- Copenhagen's cycling infrastructure model demonstrates transferable approaches to sustainable urban mobility.
- Freiburg's low-energy neighbourhood planning provides replicable examples for sustainable urban regeneration.
- Amsterdam's circular economy initiatives illustrate adaptable resource-management strategies.
- Barcelona's Superblocks project demonstrates innovative approaches to reducing traffic emissions and reclaiming public urban space.



Although these projects differ significantly in scale and context, they share several transferable characteristics including:

- integrated sustainability planning,
- long-term policy commitment,
- community participation,
- environmental education,
- and cross-sector cooperation.

The European Commission increasingly promotes policy-learning and exchange of best practices between cities, organisations, and educational institutions in order to accelerate sustainability transition processes across Europe. Programs such as Erasmus+, Horizon Europe, and the European Climate Pact encourage transnational cooperation and adaptation of successful sustainability models across different regions and communities.

Research additionally demonstrates that transferable sustainability approaches are more effective when they remain:

- participatory,
- economically accessible,
- socially inclusive,
- environmentally measurable,
- and adaptable to local capacities.

This is particularly important for youth organisations and educational institutions working within different social and regional contexts where available resources and infrastructure may vary significantly.

Community Engagement and Participatory Sustainability

Another major lesson emerging from European best practices is the central importance of community engagement and citizen participation within sustainability transition processes. Projects relying exclusively on top-down institutional approaches often encounter greater resistance and lower long-term behavioral adoption compared to initiatives actively involving local communities and citizens.

Successful sustainability initiatives consistently demonstrate that public participation contributes significantly to:

- behavioral change,
- environmental awareness,
- long-term project sustainability,
- social acceptance of climate policies,
- and community resilience.

Research conducted by UNESCO and the OECD highlights that participatory sustainability approaches strengthen civic responsibility and increase individuals' willingness to adopt environmentally responsible behaviors. (unesco.org)



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Many of the analysed European projects integrated participatory elements such as:

- community consultations,
- local volunteering activities,
- environmental workshops,
- participatory urban planning,
- youth engagement programs,
- and citizen sustainability campaigns.

For example:

- Barcelona's Superblocks initiative involved community participation within urban redesign processes.
- Youth climate movements such as Fridays for Future strengthened environmental awareness through grassroots mobilisation.
- European Solidarity Corps sustainability projects promoted volunteering and active citizenship.
- Amsterdam Smart City initiatives encouraged collaboration between citizens, educational institutions, businesses, and local authorities.

Research additionally demonstrates that sustainability projects become more effective when citizens perceive themselves as active participants rather than passive recipients of environmental policies. Community ownership and participation increase long-term commitment to sustainability objectives and strengthen collective responsibility regarding environmental challenges.

At the same time, participatory sustainability requires inclusive approaches ensuring equal access to engagement opportunities for young people, vulnerable communities, and marginalised populations. Sustainability transition may otherwise reinforce existing social inequalities and participation gaps.

Educational Impact and Sustainability Learning

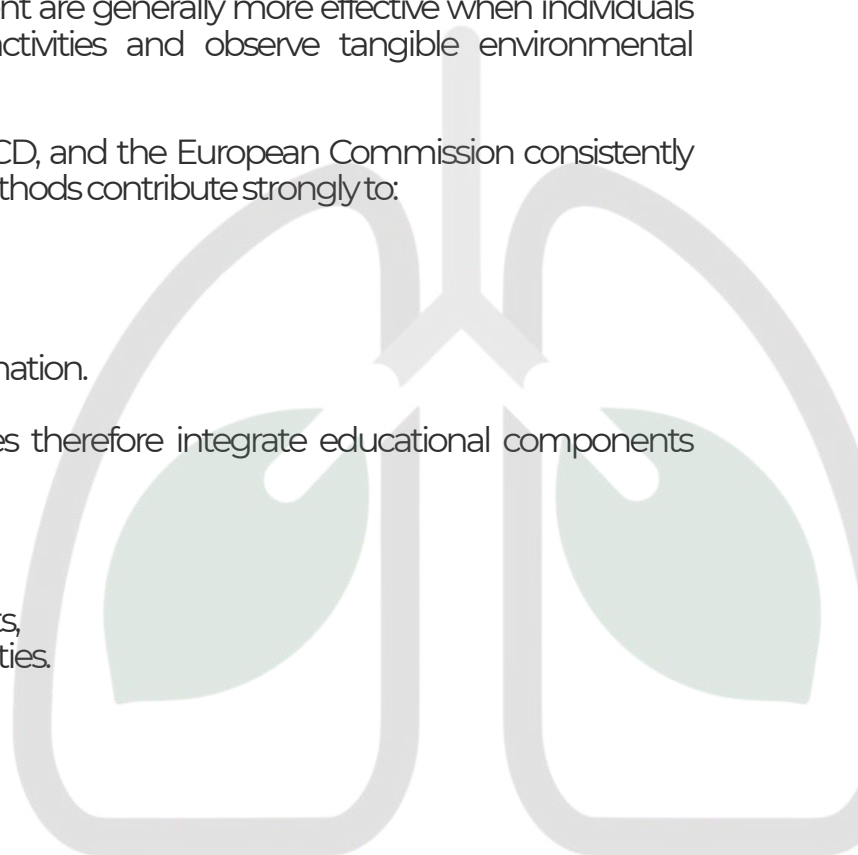
The analysed best practices also demonstrate the significant educational value of practical sustainability initiatives and experiential learning approaches. Environmental awareness and green-skills development are generally more effective when individuals participate directly in sustainability activities and observe tangible environmental outcomes within their communities.

Research conducted by UNESCO, OECD, and the European Commission consistently highlights that experiential learning methods contribute strongly to:

- sustainability literacy,
- critical thinking,
- environmental responsibility,
- practical green competences,
- and long-term behavioral transformation.

Many successful sustainability initiatives therefore integrate educational components such as:

- workshops and training sessions,
- community learning activities,
- digital awareness campaigns,
- participatory environmental projects,
- and non-formal learning opportunities.



Youth-focused initiatives particularly demonstrate the importance of combining education with active participation. Young people participating in environmental volunteering, climate campaigns, sustainability innovation projects, and community initiatives often develop stronger environmental awareness and greater confidence regarding sustainability problem-solving.

The European Union increasingly recognises the importance of sustainability education and green-skills development through initiatives connected to:

- Erasmus+,
- the European Green Deal,
- the GreenComp sustainability competence framework,
- and Education for Sustainable Development policies.

Research additionally suggests that sustainability education is most effective when it remains interdisciplinary and action-oriented rather than limited exclusively to theoretical environmental knowledge. Projects involving real-world sustainability challenges, collaborative participation, and practical implementation often produce stronger long-term educational outcomes.

Technology, Innovation, and Sustainability Transition

European best practices additionally highlight the growing role of technology and innovation within sustainability transition processes. Smart energy systems, renewable-energy infrastructure, digital sustainability tools, circular economy technologies, and sustainable mobility systems increasingly support environmental efficiency and emissions reduction.

However, the analysed projects also demonstrate that technological innovation alone is insufficient without broader social adaptation and behavioral change. Successful sustainability transition requires combining innovation with:

- education,
- public participation,
- inclusive governance,
- and sustainability-oriented cultural transformation.

For example:

- Smart-city technologies are more effective when citizens understand and engage with sustainability objectives.
- Renewable-energy systems require public trust and accessibility.
- Sustainable mobility infrastructure only succeeds when behavioral adaptation occurs simultaneously.
- Circular economy systems depend heavily on responsible consumption and community participation.

Research therefore increasingly emphasises the importance of integrating technological innovation with social sustainability and environmental literacy strategies.



Youth Participation and Long-Term Sustainability Culture

Another important lesson emerging from the examined projects is the crucial role of youth participation in shaping future sustainability culture. Young people consistently appear as:

- environmental advocates,
- sustainability innovators,
- community volunteers,
- climate activists,
- and future green professionals.

Youth participation contributes not only to immediate sustainability outcomes but also to long-term cultural transformation and intergenerational environmental responsibility. Projects involving younger generations frequently demonstrate stronger innovation capacity, digital engagement, community mobilisation, and environmental creativity. At the same time, participatory sustainability initiatives strengthen democratic participation, civic engagement, and social resilience among younger populations.

The European Commission and UNESCO increasingly recognise young people as essential actors within climate transition and sustainability governance processes rather than passive beneficiaries of environmental policies.

Recommendations for Future Sustainability Initiatives

Based on the analysed European best practices, several recommendations can be identified for future sustainability projects and educational initiatives:

- Sustainability projects should combine environmental, social, and educational dimensions simultaneously.
- Community participation and citizen engagement should remain central components of sustainability planning.
- Youth participation and non-formal education should be integrated within climate-transition initiatives.
- Long-term behavioral change requires practical and experiential learning opportunities.
- Sustainability strategies should remain inclusive and accessible for diverse populations.
- Technological innovation should be combined with sustainability literacy and ethical governance.
- Local adaptation and flexibility improve the effectiveness of sustainability initiatives.

These lessons provide valuable guidance for youth workers, organisations, educators, and communities aiming to strengthen environmental awareness, green-skills development, and active participation in sustainability transition processes.

Ultimately, European sustainability best practices demonstrate that meaningful climate action and energy transition are achievable when technological innovation, education, public participation, and long-term policy commitment operate together within inclusive and collaborative sustainability frameworks.

References

- [European Environment Agency](#)
- [UNESCO – Education for Sustainable Development](#)
- [European Commission – European Green Deal](#)
- [European Climate Pact](#)
- [OECD – Green Growth and Sustainability](#)
- [European Commission – GreenComp Sustainability Competence Framework](#)



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5.5 Key Recommendations for Youth Workers and Organisations

The analysis of European sustainability initiatives and energy-efficiency best practices demonstrates that youth workers and organisations play a particularly important role in supporting environmental awareness, green-skills development, and active participation in sustainability transition processes. As younger generations increasingly face the environmental, economic, and social consequences of climate change, non-formal education and youth work environments become essential spaces for developing sustainability competences, encouraging responsible behavior, and strengthening climate engagement.

One of the most important recommendations emerging from the examined projects is the need to approach sustainability education as a practical, participatory, and long-term process rather than as isolated awareness activities. Young people are generally more responsive to experiential and action-oriented learning environments where they can actively participate, collaborate, and apply sustainability concepts within real-world contexts. For this reason, youth organisations should prioritise interactive methodologies such as workshops, simulations, community projects, environmental volunteering, digital campaigns, and collaborative problem-solving activities that allow participants to connect sustainability concepts with everyday life experiences.

Research consistently demonstrates that environmental awareness alone is often insufficient for achieving meaningful behavioral change. Youth workers should therefore focus not only on providing information regarding climate change and sustainability challenges, but also on supporting practical green competences and encouraging sustainable habits within daily routines. Activities connected to recycling, sustainable mobility, energy-saving practices, responsible consumption, and community participation can help translate theoretical understanding into long-term behavioral engagement.

Another important recommendation concerns the integration of sustainability within broader youth participation and active citizenship frameworks. Successful European initiatives repeatedly demonstrate that young people are more likely to engage with environmental issues when they feel empowered to contribute actively to solutions and decision-making processes. Youth workers should therefore create inclusive participation opportunities allowing young people to express ideas, develop initiatives, collaborate with local communities, and participate meaningfully in sustainability-related actions. Participatory approaches strengthen not only environmental awareness but also confidence, leadership competences, democratic engagement, and social responsibility.

Youth organisations are additionally encouraged to integrate sustainability principles within their own operational practices and institutional culture. Environmental education becomes more credible and effective when organisations themselves apply sustainable approaches regarding resource use, mobility choices, waste reduction, digital practices, and event organisation. Sustainable organisational practices can therefore function both as educational tools and as practical examples of environmental responsibility. Even relatively small measures such as reducing paper consumption, promoting reusable materials, organising environmentally responsible events, or encouraging sustainable transportation options can contribute positively to sustainability culture within youth environments.



The examined European best practices also highlight the growing importance of digital sustainability and green technological innovation. Youth workers should increasingly support digital literacy connected to environmental responsibility and encourage critical understanding regarding the environmental impact of technology, consumption patterns, and digital behavior. Integrating discussions about smart energy systems, renewable technologies, circular economy solutions, and sustainable innovation can help young people better understand future sustainability transitions and emerging green labor-market opportunities.

At the same time, it is important for educational activities to remain accessible and inclusive. Economic inequalities, social exclusion, digital divides, and limited access to sustainability opportunities continue affecting many young people across Europe. Sustainability education should therefore avoid becoming associated exclusively with privilege or inaccessible “green lifestyles.” Instead, youth organisations should emphasise practical, realistic, and community-based sustainability approaches that are achievable within diverse social and economic contexts.

Collaboration and networking also emerge as particularly valuable strategies for strengthening sustainability education and environmental participation. Partnerships between youth organisations, schools, municipalities, environmental NGOs, universities, and local communities can significantly improve the quality, visibility, and long-term impact of sustainability initiatives. European programs such as Erasmus+, the European Solidarity Corps, and the European Climate Pact provide important opportunities for transnational cooperation, exchange of best practices, and development of innovative sustainability projects involving young people across different countries and cultural contexts.

Another important recommendation involves recognising the emotional and psychological dimensions of climate-related discussions among younger generations. Research increasingly demonstrates that many young people experience climate anxiety, uncertainty regarding the future, and frustration related to environmental degradation and perceived institutional inaction. Youth workers should therefore create supportive educational environments encouraging constructive dialogue, collaborative problem-solving, resilience, and hopeful engagement rather than fear-based communication approaches. Participatory sustainability activities and community action projects can help transform feelings of anxiety and helplessness into meaningful engagement and positive social contribution.

The use of non-formal learning methodologies remains particularly important within sustainability education because environmental competences are often developed more effectively through participation, experimentation, and social interaction than through exclusively theoretical instruction. Interactive workshops, role-playing activities, environmental simulations, gamification methods, youth exchanges, and community-based learning experiences can significantly strengthen motivation and long-term sustainability awareness among participants.

Finally, youth workers and organisations should recognise that sustainability education is not limited exclusively to environmental protection. Climate transition and sustainable development are closely connected to social inclusion, public health, economic resilience, democratic participation, digital transformation, and future employment opportunities. Sustainability should therefore be approached as a cross-cutting and interdisciplinary theme connected to broader questions regarding quality of life, citizenship, social justice, and collective responsibility.



Ultimately, the European best practices analysed throughout this report demonstrate that youth workers and organisations have the capacity to become important facilitators of sustainability transition and environmental engagement. By combining practical learning approaches, community participation, inclusive educational methods, and long-term sustainability strategies, youth organisations can contribute significantly to strengthening green skills, environmental awareness, and active citizenship among younger generations.

References

- [UNESCO – Education for Sustainable Development](#)
- [European Commission – Erasmus+ Environmental Sustainability Priority](#)
- [European Climate Pact](#)
- [OECD – Young People’s Environmental Sustainability Competence](#)
- [European Commission – GreenComp Sustainability Competence Framework](#)
- [European Environment Agency](#)



6. Conclusion

6.1 Final Reflections

The development of the Energy-Efficiency Research Database demonstrates the growing importance of sustainability education, environmental awareness, and green-skills development within contemporary European societies. As climate change, environmental degradation, energy insecurity, and resource-related challenges continue affecting social, economic, and environmental systems globally, the transition towards more sustainable and climate-resilient communities becomes increasingly urgent.

Throughout this deliverable, the analysis of environmental challenges, energy-efficiency principles, youth sustainability behaviors, emerging green technologies, and European best practices has highlighted that sustainability transition is not solely a technological or political process. Instead, it represents a multidimensional transformation involving behavioral adaptation, educational innovation, social participation, digital transformation, and long-term cultural change.

One of the most significant conclusions emerging from this research is the central role of young people within sustainability transition processes. Across Europe, younger generations increasingly demonstrate strong environmental awareness, willingness to participate in climate action, and growing interest in sustainable lifestyles and green innovation. At the same time, the research also identifies important challenges affecting youth participation, including educational gaps, misinformation, economic inequalities, climate anxiety, and limited access to practical sustainability opportunities.

The findings additionally demonstrate that environmental awareness alone is insufficient for achieving meaningful long-term sustainability outcomes. Effective sustainability transition requires practical engagement, participatory learning environments, community involvement, and accessible opportunities allowing young people to develop real competences connected to energy efficiency, responsible consumption, sustainable mobility, digital sustainability, and environmental citizenship.

The examined European best practices further confirm that successful sustainability initiatives are generally characterised by integrated and collaborative approaches combining technological innovation, policy support, educational participation, and citizen engagement. Sustainable cities, renewable-energy projects, circular economy systems, youth-led environmental initiatives, and smart energy infrastructures all demonstrate that climate action becomes more effective when communities, institutions, organisations, and citizens work collectively towards shared sustainability objectives.



Another important conclusion concerns the increasing interconnection between digital transformation and environmental sustainability. Smart energy systems, artificial intelligence, digital sustainability tools, and green technological innovation are expected to play a major role in future climate transition processes. However, the research also highlights the importance of ensuring that technological development remains environmentally responsible, socially inclusive, and ethically governed. Future sustainability strategies must therefore balance technological progress with resource efficiency, environmental protection, and social wellbeing.

The deliverable additionally demonstrates the important contribution of non-formal education and youth work within sustainability transition processes. Youth organisations, educators, trainers, and community groups have the capacity to create inclusive and participatory learning environments supporting environmental awareness, green-skills development, democratic participation, and active citizenship. Experiential learning methodologies, workshops, simulations, volunteering activities, and community-based sustainability projects emerge consistently as effective approaches for strengthening long-term environmental engagement among young people.

Research findings also indicate that sustainability challenges increasingly affect broader dimensions of social life including public health, emotional wellbeing, economic resilience, employment opportunities, social inclusion, and democratic participation. Climate transition should therefore not be understood exclusively as an environmental issue but rather as a comprehensive societal transformation requiring interdisciplinary and collaborative responses.

The Energy-Efficiency Research Database was designed not only as an informational resource but also as a practical educational foundation supporting youth workers and organisations in implementing sustainability-oriented activities and learning experiences. By combining scientific research, policy analysis, real-world examples, and educational perspectives, the deliverable aims to provide accessible and evidence-based knowledge capable of supporting future sustainability initiatives and youth engagement actions.

At the European level, sustainability transition will continue requiring substantial investment in education, innovation, renewable energy systems, community participation, and green-skills development. Programs such as Erasmus+, the European Green Deal, the European Climate Pact, and the Sustainable Development Goals framework increasingly recognise the strategic importance of involving younger generations in shaping climate-resilient and environmentally responsible societies.

Ultimately, this deliverable demonstrates that sustainability transition is not exclusively about reducing emissions or improving energy efficiency. It is equally about strengthening resilience, encouraging cooperation, supporting responsible citizenship, promoting social inclusion, and empowering younger generations to participate actively in shaping more sustainable futures.



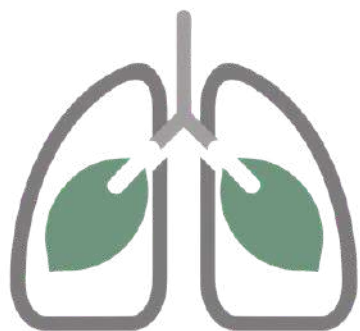
The environmental challenges facing Europe and the global community remain complex and urgent. Nevertheless, the research and examples presented throughout this deliverable also demonstrate that meaningful progress is achievable when education, innovation, participation, and collective responsibility operate together within long-term sustainability frameworks.

For youth workers, organisations, educators, and young people themselves, this research provides both practical knowledge and strategic inspiration for continuing to promote sustainability awareness, energy efficiency, and active environmental participation within local communities and broader European contexts.

References

- [European Green Deal](#)
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Fostering Energy Efficiency Leaders :
Empowering Youth to Start a
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D4.1 ENERGY-EFFICIENCY RESEARCH DATABASE

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